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DOCUMENT 00 52 13

AGREEMENT FORM

THIS AGREEMENT, entered into this _____ day of _____, 20__, by and between the COUNTY OF SAN MATEO, a Political Subdivision of the State of California, hereinafter called the "County", and SBAY Construction, Inc., hereinafter called the "Contractor".

WITNESSETH that the Contractor and the County, in consideration of the mutual covenants, considerations and agreements herein contained, agree as follows:

STATEMENT OF WORK – The Contractor shall furnish all labor and materials and perform all work for:

Project: Hall of Justice Court Tenant Improvement Project – First Floor
400 County Center, Redwood City, CA 94063
Project Number: PF0L1

in strict accordance with the Contract Documents.

TIME FOR COMPLETION – The work shall be commenced on a date to be specified in the Notice to Proceed issued by the County and shall be completed **Three Hundred Three (303) calendar days** defined as sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilized for its intended use.

COMPENSATION TO BE PAID TO CONTRACTOR – The County will pay and the Contractor will accept in full consideration for the performance of the contract, subject to additions and deductions and procedures for payment as provided therein, the sum of Seven Million Four Hundred Eighty-Nine Thousand and 00/100 Dollars ($7,489,000.00) which is the Contractor's Bid. The Contract as defined in paragraph 1.1 of the General Conditions constitutes the sole agreement of the parties hereto relating to said work and correctly states the rights, duties, and obligations of each party as of the document's date. Any prior agreement, promises, negotiations, or representations between the parties not expressly stated in this document are not binding. All subsequent modifications shall be in writing.

PREVAILING WAGE RATES - In accordance with the provisions of Section 1770 of the Labor Code, the Board of Supervisors of the County of San Mateo has ascertained the prevailing rate of wages applicable to the work to be done, which prevailing wage rates have been established as indicated in the Notice to Bidders and are incorporated herein by reference.

The Contractor's attention is further directed to the following requirements of State Senate Bill SB 854 (Stat. 2014, chapter 28), effective January 1, 2015:

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(1) No contractor or subcontractor may be listed on a bid proposal for a public works project (submitted on or after March 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5 [with limited exceptions from this requirement for bid purposes only under Labor Code section 1771.1(a)].

(2) No contractor or subcontractor may be awarded a contract for public work on a public works project (awarded on or after April 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

(3) This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

IN WITNESS WHEREOF, the parties hereto on the day and year first above written have executed this agreement in three counterparts, each of which shall, without proof or accounting for the other counterparts, be deemed an original thereof.

COUNTY OF SAN MATEO

A Political Sub-Division of the State of California

By _____
President, Board of Supervisors

Attest:

_____
Michael Callagy, County Executive
Clerk of the Board of Supervisors

By DocuSigned by: Al Matin F36200C2AE5144D...
Contractor, SBAY Construction, Inc.

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JOB COPY

TO REMAIN ON

SITE AT ALL TIMES

COUNTY OF SAN MATEO
HALL OF JUSTICE

COURTROOM TENANT IMPROVEMENT PROJECT

PROJECT MANUAL

ISSUE FOR PERMIT

FEBRUARY 28, 2025

VOLUME 1 OF 2

Mark Cavagnero Associates, Architects
San Francisco, CA

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AUTHOR ABBREVIATIONS
ALL = ALLEGION
ALF = ALFATECH
CSM = COUNTY OF SAN MATEO
MCA = MARK CAVAGNERO ASSOCIATES
PVT = PIVOT INTERIORS
TEE = TEECOM
ZFA = ZFA STRUCTURAL ENGINEERS

GENERAL REQUIREMENTS SUBGROUP
VOLUME 1

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MCA	Section 012600	Contract Modification Procedures	•			
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DOCUMENT 003100

AVAILABLE PROJECT INFORMATION

1.0 Evaluations, and Reports

1.01 Limited Pre-Renovation Hazardous Materials Survey Report, prepared by Vista Environmental Consulting, dated July 7, 2024.

1.02 The above report (1.01) is being made available to Bidders for information only. The County disclaims any responsibility for the Bidder's interpretation of the provided data as the report may not include necessary information for, any or all, construction related activities including, but not limited to, excavations, sheeting, shoring, bracing, dewatering, demolition, abatement of hazardous materials, tree protection and management, and storm water protection. The successful Bidder shall at its own expense conduct any additional evaluations that it may deem required for successful completion of the construction scope as outlined and described in the contract document plans and specifications.

END OF DOCUMENT

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VISTA ENVIRONMENTAL CONSULTING

SINCE 2007 A STELLAR PAST • A BRIGHTER FUTURE

Limited Pre-Renovation Hazardous Materials Survey Report
County of San Mateo - Hall of Justice
400 County Center, Redwood City, CA



Prepared for:

COUNTY OF SAN MATEO

555 County Center
Redwood City, CA 94063

Prepared By:
Vista Environmental Consulting
2984 Teagarden Street
San Leandro, CA 94577

July 7, 2024

Project No. 241101003

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APPENDICES

A. BUILDING DATA

Hazardous Materials Summary
Asbestos Sampling Inventory
Sample Location Drawings
Asbestos Analytical Reports
Lead XRF Sequential Reports

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EXECUTIVE SUMMARY

Vista Environmental Consulting (Vista) performed a limited pre-renovation hazardous materials survey at the County of San Mateo Hall of Justice, 400 County Center, Redwood City, CA 94063 (Project Site). The survey was performed to identify and sample accessible, suspect asbestos-containing materials, representative building components for the presence of lead-containing surface coatings/lead-based paints (LCSC/LBP), Polychlorinated Biphenyls (PCBs) in light fixture ballasts, and other hazardous materials that may be in the path the construction. Vista performed the survey on June 7 & 8, 2024.

The following building was surveyed and contain the following hazardous materials:

Building/Areas	Asbestos	Lead-Based Paint or Materials	Lead Containing Paint	Universal Waste, Suspect PCBs, and Other Hazardous Materials
Hall of Justice/Board Chambers/Court Clerk Room A, County Executive Offices, Self Help Family Law Center	☑	☑	☑	☑

The Hazardous Materials Summaries, Asbestos Sampling Inventories, Sample Location Drawings, Asbestos Analytical Reports, and , and Lead XRF Sequential Reports can be found in *Appendix A – Building Data.*

The documents found in the appendices are not stand-alone documents and should not be separated from this report. Quantities and locations listed in the tables are order of magnitude estimates and are not to be used for bidding purposes. It is the sole responsibility of the contractor to verify quantities and locations of hazardous materials in the path of construction through site visits and contractual bid set documents, including, but not limited to all specifications, drawings, and addenda. Any discrepancies between the contractual bid set documentation and site visits must be submitted in writing to the Owner or Owner's representative, prior to bidding.

BAAQMD classifications are based upon the material's condition at the time of the survey or as rendered as a result of standard manual removal/demolition techniques. The use of "mechanical means", non-standard or other aggressive removal/demolition techniques may result in a different classification.

All Class I and II asbestos (>0.1%) disturbance and/or removal operations must be conducted by a Cal/OSHA registered and State licensed asbestos removal contractor. All disturbance and/or abatement operations should be under the direction of a California Certified Asbestos Consultant.

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Should the removal of identified regulated asbestos-containing materials (RACM) involve at least 100 square feet or 100 linear feet per project site, per year, then notification to the Bay Area Air Quality Management District (BAAQMD) and Cal/OSHA must be accomplished prior to the initiation of such activities.

All activities involving potential and identified lead-containing surfaces should be conducted in accordance with California Health & Safety Code sections 17920.10 and 10525, 10525.7, Title 8, California Code of Regulations (CCR), Section 1532.1.

In addition, all removal activities involving identified lead-based paints (LBP) must be conducted in accordance with Title 17, CCR, Division 1, Chapter 8, Sections 35001 through 36100, which proscribes the use of California Department of Public Health (CDPH) certified workers, work practices, and other requirements.

Written notification to Cal/OSHA must be accomplished should LBP activities involve equal to or more than 100 square feet or 100 linear feet of removal in accordance with the requirements of 8 CCR 1532.1.

Any welding, cutting or heating of metal surfaces containing surface coatings should be conducted in accordance with 8 CCR 1537 Welding, Cutting, and Heating of Coated Metals, which require surfaces covered with toxic preservatives, and in enclosed areas, be stripped of all toxic coatings for a distance of at least 4 inches, in all directions, from the area of heat application prior to the initiation of such heat application, or 8 CCR 1536 Ventilation Requirements for Welding, Brazing, and Cutting.

All potential and identified Universal Waste materials (UW) and Electronic Waste (E-Waste) impacted by the work should be removed and recycled or disposed of in accordance with the UW guidelines established by the DTSC, as stated in 22 CCR Sections 66261.9 and 66273.1 thru 66273.90.

All ballasts must be visually inspected prior to disposal to determine if they contain PCB's. Those ballasts marked No PCB's or PCB Free can be considered as such as should be treated as UW - electronic waste. All PCB-containing devices, including, but not limited to ballasts should be removed or have the oils removed and properly handled, collected, stored, transported and recycled or disposed of by an approved recycling or disposal facility in accordance with the requirements of Title 22 CCR 67426.1.

Devices containing ozone depleting chemicals and low-level radioactive sources, should be collected, waste characterized, disposed or recycled according to California rules and regulations.

Should materials similar to those identified in this report, or if other forms of suspect hazardous materials are encountered, contractors should be instructed to immediately cease work activities which may initiate an exposure episode, and notify the appropriate management personnel.

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Report prepared for the Company by:



Christopher R. Burns
Senior Project Manager
CAC #92-0224
LRCIA #LRC-00006938

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1.0 INTRODUCTION

Vista Environmental Consulting, Inc. (Vista) has prepared this limited pre-renovation hazardous materials survey report for County of San Mateo Hall of Justice, 400 County Center, Redwood City, CA 94063(Project Site) for the County of San Mateo (COSM).

The survey of the Project Site was generally consistent with the Vista proposal dated December 29, 2022 and approved by COSM.

The following areas of the Hall of Justice building was surveyed:

- Board Chambers
- Court Clerk Room A
- County Executive Offices
- Self Help Family Law Center

The purpose of this survey was to identify hazardous building materials so they can be removed; waste characterized, and properly disposed of prior to being impacted by renovation activities. The data provided in this report can assist all parties involved in this project make informed decisions with regards to regulatory compliance and the health and safety of their employees. This survey included the following:

- Visible and accessible suspect asbestos-containing materials (ACM) were assessed and sampled to determine asbestos content.
- Representative painted and coated building components were assessed and categorized based upon standard selective demolition practices and sampled for lead content which can be used in preliminary waste stream characterization estimates.
- Visible and accessible materials with the potential to have hazardous properties that are regulated and are commonly found in buildings were assessed, but not sampled. These materials include, but are not limited to:
    - Universal Waste (UW) materials, such as non-incandescent lamps, batteries, mercury-containing devices, and electronic waste; Batteries include, but are not limited to those found in exit signs, emergency lights, fire alarm systems, and back-up power systems;
    - Polychlorinated biphenyls (PCBs) containing devices such as lamp ballasts, wet-type transformers, and hydraulic systems;
    - Devices which may contain ozone depleting chemicals, such as Heating, Ventilation and Air Conditioning (HVAC) systems, refrigerators, freezers, fire suppression systems and water coolers/fountains;
    - Devices with low-level radioactive sources such as smoke detectors and exit signs.

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2.0 METHODOLOGY

Vista performed the pre-demolition hazardous materials survey on June 7 & 8, 2024.

Vista's personnel on the project were:

- Christopher Burns, a State of California Division of Occupational Safety and Health (Cal/OSHA) Certified Asbestos Consultant (CAC) # 92-0224 and a State of California Department of Public Health (CDPH) Lead Related Construction Certified Inspector/Assessor (LRCIA) #LRC-00006938
- Javier Rocha, a Cal/OSHA Certified Site Surveillance Technician (CSST) #02-3244 and a CDPH Lead Related Construction Certified Sampling Technician (LRCST) #LRC-00000629
- Supicha Castro – Cal/OSHA CAC 23-7508 and CDPH LRCIA #LRC-00011723
- Alana Anderson, CDPH LRCST #LRC-00009273

Vista's intent was to perform a thorough survey and made a good faith effort to access all building materials down to the structural components and/or interstitial spaces. Quantities and locations are based upon areas that were accessed. Materials similar to those in this report may be present in areas which were not accessed.

2.1 *Asbestos*

The asbestos survey was performed generally in accordance with the AHERA protocol (40 CFR Part 763, Subpart E). Visual identification was performed by assessing visible and accessible structural, architectural, and mechanical components for the presence of suspect ACM at the Project Site.
This limited ACM survey was conducted in the following manner:

- ➢ Suspect ACM was categorized into homogeneous materials. A homogeneous material is defined as being a surfacing material, thermal system insulation, or miscellaneous material which is uniform in color and texture. It may also be additionally subcategorized using the date of installation, when available.
- ➢ A sampling scheme was developed based upon the location and quantity of the suspect homogeneous ACM. A rough order of magnitude estimate of each suspect homogenous ACM was calculated and recorded for future reference. A sampling scheme, including a specific number of samples per suspect homogeneous ACM, was calculated prior to sampling.
- ➢ Sampling guidelines established by the United States Environmental Protection Agency (USEPA) were utilized for sampling each suspected homogeneous ACM. Methods described in Appendix K of 8 California Code of Regulation (CCR) 1529 were utilized in the collection of each suspect homogeneous ACM sample.
- ➢ Trained California asbestos certified personnel, using appropriate sampling tools and sterile leak-tight Whirl-pak® containers, collected building materials that were suspected to contain ACM.

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- ➢ Each suspect ACM sample was collected and sealed in its container and appropriately labeled with a unique sample identification number and recorded on an asbestos bulk sampling log. Each log contains a chain-of-custody to assure the proper transition of the samples from Vista to the analytical laboratory.
- ➢ Sampling tools were decontaminated, by using a clean wet cloth, between collection of each suspect sample to prevent the possibility of cross contamination of subsequent suspect ACM samples.

Suspect ACM samples were delivered, under proper chain-of-custody protocol, to SGS Laboratories (SGS) in Hayward, California. SGS is accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) and the California Environmental Laboratory Accreditation Program (Cal-ELAP). The samples were submitted for analysis by Polarized Light Microscopy (PLM) utilizing dispersion staining techniques in accordance with the EPA's "Method for the Determination of Asbestos in Bulk Building Materials" U.S. EPA/600/R-93/116, Visual Area Estimate, dated July 1993 and adopted by the NVLAP as Test Method Code 18/A01.

2.2 *Lead*

Vista's lead construction screening survey used an X-Ray Fluorescence (XRF) direct read spectrum analyzer device to take readings of representative painted and coated surfaces for evaluation of lead levels for worker health and safety and preliminary waste characterization prior to construction activities. The device used was a Viken Detection, XRF Lead Paint Analyzer, Model Pb200i. This device is a thermoelectrically-cooled, sealed, CdTe diode detector optimized X-ray detection and uses a sealed cobalt 57, 5mCi (185 MBq) isotope for an excitation source.

This survey was a limited screening of paint for the purpose of characterizing the lead content in paint and coatings likely to be disturbed during work activities. For this purpose, XRF analysis was used to screen for lead levels and provides results that are generally representative of typical conditions but are not inclusive of all painted/coated surfaces present at the Project Site. This survey was not a surface by surface inspection as outlined in the U.S. Department of Housing and Urban Development (HUD) Guidelines For the Evaluation and Control of Lead-Based Paint Hazards in Housing pursuant to Title X of the Housing and Community Development Act of 1992. These analytical data can be helpful in evaluation of lead-related environmental risks in general, but cannot be used to calculate worker exposures and is not a substitute for employee exposure monitoring or waste stream sampling.

Lead-Based Paint (LBP) is defined by CDPH as any paint containing lead levels exceeding 0.5 wt % (or 5000 parts per million) via paint chip sampling or 1.0 milligrams per centimeter squared (mg/cm^2) or greater via X-Ray Fluorescence (XRF) direct read instrument sampling. Cal/OSHA rules apply to "any detectable concentration of lead" without a specified detection level.

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2.3 *Other Hazardous Materials*

Devices with potential hazardous materials were visually identified during the survey walk-through and their quantities were estimated and recorded. No attempt was made to disassemble devices or sample suspect materials within the devices. For example, fluorescent light fixtures must be presumed to contain Universal Waste lamps, and ballasts which contain PCB oil are electronic waste, pending removal and disassembly of each unit to determine explicit product specific information that proves otherwise.

3.0 RESULTS

The following areas of the Hall of Justice building was surveyed and contain the following hazardous materials:

Building/Areas	Asbestos	Lead-Based Paint or Materials	Lead Containing Paint	Universal Waste, Suspect PCBs, and Other Hazardous Materials
Hall of Justice/Board Chambers, Court Clerk Room A, County Executive Offices, Self Help Family Law Center	☑	☑	☑	☑

The Hazardous Materials Summaries, Asbestos Sampling Inventories, Sample Location Drawings, Asbestos Analytical Reports, and Lead XRF Sequential Reports can be found in *Appendix A – Building Data.*

The documents found in the appendices are not stand-alone documents and should not be separated from this report. Quantities and locations listed in the tables are order of magnitude estimates and are not to be used for bidding purposes. It is the sole responsibility of the contractor to verify quantities and locations of hazardous materials in the path of construction through site visits and contractual bid set documents, including, but not limited to all specifications, drawings, and addenda. Any discrepancies between the contractual bid set documentation and site visits must be submitted in writing to the Owner or Owner's representative, prior to bidding.

BAAQMD classifications are based upon the material's condition at the time of the survey or as rendered as a result of standard manual removal/demolition techniques. The use of "mechanical means", non-standard or other aggressive removal/demolition techniques may result in a different classification.

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4.0 RECOMMENDATIONS

4.1 *Asbestos*

The results of the survey indicate that asbestos-containing materials **are present** at the Project Site.

Work performed during any activities that disturb the asbestos-containing materials identified in this report must be done in compliance with the most recent edition of all applicable federal, state, and local regulations, standards, and codes governing abatement, transport, and disposal of asbestos-containing materials. These include, but are not limited to, the following:

- CCR, Title 8, Chapter 3.2, Subchapter 2, Article 2.5 - Registration Asbestos-Related Work Sections 341.6 through 341.14
- CCR, Title 8, Section 1529 - Asbestos in the Construction Industry
- BAAQMD Regulation 11, Hazardous Pollutants, Rule 2, Asbestos Demolition, Renovation and Manufacturing
- 40 CFR Part 763 - Subpart E, Asbestos Containing Materials in Schools (AHERA)
- California Code of Regulations, Title 17, Section 93015
- CCR, Title 17, Section 93015 Asbestos Airborne Toxic Control Measure (ATCM) for Construction, Grading, Quarrying and Surface Mining Operations

Materials encountered in the buildings that are not part of this report must be properly sampled for the content of asbestos or assumed to be asbestos containing prior to any disturbance.

Prior to Class I and II activities which will disturb identified or assumed asbestos, a Cal/OSHA registered and California licensed asbestos contractor must be utilized for abatement of asbestos that will be impacted. Vista recommends that all abatement operations be conducted under the direction of a California Certified Asbestos Consultant.

4.2 *Lead*

The results of the survey indicate that lead-based paints/materials and lead-containing paints/materials **are present** in the path of construction at the Project Site.

At present there is no state or federal regulation requiring mandatory lead removal or abatement prior to disturbance of building materials with identified lead paint or coatings. However, there are applicable Cal/OSHA worker protection and training requirements, Cal/EPA waste disposal requirements, CDPH requirements for public and residential buildings, and SB 460 lead hazard regulations that apply to lead-related construction activities, abatement activities and their associated wastes. The following is a brief discussion and summary of applicable regulatory requirements:

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♦ **Cal/OSHA:** Title 8, California Code of Regulation (CCR), Section 1532.1 (8 CCR 1532.1) governs occupational exposure to lead. This regulation requires that prior to initiation of certain activities, referred to as "trigger tasks", workers must be trained, medically evaluated, and properly fitted with respiratory protection, and protective clothing until statistically reliable personal eight-hour time weighted average (TWA) results indicate lead exposure levels below the Personal Exposure Limit (PEL) for each unique task which disturbs lead-based and lead-containing coatings. This process is known as a Negative Exposure Assessment or NEA.

If the result of the exposure assessment is above the Action Level (AL) additional monitoring is required and if the result is above the PEL additional exposure monitoring, worker protection (including respirator protection and PPE), training and medical requirements apply. However even where the NEA criteria is met, certain hazard communication training and work practice controls still apply where lead is disturbed. "Trigger tasks" are tasks that are assumed to exceed the PEL pending an exposure assessment and they encompass the majority of construction activities that disturb surface coatings. Examples of "trigger" tasks range from manual paint scraping as a lower expected exposure up to hot work and abrasive blasting as the highest expected exposures, and include any non-listed task that the employer determines may potentially expose employees to lead levels above the AL.

"OSHA does not consider any method that relies solely on the analysis of bulk materials or surface content of lead (or other toxic material) to be acceptable for safely predicting employee exposure to airborne contaminates. Without air monitoring results or without the benefit of historical or objective data (including air sampling which clearly demonstrates that the employee can not be exposed above the action level during any process, operation, or activity) the analysis of bulk or surface samples can not be used to determine employee exposure."- OSHA Standard Interpretation May 8, 2000.

OSHA states that these rules apply to "any detectable concentration of lead" without a specified detection level. Due to the Consumer Product Safety Commission currently allowing paint to contain up to 90 parts per million (ppm) or 0.009 wt% of lead, the variation of lead content due to aging and weathering, and the variation of detection limits associated with analysis of bulk materials, such as paint chips and surface content analysis via XRF, it is recommended that all painted or coated surfaces be treated as potentially containing lead. Positive analytical results by either method can be used to indicate that detectable lead is present but negative results cannot be interpreted as conclusively demonstrating the absence of lead.

Analytical data from analysis of bulk materials or surface content of lead can be helpful in evaluation of lead-related environmental risks in general but cannot be used to calculate worker exposures and are not a substitute for employee exposure monitoring. As a result of the above, any employee that works around potential lead-based or lead-containing coatings must have HAZCOM training and personal exposure air monitoring is additionally required for employees that disturb such coatings. Significant additional certification, notification, and work practices are required for materials found to be lead-based.

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Any welding, cutting or heating of metal surfaces containing surface coatings should be conducted in accordance with 29 CFR 1926.354 and 8 CCR 1537. These regulations require surfaces covered with toxic preservatives, and in enclosed areas, be stripped of all toxic coatings for a distance of at least 4 inches, in all directions, from the area of heat application prior to the initiation of such heat application.

♦ **Cal/EPA** through the Division of Toxic Substance Control (DTSC) regulates disposal of lead hazardous waste (22 CCR Division 4.5, Minimum Standards for Management of Hazardous and Extremely Hazardous Wastes). DTSC has issued guidance indicating that architectural debris with intact lead paint is normally expected to be handled as general construction waste. However, waste stream segregation and analysis is still required for all lead painted or coated debris regardless if the paint or coating is intact on a building component or not. The resulting wastes may be hazardous under California and federal RCRA standards for lead and therefore require proper handling, packaging, labeling, and transportation under a proper manifest to a permitted hazardous waste storage, treatment and disposal facility.

♦ **CDPH**: The Department of Public Health (CDPH) has specific requirements (Title 17 Sections 35001 thru 36100 et. al.) for hazard assessment and work in public or residential structures in regards to lead-based paint. These regulations require special certifications, work practices, and notification for such activities.

♦ **Senate Bill 460 (SB 460)**: An act to amend Section 1941.1 of the Civil Code, and to amend Sections 17961, 17980, and 124130 of, and to add Sections 17920.10, 105251, 105252, 105253, 105254, 105255, 105256, and 105257 to, the Health and Safety Code, relating to lead abatement. This bill allows for fines and criminal penalties to be levied on any person who is found to have performed lead abatement without containment or created a measurable "lead hazard" based upon current CDPH standards. A "lead hazard" means deteriorated lead-based paint, lead contaminated dust, lead contaminated soil, disturbing lead-based paint or presumed lead-based paint without containment, or any other nuisance which may result in persistent and quantifiable lead exposure.

Vista recommends that all parties that come into contact with paint that has detectable lead content follow all applicable federal, state and local regulations relating to employee health and safety and proper disposal of generated wastes.

4.3 *Other Hazardous Materials*

All potential and identified Universal Waste materials (UW) and Electronic Waste (E-Waste) impacted by the work should be removed and recycled or disposed of in accordance with the UW guidelines established by the DTSC, as stated in 22 CCR Sections 66261.9 and 66273.1 thru 66273.90.

Vista's limited visual survey indicated that light fixtures with ballasts that may contain PCB oil are present. However, due to the limited nature of the random spot checks, Vista recommends that all ballasts

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be visually inspected prior to disposal to determine if they contain PCB's. Those ballasts marked No PCB's or PCB Free can be considered as such as should be treated as UW - electronic waste.

Devices containing ozone depleting chemicals, petroleum or other chemicals, should be collected, waste characterized, disposed or recycled according to California rules and regulations.

All personnel who perform hazardous materials work must be trained and qualified to do so. They must also follow the most current OSHA regulations including 29 CFR 1910.120 and 8 CCR 5192, Hazardous Waste Operations and Emergency Response, as well as other applicable federal, state and local laws and regulations.

5.0 LIMITATIONS & EXCLUSIONS

Quantities and locations are based upon areas that were accessed. Materials similar to those in this report may be present in areas which were not accessed. Because of this, Vista recommends including line item pricing, allowances, and/or additive/deductive wording to bid sheets for unforeseen conditions.

All material quantities reported herein are rough order of magnitude estimates and should not be used for bidding purposes. All contractors are responsible for accurately determining quantities and locations of materials identified in this report.

The survey performed was limited to representative rooms/areas and did not include access of areas and sampling of materials which would have required large scale destructive testing. Vista made a good faith effort based on accepted industry standards to access all areas in order to assess their potential for having hazardous materials, however additional layers of roofing may be under the first layer of hard substrate.

Respectfully Submitted,
Vista Environmental Consulting



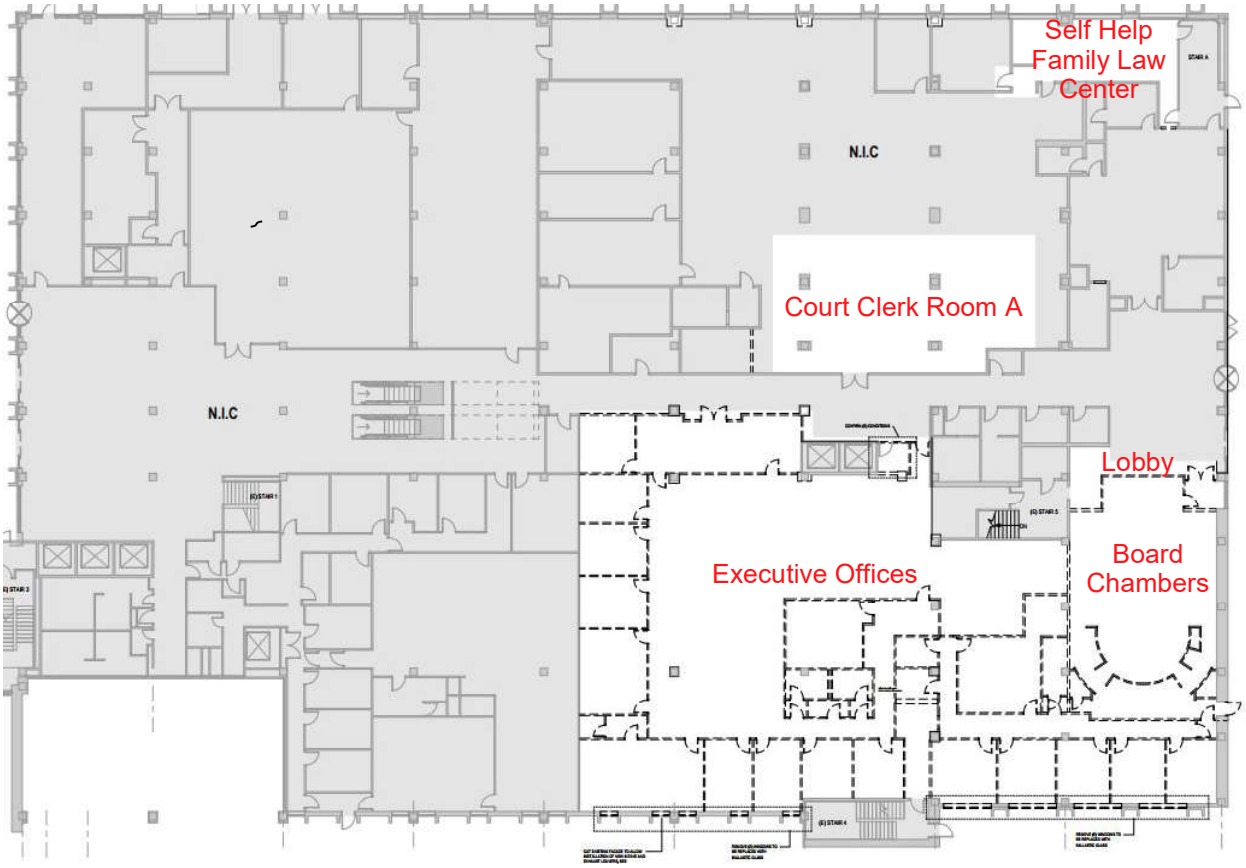
Christopher R. Burns
Senior Project Manager
CAC #92-0224
LRCIA #LRC-00006938

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APPENDIX A - BUILDING DATA

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The information contained in these appendices are not stand alone documents and should not be separated from this report. For specific regulatory requirements regarding these materials please refer to the information provided in the Main Report. Quantities and locations listed in the tables are order of magnitude estimates and are not to be used for bidding purposes. It is the sole responsibility of the contractor to verify quantities and locations of hazardous materials in the path of construction through site visits and contractual bid set documents, including, but not limited to all specifications, drawings, and addenda. Any discrepancies between the contractual bid set documentation and site visits must be submitted in writing to the Owner or Owner's representative, prior to bidding.

BAAQMD classifications are based upon the material's condition at the time of the survey or as rendered as a result of standard manual removal/demolition techniques. The use of "mechanical means", non-standard or other aggressive removal/demolition techniques may result in a different classification. BAAQMD & Cal-OSHA classifications are based on the materials being >1% asbestos pending further analytical data that proves otherwise.

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COUNTY OF SAN MATEO
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HAZARDOUS MATERIALS SUMMARY

Asbestos

HOMO. ID	MATERIAL	DESCRIPTION	LOCATION	CAL/OSHA CLASS	BAAQMD CATEGORY	ESTIMATED QUANTITY
I	Vinyl Floor Tile/Mastic	9" Beige/Black (Assumed)	County Clerk Room A and Self Help Family Law Center. This material is under carpeting and may be under Wallboard walls and millwork.	Class II	Category I - Non-Friable	4,500 SF
U	Mastic	Black/Yellow, Carpet	County Executive Offices - Throughout except South Hallway Restrooms and Kitchen	Class II	Category I - Non-Friable	9,000 SF
Z	Wallboard/Joint Compound	White/White	County Executive Offices - North Wing (Newer), South Wing (Original) mixed with Plaster	Class II	NA (Composite <1% by Point Count, Wallboard=ND, Joint Compound=2%)	20,000 SF
BB	Vinyl Floor Tile/Mastic	12" Beige, Brown Streaks/Black	County Executive Offices - North Restrooms and Foyers, NW Office (CEO's) Restroom Foyer	Class II	Category I- Non-Friable	300 SF
EE	Basecove/Mastic	4" Silver/Unknown (Assumed)	County Executive Offices - NW Office (CEO's)	Class II	Category I- Non-Friable	30 SF (90 LF)

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HAZARDOUS MATERIALS SUMMARY

HOMO. ID	MATERIAL	DESCRIPTION	LOCATION	CAL/OSHA CLASS	BAAQMD CATEGORY	ESTIMATED QUANTITY
FF	Vinyl Floor Tile/Mastic	12" Light Brown Streaked/Unknown (Assumed)	County Executive Offices - NW Office (CEO's) Restroom	Class II	Category I-Non-Friable	40 SF
MM	Glazing	White, Windows, Aluminum	County Executive Offices - Exterior SW Offices	Class II	Category I-Non-Friable	200 SF
NN	Glazing	White, Windows, Brown Aluminum	County Executive Offices - Exterior NW Offices	Class II	Category I-Non-Friable	120 SF (Windows)
UU	Vinyl Floor Tile/Mastic	9" Beige/Black, Bottom Layer	County Executive Offices - Hallway to Stair 4, Foyer to Stair 5, and SE Offices. This material is under asbestos vinyl sheet flooring, non-asbestos floor tile, and/or carpeting.	Class II	Category I-Non-Friable	950 SF
ZZ	Firedoor	Unknown (Assumed)	Throughout	Unclassified	Friable (RACM when Removed)	1,050 SF (50 EA)
B3	Fireproofing	Gray	County Executive Offices - North Wing (Newer). This material is oversprayed on plenum MEP fixture and debris is on ceiling panels.	Class I	Friable (RACM when Removed)	15,000 SF

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COUNTY OF SAN MATEO
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HAZARDOUS MATERIALS SUMMARY

HOMO. ID	MATERIAL	DESCRIPTION	LOCATION	CAL/OSHA CLASS	BAAQMD CATEGORY	ESTIMATED QUANTITY
C3	Vinyl Sheet Flooring/Mastic	Beige, Pebble Pattern/Beige	County Executive Offices - Hallway to Stair 4 s. This material is under carpeting.	Class II	Friable (RACM when Removed)	250 SF

Lead

ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	PB	UNITS
SHFLC	Window Sill	Metal	White	Intact	0.6	mg/cm2
SHFLC	Window Sill	Metal	White	Intact	0.1	mg/cm2
SHFLC	Window Sill	Metal	White	Intact	0.6	mg/cm2
SHFLC	Door Frame	Metal	White	Intact	0.2	mg/cm2
SHFLC	Door Frame	Metal	White	Intact	0.1	mg/cm2
SHFLC	Crown Molding	Vinyl	Green	Intact	0.1	mg/cm2
CCRA	Column	Drywall	Lt-Gray	Intact	0.1	mg/cm2
CCRA	Upper Wall	Drywall	Red	Intact	0.1	mg/cm2
CCRA	Ceiling	Drywall	White	Intact	0.1	mg/cm2
CCRA	Ceiling	Drywall	White	Intact	0.1	mg/cm2
CCRA	Door	Wood	Gray	Intact	0.1	mg/cm2
CCRA	Floor	Vinyl	Blue	Intact	0.3	mg/cm2
CCRA	Lower Wall	Wood	White	Intact	0.3	mg/cm2
CCRA	Lower Wall	Wood	White	Intact	0.3	mg/cm2
CCRA	Door Frame	Metal	Black	Intact	0.2	mg/cm2
Lobby	Column	Plaster	White	Intact	0.3	mg/cm2
Lobby	Column	Plaster	White	Intact	0.1	mg/cm2
Lobby	Lower Wall	Plaster	White	Intact	0.1	mg/cm2
Lobby	Lower Wall	Plaster	White	Intact	0.1	mg/cm2
Lobby	Floor	Brick	Red	Intact	0.3	mg/cm2
Lobby	Floor	Brick	Red	Intact	0.4	mg/cm2
Lobby	Floor	Brick	Beige	Intact	0.2	mg/cm2
Lobby	Door	Metal	Black	Intact	0.1	mg/cm2
Lobby	Door	Metal	Black	Intact	0.1	mg/cm2

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COUNTY OF SAN MATEO
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HAZARDOUS MATERIALS SUMMARY

ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	PB	UNITS
Lobby	Lower Wall	Drywall	White	Intact	0.2	mg/cm2
Lobby	Lower Wall	Drywall	White	Intact	0.1	mg/cm2
Lobby	Door Frame	Metal	White	Intact	0.1	mg/cm2
Board Chambers	Lower Wall	Drywall	Gray	Intact	0.2	mg/cm2
Board Chambers	Lower Wall	Drywall	Gray	Intact	0.1	mg/cm2
Board Chambers	Lower Wall	Wood	Varnish	Intact	0.1	mg/cm2
Board Chambers	Lower Wall	Wood	Varnish	Intact	0.1	mg/cm2
Board Chambers	Wall Panel	Wood	Beige	Intact	0.1	mg/cm2
Board Chambers	Wall Panel	Wood	Beige	Intact	0.1	mg/cm2
Board Chambers	Door	Metal	White	Intact	0.2	mg/cm2
Board Chambers	Door Frame	Metal	White	Intact	0.1	mg/cm2
Board Chambers	Door Frame	Metal	White	Intact	0.1	mg/cm2
Board Chambers	Floor	Vinyl	Blue	Intact	0.4	mg/cm2
Board Chambers	Floor	Vinyl	Blue	Intact	0.5	mg/cm2
Exterior	Lower Wall	Stucco	Beige	Intact	0.2	mg/cm2
Exterior	Lower Wall	Stucco	Beige	Intact	0.2	mg/cm2
Exterior	Lower Wall	Concrete	Beige	Intact	0.2	mg/cm2
Exterior	Lower Wall	Concrete	Beige	Intact	0.3	mg/cm2
Exterior	Door	Metal	Beige	Intact	0.1	mg/cm2
Exterior	Door	Metal	Beige	Intact	0.1	mg/cm2
Exterior	Door Frame	Metal	Brown	Intact	0.1	mg/cm2
Executive	Lower Wall	Drywall	Off White	Intact	0.3	mg/cm2
Executive	Door Frame	Wood	Off White	Intact	0.1	mg/cm2
Executive	Baseboard	Vinyl	Blue	Intact	0.2	mg/cm2
Executive	Baseboard	Vinyl	Blue	Intact	0.4	mg/cm2
Executive	Baseboard	Vinyl	Black	Intact	0.1	mg/cm2
Executive	**Lower Wall**	**Drywall**	**Teal**	**Intact**	**2.7**	**mg/cm2**

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COUNTY OF SAN MATEO
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HAZARDOUS MATERIALS SUMMARY

ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	PB	UNITS
Executive	Lower Wall	Drywall	Off White	Intact	0.1	mg/cm2
Executive	Lower Wall	Drywall	Off White	Intact	0.1	mg/cm2
Executive	Lower Wall	Drywall	Teal	Intact	0.1	mg/cm2
Executive	Baseboard	Vinyl	Lt-Gray	Intact	0.2	mg/cm2
Executive	Baseboard	Vinyl	Lt-Gray	Intact	0.1	mg/cm2
Executive	Baseboard	Vinyl	Beige	Intact	0.1	mg/cm2
Executive	Window Sill	Wood	Off White	Intact	0.7	mg/cm2
Executive	Window Sill	Wood	Off White	Intact	0.3	mg/cm2
Executive	Baseboard	Vinyl	Brown	Intact	0.2	mg/cm2
Executive	Baseboard	Vinyl	Brown	Intact	0.2	mg/cm2
Executive	Lower Wall	Drywall	Off White	Intact	0.1	mg/cm2
Executive	Lower Wall	Plaster	Off White	Intact	0.2	mg/cm2
Executive	Lower Wall	Plaster	Off White	Intact	0.1	mg/cm2
Executive	**Lower Wall**	**Ceramic**	**Yellow**	**Intact**	**5.5**	**mg/cm2**
Executive	Floor	Ceramic	Lt-Green	Intact	0.2	mg/cm2
Executive	Floor	Ceramic	Lt-Green	Intact	0.1	mg/cm2
Executive	Floor	Ceramic	Beige	Intact	0.3	mg/cm2
Executive	Floor	Ceramic	Brown	Intact	0.4	mg/cm2
Executive	**Lower Wall**	**Ceramic**	**Beige**	**Intact**	**2.5**	**mg/cm2**
Executive	Upper Wall	Drywall	Off White	Intact	0.1	mg/cm2
Executive	**Lower Wall**	**Vinyl**	**Tan**	**Intact**	**1.4**	**mg/cm2**
Executive	**Lower Wall**	**Vinyl**	**Tan**	**Intact**	**1.3**	**mg/cm2**
Executive	Upper Wall	Drywall	Off White	Intact	0.1	mg/cm2
Executive	Lower Wall	Drywall	Tan	Intact	0.2	mg/cm2
Executive	Lower Wall	Drywall	Tan	Intact	0.2	mg/cm2
Executive	Lower Wall	Drywall	Yellow	Intact	0.1	mg/cm2
Executive	Lower Wall	Drywall	Yellow	Intact	0.1	mg/cm2
Executive	Lower Wall	Drywall	Off White	Intact	0.1	mg/cm2
Executive	**Lower Wall**	**Vinyl**	**Varnish**	**Intact**	**1.4**	**mg/cm2**
Executive	**Lower Wall**	**Ceramic**	**Tan**	**Intact**	**5**	**mg/cm2**
Executive	Lower Wall	Drywall	Tan	Intact	0.1	mg/cm2
Executive	Lower Wall	Drywall	Off White	Intact	0.2	mg/cm2

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HALL OF JUSTICE
HAZARDOUS MATERIALS SUMMARY

ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	PB	UNITS
Executive	**Lower Wall**	**Ceramic**	**Yellow**	**Intact**	**4.1**	**mg/cm2**
Executive	Window Sill	Wood	Off White	Intact	0.1	mg/cm2
Executive	Lower Wall	Drywall	Blue	Intact	0.1	mg/cm2
Executive	Lower Wall	Drywall	Lt-Gray	Intact	0.1	mg/cm2
Executive	Door	Wood	Off White	Intact	0.1	mg/cm2
Executive	Door Frame	Wood	Off White	Intact	0.1	mg/cm2
Executive	Sink	Ceramic	Off White	Intact	0.2	mg/cm2
Executive	Baseboard	Vinyl	Teal	Intact	0.2	mg/cm2
Executive	Lower Wall	Drywall	Lt-Gray	Intact	0.2	mg/cm2
Executive	Lower Wall	Drywall	Dk-Gray	Intact	0.2	mg/cm2
Executive	Lower Wall	Drywall	Dk-Gray	Intact	0.2	mg/cm2
Executive	Lower Wall	Drywall	Lt-Gray	Intact	0.2	mg/cm2
Executive	Lower Wall	Drywall	Beige	Intact	0.1	mg/cm2
Executive	Lower Wall	Drywall	Dk-Blue	Intact	0.1	mg/cm2
Executive	Lower Wall	Drywall	Dk-Blue	Intact	0.1	mg/cm2
Executive	Lower Wall	Drywall	Purple	Intact	0.2	mg/cm2
Executive	Lower Wall	Drywall	Purple	Intact	0.1	mg/cm2
Executive	Lower Wall	Drywall	Mint Green	Intact	0.2	mg/cm2
Executive	Lower Wall	Drywall	Mint Green	Intact	0.2	mg/cm2
Executive	Lower Wall	Drywall	Off White	Intact	0.1	mg/cm2
Executive	Lower Wall	Plaster	Off White	Intact	0.2	mg/cm2
Executive	Lower Wall	Drywall	Dk-Gray	Intact	0.1	mg/cm2
Executive	Lower Wall	Drywall	Dk-Gray	Intact	0.1	mg/cm2
Executive	Door Frame	Wood	Dk-Gray	Intact	0.1	mg/cm2
Executive	Door Frame	Wood	Dk-Gray	Intact	0.1	mg/cm2

Bold = Lead Based

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COUNTY OF SAN MATEO
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HAZARDOUS MATERIALS SUMMARY

Devices with Potential Hazardous Materials

MATERIAL	CONTAMINANT	ESTIMATED QUANTITY
Fluorescent Tubes (4' Length)	Universal Waste	668
Compact Fluorescent	Universal Waste	47
Batteries: Emergency Lights & Exit Signs	Universal Waste	21
Light Fixture Ballasts	Polychlorinated Biphenyls	348
Exit Signs	Low-Level Radiation	1

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COUNTY OF SAN MATEO
HALL OF JUSTICE
ASBESTOS SAMPLING INVENTORY

HOMOGENEOUS ID	MATERIAL	DESCRIPTION	# OF SAMPLES
A	Wallboard/Joint Compound	White/White, County Clerk Room A	2
B	Basecove/Mastic	4" Blue/Beige & Brown	2
C	Acoustic Ceiling Panel	2' x 4' White, Chicken Feet	2
D	Acoustic Ceiling Tile	12" White, Uniform Hole	2
E	Acoustic Ceiling Tile	12" White, Fissure Patch	2
F	Vinyl Sheet Flooring/Mastic	Blue, Pebble/Black & Yellow	2
G	Bascove/Mastic	4" Gray/Brown & Beige	2
H	Plaster	White, County Clerk Room A	3
I	Vinyl Floor Tile/Mastic	9" Beige/Black	2
J	Acoustic Ceiling Tile/Mastic	12" White, Large Fissure/Brown	2
K	Acoustic Ceiling Panel	2' x 2' White, Solid	2
L	Mortar/Grout	Gray/Gray, Stone Floor	2
M	Wallboard/Joint Compound	White/White, Board Chambers	2
N	Mastic/Float	Yellow, Carpet Squares/White	2
O	Basecove/Mastic	4" Light Gray/Beige	2
P	Acoustic Ceiling Tile	12" Off White, Texture	2
Q	Vinyl Floor Tile/Mastic	12" Off White/Yellow	2
R	Basecove/Mastic	4" Brown/Beige	2
S	Vinyl Floor Tile/Mastic	12" Gray/Beige & Yellow	2
T	Basecove/Mastic	4" Dark Gray/Beige	2
U	Mastic	Black/Yellow, Carpet Square	2
V	Acoustic Ceiling Panel	2' x 4' White, Large Gouge	2

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COUNTY OF SAN MATEO
HALL OF JUSTICE
ASBESTOS SAMPLING INVENTORY

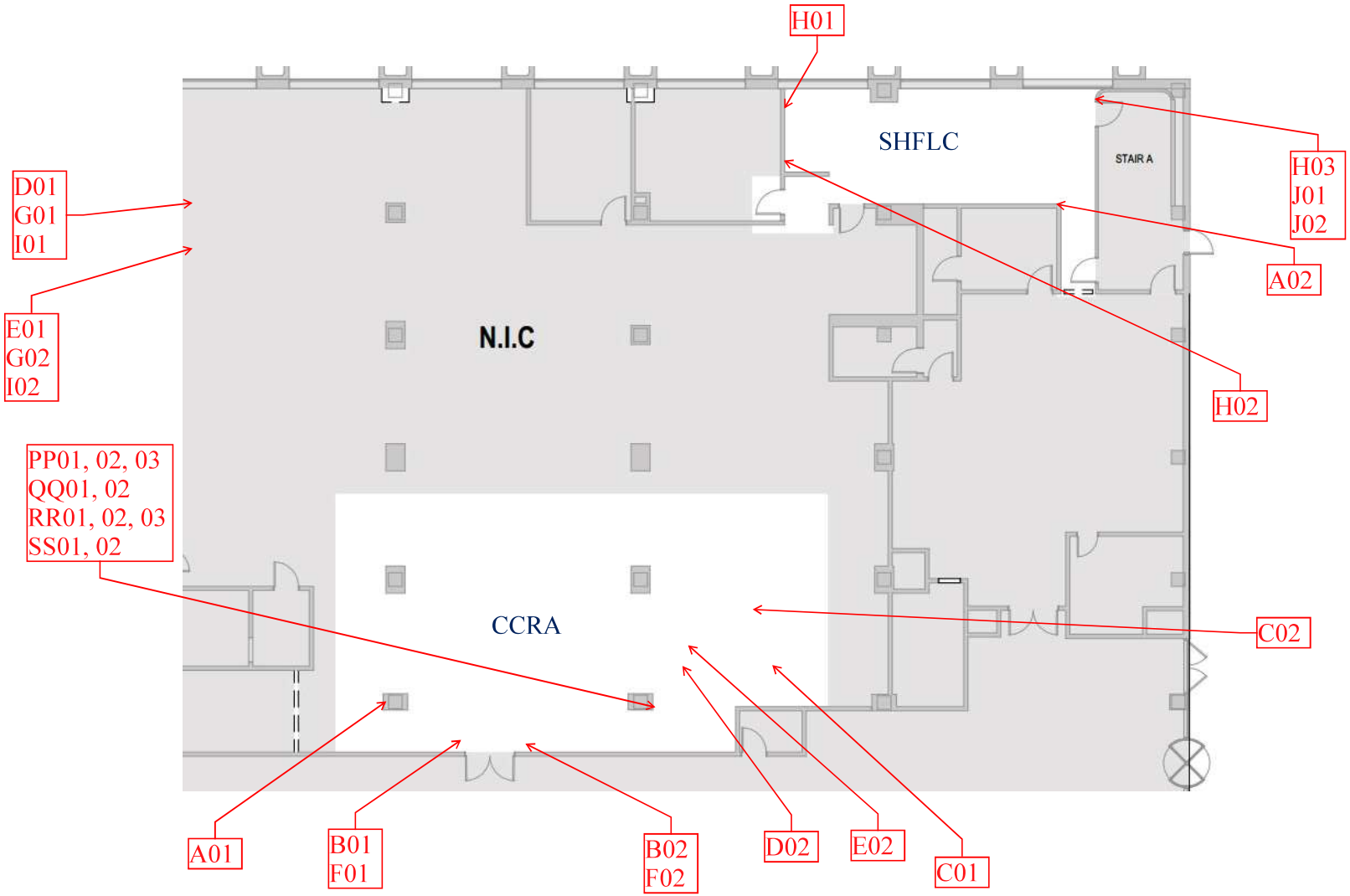
HOMOGENEOUS ID	MATERIAL	DESCRIPTION	# OF SAMPLES
W	Basecove/Mastic	4" Tan/Brown	2
X	Mortar/Grout	White/White, Ceramic Wall	1
Y	Mortar/Grout	Gray/Gray, Ceramic Floor	1
Z	Wallboard/Joint Compound	White/White	3
AA	Plaster	White/White, County Executive Offices	3
BB	Vinyl Floor Tile/Mastic	12" Beige, Brown Streaks/Black	2
CC	Basecove/Mastic	4" Brown/Brown	2
EE	Basecove/Mastic	4" Silver/Unknown	Assumed
FF	Vinyl Floor Tile/Mastic	12" Light Brown Streaked/Unknown	Assumed
GG	Vinyl Sheet Flooring/Mastic	Gray/Clear	1
HH	Mastic	White, Sink	1
II	Acoustic Ceiling Panel	2' x 4' White, Fissured	2
JJ	Wallboard/Joint Compound	White/White, Unfinished	1
KK	Firestop	Red	1
LL	Paint/Stucco	Beige/Gray	3
MM	Glazing	White, Windows, Aluminum	2
NN	Glazing	White, Windows, Brown Aluminum	2
OO	Sealant	Gray, Window Frames	2
PP	Plaster	White, Rough, Beams & Columns	3
QQ	Jacketing	White, Fiberglass Pipe, 3" OD	2
RR	Insulation	Gray, 3" OD, Elbow	3
SS	Sealant	Gray, HVAC	2

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HALL OF JUSTICE
ASBESTOS SAMPLING INVENTORY

HOMOGENEOUS ID	MATERIAL	DESCRIPTION	# OF SAMPLES
TT	Vinyl Floor Tile/Mastic	12" Gray/Yellow, 2nd Layer	2
UU	Vinyl Floor Tile/Mastic	9" Beige/Black, Bottom Layer	2
VV	Mastic	Yellow & Black, Carpet	2
WW	Acoustic Ceiling Panel	2' x 4' White, Chicken Feet	2
XX	Vinyl Floor Tile/Mastic	12' Off White, Brown Streaks/Yellow	2
YY	Texture Coat/Plaster	White, Small	3
ZZ	Fire Door	Unknown	Assumed
A3	Plaster	Gray, Rough Columns & Beams, Plenum	3
B3	Fireproofing	Gray	5
C3	Vinyl Sheet Flooring/Mastic	Beige, Pebble Pattern/Beige	1
D3	Paint/Stucco	Beige/Gray, Interior	3
E3	Concrete	Gray, Floor	2

Docusign Envelope ID: 37D6996E-9788-4CCD-AC87-6F1095B8D128



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510-346-8860

PROJECT TITLE

HALL OF JUSTICE
400 COUNTY CENTER
REDWOOD CITY

SHEET TITLE

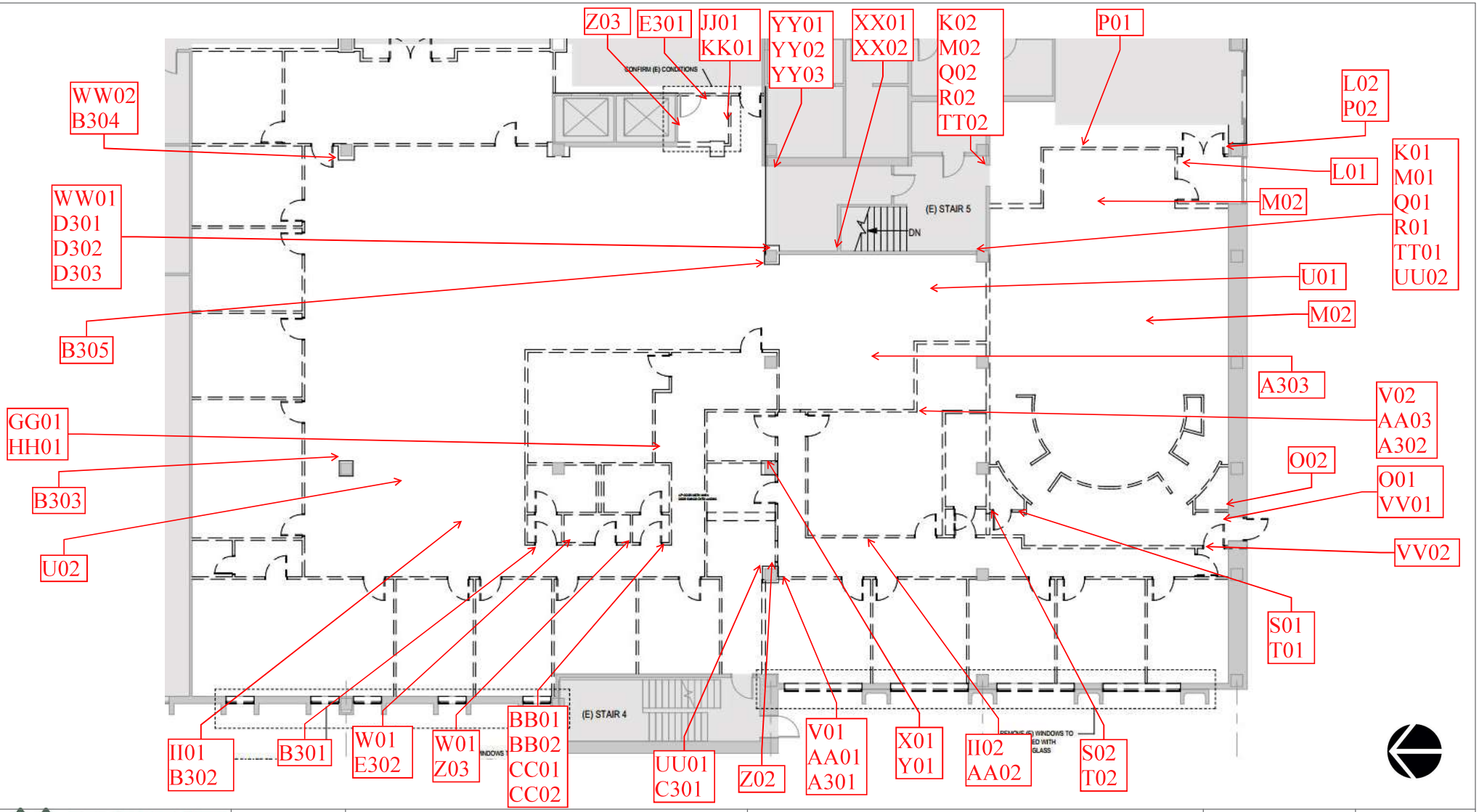
COUNTY CLERK ROOM A AND
SELF HELP FAMILY LAW CENTER
SAMPLE LOCATION DRAWING

SCALE:
DRAWN BY:
CHECKED BY:
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DATE:
DRAWING No.

FIGURE

1

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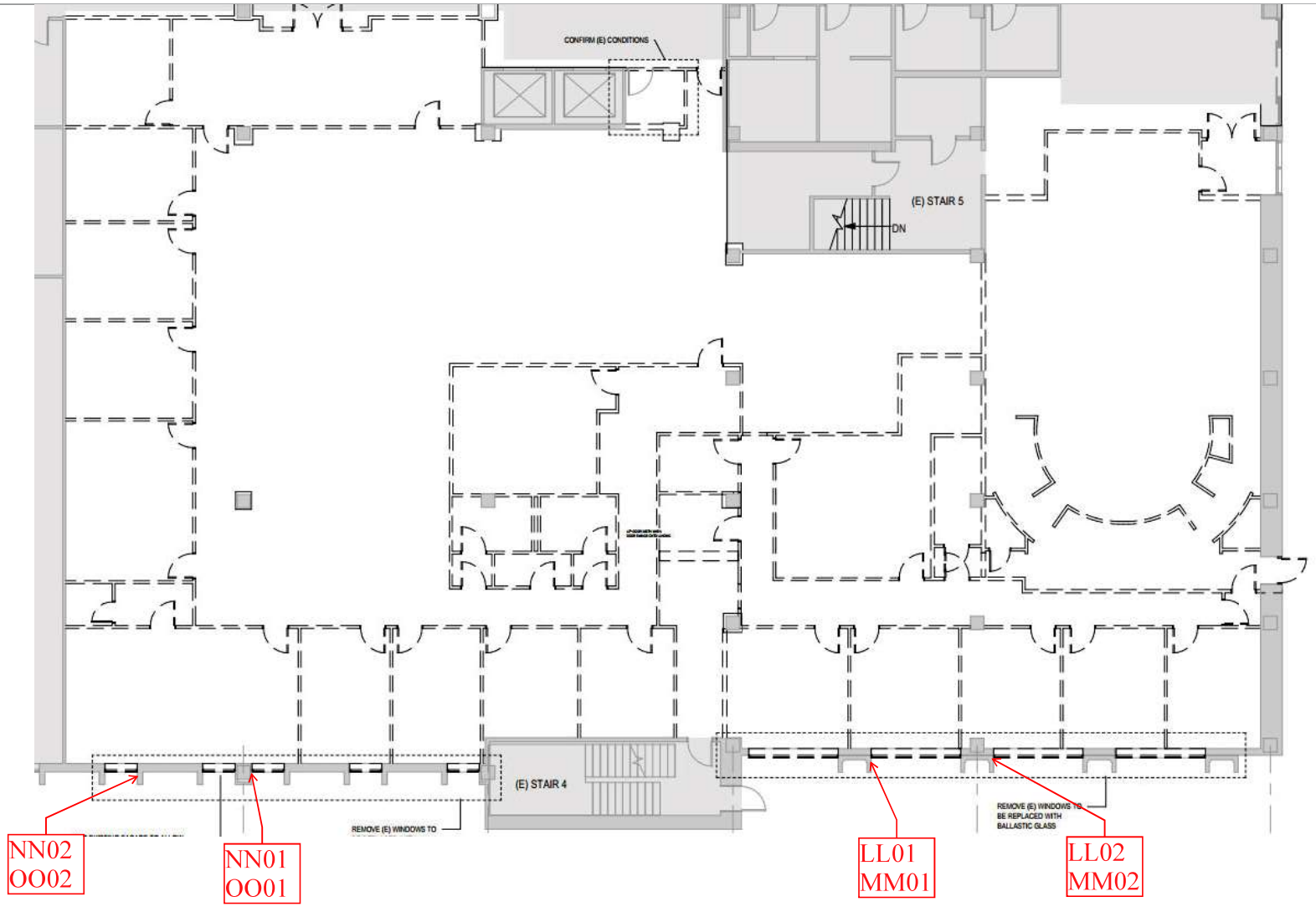
BOARD CHAMBERS AND
COUNTY EXECUTIVE OFFICES
INTERIOR
SAMPLE LOCATION DRAWING

SCALE:
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FIGURE

2

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400 COUNTY CENTER
REDWOOD CITY

SHEET TITLE

BOARD CHAMBERS AND
COUNTY EXECUTIVE OFFICES
EXTERIOR
SAMPLE LOCATION DRAWING

SCALE:
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DRAWING No.

FIGURE

3

Docusign Envelope ID: 37D6996E-9788-4CCD-AC87-6F1095B8D128

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EMSL Order: 472400949
Customer ID: 32VEOK25
Customer PO:
Project ID:

Attention: CHRIS BURNS
Vista Environmental Consulting, Inc.
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Phone: (510) 346-8860
Fax:
Received Date: 06/10/2024 2:15 PM
Analysis Date: 06/12/2024
Collected Date: 06/07/2024

Project: 241101003 - COSM - 400 COUNTY CENTER RWC (HOJ)

Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
400-A-01-Wallboard *472400949-0001*	WB/JC, WHITE/WHITE - COURT CLOCK ROOM SERVICE COUNTER	White Non-Fibrous Homogeneous		80% Gypsum 20% Non-fibrous (Other)	None Detected
400-A-01-Joint Compound *472400949-0001A*	WB/JC, WHITE/WHITE - COURT CLOCK ROOM SERVICE COUNTER	White Non-Fibrous Homogeneous		80% Ca Carbonate 20% Non-fibrous (Other)	None Detected
400-A-02-Wallboard *472400949-0002*	WB/JC, WHITE/WHITE	White Non-Fibrous Homogeneous		80% Gypsum 20% Non-fibrous (Other)	None Detected
400-A-02-Joint Compound *472400949-0002A*	WB/JC, WHITE/WHITE	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-B-01-Base Cove *472400949-0003*	BASECOVE/MAS, 4" BLUE/BEIGE & BROWN	Blue Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-B-01-Mastic *472400949-0003A*	BASECOVE/MAS, 4" BLUE/BEIGE & BROWN	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-B-02-Base Cove *472400949-0004*	BASECOVE/MAS, 4" BLUE/BEIGE & BROWN	Blue Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-B-02-Mastic *472400949-0004A*	BASECOVE/MAS, 4" BLUE/BEIGE & BROWN	Beige Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-C-01 *472400949-0005*	ACP, 2'X4' WHITE, CHICKEN FEET	Tan Fibrous Homogeneous	45% Cellulose 35% Glass	20% Non-fibrous (Other)	None Detected
400-C-02 *472400949-0006*	ACP, 2'X4' WHITE, CHICKEN FEET	Gray Fibrous Homogeneous	80% Glass	20% Non-fibrous (Other)	None Detected
400-D-01 *472400949-0007*	ACT, 12" WHITE, PUNIFORM HOLE	White Fibrous Homogeneous	45% Cellulose 35% Glass	20% Non-fibrous (Other)	None Detected
400-D-02 *472400949-0008*	ACT, 12" WHITE, PUNIFORM HOLE	Gray Fibrous Homogeneous	45% Cellulose 35% Glass	20% Non-fibrous (Other)	None Detected
400-E-01 *472400949-0009*	ACT, 12" WHITE FISSURED "PATCH"	Tan Fibrous Homogeneous	45% Cellulose 35% Glass	20% Non-fibrous (Other)	None Detected
400-E-02 *472400949-0010*	ACT, 12" WHITE FISSURED "PATCH"	Tan Fibrous Homogeneous	80% Cellulose	20% Non-fibrous (Other)	None Detected

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Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
400-F-01-Vinyl Sheet Flooring *472400949-0011*	VSF/MAS, BLUE PEBBLE/BLACK & YELLOW	Blue Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-F-01-Mastic *472400949-0011A*	VSF/MAS, BLUE PEBBLE/BLACK & YELLOW	Black Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-F-02-Vinyl Sheet Flooring *472400949-0012*	VSF/MAS, BLUE PEBBLE/BLACK & YELLOW	Tan/Blue Fibrous Homogeneous	20% Cellulose	60% Matrix 20% Non-fibrous (Other)	None Detected
400-F-02-Mastic *472400949-0012A*	VSF/MAS, BLUE PEBBLE/BLACK & YELLOW	Black/Yellow Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-G-01-Base Cove *472400949-0013*	BASECOVE/MAS, 4" GRAY/BROWN & BEIGE	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-G-01-Mastic *472400949-0013A*	BASECOVE/MAS, 4" GRAY/BROWN & BEIGE	Brown Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-G-02-Base Cove *472400949-0014*	BASECOVE/MAS, 4" GRAY/BROWN & BEIGE	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-G-02-Mastic *472400949-0014A*	BASECOVE/MAS, 4" GRAY/BROWN & BEIGE	Brown Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-H-01-Plaster 1 *472400949-0015*	PLASTER, WHITE - WALLS	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-H-01-Plaster 2 *472400949-0015A*	PLASTER, WHITE - WALLS	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-H-02-Plaster 1 *472400949-0016*	PLASTER, WHITE - WALLS	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-H-02-Plaster 2 *472400949-0016A*	PLASTER, WHITE - WALLS	Gray Non-Fibrous Homogeneous		20% Quartz 60% Matrix 20% Non-fibrous (Other)	None Detected
400-H-03-Plaster 1 *472400949-0017*	PLASTER, WHITE - WALLS	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-H-03-Plaster 2 *472400949-0017A*	PLASTER, WHITE - WALLS	Gray Non-Fibrous Homogeneous		20% Quartz 60% Matrix 20% Non-fibrous (Other)	None Detected
400-I-01-Vinyl Floor Tile *472400949-0018*	VFT/MAS, 9" BEIGE/BLACK	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-I-01-Mastic *472400949-0018A*	VFT/MAS, 9" BEIGE/BLACK	Black Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-I-02-Vinyl Floor Tile *472400949-0019*	VFT/MAS, 9" BEIGE/BLACK	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-I-02-Mastic *472400949-0019A*	VFT/MAS, 9" BEIGE/BLACK	Black Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected

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Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
400-J-01-Ceiling Tile *472400949-0020*	ACT/MAS, 12" WHITE/BROWN - LARGE FISSUE	White Fibrous Homogeneous	45% Cellulose 35% Glass	20% Non-fibrous (Other)	None Detected
400-J-01-Mastic *472400949-0020A*	ACT/MAS, 12" WHITE/BROWN - LARGE FISSUE	Brown Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-J-02-Ceiling Tile *472400949-0021*	ACT/MAS, 12" WHITE/BROWN - LARGE FISSUE	Gray/White Fibrous Homogeneous	80% Glass	20% Non-fibrous (Other)	None Detected
400-J-02-Mastic *472400949-0021A*	ACT/MAS, 12" WHITE/BROWN - LARGE FISSUE	Brown Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-K-01 *472400949-0022*	ACP, 2'X2' WHITE - SOLID	Tan Fibrous Homogeneous	45% Cellulose 35% Glass	20% Non-fibrous (Other)	None Detected
400-K-02 *472400949-0023*	ACP, 2'X2' WHITE - SOLID	Tan Fibrous Homogeneous	45% Cellulose 35% Glass	20% Non-fibrous (Other)	None Detected
400-L-01-Mortar *472400949-0024*	MORTAR/GROUT, GRAY/GRAY - STORE FLOOR	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-L-01-Grout *472400949-0024A*	MORTAR/GROUT, GRAY/GRAY - STORE FLOOR				**Layer Not Present**
400-L-02-Mortar *472400949-0025*	MORTAR/GROUT, GRAY/GRAY - STORE FLOOR	Gray Non-Fibrous Homogeneous		20% Quartz 60% Matrix 20% Non-fibrous (Other)	None Detected
400-L-02-Grout *472400949-0025A*	MORTAR/GROUT, GRAY/GRAY - STORE FLOOR				**Layer Not Present**
400-M-01-Wallboard *472400949-0026*	WB/JC, WHITE/WHITE - BOARD CHAMBERS	White Non-Fibrous Homogeneous		80% Gypsum 20% Non-fibrous (Other)	None Detected
400-M-01-Joint Compound *472400949-0026A*	WB/JC, WHITE/WHITE - BOARD CHAMBERS	White Non-Fibrous Homogeneous		80% Ca Carbonate 20% Non-fibrous (Other)	None Detected
400-M-02-Wallboard *472400949-0027*	WB/JC, WHITE/WHITE - BOARD CHAMBERS	White Non-Fibrous Homogeneous		80% Gypsum 20% Non-fibrous (Other)	None Detected
400-M-02-Joint Compound *472400949-0027A*	WB/JC, WHITE/WHITE - BOARD CHAMBERS	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-N-01-Mastic *472400949-0028*	MASTIC/FLOAT, YELLOW/WHITE - CARPET	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-N-01-Float *472400949-0028A*	MASTIC/FLOAT, YELLOW/WHITE - CARPET				**Layer Not Present**
400-N-02-Mastic *472400949-0029*	MASTIC/FLOAT, YELLOW/WHITE - CARPET	Yellow Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-N-02-Float *472400949-0029A*	MASTIC/FLOAT, YELLOW/WHITE - CARPET				**Layer Not Present**

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Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
400-O-01-Base Cove *472400949-0030*	BASECOVE/MAS, 4" LITE GRAY/BEIGE	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-O-01-Mastic *472400949-0030A*	BASECOVE/MAS, 4" LITE GRAY/BEIGE	Clear Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-O-02-Base Cove *472400949-0031*	BASECOVE/MAS, 4" LITE GRAY/BEIGE	Beige Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-O-02-Mastic *472400949-0031A*	BASECOVE/MAS, 4" LITE GRAY/BEIGE	Clear Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-P-01 *472400949-0032*	ACT, 12" OFF-WHITE - TEXTURE	White Fibrous Homogeneous	80% Glass	20% Non-fibrous (Other)	None Detected
400-P-02 *472400949-0033*	ACT, 12" OFF-WHITE - TEXTURE	Gray/White Fibrous Homogeneous	80% Glass	20% Non-fibrous (Other)	None Detected
400-Q-01-Vinyl Floor Tile *472400949-0034*	VFT/MAS, 12" OFF-WHITE/YELLOW	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-Q-01-Mastic 1 *472400949-0034A*	VFT/MAS, 12" OFF-WHITE/YELLOW	Yellow Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-Q-01 1-Mastic 2 *472400949-0034B*	VFT/MAS, 12" OFF-WHITE/YELLOW	Clear Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-Q-02-Vinyl Floor Tile *472400949-0035*	VFT/MAS, 12" OFF-WHITE/YELLOW	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-Q-02-Mastic 1 *472400949-0035A*	VFT/MAS, 12" OFF-WHITE/YELLOW	Yellow Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-Q-02-Mastic 2 *472400949-0035B*	VFT/MAS, 12" OFF-WHITE/YELLOW	Black/Clear Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-R-01-Base Cove *472400949-0036*	BASECOVE/MAS, 4" BROWN/BEIGE	Brown Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-R-01-Mastic *472400949-0036A*	BASECOVE/MAS, 4" BROWN/BEIGE	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-R-02-Base Cove *472400949-0037*	BASECOVE/MAS, 4" BROWN/BEIGE	Brown Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-R-02-Mastic *472400949-0037A*	BASECOVE/MAS, 4" BROWN/BEIGE	Beige Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-S-01-Vinyl Floor Tile *472400949-0038*	VFT/MAS, 12" GRAY/YELLOW	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-S-01-Mastic *472400949-0038A*	VFT/MAS, 12" GRAY/YELLOW	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected

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			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
400-S-02-Vinyl Floor Tile *472400949-0039*	VFT/MAS, 12" GRAY/YELLOW	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-S-02-Mastic *472400949-0039A*	VFT/MAS, 12" GRAY/YELLOW	Yellow Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-T-01-Base Cove *472400949-0040*	BASECOVE/MAS, 4" DK GRAY/BEIGE	Black Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-T-01-Mastic *472400949-0040A*	BASECOVE/MAS, 4" DK GRAY/BEIGE	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-T-02-Base Cove *472400949-0041*	BASECOVE/MAS, 4" DK GRAY/BEIGE	Gray/Black Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-T-02-Mastic *472400949-0041A*	BASECOVE/MAS, 4" DK GRAY/BEIGE	Beige Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-U-01 *472400949-0042*	MASTIC, BLACK & YELLOW - CARPET	Tan/Black Non-Fibrous Homogeneous		75% Matrix 20% Non-fibrous (Other)	**5% Chrysotile**
400-U-02 *472400949-0043*	MASTIC, BLACK & YELLOW - CARPET	Black Non-Fibrous Homogeneous		75% Matrix 20% Non-fibrous (Other)	**5% Chrysotile**
400-V-01 *472400949-0044*	ACP, 2'X4' WHITE - LARGE GOUGE	Gray Fibrous Homogeneous	35% Cellulose 45% Glass	20% Non-fibrous (Other)	None Detected
400-V-02 *472400949-0045*	ACP, 2'X4' WHITE - LARGE GOUGE	Beige Fibrous Homogeneous	45% Cellulose 35% Glass	20% Non-fibrous (Other)	None Detected
400-W-01-Base Cove *472400949-0046*	BASECOVE/MAS, 4" TAN/BROWN	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-W-01-Mastic *472400949-0046A*	BASECOVE/MAS, 4" TAN/BROWN	Brown Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-W-01-Joint Compound *472400949-0046B*	BASECOVE/MAS, 4" TAN/BROWN	White Non-Fibrous Homogeneous		80% Matrix 18% Non-fibrous (Other)	**2% Chrysotile**
400-W-02-Base Cove *472400949-0047*	BASECOVE/MAS, 4" TAN/BROWN	Beige Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-W-02-Mastic *472400949-0047A*	BASECOVE/MAS, 4" TAN/BROWN	Brown Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-W-02-Joint Compound *472400949-0047B*	BASECOVE/MAS, 4" TAN/BROWN	White Non-Fibrous Homogeneous		80% Ca Carbonate 18% Non-fibrous (Other)	**2% Chrysotile**
400-X-01 *472400949-0048*	MORTAR/GROUT, WHITE/WHITE - WALLS	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-Y-01-Mortar *472400949-0049*	MORTAR/GROUT, WHITE/WHITE - FLOORS	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected

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			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
400-Y-01-Grout *472400949-0049A*	MORTAR/GROUT, WHITE/WHITE - FLOORS				**Layer Not Present**
400-Z-01-Wallboard *472400949-0050*	WB/JC, WHITE/WHITE	White Non-Fibrous Homogeneous		80% Gypsum 20% Non-fibrous (Other)	None Detected
400-Z-01-Joint Compound *472400949-0050A*	WB/JC, WHITE/WHITE	White Non-Fibrous Homogeneous		80% Ca Carbonate 18% Non-fibrous (Other)	**2% Chrysotile**
400-Z-01-WB/JC Composite *472400949-0050B* *This is a composite result of the wallboard and joint compound.*	WB/JC, WHITE/WHITE	White Non-Fibrous Homogeneous		40% Ca Carbonate 40% Gypsum 20% Non-fibrous (Other)	**<1% Chrysotile**
400-Z-02-Wallboard *472400949-0051*	WB/JC, WHITE/WHITE	White Non-Fibrous Homogeneous		80% Gypsum 20% Non-fibrous (Other)	None Detected
400-Z-02-Joint Compound *472400949-0051A*	WB/JC, WHITE/WHITE	White Non-Fibrous Homogeneous		80% Matrix 18% Non-fibrous (Other)	**2% Chrysotile**
400-Z-02-WB/JC Composite *472400949-0051B* *This is a composite result of the wallboard and joint compound.*	WB/JC, WHITE/WHITE	White Non-Fibrous Homogeneous		50% Gypsum 50% Non-fibrous (Other)	**<1% Chrysotile**
400-Z-03-Wallboard *472400949-0052*	WB/JC, WHITE/WHITE	White Non-Fibrous Homogeneous		80% Gypsum 20% Non-fibrous (Other)	None Detected
400-Z-03-Joint Compound *472400949-0052A*	WB/JC, WHITE/WHITE	White Non-Fibrous Homogeneous		80% Ca Carbonate 18% Non-fibrous (Other)	**2% Chrysotile**
400-Z-03-WB/JC Composite *472400949-0052B* *This is a composite result of the wallboard and joint compound.*	WB/JC, WHITE/WHITE	White Non-Fibrous Homogeneous		40% Ca Carbonate 40% Gypsum 20% Non-fibrous (Other)	**<1% Chrysotile**
400-AA-01-Plaster 1 *472400949-0053*	PLASTER, WHITE/WHITE - COUNTY EXEC WALLS	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-AA-01-Plaster 2 *472400949-0053A*	PLASTER, WHITE/WHITE - COUNTY EXEC WALLS	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-AA-02-Plaster 1 *472400949-0054*	PLASTER, WHITE/WHITE - COUNTY EXEC WALLS	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-AA-02-Plaster 2 *472400949-0054A*	PLASTER, WHITE/WHITE - COUNTY EXEC WALLS	Tan/White Non-Fibrous Homogeneous		20% Quartz 60% Matrix 20% Non-fibrous (Other)	None Detected
400-AA-03-Plaster 1 *472400949-0055*	PLASTER, WHITE/WHITE - COUNTY EXEC WALLS	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected

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Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
400-AA-03-Plaster 2 *472400949-0055A*	PLASTER, WHITE/WHITE - COUNTY EXEC WALLS	Gray Non-Fibrous Homogeneous		20% Quartz 60% Matrix 20% Non-fibrous (Other)	None Detected
400-BB-01-Vinyl Floor Tile *472400949-0056*	VFT/MAS, 12" BEIGE W/ BROWN STREAKS / BLACK	White Non-Fibrous Homogeneous		75% Matrix 20% Non-fibrous (Other)	**5% Chrysotile**
400-BB-01-Mastic *472400949-0056A*	VFT/MAS, 12" BEIGE W/ BROWN STREAKS / BLACK	Black Non-Fibrous Homogeneous		75% Matrix 20% Non-fibrous (Other)	**5% Chrysotile**
400-BB-02-Vinyl Floor Tile *472400949-0057*	VFT/MAS, 12" BEIGE W/ BROWN STREAKS / BLACK	Beige Non-Fibrous Homogeneous		75% Matrix 20% Non-fibrous (Other)	**5% Chrysotile**
400-BB-02-Mastic 1 *472400949-0057A*	VFT/MAS, 12" BEIGE W/ BROWN STREAKS / BLACK	Black Non-Fibrous Homogeneous		75% Matrix 20% Non-fibrous (Other)	**5% Chrysotile**
400-BB-02-Mastic 2 *472400949-0057B*	VFT/MAS, 12" BEIGE W/ BROWN STREAKS / BLACK	Beige Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-CC-01-Base Cove *472400949-0058*	BASECOVE/MAS, 4" BROWN/BROWN	Brown Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-CC-01-Mastic *472400949-0058A*	BASECOVE/MAS, 4" BROWN/BROWN	Brown Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-CC-02-Base Cove *472400949-0059*	BASECOVE/MAS, 4" BROWN/BROWN	Brown Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-CC-02-Mastic *472400949-0059A*	BASECOVE/MAS, 4" BROWN/BROWN	Brown Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-GG-01-Vinyl Sheet Flooring *472400949-0060*	VSF/MAS, GRAY/CLEAR	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-GG-01-Mastic *472400949-0060A*	VSF/MAS, GRAY/CLEAR	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-HH-01 *472400949-0061*	MASTIC, WHITE - SINK	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-II-01 *472400949-0062*	ACP, 2'X4' WHITE, FISSUED	Gray Fibrous Homogeneous	95% Cellulose	5% Non-fibrous (Other)	None Detected
400-II-02 *472400949-0063*	ACP, 2'X4' WHITE, FISSUED	Beige Fibrous Homogeneous	95% Cellulose	5% Non-fibrous (Other)	None Detected
400-JJ-01-Wallboard *472400949-0064*	WB/JC, WHITE/WHITE - UNFINISHED	White Non-Fibrous Homogeneous		80% Gypsum 20% Non-fibrous (Other)	None Detected
400-JJ-01-Joint Compound *472400949-0064A*	WB/JC, WHITE/WHITE - UNFINISHED	White Non-Fibrous Homogeneous		80% Ca Carbonate 20% Non-fibrous (Other)	None Detected

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Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
400-KK-01 *472400949-0065*	FIRE STOP, RED - WALLS	Red Fibrous Homogeneous	10% Glass	70% Matrix 20% Non-fibrous (Other)	None Detected
400-LL-01-Paint *472400949-0066*	PAINT/PLASTER, BEIGE/GRAY - EXTERIOR WALLS	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-LL-01-Plaster *472400949-0066A*	PAINT/PLASTER, BEIGE/GRAY - EXTERIOR WALLS	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-LL-02-Paint *472400949-0067*	PAINT/PLASTER, BEIGE/GRAY - EXTERIOR WALLS	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-LL-02-Plaster 1 *472400949-0067A*	PAINT/PLASTER, BEIGE/GRAY - EXTERIOR WALLS	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-LL-02-Plaster 2 *472400949-0067B*	PAINT/PLASTER, BEIGE/GRAY - EXTERIOR WALLS	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-LL-03-Paint *472400949-0068*	PAINT/PLASTER, BEIGE/GRAY - EXTERIOR WALLS	Gray/White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-LL-03-Plaster *472400949-0068A*	PAINT/PLASTER, BEIGE/GRAY - EXTERIOR WALLS	Gray Non-Fibrous Homogeneous		20% Quartz 60% Matrix 20% Non-fibrous (Other)	None Detected
400-MM-01 *472400949-0069*	GLAZING, WHITE - ALUMINUM WINDOWS	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	**<1% Chrysotile**
400-MM-02 *472400949-0070*	GLAZING, WHITE - ALUMINUM WINDOWS	Gray/White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	**<1% Chrysotile**
400-NN-01 *472400949-0071*	GLAZING, WHITE - BROWN ALUMINUM WINDOWS	White Non-Fibrous Homogeneous		80% Matrix 18% Non-fibrous (Other)	**2% Chrysotile**
400-NN-02 *472400949-0072*	GLAZING, WHITE - BROWN ALUMINUM WINDOWS	Brown Non-Fibrous Homogeneous		80% Matrix 18% Non-fibrous (Other)	**2% Chrysotile**
400-OO-01 *472400949-0073*	SEALANT, GRAY - WINDOW FRAMES	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-OO-02 *472400949-0074*	SEALANT, GRAY - WINDOW FRAMES	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-PP-01 *472400949-0075*	PLASTER, WHITE - ROUGH OF BEAMS & COLUMNS	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-PP-02 *472400949-0076*	PLASTER, WHITE - ROUGH OF BEAMS & COLUMNS	White Non-Fibrous Homogeneous		20% Quartz 60% Matrix 20% Non-fibrous (Other)	None Detected
400-PP-03 *472400949-0077*	PLASTER, WHITE - ROUGH OF BEAMS & COLUMNS	Gray Non-Fibrous Homogeneous		20% Quartz 60% Matrix 20% Non-fibrous (Other)	None Detected
400-QQ-01 *472400949-0078*	JACKETING, WHITE - FIBER GLASS PIPE 3" OD	White Fibrous Homogeneous	80% Cellulose	20% Non-fibrous (Other)	None Detected
400-QQ-02 *472400949-0079*	JACKETING, WHITE - FIBER GLASS PIPE 3" OD	White Fibrous Homogeneous	80% Cellulose	20% Non-fibrous (Other)	None Detected

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Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
400-RR-01 *472400949-0080*	INSULATION, GRAY - 3" OD ELBOWS	Gray Fibrous Homogeneous	10% Glass	90% Non-fibrous (Other)	None Detected
400-RR-02 *472400949-0081*	INSULATION, GRAY - 3" OD ELBOWS	White Fibrous Homogeneous	10% Glass	70% Matrix 20% Non-fibrous (Other)	None Detected
400-RR-03 *472400949-0082*	INSULATION, GRAY - 3" OD ELBOWS	Gray Fibrous Homogeneous	80% Glass	20% Non-fibrous (Other)	None Detected
400-SS-01 *472400949-0083*	SEALANT, GRAY - HVAC	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-SS-02 *472400949-0084*	SEALANT, GRAY - HVAC	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-TT-01-Vinyl Floor Tile *472400949-0085*	VFT/MAS, 12" GRAY/YELLOW - 2ND LAYER	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-TT-01-Mastic *472400949-0085A*	VFT/MAS, 12" GRAY/YELLOW - 2ND LAYER	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-TT-02-Vinyl Floor Tile *472400949-0086*	VFT/MAS, 12" GRAY/YELLOW - 2ND LAYER	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-TT-02-Mastic *472400949-0086A*	VFT/MAS, 12" GRAY/YELLOW - 2ND LAYER	Yellow Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-UU-01-Vinyl Floor Tile *472400949-0087*	VFT/MAS, 9" BEIGE/BLACK - BOTTOM LAYER	Tan Non-Fibrous Homogeneous		75% Matrix 20% Non-fibrous (Other)	**5% Chrysotile**
400-UU-01-Mastic *472400949-0087A*	VFT/MAS, 9" BEIGE/BLACK - BOTTOM LAYER	Black Non-Fibrous Homogeneous		75% Matrix 20% Non-fibrous (Other)	**5% Chrysotile**
400-UU-02-Vinyl Floor Tile *472400949-0088*	VFT/MAS, 9" BEIGE/BLACK - BOTTOM LAYER	Beige Non-Fibrous Homogeneous		75% Matrix 20% Non-fibrous (Other)	**5% Chrysotile**
400-UU-02-Mastic *472400949-0088A*	VFT/MAS, 9" BEIGE/BLACK - BOTTOM LAYER	Black Non-Fibrous Homogeneous		75% Matrix 20% Non-fibrous (Other)	**5% Chrysotile**
400-UU-02-Joint Compound *472400949-0088B*	VFT/MAS, 9" BEIGE/BLACK - BOTTOM LAYER	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-VV-01 *472400949-0089*	MASTIC, YELLOW & BLACK - CARPET	Black/Yellow Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-VV-02 *472400949-0090*	MASTIC, YELLOW & BLACK - CARPET	Black/Yellow Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-WW-01 *472400949-0091*	ACP 2'X4' WHITE, CHICKEN FEET	Gray Fibrous Homogeneous	45% Cellulose 35% Glass	20% Non-fibrous (Other)	None Detected

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Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
400-WW-02 *472400949-0092*	ACP 2'X4' WHITE, CHICKEN FEET	Beige Fibrous Homogeneous	45% Cellulose 35% Glass	20% Non-fibrous (Other)	None Detected
400-XX-01-Vinyl Floor Tile *472400949-0093*	VFT/MAS, 12" OFF-WHITE, BROWN STREAKS / YELLOW	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-XX-01-Mastic *472400949-0093A*	VFT/MAS, 12" OFF-WHITE, BROWN STREAKS / YELLOW	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-XX-02-Vinyl Floor Tile *472400949-0094*	VFT/MAS, 12" OFF-WHITE, BROWN STREAKS / YELLOW	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-XX-02-Mastic *472400949-0094A*	VFT/MAS, 12" OFF-WHITE, BROWN STREAKS / YELLOW	Yellow Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-YY-01 *472400949-0095*	TEXTURE COAT PLASTER, WHITE, SMALL, WALLS	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-YY-02 *472400949-0096*	TEXTURE COAT PLASTER, WHITE, SMALL, WALLS	Pink Non-Fibrous Homogeneous		20% Quartz 60% Matrix 20% Non-fibrous (Other)	None Detected
400-YY-03 *472400949-0097*	TEXTURE COAT PLASTER, WHITE, SMALL, WALLS	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-A3-01 *472400949-0098*	PLASTER, WHITE - COLUMNS & BEAMS PLENUM	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-A3-02 *472400949-0099*	PLASTER, WHITE - COLUMNS & BEAMS PLENUM	Beige Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-A3-03 *472400949-0100*	PLASTER, WHITE - COLUMNS & BEAMS PLENUM	White Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-B3-01 *472400949-0101*	FIREPROOFING, GRAY - CONCRETE DECK	Gray Fibrous Homogeneous		60% Matrix 20% Non-fibrous (Other)	**20% Chrysotile**
400-B3-02 *472400949-0102*	FIREPROOFING, GRAY - CONCRETE DECK	White Fibrous Homogeneous		60% Matrix 20% Non-fibrous (Other)	**20% Chrysotile**
400-B3-03 *472400949-0103*	FIREPROOFING, GRAY - CONCRETE DECK	Gray Fibrous Homogeneous	10% Glass	85% Non-fibrous (Other)	**5% Chrysotile**
400-B3-04 *472400949-0104*	FIREPROOFING, GRAY - CONCRETE DECK	Gray Fibrous Homogeneous		60% Matrix 20% Non-fibrous (Other)	**20% Chrysotile**
400-B3-05 *472400949-0105*	FIREPROOFING, GRAY - CONCRETE DECK	Gray Fibrous Homogeneous		60% Matrix 20% Non-fibrous (Other)	**20% Chrysotile**
400-C3-01-Vinyl Sheet Flooring 1 *472400949-0106*	VSF/MAS, BEIGE, PEBBLE PATTERN/BEIGE	Beige Fibrous Homogeneous	20% Cellulose	60% Matrix 20% Non-fibrous (Other)	None Detected

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			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
400-C3-01-Mastic 1 *472400949-0106A*	VSF/MAS, BEIGE, PEBBLE PATTERN/BEIGE	Beige Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-C3-01-Vinyl Sheet Flooring 2 *472400949-0106B*	VSF/MAS, BEIGE, PEBBLE PATTERN/BEIGE	White Non-Fibrous Homogeneous		75% Matrix 20% Non-fibrous (Other)	**5% Chrysotile**
400-C3-01-Mastic 2 *472400949-0106C*	VSF/MAS, BEIGE, PEBBLE PATTERN/BEIGE	Black Non-Fibrous Homogeneous		75% Matrix 20% Non-fibrous (Other)	**5% Chrysotile**
400-D3-01-Paint *472400949-0107*	PAINT/STUCCO, BEIGE/GRAY - EXISTING INTERIOR WALL	Tan Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-D3-01-Stucco *472400949-0107A*	PAINT/STUCCO, BEIGE/GRAY - EXISTING INTERIOR WALL	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-D3-02-Paint *472400949-0108*	PAINT/STUCCO, BEIGE/GRAY - EXISTING INTERIOR WALL	Beige Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-D3-02-Stucco *472400949-0108A*	PAINT/STUCCO, BEIGE/GRAY - EXISTING INTERIOR WALL	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-D3-03-Paint *472400949-0109*	PAINT/STUCCO, BEIGE/GRAY - EXISTING INTERIOR WALL	Beige Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-D3-03-Stucco *472400949-0109A*	PAINT/STUCCO, BEIGE/GRAY - EXISTING INTERIOR WALL	Gray Non-Fibrous Homogeneous		20% Quartz 60% Matrix 20% Non-fibrous (Other)	None Detected
400-E3-01 *472400949-0110*	CONCRETE, GRAY - FLOORS	Gray Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (Other)	None Detected
400-E3-02 *472400949-0111*	CONCRETE, GRAY - FLOORS	Gray Non-Fibrous Homogeneous		20% Quartz 60% Matrix 20% Non-fibrous (Other)	None Detected

Analyst(s)

Aimee Hartwig (52)
Christian Albayalde (64)
Elena White (14)
Kimberly Chuc (47)

Jonathan Nomura, Laboratory Manager
or Other Approved Signatory

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Samples analyzed by EMSL Analytical, Inc. Santa Clara, CA NVLAP Lab Code 600318-0

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Analysis Date: 06/12/2024 - 06/13/2024
Collected: 06/07/2024

Project: 241101003 - COSM - 400 COUNTY CENTER RWC (HOJ)

Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy. Quantitation using 400 Point Count Procedure

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
400-Z-01-WB/JC Composite *472400949-0050B*	WB/JC, WHITE/WHITE	White Non-Fibrous Homogeneous		100.0% Non-fibrous (Other)	**<0.25% Chrysotile**
400-Z-02-WB/JC Composite *472400949-0051B*	WB/JC, WHITE/WHITE	White Non-Fibrous Homogeneous		99.75% Non-fibrous (Other)	**0.25% Chrysotile**
400-Z-03-WB/JC Composite *472400949-0052B*	WB/JC, WHITE/WHITE	White Non-Fibrous Homogeneous		100.0% Non-fibrous (Other)	**<0.25% Chrysotile**

Analyst(s)

Aimee Hartwig (3)

Jonathan Nomura, Laboratory Manager
or other approved signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 “Interim Method”) but augmented with procedures outlined in the 1993 (”final”) version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc. Santa Clara, CA NVLAP Lab Code 600318-0

Initial report from: 06/12/2024 15:11:04

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#472400949

VISTA ENVIRONMENTAL CONSULTING
2984 TEAGARDEN STREET
SAN LEANDRO, CA 94577
OFFICE 510.346.8860
FAX 888.653.8889

ASBESTOS BULK SAMPLE LOG

CLIENT: COSM DATE: 6/7/24-6/8/24

LOCATION: 400 COUNTY CENTER RWC PROJECT NUMBER: 241101003

SAMPLED BY: JR (HOJ) CAC OR SST NO: 02-3244

BUILDING	HOMO AREA ID	NUMBER	MATERIAL	DESCRIPTION	LOCATION	QUANTITY (SF/LF/EA)
400	A	01	WB/SC	WHITE/WHITE	COURT CLERK ROOM SERVICE COUNTER	
400	A	02	↓	↓		
400	B	03	BASECOAT/MAS	4" BLUE/BEIGE BROWN		
400	B	02	↓	↓		
400	C	01	ACP	2'X4' WHITE, CHICKEN FEET		
400	C	02	↓	↓		
400	D	01	ACT	12" WHITE, UNIFORM HOLE		
400	D	02	↓	↓		
400	E	01	ACT	12" WHITE PATCH "PATCH"		
400	F	01	VSF/MAS	BLUE, PEBBLE/BLACK & YELLOW		

ANALYTICAL METHOD: (PLM) 400 PT COUNT TURNAROUND TIME: SAME DAY 24HR (48 HR) 3 DAY

DATA SENT TO: Christopher Burns Via E-Mail: chrisburns@vista-env.com ; nocaladmin@vista-env.com
Questions call: Office_510.346.8860 Cell_925.348.5361

SPECIAL INSTRUCTIONS:

CHAIN OF CUSTODY:

	TRANSFER SIGNATURE	PRINTED NAME	DATE/TIME
1.		LUIS J. ROCHA	6/10/24 - 0800
2.			
3.			

PAGE 1 OF 11 RBA Erika Miranda 06102024-1415

Rel: Jonathan Nomura 6/11/24 4:00pm

Rec: Jonathan Nomura

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ASBESTOS BULK SAMPLE LOG

2984 TEAGARDEN STREET
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OFFICE 510.346.8860
FAX 888.653.8889

CLIENT: COSM DATE: 5/20, 6/7, 6/8/24

LOCATION: 400 COUNTY CENTER RWC PROJECT NUMBER: 241101003

SAMPLED BY: JR (HOJ) CAC OR SST NO: 02-3244

BUILDING	HOMO AREA ID	NUMBER	MATERIAL	DESCRIPTION	LOCATION	QUANTITY (SF/LF/EA)
400	F	02	↓	↓		
400	G	01	BASECOAT/MAS	4" GRAY/BROWN & BEIGE		
400	G	02	↓	↓		
400	H	01	PLASTER	WHITE	WALLS	
400	H	02	↓	↓	↓	
400	H	03	↓	↓	↓	
400	I	01	VFT/MAS	9" BEIGE/BLACK		
400	I	02	↓	↓		
400	J	01	ACT/MAS	12" WHITE/BROWN	CARGE FISSUE	
400	J	02	↓	↓	↓	

ANALYTICAL METHOD: (PLM) 400 PT COUNT TURNAROUND TIME: SAME DAY 24HR (48 HR) 3 DAY

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2. _____ TRANSFER SIGNATURE — _____ PRINTED NAME — _____ DATE/TIME
3. _____ TRANSFER SIGNATURE — _____ PRINTED NAME — _____ DATE/TIME

PAGE 2 OF 11 RB4 Eon Erika Miranda will 06102024-1415

Rel: Jacob Abbott 6/11/24 4:00pm PT

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ASBESTOS BULK SAMPLE LOG

CLIENT: COSM DATE: 5/20, 6/7, 6/18/24

LOCATION: 400 COUNTY CENTER RWC PROJECT NUMBER: 241101003

SAMPLED BY: JR (HOJ) CAC OR SST NO: 02-3244

BUILDING	HOMO AREA ID	NUMBER	MATERIAL	DESCRIPTION	LOCATION	QUANTITY (SF/LF/EA)
400	K	01	ACP	2'X2' WHITE	SOLID	
400	K	02	↓	↓	↓	
400	L	01	MORTAR/GROUT	GRAY/GRAY	STORE FLOOR	
400	L	02	↓	↓	↓	
400	M	01	WB/JC	WHITE/WHITE	BOARD CHAMBERS	
400	M	02	↓	↓	↓	
400	N	01	MASTIC/FLOAT	YELLOW/WHITE	CARPET	
400	N	02	↓	↓	↓	
400	O	01	BASECOVE/MAS	4" LITE GRAY/BEIGE		
400	O	02	↓	↓		

ANALYTICAL METHOD: (PLM) 400 PT COUNT TURNAROUND TIME: SAME DAY 24HR (48 HR) 3 DAY

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PAGE 3 OF 11 Rosen Erika Miranda will 06102024-1415
Rell. Jacob Pesto Jacob Pesto 6/11/24 4:00PM

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ASBESTOS BULK SAMPLE LOG

CLIENT: COSM DATE: 5/20, 6/7, 6/8/24

LOCATION: 400 COUNTY CENTER RWC PROJECT NUMBER: 241101003

SAMPLED BY: JR (HOJ) CAC OR SST NO: 02-3244

BUILDING	HOMO AREA ID	NUMBER	MATERIAL	DESCRIPTION	LOCATION	QUANTITY (SF/LF/EA)
400	P	01	ACT	12" OFF-WHITE	TEXTURE	
400	P	02	↓	↓	↓	
400	Q	01	VFT/MAS	12" OFF-WHITE/YELLOW		
400	Q	02	↓	↓		
400	R	01	BASECOVE/MAS	4" BROWN/BEIGE		
400	R	02	↓	↓		
400	S	01	VFT/MAS	12" GRAY/YELLOW		
400	S	02	↓	↓		
400	T	01	BASECOVE/MAS	4" DK GRAY/BEIGE		
400	T	02	↓	↓		

ANALYTICAL METHOD: (PLM) 400 PT COUNT TURNAROUND TIME: SAME DAY 24HR (48 HR) 3 DAY

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2. _____ (TRANSFER SIGNATURE) _____ (PRINTED NAME) _____ (DATE/TIME)
3. _____ (TRANSFER SIGNATURE) _____ (PRINTED NAME) _____ (DATE/TIME)

PAGE 4 OF 11 RB & ECV Erika Miranda will 06102024-1415

Rel: Jacob Reyes 6/11/24 4:00 pm

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ASBESTOS BULK SAMPLE LOG

CLIENT: COSM DATE: 5/20, 6/7, 6/8/24

LOCATION: 400 COUNTY CENTER RWC PROJECT NUMBER: 241101003

SAMPLED BY: JR (HOJ) CAC OR SST No: 02-3244

BUILDING	HOMO AREA ID	NUMBER	MATERIAL	DESCRIPTION	LOCATION	QUANTITY (SF/LF/EA)
400	U	01	MASTIC	BLACK & YELLOW	CARPET	
400	U	02	↓	↓	↓	
400	V	01	ACP	21X41 WHITE, LARGE GOUGE		
400	V	02	↓	↓	↓	
400	W	01	BASECOVE/MAS	4" TAN/BROWN		
400	W	02	↓	↓		
400	X	01	MORTAR/GROUT	WHITE/WHITE	WALLS	
400	Y	01	MORTAR/GROUT	WHITE/GRAY	FLOORS	
400	Z	01	WB/JC	WHITE/WHITE		
400	Z	02	|	|		

ANALYTICAL METHOD: (PLM) 400 PT COUNT TURNAROUND TIME: SAME DAY 24HR (48 HR) 3 DAY

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2. _____ TRANSFER SIGNATURE — _____ PRINTED NAME — _____ DATE/TIME
3. _____ TRANSFER SIGNATURE — _____ PRINTED NAME — _____ DATE/TIME

PAGE 5 OF 11 RB☆ ecn Erika Miranda w11 06102024-1415

Rel: Jacob DeSoto Tuck 6/11/24 Ex 4:00pm

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ASBESTOS BULK SAMPLE LOG

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FAX 888.653.8889

CLIENT: COSM DATE: 6/10, 6/7, 6/8 24

LOCATION: 400 COUNTY CENTER RWC PROJECT NUMBER: 241101003

SAMPLED BY: JR (HOJ) CAC OR SST No: 02-3244

BUILDING	HOMO AREA ID	NUMBER	MATERIAL	DESCRIPTION	LOCATION	QUANTITY (SF/LF/EA)
400	Z	03	↓	↓	↓	
400	AA	01	PLASTER	WHITE/WHITE	COUNTY EXEC WALLS	
400	AA	02	↓	↓	↓	
400	AA	03	↓	↓	↓	
400	BB	01	VFT/MAS	12" BEIGE W/ BROWN STREAKS / BLACK		
400	BB	02	↓	↓	↓	
400	CC	01	BASECOVE/MAS	4" BROWN / BROWN		
400	CC	02	↓	↓		
400	GG	01	VSF/MAS	GRAY / CLEAR		
400	HH	01	MASTIC	WHITE	SINK	

ANALYTICAL METHOD: (PLM) 400 PT COUNT TURNAROUND TIME: SAME DAY 24HR (48 HR) 3 DAY

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Questions call: Office_510.346.8860 Cell_925.348.5361

SPECIAL INSTRUCTIONS: DD NOT USED. EE, FF, ZZ (ASSUMED)

CHAIN OF CUSTODY:

	TRANSFER SIGNATURE	PRINTED NAME	DATE/TIME
1.		LUIS J. ROCHA	6/10/24 - 0800
2.			
3.			

PAGE 6 OF 11 RB & Sam Erika Miranda WH 06102024-1415

Rel: Jacob DeSoto Fx 6/11/24 4:00 pm

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OFFICE 510.346.8860
FAX 888.653.8889

CLIENT: COSM DATE: 5/20, 6/7, 6/8/24

LOCATION: 400 COUNTY CENTER RWC PROJECT NUMBER: 241101003

SAMPLED BY: JR (HOJ) CAC OR SST NO: 02-3244

BUILDING	HOMO AREA ID	NUMBER	MATERIAL	DESCRIPTION	LOCATION	QUANTITY (SF/LF/EA)
400	II	01	ACP	2'X4' WHITE, FISSUED		
400	II	02	↓	↓	↓	
400	JJ	01	CMB/JC	WHITE/WHITE	UNFINISHED	
400	KK	01	FIRESTOP	RED	WALLS	
400	LL	01	PAINT/PLASTER	BEIGE/GRAY	EXTERIOR WALLS	
400	LL	02	↓	↓	↓	
400	LL	03	↓	↓	↓	
400	MM	01	GLAZING	WHITE	ALUMINUM WINDOWS	
400	MM	02	↓	↓	↓	
400	NN	01	GLAZING	WHITE	BROKEN ALUMINUM WINDOWS	

ANALYTICAL METHOD: (PLM) 400 PT COUNT TURNAROUND TIME: SAME DAY 24HR (48 HR) 3 DAY

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SPECIAL INSTRUCTIONS: _____

CHAIN OF CUSTODY:

	TRANSFER SIGNATURE	PRINTED NAME	DATE/TIME
1.	[signature]	LUIS J. ROCHA	6/10/24-0800
2.			
3.			

PAGE 7 OF 11 RB4 Cell Erika Miranda will 06102024-1415

Rel: Jacob DeSoto Jacob DeSoto 6/11/24 4:00pm Fx

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ASBESTOS BULK SAMPLE LOG

CLIENT: COSM

DATE: 5/20, 6/7, 6/8 24

LOCATION: 400 COUNTY CENTER RWC

PROJECT NUMBER: 241101003

SAMPLED BY: JR (HOJ)

CAC OR SST NO: 02-3244

BUILDING	HOMO AREA ID	NUMBER	MATERIAL	DESCRIPTION	LOCATION	QUANTITY (SF/LF/EA)
400	NN	02	↓	↓	↓	
400	OO	01	SEALANT	GRAY	WINDOW FRAMES	
400	OO	02	↓	↓	↓	
400	PP	01	PLASTER	WHITE	ROUGH OF BEAMS & COLUMNS	
400	PP	02	↓	↓	↓	
400	PP	03	↓	↓	↓	
400	QQ	01	JACKETING	WHITE	FIBER GLASS PIPE 3" OD	
400	QQ	02	↓	↓	↓	
400	RR	01	INSULATION	GRAY	3" OD ELBOWS	
400	RR	02	|	|	|	

ANALYTICAL METHOD: (PLM) 400 PT COUNT TURNAROUND TIME: SAME DAY 24HR (48 HR) 3 DAY

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Questions call: Office_510.346.8860 Cell_925.348.5361

SPECIAL INSTRUCTIONS:

CHAIN OF CUSTODY:

1. _____ (TRANSFER SIGNATURE) LUIS J. ROCHA (PRINTED NAME) 6/10/24 - 0800 (DATE/TIME)
2. _____ (TRANSFER SIGNATURE) _____ (PRINTED NAME) _____ (DATE/TIME)
3. _____ (TRANSFER SIGNATURE) _____ (PRINTED NAME) _____ (DATE/TIME)

PAGE 8 OF 11 RB & Ecn Erika Miranda wp 6102024-1415

Rel: Jacob Dietz 6/11/24 by 4:00pm

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ASBESTOS BULK SAMPLE LOG

2984 TEAGARDEN STREET
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OFFICE 510.346.8860
FAX 888.653.8889

CLIENT: COSM DATE: 5&6, 6/7, 6/8/24

LOCATION: 400 COUNTY CENTER RWC PROJECT NUMBER: 241101003

SAMPLED BY: JR (HOJ) CAC OR SST No: 02-3244

BUILDING	HOMO AREA ID	NUMBER	MATERIAL	DESCRIPTION	LOCATION	QUANTITY (SF/LF/EA)
400	RR	03	↓	↓	↓	
400	SS	01	SEALANT	GRAY	HVAC	
400	SS	02	↓	↓	↓	
400	TT	01	VFT/MAS	12" GRAY/YELLOW	2ND LAYER	
400	TT	02	↓	↓	↓	
400	UU	01	VFT/MAS	9" BEIGE/BLACK	BOTTOM LAYER	
400	UU	02	↓	↓	↓	
400	VV	01	MASTIC	YELLOW & BLACK	CARPET	
400	VV	02	↓	↓	↓	
400	WW	01	ACP	2'X4' WHITE, CHICKEN FEET		

ANALYTICAL METHOD: (PLM) 400 PT COUNT TURNAROUND TIME: SAME DAY 24HR (48 HR) 3 DAY

DATA SENT TO: Christopher Burns Via E-Mail: chrisburns@vista-env.com ; nocaladmin@vista-env.com
Questions call: Office_510.346.8860 Cell_925.348.5361

SPECIAL INSTRUCTIONS: _____

CHAIN OF CUSTODY:

	TRANSFER SIGNATURE	PRINTED NAME	DATE/TIME
1.		LUIS J. ROCHA	6/10/24-0800
2.			
3.			06/20/24-1415

PAGE 9 OF 11 RB☆ Call Erika Miranda will
Pic: Jacob Rebato Judy Nilsen 6/11/24 4:00pm EX

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CLIENT: COSM DATE: 5/20, 6/7, 6/18/24

LOCATION: 400 COUNTY CENTER RWC PROJECT NUMBER: 241101003

SAMPLED BY: JR (HOJ) CAC OR SST No: 02-3244

BUILDING	HOMO AREA ID	NUMBER	MATERIAL	DESCRIPTION	LOCATION	QUANTITY (SF/LF/EA)
400	WW	02	↓	↓	↓	
400	XX	01	VFT/MAS	12" OFF-WHITE, BROWN	STREAKS/YELLOW	
400	XX	02	↓	↓	↓	
400	YY	01	TEXTURE COAT PLASTER	WHITE/SMALL, CURLS		
400	YY	02	↓	↓	↓	
400	YY	03	↓	↓	↓	
400	A3	01	PLASTER	WHITE	COLUMNS & BEAMS PLENUM	
400	A3	02	↓	↓	↓	
400	A3	03	↓	↓	↓	
400	B3	01	FIREPROOFING	GRAY	CONCRETE DECK	

ANALYTICAL METHOD: (PLM) 400 PT COUNT TURNAROUND TIME: SAME DAY 24HR (48 HR) 3 DAY

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Questions call: Office_510.346.8860 Cell_925.348.5361

SPECIAL INSTRUCTIONS: ZZ - ASSUMED

CHAIN OF CUSTODY:

	TRANSFER SIGNATURE	PRINTED NAME	DATE/TIME
1.		LUIS J. ROCHA	6/10/24-0800
2.			
3.			

 RBA EM Erika Miranda WH 06102024-1415

Rel: [illegible] Jacob DeSoto 6/11/24 4:09pm Ex

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OFFICE 510.346.8860
FAX 888.653.8889

CLIENT: COSM DATE: 5/20, 6/7, 6/24

LOCATION: 400 COUNTY CENTER RWC PROJECT NUMBER: 241101003

SAMPLED BY: JR (HOJ) CAC OR SST No: 02-3244

BUILDING	HOMO AREA ID	NUMBER	MATERIAL	DESCRIPTION	LOCATION	QUANTITY (SF/LF/EA)
400	B3	02				
400	B3	03				
400	B3	04				
400	B3	05				
400	C3	01	VSF/MAS	BEIGE, PEBBLE PATTERN	BEIGE	
400	D3	01	PAINT/STUCCO	BEIGE/GRAY	EXISTING INTERIOR WALL	
400	D3	02				
400	D3	03				
400	E3	01	CONCRETE	GRAY	FLOORS	
400	E3	02				

ANALYTICAL METHOD: (PLM) 400 PT COUNT TURNAROUND TIME: SAME DAY 24HR (48 HR) 3 DAY

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SPECIAL INSTRUCTIONS: _____

CHAIN OF CUSTODY:

1. _____ (TRANSFER SIGNATURE) LUIS J. ROCHA (PRINTED NAME) 6/10/24-0800 (DATE/TIME)
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3. _____ (TRANSFER SIGNATURE) _____ (PRINTED NAME) _____ (DATE/TIME)

PAGE 11 OF 11 RB & Erika Miranda will 6 10 2024 - 1415

Rel: Jacob DeSoto 6/11/24 4:00pm

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ASBESTOS BULK SAMPLE LOG

CLIENT: COSM DATE:

LOCATION: 400 COUNTY CENTER RWC PROJECT NUMBER: 241101003

SAMPLED BY: JR (HOJ) CAC OR SST NO: 02-3244

BUILDING	HOMO AREA ID	NUMBER	MATERIAL	DESCRIPTION	LOCATION	QUANTITY (SF/LF/EA)
400						
400						
400						
400						
400						
400						
400						
400						
400						
400						

ANALYTICAL METHOD: (PLM) 400 PT COUNT TURNAROUND TIME: SAME DAY 24HR (48 HR) 3 DAY

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	TRANSFER SIGNATURE	PRINTED NAME	DATE/TIME
1.		LUIS J. ROCHA	
2.			
3.			

PAGE ____ OF ____ RB & Erika Miranda 6/11/2024-1415

Rel: Jacob DeSoto Jacob DeSoto 6/11/24 4:00pm FX

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Miranda, Erika

From: Miranda, Erika on behalf of EMSL Lab - San Leandro
Sent: Tuesday, June 11, 2024 8:46 AM
To: Chris Burns; DeSoto, Jacob
Cc: nocaladmin@vista-env.com; EMSL Lab - San Leandro
Subject: RE: Extra Sample Received

Categories: Erika Miranda

Good morning,

We will proceed with analyzing sample 400-E02 for PLM EPA 600 as per your confirmation via email.

If this is incorrect or you wish to proceed differently, please let us know.

Thank you,

Erika Miranda
Laboratory Administrative Assistant
EMSL Analytical, Inc. 464 McCormick Street San Leandro, CA 94577
Phone: 510-895-3675 Toll Free: 888-455-3675

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From: Chris Burns <chrisburns@vista-env.com>
Sent: Tuesday, June 11, 2024 4:36 AM
To: DeSoto, Jacob <jdesoto@EMSL.com>
Cc: nocaladmin@vista-env.com; EMSL Lab - San Leandro <sanleandrolab@emsl.com>
Subject: Re: Extra Sample Received

[EXTERNAL E-MAIL]

Please analyze the sample.
Thanks,
Christopher Burns
Vista Environmental Consulting
925-348-5361

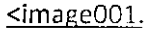
On Jun 10, 2024, at 5:36 PM, DeSoto, Jacob <jdesoto@emsl.com> wrote:

Docusign Envelope ID: 37D6996E-9788-4CCD-AC87-6F1095B8D128

Good afternoon,

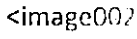
Today we received your samples for project number 241101003 – 400 County Center RWC (attached above). Upon inspection of the samples and COC we noticed we received an extra sample that was not listed on the COC labeled "400-E02". As to not delay your results we will proceed with the other samples. If you would like the extra sample analyzed, please send us an amended COC, or confirm in this email thread and we will use it as an addendum to the original COC.
If you have any other questions or concerns regarding this project, please let us know.

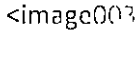
Thank you,



Jacob DeSoto
Laboratory Administrative Assistant
EMSL Analytical, Inc. 464 McCormick Street San Leandro, CA 94577
Phone: 510-895-3675 Toll Free: 888-455-3675

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<241101003.pdf>

Docusign Envelope ID: 37D6996E-9788-4CCD-AC87-6F1095B8D128

DeSoto, Jacob

From: DeSoto, Jacob
Sent: Monday, June 10, 2024 5:41 PM
To: Chris Burns; nocaladmin@vista-env.com
Cc: EMSL Lab - San Leandro
Subject: Extra Sample Received
Attachments: 241101003.pdf

Categories: Jacob DeSoto

Good afternoon,

Today we received your samples for project number 241101003 – 400 County Center RWC (attached above). Upon inspection of the samples and COC we noticed we received an extra sample that was not listed on the COC labeled "400-E02". As to not delay your results we will proceed with the other samples. If you would like the extra sample analyzed, please send us an amended COC, or confirm in this email thread and we will use it as an addendum to the original COC. If you have any other questions or concerns regarding this project, please let us know.

Thank you,

Jacob DeSoto
Laboratory Administrative Assistant
EMSL Analytical, Inc. 464 McCormick Street San Leandro, CA 94577
Phone: 510-895-3675 Toll Free: 888-455-3675

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County of San Mateo
Hall of Justice - 400 County Center, Redwood City
XRF Sequential Report

READING NO.	BUILDING	ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	RESULTS	PbC	UNITS
1	400		Calibrate				Positive	1.1	mg/cm2
2	400		Calibrate				Positive	1	mg/cm2
3	400		Calibrate				Positive	1	mg/cm2
4	400	SH	Lower Wall	Plaster	Blue	Intact	Negative	0	mg/cm2
5	400	SH	Lower Wall	Plaster	Blue	Intact	Negative	0	mg/cm2
6	400	SH	Lower Wall	Plaster	White	Intact	Negative	0	mg/cm2
7	400	SH	Lower Wall	Plaster	White	Intact	Negative	0	mg/cm2
8	400	SH	Lower Wall	Drywall	White	Intact	Negative	0	mg/cm2
9	400	SH	Lower Wall	Drywall	White	Intact	Negative	0.2	mg/cm2
10	400	SH	Window Sill	Metal	White	Intact	Negative	0.6	mg/cm2
11	400	SH	Window Sill	Metal	White	Intact	Negative	0.1	mg/cm2
12	400	SH	Window Sill	Metal	White	Intact	Negative	0.6	mg/cm2
13	400	SH	Door	Wood	White	Intact	Negative	0	mg/cm2
14	400	SH	Door	Wood	White	Intact	Negative	0	mg/cm2
15	400	SH	Door Frame	Metal	White	Intact	Negative	0.2	mg/cm2
16	400	SH	Door Frame	Metal	White	Intact	Negative	0.1	mg/cm2
17	400	SH	Crown Molding	Vinyl	Green	Intact	Negative	0	mg/cm2
18	400	SH	Crown Molding	Vinyl	Green	Intact	Negative	0.1	mg/cm2
19	400	CCRA	Column	Drywall	Lt-Gray	Intact	Negative	0.1	mg/cm2
20	400	CCRA	Column	Drywall	Lt-Gray	Intact	Negative	0	mg/cm2
21	400	CCRA	Column	Drywall	Gray	Intact	Negative	0	mg/cm2
22	400	CCRA	Column	Drywall	Gray	Intact	Negative	0	mg/cm2
23	400	CCRA	Lower Wall	Plaster	Gray	Intact	Negative	0	mg/cm2
24	400	CCRA	Lower Wall	Plaster	Gray	Intact	Negative	0	mg/cm2
25	400	CCRA	Upper Wall	Drywall	Red	Intact	Negative	0.1	mg/cm2
26	400	CCRA	Upper Wall	Drywall	Red	Intact	Negative	0	mg/cm2
27	400	CCRA	Ceiling	Drywall	White	Intact	Negative	0.1	mg/cm2
28	400	CCRA	Ceiling	Drywall	White	Intact	Negative	0.1	mg/cm2

This data is a screening of lead levels and provides results that are generally representative of typical conditions, but are not inclusive of all painted/coated surfaces at the Project Site.

VISTA ENVIRONMENTAL CONSULTING

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County of San Mateo
Hall of Justice - 400 County Center, Redwood City
XRF Sequential Report

READING NO.	BUILDING	ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	RESULTS	PbC	UNITS
29	400	CCRA	Door Frame	Metal	Gray	Intact	Negative	0	mg/cm2
30	400	CCRA	Door Frame	Metal	Gray	Intact	Negative	0	mg/cm2
31	400	CCRA	Door	Wood	Gray	Intact	Negative	0.1	mg/cm2
32	400	CCRA	Door	Wood	Gray	Intact	Negative	0	mg/cm2
33	400	CCRA	Crown Molding	Vinyl	Green	Intact	Negative	0	mg/cm2
34	400	CCRA	Crown Molding	Vinyl	Green	Intact	Negative	0	mg/cm2
35	400	CCRA	Wall Panel	Wood	Gray	Intact	Negative	0	mg/cm2
36	400	CCRA	Wall Panel	Wood	Gray	Intact	Negative	0	mg/cm2
37	400	CCRA	Floor	Vinyl	Blue	Intact	Negative	0.3	mg/cm2
38	400	CCRA	Floor	Vinyl	Blue	Intact	Negative	0	mg/cm2
39	400	CCRA	Lower Wall	Wood	White	Intact	Negative	0.3	mg/cm2
40	400	CCRA	Lower Wall	Wood	White	Intact	Negative	0.3	mg/cm2
41	400	CCRA	Door	Metal	Black	Intact	Negative	0	mg/cm2
42	400	CCRA	Door	Metal	Black	Intact	Negative	0	mg/cm2
43	400	CCRA	Door Frame	Metal	Black	Intact	Negative	0.2	mg/cm2
44	400	CCRA	Door Frame	Metal	Black	Intact	Negative	0	mg/cm2
45	400	Lobby	Column	Plaster	White	Intact	Negative	0.3	mg/cm2
46	400	Lobby	Column	Plaster	White	Intact	Negative	0.1	mg/cm2
47	400	Lobby	Lower Wall	Plaster	White	Intact	Negative	0.1	mg/cm2
48	400	Lobby	Lower Wall	Plaster	White	Intact	Negative	0.1	mg/cm2
49	400	Lobby	Floor	Brick	Red	Intact	Negative	0.3	mg/cm2
50	400	Lobby	Floor	Brick	Red	Intact	Negative	0.4	mg/cm2
51	400	Lobby	Floor	Brick	Beige	Intact	Negative	0	mg/cm2
52	400	Lobby	Floor	Brick	Beige	Intact	Negative	0.2	mg/cm2
53	400	Lobby	Door	Metal	Black	Intact	Negative	0.1	mg/cm2
54	400	Lobby	Door	Metal	Black	Intact	Negative	0.1	mg/cm2
55	400	Lobby	Floor	Vinyl	Beige	Intact	Negative	0	mg/cm2
56	400	Lobby	Floor	Vinyl	Beige	Intact	Negative	0	mg/cm2

This data is a screening of lead levels and provides results that are generally representative of typical conditions, but are not inclusive of all painted/coated surfaces at the Project Site.

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County of San Mateo
Hall of Justice - 400 County Center, Redwood City
XRF Sequential Report

READING NO.	BUILDING	ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	RESULTS	PbC	UNITS
57	400	Lobby	Crown Molding	Vinyl	Brown	Intact	Negative	0	mg/cm2
58	400	Lobby	Crown Molding	Vinyl	Brown	Intact	Negative	0	mg/cm2
59	400	Lobby	Lower Wall	Drywall	White	Intact	Negative	0.2	mg/cm2
60	400	Lobby	Lower Wall	Drywall	White	Intact	Negative	0.1	mg/cm2
61	400	Lobby	Door	Wood	Varnish	Intact	Negative	0	mg/cm2
62	400	Lobby	Door	Wood	Varnish	Intact	Negative	0	mg/cm2
63	400	Lobby	Door Frame	Metal	White	Intact	Negative	0	mg/cm2
64	400	Lobby	Door Frame	Metal	White	Intact	Negative	0.1	mg/cm2
65	400	BC	Lower Wall	Drywall	Gray	Intact	Negative	0.2	mg/cm2
66	400	BC	Lower Wall	Drywall	Gray	Intact	Negative	0.1	mg/cm2
67	400	BC	Lower Wall	Wood	Varnish	Intact	Negative	0.1	mg/cm2
68	400	BC	Lower Wall	Wood	Varnish	Intact	Negative	0.1	mg/cm2
69	400	BC	Wall Panel	Wood	Beige	Intact	Negative	0.1	mg/cm2
70	400	BC	Wall Panel	Wood	Beige	Intact	Negative	0.1	mg/cm2
71	400	BC	Door	Metal	White	Intact	Negative	0.2	mg/cm2
72	400	BC	Door Frame	Metal	White	Intact	Negative	0.1	mg/cm2
73	400	BC	Door Frame	Metal	White	Intact	Negative	0.1	mg/cm2
74	400	BC	Floor	Vinyl	Blue	Intact	Negative	0.4	mg/cm2
75	400	BC	Floor	Vinyl	Blue	Intact	Negative	0.5	mg/cm2
76	400	Exterior	Lower Wall	Stucco	Beige	Intact	Negative	0.2	mg/cm2
77	400	Exterior	Lower Wall	Stucco	Beige	Intact	Negative	0.2	mg/cm2
78	400	Exterior	Lower Wall	Concrete	Beige	Intact	Negative	0.2	mg/cm2
79	400	Exterior	Lower Wall	Concrete	Beige	Intact	Negative	0.3	mg/cm2
80	400	Exterior	Door	Metal	Beige	Intact	Negative	0.1	mg/cm2
81	400	Exterior	Door	Metal	Beige	Intact	Negative	0.1	mg/cm2
82	400	Exterior	Door Frame	Metal	Brown	Intact	Negative	0	mg/cm2
83	400	Exterior	Door Frame	Metal	Brown	Intact	Negative	0.1	mg/cm2
84	400	Exterior	Pipe	Metal	Black	Intact	Negative	0	mg/cm2

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County of San Mateo
Hall of Justice - 400 County Center, Redwood City
XRF Sequential Report

READING NO.	BUILDING	ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	RESULTS	PbC	UNITS
85	400	Exterior	Pipe	Metal	Black	Intact	Negative	0	mg/cm2
86	400	Other	Calibrate			Intact	Positive	1.1	mg/cm2
87	400	Other	Calibrate			Intact	Positive	1	mg/cm2
88	400	Other	Calibrate			Intact	Positive	1.1	mg/cm2
89	400	Other	Calibrate			Intact	Positive	1.1	mg/cm2
90	400	Other	Calibrate			Intact	Positive	1	mg/cm2
91	400	Other	Calibrate			Intact	Positive	1	mg/cm2
92	400	Executive	Lower Wall	Drywall	Off White	Intact	Negative	0.3	mg/cm2
93	400	Executive	Lower Wall	Drywall	Off White	Intact	Negative	0	mg/cm2
94	400	Executive	Door	Wood	Varnish	Intact	Negative	0	mg/cm2
95	400	Executive	Door	Wood	Varnish	Intact	Negative	0	mg/cm2
96	400	Executive	Door Frame	Wood	Off White	Intact	Negative	0.1	mg/cm2
97	400	Executive	Door Frame	Wood	Off White	Intact	Negative	0	mg/cm2
98	400	Executive	Baseboard	Vinyl	Blue	Intact	Negative	0.2	mg/cm2
99	400	Executive	Baseboard	Vinyl	Blue	Intact	Negative	0.4	mg/cm2
100	400	Executive	Baseboard	Vinyl	Black	Intact	Negative	0	mg/cm2
101	400	Executive	Baseboard	Vinyl	Black	Intact	Negative	0.1	mg/cm2
102	400	Executive	Lower Wall	Drywall	Teal	Intact	Positive	2.7	mg/cm2
103	400	Executive	Lower Wall	Drywall	Off White	Intact	Negative	0.1	mg/cm2
104	400	Executive	Lower Wall	Drywall	Off White	Intact	Negative	0.1	mg/cm2
105	400	Executive	Lower Wall	Drywall	Teal	Intact	Negative	0.1	mg/cm2
106	400	Executive	Baseboard	Vinyl	Lt-Gray	Intact	Negative	0.2	mg/cm2
107	400	Executive	Baseboard	Vinyl	Lt-Gray	Intact	Negative	0.1	mg/cm2
108	400	Executive	Baseboard	Vinyl	Beige	Intact	Negative	0	mg/cm2
109	400	Executive	Baseboard	Vinyl	Beige	Intact	Negative	0.1	mg/cm2
110	400	Executive	Window Sill	Wood	Off White	Intact	Negative	0.7	mg/cm2
111	400	Executive	Window Sill	Wood	Off White	Intact	Negative	0.3	mg/cm2
112	400	Executive	Baseboard	Vinyl	Brown	Intact	Negative	0.2	mg/cm2

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County of San Mateo
Hall of Justice - 400 County Center, Redwood City
XRF Sequential Report

READING NO.	BUILDING	ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	RESULTS	PbC	UNITS
113	400	Executive	Baseboard	Vinyl	Brown	Intact	Negative	0.2	mg/cm2
114	400	Executive	Lower Wall	Drywall	Off White	Intact	Negative	0.1	mg/cm2
115	400	Executive	Lower Wall	Plaster	Off White	Intact	Negative	0.2	mg/cm2
116	400	Executive	Lower Wall	Plaster	Off White	Intact	Negative	0.1	mg/cm2
117	400	Executive	Lower Wall	Ceramic	Yellow	Intact	Positive	5.5	mg/cm2
118	400	Executive	Floor	Ceramic	Lt-Green	Intact	Negative	0.2	mg/cm2
119	400	Executive	Floor	Ceramic	Lt-Green	Intact	Negative	0.1	mg/cm2
120	400	Executive	Floor	Ceramic	Beige	Intact	Negative	0.3	mg/cm2
121	400	Executive	Floor	Ceramic	Brown	Intact	Negative	0.4	mg/cm2
122	400	Executive	Lower Wall	Ceramic	Beige	Intact	Positive	2.5	mg/cm2
123	400	Executive	Upper Wall	Drywall	Off White	Intact	Negative	0	mg/cm2
124	400	Executive	Upper Wall	Drywall	Off White	Intact	Negative	0.1	mg/cm2
125	400	Executive	Lower Wall	Vinyl	Tan	Intact	Positive	1.4	mg/cm2
126	400	Executive	Lower Wall	Vinyl	Tan	Intact	Positive	1.3	mg/cm2
127	400	Executive	Upper Wall	Drywall	Off White	Intact	Negative	0.1	mg/cm2
128	400	Executive	Lower Wall	Drywall	Tan	Intact	Negative	0.2	mg/cm2
129	400	Executive	Lower Wall	Drywall	Tan	Intact	Negative	0.2	mg/cm2
130	400	Executive	Lower Wall	Drywall	Yellow	Intact	Negative	0.1	mg/cm2
131	400	Executive	Lower Wall	Drywall	Yellow	Intact	Negative	0.1	mg/cm2
132	400	Executive	Lower Wall	Drywall	Off White	Intact	Negative	0.1	mg/cm2
133	400	Executive	Floor	Ceramic	Lt-Gray	Intact	Negative	0	mg/cm2
134	400	Executive	Lower Wall	Drywall	Orange	Intact	Negative	0	mg/cm2
135	400	Executive	Lower Wall	Drywall	Orange	Intact	Negative	0	mg/cm2
136	400	Executive	Lower Wall	Vinyl	Varnish	Intact	Positive	1.4	mg/cm2
137	400	Executive	Lower Wall	Ceramic	Tan	Intact	Positive	5	mg/cm2
138	400	Executive	Floor	Ceramic	Tan	Intact	Negative	0	mg/cm2
139	400	Executive	Lower Wall	Drywall	Tan	Intact	Negative	0	mg/cm2
140	400	Executive	Lower Wall	Drywall	Tan	Intact	Negative	0.1	mg/cm2

This data is a screening of lead levels and provides results that are generally representative of typical conditions, but are not inclusive of all painted/coated surfaces at the Project Site.

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County of San Mateo
Hall of Justice - 400 County Center, Redwood City
XRF Sequential Report

READING NO.	BUILDING	ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	RESULTS	PbC	UNITS
141	400	Executive	Lower Wall	Drywall	Off White	Intact	Negative	0.2	mg/cm2
142	400	Executive	Door	Wood	Varnish	Intact	Negative	0	mg/cm2
143	400	Executive	Lower Wall	Ceramic	Yellow	Intact	Positive	4.1	mg/cm2
144	400	Executive	Floor	Ceramic	Lt-Green	Intact	Negative	0	mg/cm2
145	400	Executive	Lower Wall	Panel	Gray	Intact	Negative	0	mg/cm2
146	400	Executive	Lower Wall	Panel	Gray	Intact	Negative	0	mg/cm2
147	400	Executive	Window Sill	Wood	Off White	Intact	Negative	0.1	mg/cm2
148	400	Executive	Lower Wall	Drywall	Blue	Intact	Negative	0	mg/cm2
149	400	Executive	Lower Wall	Drywall	Blue	Intact	Negative	0.1	mg/cm2
150	400	Executive	Lower Wall	Drywall	Lt-Gray	Intact	Negative	0.1	mg/cm2
151	400	Executive	Window Sill	Wood	Off White	Intact	Negative	0	mg/cm2
152	400	Executive	Door	Wood	Off White	Intact	Negative	0.1	mg/cm2
153	400	Executive	Door Frame	Wood	Off White	Intact	Negative	0	mg/cm2
154	400	Executive	Door Frame	Wood	Off White	Intact	Negative	0.1	mg/cm2
155	400	Executive	Sink	Ceramic	Off White	Intact	Negative	0.2	mg/cm2
156	400	Executive	Baseboard	Vinyl	Teal	Intact	Negative	0.2	mg/cm2
157	400	Executive	Baseboard	Vinyl	Teal	Intact	Negative	0	mg/cm2
158	400	Executive	Lower Wall	Drywall	Lt-Gray	Intact	Negative	0.2	mg/cm2
159	400	Executive	Lower Wall	Drywall	Dk-Gray	Intact	Negative	0.2	mg/cm2
160	400	Executive	Lower Wall	Drywall	Dk-Gray	Intact	Negative	0.2	mg/cm2
161	400	Executive	Lower Wall	Drywall	Lt-Gray	Intact	Negative	0.2	mg/cm2
162	400	Executive	Door	Wood	Natural	Intact	Negative	0	mg/cm2
163	400	Executive	Door	Wood	Lt-Gray	Intact	Negative	0	mg/cm2
164	400	Executive	Lower Wall	Drywall	Beige	Intact	Negative	0.1	mg/cm2
165	400	Executive	Lower Wall	Drywall	Dk-Blue	Intact	Negative	0.1	mg/cm2
166	400	Executive	Lower Wall	Drywall	Dk-Blue	Intact	Negative	0.1	mg/cm2
167	400	Executive	Lower Wall	Drywall	Purple	Intact	Negative	0.2	mg/cm2
168	400	Executive	Lower Wall	Drywall	Purple	Intact	Negative	0.1	mg/cm2

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County of San Mateo
Hall of Justice - 400 County Center, Redwood City
XRF Sequential Report

READING NO.	BUILDING	ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	RESULTS	PbC	UNITS
169	400	Executive	Lower Wall	Drywall	Mint Green	Intact	Negative	0.2	mg/cm2
170	400	Executive	Lower Wall	Drywall	Mint Green	Intact	Negative	0.2	mg/cm2
171	400	Executive	Lower Wall	Drywall	Off White	Intact	Negative	0.1	mg/cm2
172	400	Executive	Lower Wall	Plaster	Off White	Intact	Negative	0.2	mg/cm2
173	400	Executive	Floor	Ceramic	Red	Intact	Negative	0	mg/cm2
174	400	Executive	Lower Wall	Drywall	Lt-Gray	Intact	Negative	0	mg/cm2
175	400	Executive	Lower Wall	Drywall	Dk-Gray	Intact	Negative	0.1	mg/cm2
176	400	Executive	Lower Wall	Drywall	Dk-Gray	Intact	Negative	0.1	mg/cm2
177	400	Executive	Door	Wood	Varnish	Intact	Negative	0	mg/cm2
178	400	Executive	Door Frame	Wood	Dk-Gray	Intact	Negative	0.1	mg/cm2
179	400	Executive	Door Frame	Wood	Dk-Gray	Intact	Negative	0.1	mg/cm2
180	400	Executive	Calibrate			Intact	Positive	1.1	mg/cm2
181	400	Executive	Calibrate			Intact	Positive	1	mg/cm2
182	400	Executive	Calibrate			Intact	Positive	1.1	mg/cm2

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DOCUMENT 00 62 23

RECYCLING AND DIVERSION OF DEBRIS FROM CONSTRUCTION AND DEMOLITION

UNDER THE

COUNTY OF SAN MATEO, ORDINANCE NO. 4099, CHAPTER 4.105

AND THE

COUNTY OF SAN MATEO
CONSTRUCTION, DECONSTRUCTION, AND DEMOLITION GUIDE

4.105.010 Definitions

For purposes of this chapter, the following definitions apply:

(a) “Construction and demolition debris” means and includes:

1. Discarded materials generally considered to be not water soluble and non-hazardous in nature, including but not limited to steel, copper, aluminum, glass, brick, concrete, asphalt material, pipe, gypsum, wallboard, and lumber from the construction or destruction of a structure as part of a construction or demolition project or from the renovation of a structure and/or landscaping, including rocks, soils, tree remains, trees, and other vegetative matter that normally results from land clearing, landscaping and development operations for a construction project.

2. Remnants of new materials, including but not limited to: cardboard, paper, plastic, wood, and metal scraps from any construction and/or landscape project.

(b) “Contractor” means any person or entity holding, or required to hold, a contractor’s license of any type under the laws of the State of California, or who performs (whether as contractor, subcontractor, owner-builder, or otherwise) any construction, demolition, remodeling, renovation, or landscaping service relating to buildings or accessory structures in the unincorporated area of San Mateo County.

(c) “Covered Project” means and includes any project which consists of one or more of the following:

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1. Demolition work only, where the cost of the work exceeds $5,000 as determined by the Building Official;

2. The renovation, remodel or addition to an existing structure, or the construction of a new structure where the cost of the work exceeds $250,000, as determined by the Building Official;

3. Commercial, residential, or multi-family residential development, and any new structure that is equal to or greater than 2,000 square feet.
(d) “Designated recyclable and reusable materials” means and includes:

1. Inert solids

2. Wood materials, including any and all dimensional lumber, fencing or construction wood that is not chemically treated, creosoted, CCA pressure treated, contaminated or painted;

3. Vegetative materials, including trees, tree parts, shrubs, stumps, logs, brush or any other type of plants that are cleared from a site for construction or other use;

4. Metals, including all metal scrap such as, but not limited to, pipes, siding, window frames, door frames and fences;

5. Roofing materials including wood shingles and shakes as well as asphalt, stone and slate based roofing material;

6. Salvageable materials and structures, including, but not limited to doors, windows, fixtures, hardwood flooring, sinks, bathtubs and appliances;

7. Any other materials that the Building Official determines can be diverted due to the identification of a recycling facility, reuse facility, or market accessible from the County.

(e) “Inert solids” includes asphalt, concrete, rock, stone, brick, sand, soil and fines;

(f) “Salvage” means the controlled removal of materials from a covered project, for the purpose of reuse or storage for later reuse;

(g) “Structure” means anything constructed or erected. (Ord. 4099, 02/26/02)

4.105.020 Deconstruction and Salvage and Recovery

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Record keeping of construction debris disposal will be entered into Green Halo Systems web based program. After issuance of a building permit, an email correspondence will be sent to create a Green Halo Systems account allowing for establishment, monitoring, and documenting disposal of construction debris.

(a) Contractors are encouraged to make every structure planned for demolition available for deconstruction, salvage, and recovery prior to demolition; and to recover the maximum feasible amount of salvageable designated recyclable and reusable materials prior to demolition.

(b) Recovered and salvaged designated recyclable and reusable materials from the deconstruction phase shall be counted towards the diversion requirements of this chapter. (Ord. 4099, 02/26/02)

4.105.030 Diversion Requirements

(a) One hundred percent (100%) of inert solids, and at least sixty five percent (65%) of the remaining construction and demolition debris tonnage shall be diverted.

(b) For each covered project, the diversion requirements of this chapter shall be met by submitting and following a “Waste Management Plan” that includes the following:

1. Deconstructing and salvaging all or part of the structure as practicable. AND

2. Directing one hundred percent (100%) of inert solids to reuse or recycling facilities approved by the County. AND

3. Either:

a. Taking all mixed construction and demolition debris to the Mixed Construction and Demolition Debris Recycling facilities approved by the County and taking all sorted or crushed construction and demolition debris to approved facilities, OR

b. Source separating non-inert materials, such as cardboard and paper, wood, metals, green waste, new gypsum wallboard, tile, porcelain fixtures, and other easily recycled materials, and directing them to recycling facilities approved by the County and taking the remainder (but no more than 50% by weight or yardage) to a facility for disposal. In this option, calculations must be provided to show that 50% of construction and demolition debris (in addition to 100% of inert solids) has been diverted. (Ord. 4099, 02/26/02)

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4.105.040 Information Required Before Issuance of Permit:

Every contractor shall submit a properly completed Waste Management Plan on a form prescribed by the County, as an integral part of the building or demolition permit application process for a covered project. The Waste Management Plan shall indicate the intended salvage, reuse, and recycling facilities, chosen from a list of facilities approved by the County, for all construction and/or demolition debris from the project. Approval of alternative facilities or special salvage or reuse options may be requested of the Building Official. Approval by the Building Official, or designee, of the Waste Management Plan as complying with this chapter shall be a condition precedent to the issuance of any building or demolition permit for a covered project. (Ord. 4099, 02/26/02)

4.105.050 Administrative Fee

As a condition precedent to the issuance of any building or demolition permit for a covered project, the applicant shall pay to the County a fee as established by resolution to compensate the County for all expenses incurred in administering this chapter. (Ord. 4099, 02/26/02)

4.105.060 Reporting

(a) No later than thirty (30) days following the completion of a demolition project or construction project, the contractor shall, as a condition of final approval and for issuance of any certificate of occupancy, submit documentation to the County that demonstrates compliance with the requirements of this chapter.

(b) The documentation shall consist of photocopies of receipts and weight tags or other records of measurement or equivalent documentation from recycling companies, deconstruction contractors, and landfill and disposal companies. The contractor's approved Waste Management Plan shall be completed by recording and confirming the type of debris diverted and the facilities to which it was taken. The contractor shall sign the completed Waste Management Plan form to certify its accuracy as part of the documentation of compliance.

(c) Progress reports during construction may be required.

(d) All documentation submitted pursuant to this section is subject to verification by the County.

(e) It is unlawful for any person to submit documentation to the County under this section which that person knows to contain any false statements, including but not limited to false statements regarding tonnage of materials recycled or diverted, or

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to submit any false or fraudulent receipt or weight tag or other record of measurement. (Ord. 4099, 02/26/02)

4.105.070 Penalties and Enforcement

(a) Each violation of the provisions of this chapter shall constitute a misdemeanor and shall be punishable by imprisonment in the county jail for up to six (6) months,

or by a fine of up to one thousand dollars ($1,000), or both. Each day that a violation continues shall be deemed a new and separate offense.

(b) The Building Official shall have the authority to enforce this chapter as specified in section 9021 of the San Mateo County Building Regulations, including but not limited to the authority to order that work be stopped where any work is being done contrary to the provisions of this chapter. (Ord. 4099, 02/26/02)

END OF DOCUMENT 00 62 23

See the next page for County of San Mateo 'Construction, Deconstruction, and Demolition Guide'.

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CONSTRUCTION, DECONSTRUCTION, AND DEMOLITION GUIDE

FOR SAN MATEO COUNTY



OFFICE OF SUSTAINABILITY
COUNTY OF SAN MATEO

WWW.SMCSUSTAINABILITY.ORG
888-442-2666

Docusign Envelope ID: 37D6996E-9788-4CCD-AC87-6F1095B8D128

FREQUENTLY ASKED QUESTIONS

WHAT DOES C&D STAND FOR?
Construction and Demolition.

WHY IS IT IMPORTANT THAT C&D WASTE BE RECYCLED?

A lot of natural resources can be saved by recycling C&D waste, which makes up 29% of the materials going into the landfill.

DO ALL THE CITIES HAVE THE SAME RECYCLING REQUIREMENTS?

No. All cities require a minimum of California Green Building Standards Code (CALGreen) detailed below. Local ordinances or building regulations may have more stringent requirements and may have different penalties. Refer to the chart on pages 2-3 for details on a specific city.

WHAT ARE THE CALGREEN REQUIREMENTS?

CALGreen requires that the following projects recycle and/or salvage for reuse a minimum of 65% of the nonhazardous C&D debris:

- Renovations, remodels or additions to an existing structure that increases the building's conditioned area, volume, or size
- The construction of a new permitted structure

For more information or other specific requirements visit www.dgs.ca.gov/BSC/Resources/Page-Content/Building-Standards-Commission-Resources-List-Folder/CALGreen.

WHY AM I ASKED WHAT CITY MY WASTE CAME FROM?

The State requires each city and unincorporated county to reduce waste through recycling, composting, or other diversion activities. Landfill and transfer station gatekeepers ask where the waste is coming from to gather information to report to the cities or county.

WHAT IS A MIXED C&D RECYCLING FACILITY?

At a mixed C&D recycling facility, different materials are sorted from a load of mixed debris. A load of mixed C&D generally includes drywall, metal, untreated wood, yard trimmings, and small amounts of inert materials. Large amounts of inerts should go into rock boxes.

WHAT ARE INERT MATERIALS?

Inert solids or aggregates include asphalt, brick, concrete, dirt, fines, rock, sand, soil, and stone.

WHAT DOES OX MOUNTAIN LANDFILL ACCEPT FOR RECYCLING?

Ox Mountain Landfill accepts loads of certain materials for reuse on site. These materials are: asphalt, bricks, concrete, dirt, fines, rock, sand, soil, stone, and untreated wood.

Mixed loads with untreated wood and/or green waste mixed with inerts (asphalt, brick, concrete, dirt, fines, rock, sand, soil, and stone) will not be sorted and therefore **NOT RECYCLED**, but landfilled.

However, a load with mixed inerts only (asphalt, brick, concrete, dirt, fines, rock, sand, soil, and stone) will be accepted for Alternative Daily Landfill Cover.

WHAT IS ALTERNATIVE DAILY COVER?

Alternative daily cover (ADC) means cover material other than earthen material placed on the surface of the active face of a municipal solid waste landfill at the end of each operating day to control vectors, fires, odors, blowing litter, and scavenging.

HOW DO I MAKE SURE MY RECEIPTS SHOW THAT I RECYCLED MATERIALS?

First, you must make sure that you are taking your load to a facility that can recycle the materials you have. When you are at the gate of any facility, be sure to tell them that you would like to recycle the material and the name of the city or unincorporated county location it is from. You will need a receipt that reflects this information. The receipt will indicate that the material was either recycled or disposed. The receipts will be needed for your final inspection.

WHAT IF A DEBRIS BOX COMPANY HANDLES ALL MY WASTE?

To meet local recycling requirements, you will need to request that the debris box company take your waste to an approved recycling facility and provide you with appropriate receipts from those facilities.

WHAT DO I DO ABOUT THE WASTE GENERATED BY MY SUBCONTRACTORS?

The general contractor or applicant is responsible for ensuring that the recycling requirements are met for all waste generated on site, including waste generated by the subcontractors. Share this information with your subcontractors.

CITY C&D RECYCLING REQUIREMENTS 2–3

Most cities in San Mateo County have a recycling ordinance or building regulations that requires contractors to recycle most waste generated on the job. Some cities may limit building contractors to a few approved recycling facilities and debris box companies. According to the CALGreen State Code, where a local jurisdiction does not have a construction and demolition waste management ordinance or building regulations, a construction waste management plan shall be submitted for approval to the enforcing agency. See pages 2-3 to view Unincorporated San Mateo County and city requirements.

DECONSTRUCTION, SALVAGE, & REUSE 4-5

Consider deconstruction before demolition. Many items such as wood floors, doors, windows, electrical equipment and bathroom fixtures can be reused and salvaged from a building. See pages 4-5 to determine if salvage is appropriate at your site.

RECYCLING FACILITIES 6–7

Waste generated at a construction site can be recycled in two ways:

- Source separate recyclables by material, such as cardboard, metal, clean wood, etc. into individual bins. Separating recyclables allows you to take advantage of lower dumping fees and higher recycling rates.
- Put recyclable materials into one bin and take it to a recycling facility that specializes in sorting mixed materials. See pages 6-7 for a list of C&D sorting facilities in the Bay Area.

HAZARDOUS & UNIVERSAL WASTE 8–9

Many types of hazardous and universal waste are found at construction and demolition sites. These materials must be identified and handled correctly prior to deconstruction or demolition and during construction. See pages 8-9 to find a list of potential wastes and where to take them.

HAULING & DEBRIS BOX COMPANIES 10

You may either haul your own recyclable materials or hire a debris box company and request that the material be recycled. Note that in some cities you may be required to use a certain debris box company. See pages 2-3 to view city requirements and page 10 for a list of debris box companies.

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CITY	DEPOSIT REQUIRED	CALGREEN REQUIRED PROJECTS: • The renovation, remodel or addition to an existing structure that increases the building's conditioned area, volume, or size • The construction of a new permitted structure See below for additional required projects	CALGREEN RECYCLING REQUIREMENTS: Salvage or recycle 65% A = Alterations or Addition C = New Construction D = Demolition R = Roofing See below for additional recycling requirements	DEBRIS BOX REGULATIONS See below for cities with exclusive contracts with specific debris box companies.	NAME OF FORM Contractors must fill out a form detailing their recycling plan. Upon completion of the project, copies of recycling and disposal receipts must be submitted.
ATHERTON 650-752-0560	yes	Any project over $50,000 or generating more than 10 tons of debris	• Must allow 10 working days for salvage prior to demolition • **A, C, or D:** recycle 75% of total waste • **Shingle/shake roofing:** recycle 75% of total waste	Open to all haulers	Construction, Demolition, Recycling Calculator
BELMONT 650-595-7450	no**	Specifications according to CALGreen Building Standards	Specifications according to CALGreen Building Standards	Open to all haulers	Construction and Demolition Recycling and Waste Reduction Plan
BRISBANE 415-508-2120	yes	Demolition over 200 ft², remodel or new construction over 1,000 ft² or $75,000, and re-roofing over 500 ft²	• Must allow 5 working days for salvage prior to demolition • **D:** recycle 100% of inert solids*, recycle or salvage 65% of other construction debris • **R:** recycle 65% of total waste	South San Francisco Scavenger Company	Construction and Demolition Recycling and Waste Reduction Plan
BURLINGAME 650-558-7260	yes	All permitted projects with a valuation greater than $50,000	• Inert solids can't be counted for more than 25% of the diversion • Alternative daily cover is not counted as recycled material	Open to all haulers	Construction and Demolition Recycling and Waste Reduction Form
COLMA 650-757-8888	yes	All demolition, remodel, or construction projects	• Must salvage if possible • **R:** recycle 65% of total waste	Republic Services of Daly City	Construction and Demolition Recycling Forms
DALY CITY 650-991-8061	yes	All complete demolitions, all alterations over $15,000, all new construction, all roofing tear-offs over 100 ft²	• **R:** recycle 65% of total waste • All projects over $30,000 must submit Waste Management Plan	Republic Services of Daly City	Waste Management Plan
EAST PALO ALTO 650-853-3129	yes	All demolition	Specifications according to CALGreen Building Standards	Open to all haulers	Waste Management Plan
FOSTER CITY 650-286-3227	yes	All demolition and new construction projects, specified residential and commercial alterations	• Reuse and salvage to the greatest extent feasible • **A, D, or R:** recycle a minimum of 50% of total waste	Open to all haulers	Waste Management Plan
HALF MOON BAY 650-726-8284	no**	Projects over $5,000	Specifications according to CALGreen Building Standards	Open to all haulers	Waste Management Plan
HILLSBOROUGH 650-375-7436	no**	All demolition, alteration, and new construction projects	• If hauling mixed debris, must use approved mixed processing facility • Alternative daily cover is not counted as recycled material	Must use a hauler from the approved list.	Recycling and Waste Reduction Plan Compliance Report

CITY	DEPOSIT REQUIRED	CALGREEN REQUIRED PROJECTS: • The renovation, remodel or addition to an existing structure that increases the building's conditioned area, volume, or size • The construction of a new permitted structure See below for additional required projects	CALGREEN RECYCLING REQUIREMENTS: • Salvage or recycle 65% A = Alterations or Addition C = New Construction D = Demolition R = Roofing See below for additional recycling requirements	DEBRIS BOX REGULATIONS See below for cities with exclusive contracts with specific debris box companies.	NAME OF FORM Contractors must fill out a form detailing their recycling plan. Upon completion of the project, copies of recycling and disposal receipts must be submitted.
MENLO PARK 650-330-6704	no**	Specifications according to CALGreen Building Standards	• Must allow 7 working days for salvage prior to demolition • Alternative daily cover is not counted as recycled material	Open to all haulers	Green Halo
MILLBRAE 650-259-2444	no**	Specifications according to CALGreen Building Standards	Specifications according to CALGreen Building Standards	South San Francisco Scavenger Company	Waste Management Plan
PACIFICA 650-738-7344	no	Specifications according to CALGreen Building Standards	Specifications according to CALGreen Building Standards	Recology of the Coast	Waste Management Plan
PORTOLA VALLEY 650-851-1700 x 211	yes	Any permitted construction, demolition or re-roofing projects; Non-res additions/ alterations larger than 1,000 ft² or greater than $200,000	• Must allow 5 working days for salvage prior to demolition • **A, C, D, or R:** recycle 75% of total waste	Open to all haulers	Green Halo or Waste Management Plan
REDWOOD CITY 650-780-7350	yes	All demolitions, new construction, all tear off roofing permits and any construction valuation of $50,000 or greater	• **A, C, or D:** recycle 100% of inert solids*, recycle or salvage 65% of total waste	Open to all haulers	Waste Management Plan
SAN BRUNO 650-616-7074	yes	Any complete demolition, alteration, or addition valued over $50,000	• **A:** recycle 50% of total waste	Recology San Bruno	Recycling and Waste Reduction Form
SAN CARLOS 650-802-4261	yes	Any project over $50,000 or generating more than 5 tons of debris	Specifications according to CALGreen Building Standards	Open to all haulers	Construction and Demolition Waste Management Plan Agreement
SAN MATEO 650-522-7346	yes	Any demolition or construction project. Any remodel with a valuation of $50,000 or more.	• All projects recycle or salvage 65% of total waste • Inert solids can't be counted for more that 25% of the diversion	Open to all haulers	Construction and Demolition Recycling and Waste Reduction Plan
SOUTH SAN FRANCISCO 650-829-6670	yes	Demolition over $500, construction or remodel over $50,000, or size equal or greater than 2,000 ft², roofing projects over 100 ft².	• **A, C, or D:** recycle 100% of inert solids*, minimum of 65% of all non-inert solids	South San Francisco Scavenger Company	Construction and Demolition Waste Management Plan
WOODSIDE 650-851-6796	yes	Any project over $10,000 or generating more than 10 tons of debris	• Must allow 5 working days for salvage prior to demolition • **D:** recycle 65% of total waste, at least 15% must be non-inert material*	Open to all haulers	Waste Management Plan
UNINCORPORATED SAN MATEO COUNTY 888-442-2666	no**	All demolition projects	• **A, C, or D:** Recycle or salvage 65% of total waste and recycle all inert solids*	Open to all haulers except El Granada, Miramar, Montara, Moss Beach, Pillar Point, and Princeton; these areas are required to use Recology of the Coast.	Green Halo ~~or Waste Management Plan~~

* Inert solids include asphalt, brick, concrete, dirt, fines, rock, sand, soil, and stone.
** Fines or penalties may apply for non-compliance.

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DECONSTRUCTION, also referred to as SALVAGE or SOFT DEMOLITION, is a cost-effective and environmentally responsible alternative to conventional building demolition.

Deconstruction is the opposite of construction. In a deconstruction hazardous materials are removed, reusable appliances, flooring, and other building materials are salvaged, and nonreusable materials are recycled.

Plan Ahead

Most people think that their building is old and not worth saving. Old buildings can have some of the best materials! If you know you will be taking down a building, plan ahead to allow time for deconstruction. It takes much longer to deconstruct a building because the building is taken apart carefully to remove materials to be reused later. In some jurisdictions, such as Unincorporated San Mateo County, you may be able to get a demolition permit before your new construction permit is approved to allow extra time.

To successfully deconstruct a building for salvage, you may have a deconstruction or soft demolition contractor identify and remove the usable materials, or you may remove the materials yourself. You can reuse the materials on another project, take them to a salvage yard, or donate them. Please take special care to identify and remove any electrical components that may contain mercury such as lights, thermostats, and switches. These must be treated as hazardous waste.

Donating Materials for a Tax Deduction

Deconstruction can cost 2-3 times as much as demolition because there is more labor involved. To offset this cost, you may donate materials to a nonprofit organization and be eligible for a tax deduction receipt. Donations of $5,000 or more need to be certified by a 3rd party IRS Qualified appraiser.

Below is an example from The ReUse People of America of costs of deconstruction versus demolition. Costs will vary on projects depending on the size, age, style, and construction of the building. In many cases, the owner can save money by doing deconstruction instead of demolition. In the example below, the owner saved $9,312 by doing deconstruction instead of paying $11,100 for demolition.

*The value you get from the tax deduction may vary depending on your tax liability. Consult with an accountant for more specific advice.

	Deconstruction	Demolition
House removal labor costs	-$26,738	-$6,000
Recycling and disposal costs	-$5,100	-$5,100
Appraisal costs	-$2,500	$0
Subtotal costs	-$34,338	-$11,100
Donation value of materials	$93,000	N/A
Cash value (from tax donation at 35% tax bracket)*	+$32,550	N/A
Total cost	**-$1,788**	**-$11,100**

DECONSTRUCTION APPRAISERS

The appraisers listed below have local offices.

GREEN EARTH APPRAISALS
525 Broadway
Millbrae, CA 94030
650-455-6683
http://greenearthappraisals.com

H. PETER CURRAN, LLC
Sanidel, FL 33957
203-762-5469
www.hpcappraisals.com

LESLIE SUH APPRAISALS
Alamo, CA 94507
925-389-1801
www.lesliesuhappraisals.com

PROPERTY PROS
Encinitas, CA 92023
800-561-3023
http://greenearthappraisals.com

MICHAEL STOREY
Woodstock, MD 21163
410-913-8255

SALVAGE YARDS

BUILDING RESOURCES
701 Amador Street
San Francisco, CA 94124
415-285-7814
www.buildingresources.org
Accepts and sells a wide variety of salvaged building materials.

OHMEGA SALVAGE
2407 San Pablo Avenue
Berkeley, CA 94702
510-204-0767
www.ohmegasalvage.com
Accepts and sells vintage architectural salvage mid-century and older.

URBAN ORE
900 Murray Street
Berkeley, CA 94710
510-841-7283
www.urbanore.com
Accepts and sells a wide variety of salvaged building materials.

DECONSTRUCTION SERVICES

GREENWORX/THOR
San Francisco
888-714-7444
www.greenworxusa.com

MARCAN ENTERPRISE
San Mateo
650-366-3066
www.marcanenterprise.com

PENINSULA HAULING AND DEMOLITION
San Carlos
650-596-8105
www.peninsulahauling.com

REBUILD GREEN
Palo Alto
650-720-1301
www.rebuildgreen.net

SCOTT'S DEMOLITION
San Mateo
650-593-7799
www.scottsdemolition.com

TNT DEMOLITION
San Carlos
650-341-9423
www.tntdemo.com

WHOLE HOUSE BUILDING SUPPLY & SALVAGE
San Mateo
650-218-8596
www.driftwoodsalvage.com
Call for an appointment. Accepts and sells used building materials and runs salvage sales at individual homes they are deconstructing.

DECONSTRUCTION SERVICES AND SALVAGE YARDS

FIREWOOD FARMS
551 San Mateo Road (HWY 92)
Half Moon Bay, CA 94019
650-726-3266
www.firewoodfarms.com
Deconstructs old barns and sells flooring and other salvaged wood products.

PLACEMAKERS, INC.
1062 Center Street
San Carlos, CA 94070
650-273-7530
www.placemakersinc.com
Accepts and sells salvaged materials. Provides deconstruction service.

REUSABLE LUMBER COMPANY
La Honda
650-529-9122
www.reusablelumber.com
Call for appointment. Will deconstruct homes for usable wood or pick up wood from construction sites.

THE REUSE PEOPLE
9235 San Leandro Street
Oakland, CA 94603
888-588-9490
www.thereusepeople.org
Accepts and sells a wide variety of salvaged building materials. Provides deconstruction services.

Examples of reusable building materials:

- Architectural details (columns, fireplace mantels, moulding, etc.)
- Brick & block
- Doors & windows
- Electrical equipment
- Flooring
- Hardware
- Heating ducts
- Light fixtures
- Lumber
- Paneling
- Plumbing fittings and fixtures (faucets, toilets, bathtubs, etc.)
- Siding
- Steel beams & studs
- Wainscoting







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A SORTING FACILITY specializes in sorting recyclable construction material. Mixed C&D loads can include all the materials listed below, and the majority of it will be recycled. Large quantities of inert solids (asphalt, concrete, dirt) should be kept separate from mixed C&D loads.

Unless you are taking your recycling to a sorting facility, the following materials must be separated and brought in as loads of only one material type. Some facilities accept MIXED INERTS (mixed loads of crushed asphalt, concrete, dirt) for recycling. Mixed inert loads will cost more than separated loads.

RECYCLING FACILITIES	SORTING FACILITIES	mixed inerts	asphalt	bricks	carpet & padding	cardboard	concrete	dirt	drywall (unpainted)	landfill (waste)	metal	pallets	porcelain	rock	roofing (composite)	wood (untreated)	yard trimmings
SAN MATEO COUNTY																	
Andreini Brothers, Inc. 151 Main Street Half Moon Bay, CA 94019 650-726-2065; www.andreinibrothers.com			✔				✔							✔			
Blue Line Transfer, Inc. 500 East Jamie Court South San Francisco, CA 94080 650-589-4020; www.ssfscavenger.com	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Brisbane Recycling Company* 5 Beatty Road Brisbane, CA 94005 415-468-8822; www.brisbanerecycling.com			✔				✔										
CEMEX 775 Seaport Boulevard Redwood City, CA 94063 650-369-9189; www.cemex.com			✔				✔							✔			
Graniterock 195 Seaport Boulevard Redwood City, CA 94063 650-482-3840; www.graniterock.com			✔				✔	Offers portable crushing services.									
Half Moon Bay Building and Garden Supply* 119 Main Street Half Moon Bay, CA 94019 650-726-6696 www.halfmoonbaybuildingandgarden.com			✔				✔										
Ox Mountain Sanitary Landfill 12310 San Mateo Road (HWY 92) Half Moon Bay, CA 94019 650-726-1819; www.republicservices.com		✔	✔	✔		✔	✔	✔		✔	✔	✔		✔		✔	
Pescadero Transfer Station Bean Hollow Road at Artichoke Pescadero, CA 94060 650-592-2411						✔				✔	✔	✔				✔	✔
Recology of the Coast 1046 Palmetto Avenue Pacifica, CA 94044 650-355-9000; www.recology.com						✔					✔	✔				✔	
Rice Trucking-Soil Farm 2119 Cabrillo HWY S. Half Moon Bay, CA 94019 650-726-0100; www.soilfarm.net								✔									

RECYCLING FACILITIES	SORTING FACILITIES	mixed inerts	asphalt	bricks	carpet & padding	cardboard	concrete	dirt	drywall (unpainted)	landfill (waste)	metal	pallets	porcelain	rock	roofing (composite)	wood (untreated)	yard trimmings
Shoreway Environmental Center 333 Shoreway Road San Carlos, CA 94070 650-802-8355; www.sbrecycling.net	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Sims Metal 699 Seaport Boulevard Redwood City, CA 94063 650-369-4161; www.simsmm.com											✔						
Foremost Recycling 199 Seaport Boulevard Redwood City, CA 94063 650-641-3080; www.SRDrecycling.com		✔	✔	✔			✔	✔						✔			
ALAMEDA COUNTY																	
Davis Street Recycling Center 2615 Davis Street San Leandro, CA 94577 510-638-2303; http://davisstreet.wm.com	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Inner City Recycling* 9009 Railroad Ave. Oakland, CA 94603 510-568-7625			✔				✔	Offers portable crushing services.						✔			
Hayward Transfer Station 3458 Enterprise Way Hayward, CA 94545 510-606-1548; http://haywardtransfer.com	✔		✔	✔	✔	✔	✔		✔	✔	✔		✔	✔	✔	✔	
Vasco Road Landfill 4001 North Vasco Road Livermore, CA 94551 925-447-0491; www.republicservices.com	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔
SAN FRANCISCO COUNTY																	
Recology San Francisco 501 Tunnel Avenue San Francisco, CA 94134 415-330-1400; www.recology.com	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
SANTA CLARA COUNTY																	
Guadalupe Landfill 15999 Guadalupe Mines Road San Jose, CA 95120 408-268-1670; http://guadalupe.wm.com	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔
Newby Island Landfill 1601 Dixon Landing Road Milpitas, CA 95035 408-262-1401; http://local.republicservices.com/site/newby-island	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Zanker Recycling 675 Los Esteros Road San Jose, CA 95134 408-263-2384; www.zankerrecycling.com	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

* Also has debris boxes for the materials they accept for recycling.

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At a construction site, it is very important to be aware of HAZARDOUS MATERIAL so you can separate it from other waste and properly dispose of it.

Prior to a demolition, it is necessary to identify and remove hazardous wastes. You should also be prepared to manage hazardous waste generated during construction and at the end of the project.

HAZARDOUS WASTE ACCEPTED BY THE HHW OR VSQG PROGRAM

- Ballasts
- Caulk containing PCBs
- Cleaning supplies
- Fluorescent light bulbs and tubes
- Garden chemicals
- Glues, mastics, adhesives
- Oils
- Paint chips (paint removed from projects conducted before 1980 contain lead)
- Paints, thinners, stains
- Pesticides, herbicides
- Pool chemicals

HAZARDOUS WASTE NOT ACCEPTED BY THE HHW OR VSQG PROGRAM

- Appliances
- Asbestos
- Pressure-treated wood
- Railroad ties
- Telephone poles

For more information on where to recycle items that are not accepted by the HHW or VSQG program call our toll free hotline at 888-442-2666.

PROPER DISPOSAL OF HAZARDOUS WASTE

SAN MATEO COUNTY HOUSEHOLD HAZARDOUS WASTE (HHW) PROGRAM

If you are a San Mateo County resident, you may use the free HHW program. To make an appointment or for more details, visit www.smchealth.org/hhw. Call 650-363-4718 if you have questions.

VERY SMALL QUANTITY GENERATOR (VSQG) PROGRAM

A VSQG (per state law) is any business that generates less than 100 kilograms (about 220 pounds or 27 gallons) of hazardous waste per month. The VSQG Program is designed to provide an inexpensive hazardous waste disposal option to eligible businesses, non-profits, and other government agencies. Visit www.smchealth.org/vsqg for details. Call 800-207-8222 to make an appointment at the next collection event. There are minimal fees.

TRANSPORTING HAZARDOUS WASTE

Legally, you can only transport up to 10 gallons of hazardous waste at one time without a special license and permit. Qualified VSQG businesses may legally carry up to 27 gallons or 220 pounds of a hazardous waste for disposal to the VSQG Facility.

You may also select a hazardous waste management company to collect and haul hazardous waste for you.

IF YOU DO NOT QUALIFY FOR THE VSQG PROGRAM

If your business generates more than 100 kilograms of hazardous waste per month, you will need to find the appropriate commercial hazardous waste management company to handle your material. Companies that provide this service may be found by visiting www.smchealth.org/vsqg or by contacting the County's Hazardous Materials Program at 650-372-6200.

PAINT RECYCLING

Paint (interior/exterior), primers, stains, sealers and clear coatings (e.g., shellac and varnish) can be recycled for free at many locations throughout the Bay Area. For a complete list of products that can be recycled and the locations to bring it to, visit www.paintcare.org or call 888-442-2666.

LOCATIONS IN THE BAY AREA TO DISPOSE OF:

- Asbestos
- Pressure-treated wood
- Railroad ties
- Telephone poles

Altamont Landfill
10840 Altamont Pass Road
Livermore, CA 94551
Call first 925-455-7300
(friable and non-friable asbestos)

Kirby Canyon Recycling & Disposal Facility
910 Coyote Creek Golf Drive
Morgan Hill, CA 95037
Call first 559-834-9151
(non-friable asbestos only)

Newby Island Landfill
1601 Dixon Landing Road
Milpitas, CA 95035
Call first 800-204-4242
(non-friable asbestos only)

Ox Mountain Sanitary Landfill
12310 San Mateo Road
Half Moon Bay, CA 94019
Call first 800-204-4242
(non-friable asbestos only)



PROPER DISPOSAL OF UNIVERSAL WASTE

Hazardous waste regulations designate a category of hazardous wastes called universal waste. California's Universal Waste Rule allows individuals and businesses to transport, handle and recycle certain common hazardous wastes, termed universal wastes, in a manner that differs from the requirements for most hazardous wastes. The more relaxed requirements for managing universal wastes were adopted to ensure that they are managed safely and are not disposed of in the trash.

WHAT ARE UNIVERSAL WASTES?

Universal wastes are hazardous wastes that are widely produced by households and many different types of businesses. Universal wastes include televisions, computers and other electronic devices as well as batteries, fluorescent lamps, mercury thermostats, and other mercury containing equipment. See complete list in the column to the right. For more information visit www.dtsc.ca.gov/hazardouswaste/universalwaste. For a full list of locations, visit www.RecycleStuff.org.

LOCATIONS THAT WILL RECYCLE UNIVERSAL WASTE FOR A FEE

* Takes some items for free from San Mateo County residents. Call first.

**Takes only universal waste from residents, not businesses.

AERC*
30677 Huntwood Avenue, Hayward
510-429-1129
www.cleanearthinc.com/AERC
- Batteries
- Electronic devices
- Fluorescent light bulbs and tubes
- HID lamps
- Mercury containing devices

Blue Line Transfer Station**
500 East Jamie Ct., So. San Francisco
650-589-5511
www.ssfscavenger.com
- Batteries
- Electronic devices
- Fluorescent light bulbs and tubes

Crown Computer Recycling*
110 Glenn Way Unit 19, San Carlos
650-591-0600
- Electronic devices

Quick Light Recycling, LLC
Brisbane
415-596-2305
www.quicklightrecycling.com
- Batteries
- Fluorescent light bulbs and tubes
- HID lamps

ReVolt Recycling
657 143rd Avenue, San Leandro
510-352-2665
www.revoltrecycling.com
- Batteries
- Electronic devices
- Fluorescent light bulbs and tubes
- HID lamps
- Mercury containing devices

Shoreway Environmental Center**
333 Shoreway Road, San Carlos
650-802-8355
www.sbrecycling.net
- Batteries
- Electronic devices
- Fluorescent light bulbs and tubes

ZARC*
26 South Linden Avenue
South San Francisco
650-871-7327
www.zarcrecycling.com
- Electronic devices

At a construction site, it is very important to be aware of UNIVERSAL WASTE so you can separate it from other waste and properly dispose of it.

Prior to any renovation, it is necessary to identify and remove universal wastes. You should also be prepared to deal with universal waste generated during construction and at the end of the project.

If a nonresidential project is ≥ 1000 sq. ft. or ≥ $200,000, be prepared to report on how the universal waste was managed.

UNIVERSAL WASTE ACCEPTED BY THE HHW PROGRAM FOR FREE OR THE VSQG PROGRAM FOR A FEE

- Batteries
- Fluorescent light bulbs and tubes
- High Intensity Discharge (HID) Lamps: metal halide lamps, sodium vapor lamps and electric lamps that contain added mercury
- Non-empty aerosol cans that contain hazardous waste
- Any mercury waste: thermometers, pressure or vacuum gauges, dilators and weighted tubing, rubber flooring, gas flow regulators, counterweights and dampers switches and thermostats

UNIVERSAL WASTE NOT ACCEPTED BY THE HHW OR VSQG PROGRAM

- Electronic Devices: Televisions, VCR and DVD Players, computers, computer monitors, cathode ray tubes (CRTs), and cellphones

For more information on where to recycle items that are not accepted by the HHW or VSQG program, visit www.RecycleStuff.org or call our toll free hotline at 888-442-2666.

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DEBRIS BOX REGULATIONS

When you use a debris box company, you need to request that your C&D materials be recycled and receipts can be provided. Key questions to ask when selecting a company are:

- What recyclable materials are you willing to pick-up?
- Do you offer a reduced fee if recyclables are separated from other waste?
- What are your requirements for separating recyclable materials?
- How much contamination do you allow?

The following areas have exclusive contracts with specified debris box companies or only allow registered debris box companies: Brisbane, Colma, Daly City, Hillsborough, Millbrae, Pacifica, San Bruno, South San Francisco and certain Unincorporated San Mateo County areas (El Granada, Miramar, Montara, Moss Beach, Pillar Point, and Princeton). All other cities may use any of the following companies that haul mixed loads and sorted materials in San Mateo County.

HAULING COMPANIES

1800 GOT JUNK
Santa Clara
1-800-got-junk (468-5865)
www.1800gotjunk.com

KUNZ VALLEY TRASH
Boulder Creek
831-338-9050
www.kunzvalleytrash.com

PENINSULA HAULING AND DEMOLITION
San Carlos
650-596-8105
www.peninsulahauling.com

HAULING AND DEBRIS BOX COMPANIES

ASSOCIATED TRUCKING
San Bruno
650-652-3960
www.associatedtruckinginc.com

BAKER BROTHERS
San Mateo
650-458-8999

ECO-DUMPSTER
Redwood City
650-367-7644
http://ecodumpster.com

GREENWORX
San Francisco
888-714-7444
www.greenworxusa.com

JD SERVICES
Burlingame
888-534-2857
www.jdhauling.com

JUNK KING
South San Francisco
650-394-7484
www.junk-king.com

DEBRIS BOX COMPANIES

AMERICAN DEBRIS BOX
Half Moon Bay
866-DEBRIS-1 (332-7471)
www.americandebrisbox.com

CERTIFIED BLUE RECYCLING*
San Leandro
510-904-3929
www.certified-blue-recycling.com

CITYWIDE DEBRIS BOX AND RECYCLING*
San Francisco
415-822-3688
www.citywidedebrisbox.com

FERMA CORPORATION*
Mountain View
877-337-6211
www.fermacorp.com

GREENWASTE RECOVERY
San Jose
650-568-9900
www.greenwaste.com
Serves Woodside, Portola Valley, East Palo Alto, Atherton, Menlo Park, and Redwood City.

PENINSULA DEBRIS BOX
San Mateo
800-799-1737
www.pdbs.us

PLACEMAKERS, INC.
San Carlos
650-273-7530
www.placemakersinc.com

RECOLOGY OF THE COAST
Pacifica
650-355-9000
www.recology.com
Serves Pacifica - Miramar.

RECOLOGY PENINSULA SERVICES
Burlingame
650-558-9575
www.recologypeninsulaservices.com
Serves Burlingame - East Palo Alto.

RECOLOGY SAN BRUNO
San Bruno
650-583-8536
www.recology.com
Serves San Bruno.

REDWOOD DEBRIS BOX SERVICE
Burlingame
650-872-2310
www.rdsredwood.com

REPUBLIC SERVICES OF SAN MATEO COUNTY
Daly City
650-592-2411
www.republicservices.com

SOUTH SAN FRANCISCO SCAVENGER COMPANY, INC.
South San Francisco
650-589-4020
www.ssfscavenger.com
Serves South San Francisco, Brisbane, and Millbrae.

* Also has debris boxes for hazardous waste.

STILL HAVE QUESTIONS?

Call **888-442-2666** or visit
www.smcsustainability.org for more information.

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DOCUMENT

WARRANTY FORM

(Contractor's or Subcontractor's own letterhead)

WARRANTY GUARANTEE FOR THE:

Project Name: **Hall of Justice Court Tenant Improvement Project**
Project No.: P30L1
Project/Facility Address: Hall of Justice, 400 County Center, Redwood City CA 94063

We, _____(Contractor's name) hereby guarantees

(Scope of Contractor's Work) _____

_____which Contractor has installed for the County of San Mateo for the above project

beginning _____ for _____ year(s) in accordance with the Contract Documents.

We agree to repair or replace to the satisfaction of the Owner any and all such work that may prove defective in workmanship or materials within that period, ordinary wear and tear and unusual abuse or neglect excepted, together with all other Work which may be damaged or displaced in connection with such Work. This Warranty includes labor and materials.

In the event of our failure to comply with the above-mentioned conditions within seven (7) calendar days after being notified in writing, we collectively and separately do hereby authorize the Owner to proceed to have the defects repaired and made good at our expense, and will pay the costs and charges therefore immediately upon demand.

I hereby certify that I am authorized to sign this document.

Date_____ _____
(Signature of Contractor)

_____
Print Name and Title

Date_____ _____
(Signature of Subcontractor)

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Print Name and Title
(Subcontractor must co-sign with Contractor)

Representative(s) to be contacted for service subject to terms of Contract:

NAME: _____

ADDRESS: _____

PHONE NO.: _____

END OF DOCUMENT 00 65 36

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SECTION 011000

SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. Related Requirements:
   1. Document 01 35 13.19 "Special Project Procedures for San Mateo County Facility."

1.2 SCOPE OF WORK

A. Abbreviated Written Summary: Briefly and without force and effect upon the Contract Documents, the Work of the Contract can be summarized as follows
   1. The Project includes the interior remodel of court rooms, support spaces, and administrative office of the San Mateo County Hall of Justice. The project also includes the upgrade of exterior windows.

1.3 HAZARDOUS MATERIALS

A. Hazardous Materials Removal: The Contractor shall remove hazardous materials encountered in the Work. A report on the presence of hazardous materials is included in Document 003000 "Available Information, titled "Limited Pre-Renovation Hazardous Materials Survey Report" prepared by Vista Environmental Consulting, dated July 7, 2024.
   1. The Contractor shall coordinate with the Owner on all issues related to hazardous material management.
   2. The Contractor shall comply with applicable codes, laws, regulations and standards regarding work with and around potentially hazardous materials.
   3. The Contractor shall be responsible for insuring that personnel within the work area are protected from exposure to hazardous materials.

B. The Architect (Mark Cavagnero Associates,) and any of the Architect's consultants assume no responsibility for the management of hazardous materials that may be on this site.

1.4 CONTRACT DOCUMENTS

A. Conflicts: Reasonable efforts have been made to coordinate the Contract Documents. Bring conflicts to the attention of the Architect for resolution prior to award of the Contract.

B. Dimensions: Request a clarification from the Architect, if, in the Contractor's opinion, there are dimensional conflicts or missing dimensions that are critical to the writing of a bid proposal or doing the Work.

C. Division 01, General Requirements: The requirements of Division 01 govern every technical specification section in the Project Manual.

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1.5 CONTRACTOR USE OF PREMISES

A. Limit use of the premises to construction activities in areas indicated; allow for Owner occupancy and use by the public of the Sanctuary.

B. Coordinate use of premises and access to site with the Owner and Architect.

C. Confine operations to areas within Contract limits indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.

D. Schedule deliveries to minimize requirements for storage of materials.

E. Assume full responsibility for the protection and safekeeping of products under this Contract, stored on the site.

F. Limit use of site for work and storage to areas within the site boundaries unless specific areas are allowed in writing by the Owner. Coordinate use of areas outside the property line with the Owner and Authorities Having Jurisdiction.

G. Move any stored products, under Contractor's control, which interfere with operations of the Owner, or separate contractor.

H. If necessary, obtain and pay for the use of additional storage or work areas needed for operations. Unless otherwise agreed upon, on-site storage shall be limited to areas of new construction.

I. Do not unreasonably encumber space with materials.

J. Work area must be kept clean and safe at all times.

K. No propane or similar flammable gas or liquid used in construction is permitted to be stored on the premises. It is to be removed from the premises when not is use during the off hours and weekends.

L. Repair damage caused by construction operations. Take precautions necessary to protect the building and occupants during the construction period.

M. Contractors shall submit both home and office numbers to the Owner’s Project Manager’s office for a minimum of 2 employees in the event they must be contacted during off hours or weekends.

1.6 COORDINATION

A. Coordinate work to assure efficient and orderly sequence of installation of construction elements.

B. Verify that characteristics of interrelated operation equipment are compatible; coordinate work having interdependent responsibilities for installing, connection to, and placing such equipment in service. Coordinate space requirements and installation of mechanical and electrical work; make runs parallel with lines of building.

C. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated. Coordinate locations of fixtures and outlets with finish elements.

D. Coordinate construction schedule and operations with Owner and Architect.

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E. Verify all existing conditions prior to bidding and re-verify conditions prior to commencement of any portion of the work. Notify Architect of any discrepancies between the existing conditions and those indicated in the contract documents prior to bidding or commencement of construction activities.

F. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications.

1.7 FIELD ENGINEERING

A. Provide project engineering service; establish lines and levels by use of recognized engineering survey practices.
   1. Finish heights on existing concrete floors may vary considerably. Contractor shall establish high and low points and coordinate required vertical clearances for millwork, doors, door and window frames, etc.

B. Locate and protect control and reference points.

1.8 REGULATORY REQUIREMENTS AND REFERENCE STANDARDS

A. Regulatory Requirements:
   1. Architect has contacted governing authorities and reviewed design requirements of local, state and federal agencies for applicability to Project.
   2. Contractor shall be responsible for contacting governing authorities directly for necessary information and decisions bearing upon performance of Work.

B. Reference Standards:
   1. For Products specified by association or trade standards, comply with requirements of referenced standard, except when more rigid requirements are specified or are required by applicable codes.
   2. Applicable date of each standard is that in effect as of Contract date, except when a specific date is specified.

1.9 ENVIRONMENTAL PROTECTION AND NOISE CONTROL

A. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

B. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
   1. Notify Owner's Representative not less than two days in advance of proposed disruptive operations.
   2. Obtain Owner's Representative's written permission before proceeding with disruptive operations.

1.10 ORDERING OF MATERIALS

A. Certain materials are considered custom or long-lead items and must be expedited through submittals and ordering. Contractor shall verify delivery for all materials and schedule submittals and orders accordingly.

B. Contractor shall provide written verification that each custom or long-lead item has been ordered in sufficient time to meet proposed construction schedule.

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1.11 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.
   1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except as otherwise indicated.
   1. All demolition work shall be performed between the hours of 5:00 p.m. and 8:00 p.m.
   2. All work associated with anchoring to the floor deck above shall be performed between the hours 5:00 p.m. and 8:00 p.m.
   3. Limit construction equipment maintenance to the same hours.
   4. Weekend Hours: Obtain hours from Owner's Representative.
   5. Early Morning Hours: Obtain hours from Owner's Representative.
   6. Hours for Utility Shutdowns: Obtain from Owner's Representative.
   7. Customer Service Counter – All work shall be performed outside of normal business hours, beginning Friday through Sunday.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
   1. Notify Owner's Representative not less than five days in advance of proposed utility interruptions.
   2. Obtain Owner's Representative written permission before proceeding with utility interruptions.

D. Nonsmoking Building: Smoking is not permitted within the buildings, gardens, or within 25 feet (8 m) of entrances, operable windows, or outdoor air intakes.

E. Controlled Substances: Use of tobacco products and other controlled substances on the Project site is not permitted.

1.12 SURVEYS, LINES AND LEVELS

A. Responsibility: The Contractor shall provide project engineering services, and be responsible for properly laying out the Work and for lines, levels and measurements for the Work. Verify the figures indicated on the Drawings before laying out the Work and report errors or inaccuracies to the Architect before commencing work.

1.13 CERTIFICATE OF SUBSTANTIAL COMPLETION

A. Certificate of Substantial Completion will be executed for the Work occupied.

B. Prior to Owner occupancy, mechanical and electrical systems shall be fully operational. Required inspections and tests shall have been successfully completed.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

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SECTION 012000

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. General: This Section specifies administrative and procedural requirements for Allowances and Alternates.

B. Work Specified Elsewhere:

1. Contract Modification Procedures: Section 012600.

1.2 ALTERNATES

A. Summary:

1. General: This Section specifies administrative, procedural, and technical requirements for Alternates.

2. Definition: An Alternate is an amount proposed by Bidders and stated on the Bid Form for certain construction activities defined in the Contract Documents that may be added to or deducted from Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems or installation methods described in Contract Documents.

3. Coordination: Coordinate related Work and modify or adjust adjacent Work as necessary to ensure that Work fully affected by each accepted Alternate is complete and fully integrated into Project.

4. Notification: Immediately following award of Contract, prepare and distribute to each party involved, notification of status of each Alternate. Indicate whether Alternates have been accepted, rejected or deferred for consideration at a later date. Include a complete description of negotiated modifications to Alternates.

5. Schedule: A Schedule of Alternates is included at the end of this Article. Specification Sections referenced in the Schedule contain requirements for Base Bid materials and methods only. Requirements necessary to achieve alternate Work are described under each Alternate.

6. Miscellaneous Work: Include as part of each Alternate, miscellaneous devices, accessory objects and similar items incidental to or required for a complete installation whether or not mentioned as part of Alternate.

B. Schedule of Alternates:

1. To be Determined.

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PART 2 – PRODUCTS
(not used)

PART 3 - EXECUTION
(not used)

END OF SECTION

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SECTION 012600

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. General: This Section specifies administrative and procedural requirements governing handling and processing contract modifications.

1. Clarification of Contract Documents.

2. Initiating, processing, and finalizing modifications to Contract Documents.

B. Requirements Specified Elsewhere: Administrative and procedural requirements for following are specified under referenced Sections:

1. Price and Payment Procedures: Section 012000.

2. Submittal and Submittal Schedules: Section 013300.

3. Construction and Progress Schedules: Section 013200.

4. Requests for Information Section 013131

5. Product Substitution Procedures: Section 016113.

1.2 BULLETINS

A. General: Bulletins are issued for the following purposes:

1. Clarifications: Initiated by the Architect or Owner a Bulletin is drafted and issued by the Architect describing clarifications to the Contract Documents or supplemental instructions which have no impact to the project cost or schedule.

2. Description of Proposed Modifications: Initiated by Owner, Contractor, or Architect, a Bulletin is drafted and issued by the Architect to specifically describe a potential change in the Contract Documents.

3. Contract Change Proposal Request: When the modification proposed by the Bulletin involves a change in the Contract Sum and/or Contract Time the Contractor is directed to respond to the Bulletin within ten working days of its receipt by means of a Contract Change Proposal.

B. Purpose: Bulletins issued by the Architect are for information only. Do not consider them an instruction either to stop work in progress, or to execute the proposed change.

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1.3 CONTRACT CHANGE PROPOSAL (CCP):

A. General: When directed by a Bulletinor when latent or other unforeseen conditions require modifications to the Contract, the Contractor shall propose changes by submitting a Contract Change Proposal to the Architect and the Owner.

B. Statement of Reasons: Include a statement outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.

C. Quantities: Include a list of quantities of products to be purchased and unit costs along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.

D. Contract Time: Include a statement indicating the effect, if any, the proposed change in the Work will have on the Contract Time.

E. Miscellaneous Costs: Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

F. Substitutions: Comply with requirements in Section 016113 if the proposed change in the Work requires the substitution of one product or system for a product or system specified.

G. The Architect will review and respond to the Contractor's proposal within ten (10) working days after its receipt.

H. The General Contractor shall thoroughly review subcontractor change proposals for validity and completeness. This includes confirming the change is a valid contract adjustment, and appropriate quantities and rates are used. Contractor shall attest to this review upon submission of change proposal.

1.4 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: When the Owner and Contractor are not in total agreement on the terms of a Bulletin or a Contract Change Proposal, the Owner may issue a Construction Change Directive instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order. The Construction Change Directive will contain a complete description of the change in the Work and designate the method to be followed to determine change in the Contract Sum or Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.5 CHANGE ORDER

A. Procedures: Upon the Owner's approval of a Bulletin and a Contract Change Proposal, the Contractor will issue a Change Order for signatures of the Owner and Contractor, as provided in the General Conditions. A Change Order may include more than one Bulletin or Contract Change Proposal.

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1.6 COORDINATION

A. Schedule of Values and Application for Payment Revisions: Promptly revise Schedule of Values and Application for Payment forms to document each Change Order as a separate line item.

B. Progress Schedule Revisions: Promptly revise Progress Schedule to reflect any change in Contract Time; revise schedules to adjust times for other items of work affected by the change and resubmit.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

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SECTION 013100

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Coordination.

B. Administrative and supervisory personnel.

C. General installation provisions.

D. Cleaning and protection.

1.3 COORDINATION

A. Coordinate activities included in various Sections to assure efficient and orderly installation of each component. Coordinate operations included under different Sections that are dependent of each other for proper installation and operation.

B. Where installation of one component depends on installation of other components before or after its own installation, schedule activities in the sequence required to obtain the best results.

C. Where space is limited, coordinate installation of different components to assure maximum accessibility for maintenance, service and repair.

D. Make provisions to accommodate items scheduled for later installation.

E. Prepare memoranda for distribution to each party involved outlining required coordination procedures. Include required notices, reports, and attendance at meetings.

F. Prepare similar memoranda for the Owner and separate Contractors where coordination with Work by others is required.

1.4 ADMINISTRATIVE PROCEDURES

A. Coordinate scheduling and timing of administrative procedures with other activities to avoid conflicts and ensure orderly progress.

B. Preparation of schedules. See Section 013200.

C. Installation and removal of temporary facilities. See Section 015000.

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D. Delivery and processing of submittals. See Section 013300.

E. Progress meetings. See Section 013119.

F. Project closeout activities. See Section 017000.

1.5 COORDINATION DRAWINGS

A. Prepare Coordination Drawings where close coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space necessitates maximum utilization of space for efficient installation of different components.

B. Show relationship of components shown on separate Shop Drawings.

C. Indicate required installation sequences.

1.6 INSPECTION OF CONDITIONS

A. The Installer of each component shall inspect the substrate and conditions under which Work is performed. Do not proceed until unsatisfactory conditions have been corrected.

1.7 MANUFACTURER'S INSTRUCTIONS

A. Comply with manufacturer's installation instructions and recommendations, to the extent that they are more stringent than requirements in Contract Documents.

B. Inspect material immediately upon delivery and again prior to installation. Reject damaged and defective items.

C. Provide attachment and connection devices and methods necessary for securing each construction element. Secure each construction element true to line and level. Allow for expansion and building movement.

1.8 VISUAL EFFECTS

A. Provide uniform joint widths in exposed Work. Arrange joints to obtain the best effect. Refer questionable choices to the Architect for decision.

B. Recheck measurements and dimensions, before starting installation.

C. Install each component during weather conditions and project status that will ensure the best results. Isolate each part from incompatible material as necessary to prevent deterioration.

D. Coordinate temporary enclosures with inspections and tests, to minimize uncovering completed construction for that purpose.

1.9 MOUNTING HEIGHTS

A. Where mounting heights of exposed items are not indicated, refer decisions to the Architect. Where mounting heights of concealed items are not indicated, install components at standard heights for the application indicated. See also Drawings for typical mounting heights.

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1.10 CLEANING AND PROTECTION

A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

B. Clean and maintain completed construction as often as necessary through the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

C. Limiting Exposures: Supervise operations to ensure that no part of construction, completed or in progress, is subject to harmful or deleterious exposure. Such exposures include:
1. Excessive weathering.
2. Excessively high or low temperatures or humidity.
3. Air contamination or pollution.
4. Water or ice.
5. Chemicals or solvents.
6. Heavy traffic, soiling, staining and corrosion.
7. Rodent and insect infestation.
8. Unusual wear or other misuse.
9. Contact between incompatible materials.
10. Theft or vandalism.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

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SECTION 013119

PROJECT MEETINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Pre-construction conference.

B. Progress meetings.

C. Project meetings.

D. Preinstallation meetings.

E. Coordination meetings.

1.3 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated. Virtual Project Meetings may occur per the approval of Project Owner's Representative and/or Project Architect.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
   2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
   3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.

1.4 PRE-CONSTRUCTION CONFERENCE

A. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

B. Convene a pre-construction conference after execution of the Agreement and prior to commencement of construction activities. Review responsibilities and personnel assignments.

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C. Attendees: Authorized representatives of Owner, Architect and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference and be represented by persons authorized to conclude matters relating to the Work. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

D. Agenda: Discuss items of significance that could affect progress, including the following:
1. Tentative construction schedule.
2. Phasing.
3. Critical work sequencing and long-lead items.
4. Designation of key personnel and their duties.
5. Procedures for processing field decisions and Change Orders.
6. Procedures for RFIs.
7. Procedures for testing and inspecting.
8. Procedures for processing Applications for Payment.
9. Distribution of the Contract Documents.
10. Submittal procedures.
11. Preparation of Record Documents.
12. Use of the premises and existing building.
13. Work restrictions.
14. Owner's occupancy requirements.
15. Responsibility for temporary facilities and controls.
16. Construction waste management and recycling.
17. Parking availability.
18. Office, work, and storage areas.
19. Equipment deliveries and priorities.
20. First aid.
21. Security.
22. Progress cleaning.
23. Working hours.
24. Minutes: Record and distribute meeting minutes.

E. Review progress of other activities and preparations for the activity under consideration at each conference, including time schedules, manufacturers' recommendations, weather limitations, substrate acceptability, compatibility problems and inspection and testing requirements.

F. Record significant discussions, agreements and disagreements of each conference, along with the approved schedule. Distribute the meeting record to everyone concerned, promptly, including the Owner and Architect.

G. Do not proceed if the conference cannot be successfully concluded. Initiate necessary actions to resolve impediments and reconvene the conference at the earliest feasible date.

1.5 CONSTRUCTION PROGRESS MEETINGS

A. Conduct progress meetings bi-weekly, at a time agreed to by all parties. Notify the Owner and Architect of scheduled dates. Coordinate meeting dates with preparation of the payment request.

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B. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

C. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to current status of the Project.
   1. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      a. Review schedule for next period.
   2. Review present and future needs of each entity present, including the following:
      a. Interface requirements.
      b. Sequence of operations.
      c. Status of submittals.
      d. Deliveries.
      e. Off-site fabrication.
      f. Access.
      g. Site utilization.
      h. Temporary facilities and controls.
      i. Work hours.
      j. Hazards and risks.
      k. Progress cleaning.
      l. Quality and work standards.
      m. Status of correction of deficient items.
      n. Field observations.
      o. RFIs.
      p. Status of proposal requests.
      q. Pending changes.
      r. Status of Change Orders.
      s. Pending claims and disputes.
      t. Documentation of information for payment requests.
   3. Minutes: Record the meeting minutes.
   4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. To be distributed by end of day on meeting date.
      a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.6 PREINSTALLATION CONFERENCES

A. Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

B. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.

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C. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   1. The Contract Documents.
   2. Options.
   3. Related RFIs.
   4. Related Change Orders.
   5. Purchases.
   6. Deliveries.
   7. Submittals.
   8. Review of mockups.
   9. Possible conflicts.
   10. Compatibility problems.
   11. Time schedules.
   12. Weather limitations.
   13. Manufacturer's written recommendations.
   14. Warranty requirements.
   15. Compatibility of materials.
   16. Acceptability of substrates.
   17. Temporary facilities and controls.
   18. Space and access limitations.
   19. Regulations of authorities having jurisdiction.
   20. Testing and inspecting requirements.
   21. Installation procedures.
   22. Coordination with other work.
   23. Required performance results.
   24. Protection of adjacent work.
   25. Protection of construction and personnel.

D. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

E. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
   1. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

1.7 COORDINATION MEETINGS

A. Conduct Project coordination meetings at intervals as agreed by Owner and Architect. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

B. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

C. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

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1. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
2. Schedule Updating: Revise Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
3. Review present and future needs of each contractor present, including the following:
   a. Interface requirements.
   b. Sequence of operations.
   c. Status of submittals.
   d. Deliveries.
   e. Off-site fabrication.
   f. Access.
   g. Site utilization.
   h. Temporary facilities and controls.
   i. Work hours.
   j. Hazards and risks.
   k. Progress cleaning.
   l. Quality and work standards.
   m. Change Orders.
4. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.8 REPORTING

A. General: No later than 3 days after each meeting, distribute copies of minutes of the meeting to each party present and to parties who should have been present. Include a summary, in narrative form, of progress since the previous meeting.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

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SECTION 013131

REQUEST FOR INTERPRETATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specifications, apply to this Section.

1.2 SECTION INCLUDES

A. Procedures to be followed by Contractor upon discovery of any apparent conflicts, omissions, or errors in Contract Documents or upon having any question concerning interpretation.

1.3 PROCEDURES

A. Notification by Contractor:
   1. Submit all requests for clarification and additional information in writing to Architect using the Contractor's standard form as approved by Architect.
   2. Number RFIs sequentially. Follow RFI number with sequential decimal suffix as necessary for each resubmission. For example, the first RFI would be "001.0". The second RFI would be "002.0". The first resubmittal of RFI "002.0" would be "002.1".
   3. Limit each RFI to one issue on one subject and to no more than three questions.
   4. Submit RFIs if one of the following conditions occur:
      a. Contractor discovers an unforeseen condition or circumstance that is not described in the Contract Documents.
      b. Contractor discovers an apparent conflict or discrepancy between portions of the Contract Documents that appears to be inconsistent or is not reasonably inferred from the intent of the Contract Documents.
      c. Contractor discovers what appears to be an omission from the Contract Documents that cannot be reasonably inferred from the intent of the Contract Documents.
      d. RFIs will not be recognized or accepted if, in the opinion of Architect, one of the following conditions exist and may result in the Architect requesting monetary compensation from the Contractor for time spent to review any of the following:
         1) Contractor submits the RFI as a request for substitution.
         2) Contractor submits the RFI as a submittal.
         3) Contractor submits the RFI under the pretense of a Contract Documents discrepancy or omission without thorough review of the Documents.
         4) Contractor submits the RFI in a manner that suggest that specific portions of the Contract Documents are assumed to be excluded or by taking an isolated portion of the Contract Documents in part rather than whole.
         5) Contractor submits an RFI in an untimely manner without proper coordination and scheduling of work or related trades.

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5. Ask for any clarification or request for information immediately upon discovery. Submit RFIs in a reasonable time frame so as not to affect the project schedule while allowing the full response time described below.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
   1. Project name.
   2. Project number.
   3. Date.
   4. Name of Contractor.
   5. Name of Architect.
   6. RFI number, numbered sequentially.
   7. RFI subject.
   8. Specification Section number and title and related paragraphs, as appropriate.
   9. Drawing number and detail references, as appropriate.
   10. Field dimensions and conditions, as appropriate.
   11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   12. Contractor's signature.
   13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
      a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

1.4 RESPONSE TIME

A. Architect, whose decision will be final and conclusive, shall resolve such questions and issue instructions to Contractor within a reasonable time frame. RFIs will receive a response within 10 business days on average. In some cases this time may need to be lengthened for complex issues, or shortened for emergency situations, as mutually agreed by all parties.

B. Should Contractor proceed with the work affected before receipt of a response from Architect, within the response time described above, any portion of the work which is not done in accordance with Architect’s interpretations, clarifications, instructions, or decisions is subject to removal or replacement and Contractor shall be responsible for all resultant losses.

C. Additional Detailed Instructions:
   1. Architect may furnish additional detailed, written instructions to further explain the work and such instructions shall be a part of Contract Documents. Should additional detailed instructions in the opinion of Contractor constitute work in excess of the scope of Contract, Contractor shall submit written notification thereof to Architect within 5 business days following receipt of such instruction, and in any event prior to the commencement of work thereon.
   2. Architect will then consider such notice and if Architect considered it justified, Architect’s instructions will be revised, or a Bulletin will be issued.
   3. Contractor has no claim for additional compensation or extension of the schedule because of any such additional instructions unless Contractor gives Architect written notice thereof within the time frame as specified above.

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D. Failure to Agree: In the event of failure to agree as to the scope of Contract requirements, Contractor shall follow procedures set forth in the disputes clause.

E. A response to an RFI does not suggest a change in Cost or Time. Typically a response represent a clarification or final evolution of design. This does not necessarily entitle the Contractor to a contract change.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

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SECTION 013200

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Preliminary Construction Schedule.
   2. Contractor's Construction Schedule.
   3. Submittals Schedule.
   4. Daily construction reports.
   5. Material location reports.
   6. Field condition reports.
   7. Special reports.

1.3 RELATED SECTIONS

A. Section 013200 – Project Management and Coordination: Administrative Procedures.

B. Section 013300 - Submittal Procedures: Submitting schedules and reports.

C. Section 014000 - Quality Requirements: Submitting a schedule of tests and inspections.

1.4 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
   1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
   2. Predecessor Activity: An activity that precedes another activity in the network.
   3. Successor Activity: An activity that follows another activity in the network.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

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E. Float: The measure of leeway in starting and completing an activity.
   1. Float time belongs to Owner is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
   2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
   3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

F. Major Area: A story of construction, a separate building, or a similar significant construction element.

G. Milestone: A key or critical point in time for reference or measurement.

H. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

I. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.5 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:
   1. Working electronic copy of schedule file, where indicated.
   2. PDF electronic file.

B. Startup construction schedule.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
   1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
   2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
   3. Total Float Report: List of all activities sorted in ascending order of total float.
   4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at weekly intervals.

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I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Special Reports: Submit at time of unusual event.

1.6 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

1.7 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from parties involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.
   1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
   1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
   2. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
   3. Startup and Testing Time: Include not less than 10 days for startup and testing.
   4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
   1. Phasing: Arrange list of activities on schedule by phase.
   2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.

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3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Work Restrictions: Show the effect of the following items on the schedule:
   a. Coordination with existing construction.
   b. Limitations of continued occupancies.
   c. Uninterruptible services.
   d. Partial occupancy before Substantial Completion.
   e. Use of premises restrictions.
   f. Provisions for future construction.
   g. Seasonal variations.
   h. Environmental control.
6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
   a. Subcontract awards.
   b. Submittals.
   c. Purchases.
   d. Mockups.
   e. Fabrication.
   f. Sample testing.
   g. Deliveries.
   h. Installation.
   i. Tests and inspections.
   j. Adjusting.
   k. Curing.
   l. Startup and placement into final use and operation.
7. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
   a. Structural completion.
   b. Permanent space enclosure.
   c. Completion of mechanical installation.
   d. Completion of electrical installation.
   e. Substantial Completion.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion, and the following interim milestones:
   1. Temporary enclosure and space conditioning.

E. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
   1. Refer to Division 1 Section "Payment Procedures" for cost reporting and payment procedures.

F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
   1. Unresolved issues.
   2. Unanswered Requests for Information.

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3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time.

G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Preliminary Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for commencement of the Notice to Proceed.
   a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
   a. Preparation and processing of submittals.
   b. Mobilization and demobilization.
   c. Purchase of materials.
   d. Delivery.
   e. Fabrication.
   f. Utility interruptions.
   g. Installation.
   h. Work by Owner that may affect or be affected by Contractor's activities.
   i. Testing and commissioning.
2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.

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3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

E. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Principal events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the Schedule of Values).

F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

G. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
    a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
    b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.

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5. Material deliveries.
6. High and low temperatures and general weather conditions.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (refer to special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial Completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation on form agreed to by Architect, Owner, and Contractor. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

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B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
   1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
   2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
   3. As the Work progresses, indicate Actual Completion percentage for each activity.

C. Distribution: Distribute copies of approved schedule to Architect and Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
   1. Post copies in Project meeting rooms and temporary field offices.
   2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION

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SECTION 013300

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 RELATED SECTIONS

A. Section 013200 - Construction Progress Documentation: Submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.

B. Section 014000 - Quality Requirements: Submitting test and inspection reports.

C. Section 017000 - Execution and Closeout Requirements for submitting warranties.

D. Section 017000 - Execution and Closeout Requirements for demonstration of equipment and training of Owner's personnel.

E. Divisions 2 through 28 Sections for specific requirements for submittals in those Sections.

1.4 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Owner’s and Architect’s responsive action.

B. Informational Submittals: Written information that does not require Owner’s and Architect’s responsive action. Submittals may be rejected for not complying with requirements.

1.5 DISTRIBUTION OF SCHEDULES

A. Distribute copies of the Submittal Schedule within 30 days of start of construction to the Architect, Owner, subcontractors, and other parties required to comply with scheduled dates. Post copies in the temporary field office. When revisions are made, distribute to the same parties and post in the same locations.

B. Updating: Revise Schedule after each meeting or activity, where revisions have been made. Issue the updated Schedules concurrently with report of each meeting.

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1.6 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: At Contractor's written request, electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.

1. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

2. Digital Drawing Software Program: The Contract Drawings are available in REVIT 2022, and as exported to Autocad Drawings.

3. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

4. The following digital data files will by furnished for each appropriate discipline:

a. Floor plans.

b. Reflected ceiling plans.

c. Elevations

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Owner and Architect reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Owner’s and Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 10 business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.

2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.

3. Resubmittal Review: Allow 5 business days for review of each resubmittal.

4. Sequential Review: Where sequential review of submittals by Architect, Architect’s consultants, Owner’s consultants, Owner, or other parties is indicated, allow 15 business days for initial review of each submittal.

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5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Owner's consultants, allow 15 business days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

2. Name file with submittal number or other unique identifier, including revision identifier.

a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., CEE-061000.01). Resubmittals shall include an "R" with the resubmittal number after another decimal point (e.g., CEE-061000.01.R1).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.

4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:

a. Project name.

b. Date.

c. Name and address of Architect.

d. Name of Construction Manager.

e. Name of Contractor.

f. Name of firm or entity that prepared submittal.

g. Names of subcontractor, manufacturer, and supplier.

h. Category and type of submittal.

i. Submittal purpose and description.

j. Specification Section number and title.

k. Specification paragraph number or drawing designation and generic name for each of multiple items.

l. Drawing number and detail references, as appropriate.

m. Location(s) where product is to be installed, as appropriate.

n. Related physical samples submitted directly.

o. Indication of full or partial submittal.

p. Transmittal number, numbered consecutively.

q. Submittal and transmittal distribution record.

r. Other necessary identification.

s. Remarks.

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5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
    a. Project name.
    b. Number and title of appropriate Specification Section.
    c. Manufacturer name.
    d. Product name.

F. Options: Identify options requiring selection by Architect.

G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked "No Exceptions Taken", or "Make Corrections Noted".

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Transfer electronic submittals as PDF electronic files directly to Architect using a mutually agreed method for electronic file transfer..
    a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2.2 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections. Submit one electronic copy unless specified otherwise.

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B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
    a. Manufacturer's written recommendations.
    b. Manufacturer's product specifications.
    c. Manufacturer's installation instructions.
    d. Standard color charts.
    e. Manufacturer's catalog cuts.
    f. Wiring diagrams showing factory-installed wiring.
    g. Printed performance curves.
    h. Operational range diagrams.
    i. Mill reports.
    j. Standard product operation and maintenance manuals.
    k. Compliance with specified referenced standards.
    l. Testing by recognized testing agency.
    m. Application of testing agency labels and seals.
    n. Notation of coordination requirements.
    o. LEED data and certificates.
4. Submit Product Data before or concurrent with Samples.
5. Number of Copies: Submit one electronic copies of Product Data in pdf format, unless otherwise indicated. Architect will return one electronic copy with simultaneous distribution to the Owner and the Owner's Construction Manager.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    a. Dimensions.
    b. Identification of products.
    c. Fabrication and installation drawings.
    d. Roughing-in and setting diagrams.
    e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
    f. Shop work manufacturing instructions.

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g. Templates and patterns.

h. Schedules.

i. Design calculations.

j. Compliance with specified standards.

k. Notation of coordination requirements.

l. Notation of dimensions established by field measurement.

m. Relationship to adjoining construction clearly indicated.

n. Seal and signature of professional engineer if specified.

o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 42 inches (750 by 1000 mm).

3. Submit Shop Drawings in the following format:

a. PDF electronic file.

D. Samples: Submit physical Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

2. Identification: Attach label on unexposed side of Samples that includes the following:

a. Generic description of Sample.

b. Product name and name of manufacturer.

c. Sample source.

d. Number and title of appropriate Specification Section.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.

b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be

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selected from manufacturer's product line. Architect will retain one and return one submittal with options selected. Mark up and retain one returned Sample set as a Project Record Sample.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

   a. Number of Samples: Submit the number of Samples required to be returned to the Contractor, plus one to be retained by the Architect. Mark up and retain one returned Sample set as a Project Record Sample.

      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Submittals Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."

F. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.

2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.

4. Number of Copies: Submit one electronic copy of subcontractor list, unless otherwise indicated. Architect will return one electronic copy.

   a. Mark up and retain one returned copy as a Project Record Document.

2.3 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit one electronic copy of each submittal, unless otherwise indicated. Architect will not return copies.

2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

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3. Test and Inspection Reports: Comply with requirements specified in Division 1 Section "Quality Requirements."

4. Contractor's statement that the Submittal complies with the Construction Documents.

B. Coordination Drawings: Comply with requirements specified in Division 1 Section "Project Management and Coordination."

C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

E. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

G. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

J. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

K. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.

2. Date of evaluation.

3. Time period when report is in effect.

4. Product and manufacturers' names.

5. Description of product.

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6. Test procedures and results.

7. Limitations of use.

L. Schedule of Tests and Inspections: Comply with requirements specified in Division 1 Section "Quality Requirements."

M. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

N. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

O. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 1 Section "Operation and Maintenance Data."

R. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.

2. Required substrate tolerances.

3. Sequence of installation or erection.

4. Required installation tolerances.

5. Required adjustments.

6. Recommendations for cleaning and protection.

S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.

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2. Statement on condition of substrates and their acceptability for installation of product.

3. Statement that products at Project site comply with requirements.

4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.

5. Results of operational and other tests and a statement of whether observed performance complies with requirements.

6. Statement of whether conditions, products, and installation will affect warranty.

7. Other required items indicated in individual Specification Sections.

T. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

U. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.

1. Architect will not review submittals that include MSDSs and will return the entire submittal for resubmittal.

2.4 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three hard copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Owner and Architect.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of

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reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. "No Exceptions Taken": Submittal has been reviewed only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Contractor is responsible for compliance with the requirements of the plans and specifications. Review of a specific item shall not include approval of an assembly of which the item is a component. Contractor is responsible for dimensions to be confirmed and correlated at the job site, information that pertains solely to the fabrication process or to the means, methods, techniques, sequences and procedures of construction, coordination of the work of all trades and for performing all work in a safe and satisfactory manner. No comments have been recorded and no resubmittal is required.

2. "Make Corrections Noted": Submittal has been reviewed in accordance with the above. When the Contractor has made the corrections noted in the review comments, the submittal will be considered to have the same status as if it had been marked "No Exceptions Taken". No resubmittal is required and no action resubmittal shall be made. However the Contractor, Agency or Architect may request that a record copy be submitted as an Informational Submittal for any of the concerned parties.

3. "Revise and Resubmit": The Contractor shall revise the submittal based on the review comments provided and shall resubmit the entire submittal until a mark of 'No Exceptions Taken' or 'Make Corrections Noted' is obtained.

4. "Rejected": The submittal does not comply with the Contract Documents. Resubmit in conformance with the Contract Documents.

C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION

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DOCUMENT 01 35 13.19

SPECIAL PROJECT PROCEDURES FOR SAN MATEO COUNTY FACILITY

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 Prior to the start of a project, the Contractor shall comply with the Contract Documents (Drawings and Specifications) Drawings and must obtain approval from the County's Representative for any and all necessary arrangements for routing of workers, equipment, and material to the job location, schedule for elevator usage; and procedures in clean and sterile areas. In addition, the Contractor shall become familiar with applicable San Mateo County (or Facility) policies and procedures and comply with the following for the duration of the Project.

1.2 UTILITY INTERRUPTIONS AND PRIOR NOTIFICATION

1.2.1.1 All mobile or fixed noise-producing equipment used on the project, which is regulated for noise output by a local, state, or federal agency, shall comply with such regulation while in the course of project activity.

1.2.1.2 Electrically powered equipment instead of pneumatic or internal combustion powered equipment shall be used, where feasible and needed to control excessive noise.

1.2.1.3 Material stockpiles and mobile equipment staging, parking, and maintenance areas shall be located as far as practicable from noise-sensitive judicial operations.

1.2.1.4 Construction site and access road speed limits shall be established and enforced during the construction period.

1.2.1.5 The hours of material transport shall be restricted to the periods and days permitted by both this contract and local noise or other applicable ordinance.

1.2.1.6 The use of noise producing signals, including horns, whistles, alarms, and bells shall be for safety warning purposes only.

1.2.1.7 No project related public address or music system shall be audible at any adjacent noise-sensitive spaces/areas/corridors.

1.2.2 Dust: Dust control is a critical activity given the proximity of construction to Facility operations. The Contractor shall prepare a submittal that identifies source air pollution and related pollution reduction measures. The following dust control measures shall be employed:

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1.2.2.1 Develop a staging area, vehicle and truck routes, and a daily meeting to assure all applicable control measures are established for that particular workday.

1.2.2.2 Dust barriers shall be provided by the Contractor as necessary to contain dust within the construction site.

1.2.3 Demolition: The Contractor shall plan the demolition activities to minimize environmental impacts on facility operations in accordance with Sections 024119 Selective Demolition. The Contractor has the option of recycling demolished building material, but must do so in compliance with these Contract Documents and other Regulations. In addition to the above mitigation measures, the following applies to demolition activities:

1.2.3.1 Provide the County's Representative with ten (10) Day advance written notice of which building areas will be demolished next, so that they take the necessary steps to prevent airborne contaminants from entering nearby buildings/areas.

1.2.3.2 Identify the material that are recyclable and if possible, send to recycling facility.

1.2.3.3 Waste and debris may be segregated, processed, and recycled to minimize waste volume and number of trips. If not possible to segregate, then procedure acceptable to County of San Mateo to Contractor's Waste Management Plan will be allowed.

1.2.4 Odors: When odors are a concern, arrangements shall be made by the Contractor for their containment or control. Where this is not feasible, specific arrangements should be made to minimize the disturbance of normal Facility activities. Where controllable, fumes and odors shall not be allowed to migrate to occupied areas. The Contractor shall immediately notify the County's Representative. If necessary, Facility Maintenance & Operations Department personnel shall modify adjacent air circulation systems as deemed necessary during the construction period.

1.2.5 Vibrations: The impacts of vibration for facility replacement and renovation activities will be limited. If vibration becomes an impact to facility operations, the Contractor shall stop operations, reschedule and/or implement the following with the approval of the County Representative:

1.2.5.1 Route heavily loaded trucks and equipment away from the most sensitive spaces if possible.

1.2.5.2 Select demolition methods not involving impact, where practicable

1.2.6 Environmental Mitigation Measures: Questions about which items are applicable to the Contractor shall be directed to the County's Representative.

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1.3 SHIPMENTS AND MATERIALS

1.3.1 Equipment and materials shall not be shipped to the Facility unless specific arrangements are made for receipt and acceptance of these items. When such shipments are authorized, they are the total responsibility of the Contractor. The placement of such materials shall be limited to the specific lay-down and staging areas as defined in the Contractor's Construction Plan established for the project unless approved in advance by the County Project Manager. The County accepts no responsibility for the receipt, storage, or protection of the Contractor's materials and equipment.

1.4 PARKING

1.4.1 The County's Representative will meet with the Contractor to determine parking requirements.

1.4.2 The primary parking and storage area shall be designated areas.

1.4.3 The County's Representative will notify Facility Maintenance & Operations Department of parking area proposed to be used by construction personnel if at variance with this procedure.

1.4.4 Contractor and related personnel shall park in authorized areas only.

1.4.5 Parking in staff and visitor parking spaces is prohibited.

1.5 CAFETERIA AND FOOD

1.5.1 Construction personnel will be allowed access to the Facility cafeteria.

1.5.2 Construction personnel shall police their own areas. All cups, cans, paper, wrappers, and discarded food must be placed in trash receptacles at the end of each break.

1.5.3 Contactors shall submit the proposed location of any break and eating areas to the County's Representative for approval.

1.6 BADGES

1.6.1 Badges shall be worn by all of the Contractor's personnel and all of their subcontractors' personnel.

1.7 PHONES

1.7.1 No cellular telephones shall be operated in staff's work areas.

1.8 SMOKING AND TOBACCO

1.8.1 Smoking is not permitted indoors.

1.8.2 Smoking is not permitted within the facilities under construction.

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1.8.3 Smoking is permitted in designated areas. Contractor to contact the County Project Manager for approved smoking areas.

1.8.4 All ashes and cigarette butts must be deposited in approved receptors.

1.8.5 No chewing tobacco or spitting of tobacco is permitted.

1.9 SECURITY

1.9.1 All personnel must obey and act immediately upon any request by security.

1.9.2 A list of emergency phone numbers will be provided by the Facility Maintenance & Operations Department.

1.10 SAFETY

1.10.1 General

1.10.1.1 Watch for visitors and staff.

1.10.1.2 Work only where there is a positive barrier separation between construction activities and others.

1.10.1.3 Clean up all areas immediately in occupied areas.

1.10.1.4 Do not drape cords across corridors. All cords must be attached to the ceiling or taped to the floor (use tape with non-marring adhesive).

1.10.1.5 Maintain a minimum of 5'-0" clear within all corridors.

1.10.1.6 Do not leave materials or equipment in the corridor.

1.10.2 Safety equipment and consideration should include, but are not limited to:

1.10.2.1 Anyone known to be under the influence of alcohol or drugs shall be dismissed from the Project at once and not be allowed to return.

1.10.2.2 Offensive language is not permitted in any area where it may be overheard by staff or visitors.

1.10.2.3 Provide adequate emergency first aid equipment.

1.10.2.4 Post location and emergency phone numbers for local medical care.

1.10.2.5 Monitor safe ladder usage.

1.10.2.6 Verify adequate exhaust controls for equipment during construction.

1.10.2.7 Monitor noise levels and establish safe limitations.

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1.10.2.8 Ensure adequate ventilation for air contaminants.

1.10.2.9 Insist on personal protective equipment (PPE), such as hard hats, safety shoes, and eye, ear, and face protection equipment.

1.10.2.10 Safety nets, belts, and lifelines shall be used, as appropriate.

1.10.2.11 Provide adequate emergency fire protection equipment.

1.10.2.12 Post location and emergency phone numbers for local fire departments.

1.10.2.13 Provide safe storage for all flammable and combustible materials.

1.10.2.14 Insist on safe and proper use of hand power tools and electrical drop cords.

1.10.2.15 Operation of cranes, derricks, and hoists should be in accordance with manufacturer's recommendations and appropriate ANSI and Cal/OSHA regulations.

1.10.2.16 All construction operations and personnel are subject to CAL-OSHA.

1.10.2.17 Provide adequate barricades and safety lighting at all open trenches adjacent to public access (must accommodate proper warning for blind persons).

1.10.2.18 Properly fence or barricade entire confines of project site so as to avoid public access or unauthorized personnel.

1.10.2.19 All wall, floor, and ceiling penetrations shall be sealed to maintain fire and smoke ratings in accordance with CBC, NFPA 99 and *Life Safety Code*.

1.10.2.20 All emergency exit passages must be maintained free of obstructions.

1.10.2.21 Provide barricades and containment barriers in accordance with the scope of Work of the Construction Documents (Drawings and Specifications).

1.10.3 Fire Prevention During Welding, Cutting, and Other Hot Work

1.10.3.1 All hot work shall be in accordance with the Facility's requirements and procedures in this Section.

1.10.3.2 Hot work includes welding, heat treating grinding, thawing pipe, powder-driven fasteners, hot riveting, and similar applications producing a spark, flame, or heat.

1.10.3.3 Hot work shall be performed in a designated area that is approved for hot work by the County's Representative.

1.10.3.4 The Contractor shall ensure that only approved apparatus, such as torches, manifolds, regulators, or pressure-reducing valves, and acetylene generators, are used.

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1.10.3.5 The Contractor shall ensure that all individuals involved in hot work are:

1.10.3.5.1 Trained in the safe operation of their equipment and the safe use of the process.

1.10.3.5.2 Have an awareness of the inherent risks involved and understand the emergency procedures in the event of a fire.

1.10.3.5.3 Are aware if any special risks, such a flammable materials or hazardous conditions at the hot work site.

1.18.3.6 See PART 2 – EXECUTION, for HOT WORK PROCEDURE.

1.10.4 Alarms

1.10.4.1 Fire alarm signals are initiated manually or automatically through smoke and heat sensing devices.

1.10.4.2 Construction activities often create dust or smoke, which will activate the fire alarm system. Prior to conducting any work, notify the County Project Manager of the scope of work, the duration and location of the work, and determine if the work will create dust or smoke. If the work will create dust or smoke, proceed as follows:

1.10.4.2.1 For localized operations, cover the smoke detector with a dust cover approved by the County Project Manager and Regulatory Agency. Remove promptly when work is complete.

1.10.4.2.2 For larger areas, the detection system must be disabled. This is to be done only by the Facility's Engineering staff. Even though the system is disabled, dust covers must be installed on all area smoke detectors.

1.17.5.2.1.1 Contractor shall provide a continuous fire-watch until the system is restored/reenabled. System will need to be reenabled by end of work day.

1.17.5.2.1.2 Remove dust covers promptly when work is complete.

1.17.5.2.1.3 Detection system shall be restored to proper working order prior to releasing the fire-watch

.

1.17.5.3 See PART 2 – EXECUTON for FIRE WATCH PROTOCOL/PROCEDURE.

1.10.5 Project Inspector

1.10.5.1 Provision of inspectors by the County, if any, or by Fire Marshal, or other Regulatory Agency pursuant to provisions of this section shall be subject to following:

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1.10.5.1.1 Contractor shall allow inspectors full access to project at all times Work is in progress.

1.10.5.1.2 Contractor shall not take any direction, approvals or disapprovals from inspectors.

1.10.5.1.3 Contractor shall not rely on inspectors to ensure Work is completed in accordance with Contract documents.

1.10.5.2 Acts or omissions of any inspector (including, without limitation, inspector's failure to observe or report deficiencies in Contractor's Work) shall not relieve Contractor from its responsibility to complete Work in accordance with Contract Documents.

1.10.6 Directory For Assistance

1.10.6.1 A list of emergency phone numbers will be provided by the San Mateo County Facilities Engineering Department.

PART 2 - EXECUTION

2.1 **UTILITY SYSTEM SHUTDOWNS**

3.2.1 DOCUMENTS/FORMS

3.2.1.1 Attachment 1 – UTILITY SYSTEM SHUT DOWN NOTICE

2.2 **LIFE SAFETY – ABOVE CEILING WORK**

2.2.1 PURPOSE

To ensure the safety of our staff and visitors during above ceiling work and to meet regulatory requirements.

2.2.2 PROCEDURE

3.2.2.1 An Above Ceiling Work Permit (see attached permit) is required for any work performed. The permit may be secured from the Facilities Plant & Engineering Department.

3.2.2.2 The permit must be completely filled out by the person requesting the permit and authorized by the Facility Maintenance & Operations Department or his designee. The permit must be in the possession of the person(s) performing the work at all times while work is under way.

3.2.2.3 The person performing the work must notify the appropriate inspector prior to the commencement of work, before any work is concealed and after the work is completed. Work may not proceed until the inspections are complete.

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3.2.2.4 Prior to beginning of any work, the area must be inspected by the persons desiring or performing the work and the appropriate inspector. Any pre-existing conditions should be noted on the permit.

3.2.2.5 All penetrations and attachments must be made in accordance with the California Building Code (CBC), the current UL Fire Resistance directory.

3.2.2.6 Supporting work from the ceiling grid is prohibited.

3.2.2.7 For safety and security purposes, any and all tools or other sharp objects should be in the possession of the workers at all times and/or locked/secured.

3.3.3 DOCUMENTS/FORMS

3.3.1 Attachment 2 – ABOVE-CEILING WORK PERMIT

3.4 LIFE SAFETY – HOT WORK

3.4.1 PURPOSE

To define the steps that should be taken to issue a hot work permit to lessen the possibility of accidental fires in or around the site.

3.4.2 PROCEDURE

3.4.2.1 The Facilities Maintenance and Operation Department shall be solely responsible for issuing "hot work" permits to outside contractors and County Crafts personnel. The permit must be issued prior to the start of the work and returned to the Chief or Supervising Stationary Engineer to determine if the area is free from combustible or hazardous materials and that adjacent equipment and operations are considered safe from any effects of the work.

3.4.2.2 Before a "hot work" permit is issued, the work shall be surveyed by the Chief of Plant & Engineering or the Supervising Stationary Engineer to determine if the area is free from combustible or hazardous materials and that adjacent equipment and operations are considered safe from any effects of the work.

3.4.2.3 All job sites involving "hot work" shall have a portable fire extinguisher of appropriate size and type at hand in the event an accidental fire is started. If the Chief of Plant & Engineering or the Supervising Stationary Engineer deems it necessary, a separate fire watch shall be maintained during the course of any "hot work"

3.4.2.4 The Chief of Plant & Engineering of the Supervising Stationary Engineer shall write on the back of the permit any special conditions that must be met before the work proceeds. The permit is to be displayed in an open and prominent location at the job site.

3.4.2.5 No "hot work" shall be performed on natural gas or oxygen lines unless the lines have been isolated, purged, and inspected by the Supervising Stationary Engineer and a permit has been issued for the work.

4.4.2.6 During the course of all maintenance and contractor work, the job site shall be kept free of combustible material when "hot work" is in progress. This includes volatile and hazardous liquids which when in the presence of heat will give off combustible or toxic vapors.

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4.4.2.7 No welding or flame cutting of ventilation ducts shall be permitted under any circumstances.

3.4.3 DOCUMENTS/FORMS

3.4.3.1 Attachment 3 – HOT WORK PERMIT

3.5 LIFE SAFETY – FIRE WATCH PROTOCOL

3.5.1 PURPOSE

To initiate appropriate action to ensure the safety and well being of the staff and visitors in the event of the Fire Alarm and/or Sprinkler System compromise or malfunction. Once the fire alarm and/or sprinkler system malfunction has been detected, the Fire Marshal and Facility Maintenance & Operations Department and/or the County Project Manager will be notified. The Facility Maintenance & Operations Department will immediately begin investigation and repair of the malfunction.

3.5.2 POLICY

The Fire Watch Protocol will be initiated when indicated according to the Interim Life Safety Measure (ILSM) policy designed to address identified Life Safety Code deficiencies that cannot be immediately corrected or during periods of construction. ISLM are essential when a fire alarm system is out of service more than 4 hours in a 24-hour period and/or when a fire sprinkler system is out of order more than 10 hours in a 24-hour period. The Facility Maintenance & Operations Department or designee, and the local Fire Marshal/Fire Department will be notified by PBX.

Upon detection of a Fire Alarm and/or Sprinkler System malfunction, the Fire Impairment Coordinator (a Facility Engineer), or as designated by the Facility Maintenance & Operations Department, will immediately begin an investigation and take action to repair.

3.5.2 PROCEDURE

3.5.2.1 Monitoring

Every hour, the designated person on duty will monitor the building by walking the unoccupied and occupied areas to check for the following conditions and complete the Fire Watch Log. The designated person/personnel shall be provided by the contractor. may include Security, Facility Maintenance & Operations Department Engineer, qualified Contractor are knowledgeable and trained to perform fire watch functions . Areas include:

1. Area of work and corridors. Hallways, private offices, mechanical/electrical spaces, roofs and unoccupied spaces are free of fire hazards, combustibles or any other conditions that could develop into a fire hazard.

2. Minimum clearances are maintained on hallways and exit pathways.

3. Fire Extinguishers are full and dates are current.

4. Malfunctioning equipment and supplies are out of service and labeled.

5. All Contractor’s personnel and all of their subcontractors’ personnel need to adherence to County smoking policy.

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6. Walls checked for hot spots

7. All areas checked for signs of smoke and/or combustion

3.5.2.2 The Fire Watch Protocol will be maintained until the Fire Marshal has given clearance. Fire watch will be maintained until project construction personnel has returned to the site to begin their next work shift.

3.5.3 DOCUMENTS/FORMS

3.5.3.1 Attachment 4 – FIRE WATCH LOG

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Attachment 1
DEPARTMENT OF' PUBLIC WORKS
SAN MATEO COUNTY FACILITY MAINTENANCE & OPERATIONS DEPARTMENT
PHONE: (650) 363-4444

UTILITY SYSTEM SHUTDOWN NOTICE

MUST BE SUBMITTED AT LEAST 3 DAYS (72 HOURS) PRIOR TO SHUTDOWN

System:
Location/Building:
Reason for Shutdown:
Date & Time of Work To Be Performed:
Areas Affected:
System Shutdown Sequence:
Name & Contact Info of Person Requesting:
Name & Contact Info of Responsible Person/Contractor:
Name of Engineering Staff Assigned: **Shutdown Approved By:** **Chief of Plant & Engineering:** **Supervising Stationary Engineer:**
Notifications Made to the Departments: **Email(s):** **Shutdown Notice Posted:**

Note: Fire Alarm System Shutdown should be coordinated with PBX and Cal-Security. Keller Center to be notified before any strobes and chimes are tested.

END OF DOCUMENT

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Attachment 2
SAN MATEO COUNTY
ABOVE-CEILING WORK PERMIT

Name _____ **Date** _____

Department/Company_____

Phone_____ **Fax** _____

Location _____ **Room Number** _____

Description of Work:_____

Wiring to be installed or modified:

Communication _____	**Door Control** _____
Fiber Optic_____	**Fire Alarm**_____
Security _____	**Telephone**_____
Other _____	**Electric low or high Voltage**_____
HVAC _____	**Television**_____

How work will be supported:

Deck _____	**Existing Casework** _____
Existing piping or conduit rack_____	**New pipe or conduit rack** _____
Existing Cable Tray_____	**New cable tray** _____
Wall _____	**Other** _____

Will any penetration modifications be made to the visible ceiling or walls:

Yes_____ **No**_____

Describe: _____

Start Date_____ **Time** _____ **Completion Date**_____ **Time**_____

Authorized to Proceed _____**Date** _____

Interim Inspection _____ **Date** _____

Final Inspection _____ **Date** _____

END OF DOCUMENT

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Attachment 3
HOT WORK PERMIT

(SEE ATTACHED EXAMPLE SMC HOT WORK PERMIT)



HOT WORK PERMIT

The supervisor, in issuing this permit, certifies that all safety factors have been considered and cared for satisfactorily.

Return this permit upon completion of the job which it is to cover to the authorizing supervisor. The supervisor will write "complete", date and initial across the face of the permit.

AREA OF HOT WORK:

WORK TO BE DONE:

		YES	NO	N/A
1.	Read the Hot Work Permit Procedure.			
2.	Work area and equipment has been made free of flammable, combustible, and hazardous materials.			
3.	Gas Test taken.			
4.	Is a fire extinguisher on the job?			
5.	Smoke alarms covered?			
6.	Lines disconnected and/or blanked?			
7.	Is a fire watch provided?			
8.	Adjoining equipment and operations considered ok from standpoint of possible effect on the job.			
9.	Other necessary precautions. SPECIFY:			

APPROVAL

I have personally checked the conditions necessary and as specified. I authorize this "Hot" work to begin.

APPROVED BY:_____ DATE:____ TIME:____

HOT WORK PERMIT IS GOOD FOR _____HOURS ONLY.

THIS PERMIT CAN BE ISSUED FOR ONLY ONE SHIFT; IT BECOMES VOID AT THE END OF WORK SHIFT DAY.

JT35SU Emed Co., Inc., Bflo., NY 14240 1-800-442-3633

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Attachment 4
FIRE WATCH LOG

Date	Time	Location	Comments	Signature

END OF DOCUMENT

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Attachment 5
PROJECT METHOD OF PROCEDURE (MOP) FORM

MOP Title: _____

Date of Request: _____Project Number: _____

Contractor: _____ Subcontractor:_____

Date of Work: _____to _____

Start Time: _____ End Time: _____Critical Path Schedule Item: No _____ Yes _____

Start Date per Schedule: _____Duration _____

Completion of prior MOP's required before proceeding: No _____ Yes _____
If Yes, which MOP/MOP's _____MOP scheduled completion: _____

Facility Support Required: No _____ Yes _____

If Yes, staff size/expertise _____Duration _____

Fall Protection Measures Req.: No _____ Yes _____

If Yes, type: OH ladder work, lift equipment, scaffolding, other: _____

Dust Protection/Filter Protection: No _____ Yes _____ Security Required: No _____ Yes _____

Flagperson Required: No _____ Yes _____

Utility Shut Down Required: No _____ Yes _____
If Yes, Facility Systems Affected _____Length of shut down _____

Utility/Systems contingency/backup plan: If required attach written plan and sequence of operations.

Fire Watch Req.: No _____ Yes _____
Proper Advance Notice Provided. (72 hours minimum required): No _____ Yes _____
If No Explain special circumstances _____.

Logistics plan for protection barriers/security/safety measures/ access attached:

Access area blocked or inaccessible _____duration _____

Risk Level to Operating Facility: Low _____ Medium _____ High _____

Deliveries Req.: No _____ Yes _____
If yes, size of truck _____ Frequency of deliveries _____

Contract Work: No _____ Yes _____

C.O. Work: No _____ Yes _____ If Yes, C.O. # _____

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PROJECT METHOD OF PROCEDURE (MOP) FORM, CONT.

Description of Work: Detail work durations for specific steps/scope of work. Attach corresponding SMMC forms for the Work :		
CM/PM will contact the duty engineer prior to the start of work and after completion of work.		
Project Observation (Name/Number):		
Area Affected:		
Inspections		
Overtime inspection costs associated with the scope of work outlined above shall be borne by: County/DPW _____ Contractor _____ No Overtime Inspection Required _____		
Safety Measures		
Hot Work Permit Required: Yes _____ Not Required _____ Special Safety Required: Yes _____ Not Required _____ If YES Explain: _____		
Submitted By:		
Contractor Manager/Superintendent:	Date:	Cell Phone #
Recommended By:		Approved By:
IOR:	Date:	Cell Phone #
Construction Manager:	Date:	Cell Phone #

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Approved By:		
Facility Plant & Engineering:	Date:	Cell Phone #
Facility Safety:	Date:	Cell Phone #
Facility Security:	Date:	Cell Phone #
County of San Mateo, DPW Capital Projects:	Date:	Cell Phone #
*By signing above, signatory warrants and represents that he/she executed this MOP in his/her authorized capacity and that by his/her signature on this MOP, he/she or the entity upon behalf of which he/she acted, executed this MOP.		

END OF DOCUMENT

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SECTION 014000

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 REGULATORY REQUIREMENTS

A. General: Specific reference in Contract Documents to codes and regulations or requirements of regulatory agencies shall mean latest printed edition of each adopted by the regulatory agency at the date of the Contract Documents unless document referenced is shown dated.

B. References: Perform Work per applicable requirements of regulatory agencies, as noted on drawings.

D. Compliance: The intent of the Drawings and Project Manual is to complete Project per applicable Regulatory Requirements. Should any conditions develop not covered by the Contract Documents where the finished Work will not comply with Regulatory Requirements, a Change Order detailing and specifying the required work shall be submitted and approved before proceeding with the Work.

E. Conflicts:

1. Between Referenced Regulatory Requirements: Comply with the one establishing more stringent requirement.

2. Between Referenced Regulatory Requirement and Contract Documents: Comply with the one establishing the more stringent requirement.

3. Where a conflict is discovered, notify the Architect before taking action.

1.2 SPECIAL SEISMIC REQUIREMENTS

A. General: Work having special seismic requirements is specified in individual Sections.

B. Equipment and Systems: Anchor, support, and brace to resist seismic forces as specified.

C. Prototype and Non-Standard Equipment: It is not intended that prototype or non-standard equipment be provided; however, items of equipment shown or specified to be anchored shall maintain integrity at point of anchorage after being subjected to accelerations equivalent to those established below.

D. Manufactured and Fabricated Items: Anchorage, support, and bracing for various manufactured and fabricated items and systems are detailed and scheduled on Drawings. Provide as shown.

E. Anchorage, Support, and Bracing not Detailed and for Substitutions:

1. For anchorage of floor and roof-mounted equipment weighing 500 pounds or more, suspended or wall-mounted equipment weighing over 20 pounds or supported by vibration isolation devices, piping, duct work and conduit bracing systems, and proposed changes to details shown, submit the following:

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a. Drawings including description, layout, and location of item(s) to be anchored or braced with anchorage or brace points noted and dimensioned, details of anchorage or brace at large scale with members, parts, brackets shown, together with connections, bolts, welds, etc., clearly identified and specified. For expansion bolts, include design load and capacity if different from those specified in Section 055000.

b. Calculations for anchorages proposed shall be prepared by a California-registered Structural Engineer. Do not put calculations on Drawings. Design of anchorages shall comply with the above regulations using minimum coefficients, Cp for essential buildings, listed in CCR, Title 24, Part 2, Table No. 23P at code stresses.

1.3 REFERENCES

A. Applicability: Except where Contract Documents or applicable codes include more stringent requirements, referenced construction industry standards have same force and effect as if bound or copied directly into Contract Documents. Such standards are made part of Contract Documents by reference.

B. Publication Dates: Comply with Reference Standards in effect as of date of Contract Documents, unless otherwise noted.

C. Conflicting Requirements: Where compliance with two or more standards is specified, and standards may establish different or conflicting requirements for minimum quantities or quality levels. Refer requirements that are different, but apparently equal, and uncertainties to Architect for decision before proceeding.

D. Minimum Quantity and Quality Levels: Quantity or quality level shown or specified shall be minimum provided or performed. Actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Refer uncertainties to Architect for decision before proceeding.

E. Copies of Standards: Each entity engaged in construction on Project is required to be familiar with Reference Standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents. Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.

F. Abbreviations of Names: Trade Association and Organization Names are abbreviated in Contract Documents as follows:

AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AHDGA	American Hot Dip Galvanizers Association
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
APA	American Plywood Association
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWS	Architectural Woodwork Standards

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AWS	American Welding Society
BHMA	Builders Hardware Manufacturers Association
CCR	California Code of Regulations
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard
FM	Factory Mutual System, Factory Mutual Engineering Corporation
FS	Federal Specifications
FSS	Federal Safety Standard
ICC	International Code Council
IEEE	Institute of Electrical and Electronic Engineers
NAAMM	National Association of Architectural Metal Manufacturers
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
PS	United States Department of Commerce Product Standard
RIS	Redwood Inspection Service
SDI	Steel Door Institute
SDI	Steel Deck Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
SSPC	Steel Structures Painting Council
TCNA	Tile Council of North America
UL	Underwriters Laboratories Inc.
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code
USS	United States Standard
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WHI	Warnock Hersey International
WI	Woodwork Institute
WWPA	Western Wood Products Association

1.4 EXPLANATION OF SPECIFICATIONS

A. Specification Format and Content Explanation:

1. Specification Format: These Specifications are organized into Divisions and Sections based on Construction Specifications Institute's (CSI) 2016 MasterFormat numbering system (49 divisions).

2. Specification Language: These Specifications use certain conventions in use of language and intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are explained as follows:

a. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated type. Words and meanings shall be interpreted as appropriate. Words that are implied, but not stated, shall be interpolated as the sense required. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and context of Contract Documents so indicates.

b. Imperative Mood: Imperative mood is used generally in Specifications. Requirements expressed in imperative mood are to be performed by the Contractor. At certain locations in text, for clarity, subjective language is used to describe responsibilities that must be fulfilled indirectly by Contractor, or by others when so noted.

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3. Shall Be: The words "shall be" are included by inference wherever a colon (:) is used within a sentence or phrase.

4. Assignment of Specialists: Certain Sections of Specifications require that specific construction activities shall be performed by specialists who are recognized experts in operations to be performed. Specialists must be engaged for those activities, and assignments are requirements over which Contractor has no choice or option. Nevertheless, ultimate responsibility for fulfilling Contract requirements remains with Contractor. This requirement shall not be interpreted to conflict with reinforcement of building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.

B. Definitions: Terms used on Drawings and in Project Manual, in addition to those defined in General Conditions, shall have following meanings.

1. Approved: The term "approved," where used in conjunction with Architect's action on Contractor's submittals, applications, and requests, is limited to Architect's duties and responsibilities as stated in Conditions of the Contract.

2. Directed: Terms such as "directed," "requested," "authorized," "accepted," "selected," "approved," "required," and "permitted" mean "directed by the Architect or Owner," "requested by the Architect or Owner," and similar phrases.

3. Furnish: The term "furnish" means "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."

4. Indicated: The term "indicated" refers to graphic representations, notes or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.

5. Install: The term "install" is used to describe operations at the project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."

6. Installer: An "Installer" is an entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

7. Per: The word "per" means "in accordance with" or "in compliance with."

8. Project Site: Space available to the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.

9. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."

10. Required: The term "required" means "required by code, by good building practice, by the conditions prevailing, by Contract Documents, by Owner, or Architect."

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11. Regulations: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

12. Testing Agency and Testing Laboratory: These terms have meanings specified herein.

13. Trades: Use of titles such as "carpentry" is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

1.5 QUALITY ASSURANCE

A. Testing Laboratory:

1. General: Owner will retain and pay expenses of an independent Testing Laboratory, to perform and report on tests and inspections described in the Specifications and as otherwise deemed necessary and appropriate by Owner.

2. Additional Duties: As required, Testing Laboratory will review material and product reports of Testing Agency for compliance with Contract Documents.

3. Contractor's Responsibilities:

a. Materials: Secure and deliver to Testing Laboratory adequate quantities of representative samples of materials proposed for use and which require testing.

b. Test Reports: Submit copies of product test reports as required.

c. Incidental Labor and Facilities: As follows:

1) To provide access to Work to be tested.

2) To obtain and handle samples at Project site or at source of product to be tested.

3) To facilitate inspections and tests.

4) For storage and curing of test samples.

d. Scheduling: Notify testing laboratory sufficiently in advance of operations to allow for Testing Laboratory assignment of personnel and scheduling of tests.

e. Delayed Testing: When tests or inspections cannot be performed after such notice, reimburse Owner for Testing Laboratory personnel and travel expenses incurred due to Contractor's negligence.

4. Testing Laboratory Qualifications:

a. General: Meet Recommended Requirements for Independent Laboratory Qualification, published by American Council of Independent Laboratories.

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b. Concrete and Steel Work: Meet basic requirements of ASTM E329, Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction.

c. Authorization: Authorized to operate in State of Project.

B. Testing Agency:

1. General: Owner shall retain and pay expenses of Testing Agency or Testing Agencies, to perform and report on Work specified in Contract Documents. The Testing Agency shall be an organization other than the Testing Laboratory, and with prior acceptance of the Architect, may be a commercial testing organization, the testing laboratory of a trade association, the certified laboratory of a supplier, the Contractor's own forces, or other organization. Testing Agency shall have been in business for 5 years.

C. Test Reports:

1. Distribution: Testing Laboratory and Testing Agency shall each distribute copies of their reports to the following: Architect, Project Inspector, Structural Engineer, Owner, and Contractor.

D. Multiple Tests and Inspections: Certain portions of the Work will be tested or inspected at various stages, sometimes off Site, between their inception and final positioning in the completed Work. Nothing in any prior acceptance or satisfactory test result shall govern if at any subsequent time the Work, or portion thereof, is found not to conform to Contract Documents.

E. Additional Testing and Inspection:

1. General: If initial tests or inspections made by Testing Laboratory reveal that materials do not comply with Contract Documents, or if Architect has reasonable doubt that materials comply with Contract Documents, additional tests and inspections shall be made as directed.

2. Complying Materials: If additional tests and inspections establish that materials comply with Contract Documents, all costs for such tests and inspections shall be paid by Owner.

3. Non-Complying Materials: If additional tests and inspections establish that materials do not comply with Contract Documents, all costs of such tests and inspections shall be deducted from Contract Sum.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

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SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 WORK RESTRICTIONS

A. Contractor's Use of Premises:

1. General: Contractor's and worker's use of premises for Work and storage is subject to approval of the Owner and limited to the area designated in the Drawings.

3. Smoking: Not permitted inside any facility at any time.

B. Owner Occupancy:

1. The Contractor shall allow the Owner to take possession of and use any completed or partially completed portion of the structure during the progress of the Work as soon as possible without interference to the Work.

2. Possession, use of structure or Work, and placing and installation of equipment by the Owner shall not in any way evidence the completion of the Work or any part of it.

3. The Contractor shall not be held responsible for damage to the occupied part of the Work resulting from Owner's occupancy.

4. Utility Services, Heating, and Cooling: Make available, in areas occupied, on a 24-hour day and 7-day week basis if required, any utility services, heating and cooling as are in condition to be put in operation at the time of early occupancy.

a. Responsibility for operation and maintenance of equipment shall remain with the Contractor.

b. The Contractor shall make, and Architect shall certify, an itemized list of each piece of equipment operated with the date operation commences.

c. The Owner shall pay for utility costs arising out of occupancy by the Owner during construction.

5. Use and occupancy by the Owner prior to acceptance of the Work does not relieve the Contractor of its responsibility to maintain insurance and bonds required under the Contract until entire Work is completed and accepted by the Owner.

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1.2 TEMPORARY UTILITIES

A. General:

1. Provide and maintain temporary utilities for construction operations and temporary structure as required; remove on completion of Work.

2. Connection Expense: Expense of connections of water and electricity from Site sources paid for by the Contractor.

3. Coordinate temporary utilities with Owner.

4. Availability: Owner does not guarantee amounts available, nor will the Owner be responsible for interruptions in service.

5. Requirements of Regulatory Agencies: Comply with authorities having jurisdiction and with Owner's directions.

6. Requirements of Public Utilities:

a. Contractor shall take suitable steps to ensure that public utilities encountered in connection with the Work will not be damaged.

b. Send notices, make necessary arrangements and provide services required for the care of gas mains, water pipes, sewer pipes, telephone and telegraph conduits, cables, and other equipment or property.

B. Temporary Water and Electricity:

1. General: Contractor may take water or electric energy in such quantities and at such times as they are available. If this is done, Contractor shall provide equipment, including metering, connections, transformers, and other materials necessary for extending water and power lines to the Site of Work. Make the installation in locations designated by the Architect. Construct in conformance with safety regulations. Pay for connections and removal of connections to the City water and power mains.

2. Costs: Contractor will pay for cost of water and electric energy used by Contractor. (ECB to confirm)

3. Power Outlets: Provide for construction operations, with branch wiring and distribution boxes.

4. Flexible Power Cords: Provide as required.

5. Branch Piping: Install with taps located so that water is available throughout the construction by the use of hoses.

6. Distribution Equipment: Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.

C. Temporary Lighting:

1. Artificial Lighting: Provide adequate artificial lighting for work areas when natural light is not adequate.

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2. Exterior Lighting: Provide and maintain lighting to exterior staging and storage areas after dark for security purposes as required.

3. Branch Wiring: Provide from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.

D. Use of the Permanent Heating System: The permanent heating system, or a portion thereof, may be used provided the Contractor: (1) obtains approval of the Owner; (2) assumes full responsibility for the entire heating system; and (3) pays for costs for fuel, operation, maintenance and restoration of the system, including filter replacement. Use of the building's air conditioning system is not permitted during construction.

E. Temporary Ventilation:

1. General: Ventilate enclosed areas to assist curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

2. Building Supply Fans: Do not use unless filters, as specified are in place. Clean or replace filters prior to acceptance by Owner.

3. Costs: Pay all costs of installation, maintenance, operation and removal, and for fuel consumed.

F. Temporary Telephone Service:

1. General: Provide, maintain and pay for telephone service to field office at time of project mobilization.

2. Charges: Contractor is responsible for payment of toll charges for all phone calls including any made by unauthorized personnel.

G. Temporary Fire Protection:

1. General: Provide and maintain fire extinguishers, fire hoses and other equipment as necessary for proper fire protection during construction. Use fire protection equipment for fire protection only. Provide fire equipment, qualified maintenance personnel, and take any special precautions necessary, as required by authorities having jurisdiction.

H. Systems Operation:

1. General: Comply with applicable mechanical and electrical requirements specified in Divisions 21 through 26. Maintain and operate systems to assure continuous service. Modify and extend systems as Work progress requires.

I. Removal of Utilities, Facilities, and Controls:

1. General: Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion. Clean or repair damage caused by installation or use of temporary work. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

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1.3 CONSTRUCTION FACILITIES

A. Field Offices:

1. General: Provide and maintain temporary structures for field offices, per applicable requirements of Federal, State and local codes and regulations, during entire construction period.

2. Use of Existing Facilities: Coordinate locations of all construction facilities with the Owner. Existing facilities may be used with prior approval of the Owner.

3. Materials, Equipment, and Furnishings: New or used; adequate for purpose intended.

4. Construction:

a. Structurally sound.

b. Weathertight.

c. Painted in color as selected.

d. Floors raised above ground.

e. Sturdy solid doors with provisions for locking.

f. Temperature transmission resistance compatible with occupancy and storage requirements.

g. Neat appearance maintained throughout duration of Work.

5. Portable or Mobile Buildings: Fulfilling specified requirements may be used.

C. Storage Sheds:

1. Requirements in addition to general items specified:

a. Number and Sizes: Adequate for storage and handling requirements.

b. Ventilation: Comply with specified and code requirements for products stored.

c. Heating: Adequate to maintain temperatures specified in the respective Specification Sections for the products stored.

d. Lighting: As required to facilitate product handling and inspection.

D. Field Office and Shed Installation:

1. Fill and grade sites for temporary structures to provide positive surface drainage.

2. Installation: Construct temporary structures on proper foundations and provide connections for utility services.

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a. Adequately anchor portable or mobile buildings to the ground when used.

b. Provide steps and landings at entrance doors.

3. Maintenance and Cleaning: Provide periodic maintenance and cleaning for temporary structures, furnishings, equipment, and services.

4. Removal: Remove temporary structures from the Site as soon as the progress of the Work will permit. Removal shall include foundations, steps, landings, utility services and contents of the temporary structures.

5. Restoration: Restore portions of Site occupied by temporary structures to a new condition acceptable to the Owner.

E. Sanitary Facilities:

1. General: Construction personnel shall have access to restrooms in HOJ South Lobby.

1.4 TEMPORARY BARRIERS AND ENCLOSURES

A. Provide and maintain suitable temporary barriers as required to prevent public entry, and to protect the Work and existing facilities from construction operations; remove when no longer needed.

B. Regulatory Agencies: Should regulatory agencies require construction of temporary barriers not shown or specified, they shall be constructed at no increase in Contract Sum. Provide any required signage for temporary exit directions.

C. Maintenance: Maintain barriers in an orderly, neat appearance at all times.

D. Temporary Interior Partitions:

1. Partitions: Dustproof and sound resistant. Construct of gypsum board and metal or wood studs to 1-hour fire rating. Fill cavity with acoustical insulation and caulk top and bottom on both sides.

2. Doors: Lockable, self-closing and 45-minute fire rated. Seal heads, jambs, and sills with foam tape.

3. Finish: On public side tape gypsum board joints and paint gypsum board and doors and door frames with two coats of acrylic latex paint in color to match adjacent surfaces.

E. Installation: Install barriers and other items as specified, structurally adequate for the intended purposes, and to present a neat and uniform appearance. Maintain during entire construction period. Relocate as required by progress of the Work.

F. Blocking of Windows: Close off window openings to protect glazing from breakage using 3/4-inch plywood. Tightly fit plywood to prevent infiltration of dust into building. Support plywood at 2'-0" on center, using appropriately sized wood members and connectors. Paint wood where visible to match adjacent existing surfaces.

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G. Removal: Completely remove temporary barriers and barricades, when their use is no longer needed, and when acceptable to Architect. Clean or repair damage caused by installation or use of temporary work. Remove and properly dispose of debris resulting from removal and reconditioning operations. Leave area in a new condition acceptable to the Architect.

1.5 TEMPORARY CONTROLS

A. Noise Control:

1. Comply with City of San Mateo Municipal Code, Chapter 7.30 “Noise Regulations.”

2. Prohibited Equipment: Equipment which operates with noise levels in excess of 80 decibels measured at a distance of 100 feet from the equipment is prohibited.

2. Impact tools and equipment are not subject to the decibel limit, provided that such impact tools and equipment shall have intake and exhaust mufflers recommended by the manufacturers thereof and approved by the County of San Mateo Capital Projects and Superior Court – County of San Mateo as best accomplishing maximum noise attenuation, and that pavement breakers and jackhammers shall also be equipped with acoustically attenuating shields or shrouds recommended by the manufacturers thereof and approved by the County of San Mateo Capital Projects and Superior Court – County of San Mateo as best accomplishing maximum noise attenuation.

3. Objectionable Activities: Cooperate with Owner if an ongoing construction activity becomes objectionable by its longevity, or by overlapping into an activity started later by the Owner. It is understood and agreed that both parties shall cooperate so that neither will be unduly inconvenienced by this requirement.

B. Dirt and Dust Control:

1. General: Conduct demolition and construction operations in a manner to prevent dust and dirt from interfering with progress of Work or Owner's activities. Prevent dust and dirt from accumulating in construction or adjacent areas.

2. Comply with City of San Mateo Municipal Code, Section 23.40.050 – Performance Standards.

C. Pollution Control:

1. General: Burning of refuse, debris, or other materials will not be permitted on the Site. Comply with regulatory requirements and anti-pollution ordinances during the conduct of construction and disposal operations.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

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SECTION 016113

PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 PRODUCTS

A. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock.

B. "Named Products" are items identified by manufacturer's product name, including make or model designation indicated in the manufacturer's product literature.

C. "Materials" are products that are shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.

D. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

E. “Substitutions”: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
   1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
   2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

A. Substitutions will only be considered during bidding until the contract is signed. Exceptions to this requirement include discontinuation of a product and products that do not meet code requirements.

B. Where the terms ‘or equal’, ‘or accepted equal’, or ‘or accepted equivalent’ are used in the specifications, this shall be interpreted as a requirement to request a substitution subject to the provisions of this Section.

C. The first listed manufacturer is to be considered the ‘Basis of Design’ whether stated or not. Any additional manufacturers are to be considered substitutions, subject to the procedures and provisions of this Section.

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D. Requests for substitutions, submitted to the Architect by the Contractor after commencement of construction, will be reviewed at the Architect's standard hourly rate. The time required to review the substitution request and any subsequent changes to the drawings shall be charged to the Contractor.

E. Substitution Requests: Submit one electronic copy of each request for consideration and three product samples where applicable or requested. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Substitution Request Form: Use facsimile of CSI Form 1.5C provided in this Project Manual or another similar form acceptable to Owner and Architect.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
      b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
      d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
      e. Samples, where applicable or requested.
      f. Certificates and qualification data, where applicable or requested.
      g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
      h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
      i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES where applicable.
      j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
      k. Cost information, including a proposal of change, if any, in the Contract Sum.
      l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
      m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
   3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 calendar days of receipt of request, or seven calendar days of receipt of additional information or documentation, whichever is later.
      a. Forms of Acceptance: Change order or Bulletin indicating changes in the Work.

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b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

A. The Contractor's submittal and Architect's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.

B. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

C. Descriptive Specification Requirements: Where Specifications describe a product, listing characteristics required, with or without use of a brand name, provide a product that provides the characteristics and otherwise complies with requirements.

D. Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions." The following are not considered substitutions:
1. Revisions to Contract Documents requested by the Owner or Architect.
2. Specified options of products and construction methods included in Contract Documents.
3. Compliance with governing regulations and orders issued by governing authorities.

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming one or More Manufacturers with a Provision for Substitutions: Submit a request for substitution, during Bidding only, for any manufacturer not named.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 business days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect

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will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed unless otherwise indicated.

C. Architect's Action: Within one week of receipt of the request for substitution, the Architect will request additional information necessary for evaluation. Within 15 calendar days of receipt of the request, or 7 calendar days of receipt of additional information, whichever is later, the Architect will notify the Contractor of acceptance or rejection. If a decision on use of a substitute cannot be made within the time allocated, use the product specified. Acceptance will be in the form of a Change Order or Bulletin.

PART 3 - EXECUTION – NOT USED

END OF SECTION

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SUBSTITUTION REQUEST

(During the Bidding/Negotiating Stage)

Project: San Mateo County Hall of Justice

Substitution Request Number: _____

From: _____

To: Mark Cavagnero Associates Architects

Date: _____

ATTN: _____

A/E Project Number: _____

Re: _____

Contract For: _____

Specification Title: _____

Description: _____

Section: _____ Page: _____

Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

A/E's REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: Date:

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

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SECTION 017000

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 CUTTING AND PATCHING

A. General: The Contractor shall be responsible for all cutting, fitting or patching that may be required to complete the Work or to make its several parts fit together properly. Execute cutting, fitting and patching required to uncover work, to provide for installation of ill-timed work, remove and replace defective work, remove and replace work not conforming with requirements of the Contract Documents, remove samples of installed work as specified for testing, and to install specified work in existing construction.

B. Performance: Provide shoring, bracing and support as required to maintain structural integrity; provide protection for other portions of the Work and from the weather. Execute fitting and adjustment of products to furnish finished installation; execute by methods which will prevent damage to other work and will furnish proper surfaces to receive installation of repairs and new work. Restore work which has been cut or removed and install new products to furnish completed Work in accordance with the Contract Documents. Refinish assemblies completely; refinish continuous surfaces to nearest intersections.

C. Request for Consent to Cutting: Prior to performing any cutting which affects structural integrity of the Work, submit written notice requesting consent to proceed with the cutting, including identification of the Work; description of affected work; necessity for cutting; effect on other work and on structural integrity; scope of cutting and patching, trades to execute the work, products proposed to be used, and extent of refinishing; alternatives to cutting and patching. Prior to cutting and patching done on the instruction of the Architect, submit cost estimate. Should conditions of work, or schedule, indicate change of materials or methods, submit written recommendation to Architect.

1.2 CLEANING

A. General: Perform cleaning operations as required during construction to prevent accumulations of dust, dirt, soil, and debris. Comply with regulatory requirements and anti-pollution ordinances during conduct of cleaning and disposal operations. Cleaning for specific products or work is specified in the appropriate individual specification Sections.

B. Cleaning Materials: Use cleaning materials which will not create hazards to health or property, and which will not damage surfaces, and are recommended by manufacturer of surfaces to be cleaned.

C. Dust Control: Clean interior spaces prior to start of finish painting, and continue cleaning as required until painting is completed. Schedule operations to prevent dust and other contaminants resulting from cleaning operations from adhering to wet or newly-coated surfaces.

D. Final Cleaning:

1. General: Remove dust, dirt, grease, stains, fingerprints, labels, spilled, splattered and other foreign materials from interior and exterior surfaces exposed to view. Clean interior and exterior glass an surfaces exposed to view, remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

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2. Equipment and Fixtures: Clean to a sanitary condition.

3. Filters: Clean or replace, if required, filters of operating equipment.

4. Waste and Surplus Materials: Remove from site.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents:

1. As-Built Documents: During construction store As-Built Documents in Contractor's field office apart from documents used for construction. Maintain As-Built Documents in a clean, dry, legible condition and in good order. Do not use As-Built Documents for construction.

2. Documents Required: Maintain on site, one set of the following on which to record actual revisions to Work:

a. Contract Drawings.

b. Project Manual.

c. Addenda.

d. Change Orders and other Modifications to the Contract.

e. Approved shop drawings, product data, and samples.

3. Recording: Record following information concurrent with construction progress. Update documents weekly.

a. Deviations from sizes, locations, and other features of installations shown in Contract Documents.

b. Give sufficient information to locate Work concealed in the ground and in the building with reasonable ease and accuracy. In some instances, this may be by dimension, in others, it may be in relation to the spaces in the building near which it was installed. Architect's decision in this matter will be final.

c. Provide actual numbering of each electrical circuit.

d. Location of all significant Work concealed in the ground and inside the building whose general locations are changed by the Contractor from those shown on the Contract Documents.

e. Locations of all items, not necessarily concealed, which the Contractor elects to vary, with the Architect's review and acceptance, from the Contract Documents.

4. Final As-Built Documentation or Record Documents: Provide CAD drawings and hand-written marked-up specifications.

5. Additional Drawings: Provide as necessary for clarification.

6. Shop Drawings: Provide reproducible As-Built Documents, made from final shop drawings, which have been updated to show actual conditions, for Work specified in the individual Sections.

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7. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:

   a. Manufacturer's name and product model and number.

   b. Product substitutions or alternates utilized.

   c. Changes made by Addenda and Modifications.

8. Large-Scale Layout Drawings: Divisions 20 through 29 of the Specifications require the preparation of large-scale, detailed Layout Drawings of the Work of those Divisions. These Layout Drawings are not shop drawings as defined by the General Conditions, but together with shop drawings these Layout Drawings of all other affected Sections are used to check, coordinate, and integrate the Work of the various Sections. Include these Layout Drawings as part of the As-Built Documents.

9. Record Drawings: At Substantial Completion, Architect will transmit to Contractor a complete set of drawings, which have been revised to show all contractual modifications, in a reproducible or electronic form. Contractor shall transcribe all information from his As-Built Drawing and submit to Architect.

10. Designer Title Block and Seal: Delete from documents.

11. Submittal: Submit documents to Owner’s Representative with claim for final Application for Payment.

12. Review: As-Built and Record Documents are subject to review and acceptance by the Architect.

B. Operating and Maintenance Data:

1. General: Compile product data and related information appropriate for Owner's maintenance and operation of products, equipment, and systems furnished under the Contract. Prepare operating and maintenance data as specified herein and as referenced in other Sections. Instruct Owner's personnel in the maintenance and operation of equipment and systems.

2. Submittals: Prior to Substantial Completion submit one copy of completed Operating and Maintenance Manuals in final form for review. Copy will be returned with Architect's comments. No final inspection will be made until required Manuals have been submitted and accepted. Submit three (3) Manuals in final accepted form prior to final acceptance of the Project by the Owner.

3. Format: Prepare data in a reproducible and electronic form of an instructional manual for use by Owner's personnel.

4. Binders:

   a. Commercial quality three-ring binders with durable and cleanable plastic covers.

   b. When multiple binders are used, correlate the data into related groupings.

      1) Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS." List:

         a) Title of Project.

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b) Identity of general subject matter covered in the manual.

5. Table of Contents: Include in each volume, neatly typewritten.

a. Identify Contractor, name of responsible principal, address and phone number.

b. List each product included, indexed to the content of the volume.

c. Identify each product by product name and other identifying symbols as set forth in the Contract Documents.

d. List, with each product, the name, address, and telephone number of:

1) Subcontractor or installer.

2) Maintenance contractor, as appropriate.

3) Identify area of responsibility of each of the previously mentioned parties.

4) Nearest source of supply for parts and replacement.

6. Organization:

a. Size: 8-1/2 inches by 11 inches.

b. Paper: 20-pound, minimum, white, for typed pages.

c. Text: Manufacturer's printed data, or neatly typewritten.

d. Drawings:

1) Provide reinforced punched binder tab, bind in with text.

2) Fold larger drawings to the size of the text pages.

e. Fly-Leaf: Provide for each separate product, or each piece of operating equipment.

1) Provide typed description of product, and major components parts of equipment.

2) Provide indexed tabs.

7. Content:

a. Product Data: Include only those sheets which are pertinent to the specific product. Annotate each sheet to:

1) Clearly identify specific product or part installed.

2) Clearly identify data applicable to installation.

3) Delete references to inapplicable information.

b. Drawings:

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1) Supplement product data with Drawings as necessary to clearly illustrate:

a) Relations of components parts of equipment and systems.

b) Control and flow diagrams.

2) Coordinate Drawings with information in As-Built Documents, to assure correct illustration of completed installation.

3) Do not use Project Record Documents as maintenance Drawings.

c. Written text, as required to supplement product data for the particular installation:

1) Organize in a consistent format under separate headings for different procedures.

2) Provide a logical sequence of instructions for each procedure.

d. Copy of each Warranty, Bond, and Maintenance Contract issued:

1) Provide information sheet for Owner's personnel, giving:

a) Proper procedures in the event of failure.

b) Circumstances which might affect the validity of Warranties and Bonds.

e. Manual for Equipment and Systems:

1) Submit three copies of complete manual in final form.

2) Content: For each unit of mechanical equipment and each mechanical system, as appropriate:

a) Description of unit, or system, and component parts:

(1) Function, normal operating characteristics, and limiting conditions.

(2) Performance curves, engineering data and tests.

(3) Complete nomenclature and commercial number of replaceable parts.

b) Operating procedures:

(1) Startup, break-in, routine and normal operating instructions.

(2) Regulation, control, stopping, shutdown and emergency instruction.

(3) Summer and winter operating instructions.

(4) Special operating instruction.

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c) Maintenance procedures:

(1) Routine operations.

(2) Guide to "trouble-shooting."

(3) Disassembly, repair and reassembly.

(4) Alignment, adjusting and checking.

d) Servicing and lubrication schedule, with list of lubricants required.

e) Manufacturer's printed operating and maintenance instructions.

f) Description of sequence of operation by control manufacturer.

g) Original manufacturer's parts list, illustrations, current prices, recommended quantities to be maintained in storage, assembly drawings and diagrams required for maintenance.

(1) Predicted life of parts subject to wear.

(2) Items recommended to be stocked as spare parts.

h) As-installed control diagrams by controls manufacturer.

i) Contractor's and subcontractors' coordination drawings. As installed color coded piping diagrams.

j) Charts of valve tag numbers, with location and function of each valve.

3) Content, for each electrical and electronic system, as appropriate:

a) Description of system and component parts.

(1) Function, normal operating characteristics, and limiting conditions.

(2) Performance curves, engineering data, and tests.

(3) Complete nomenclature and commercial number of replaceable parts.

b) Circuit directories of panelboards.

(1) Electrical service.

(2) Controls.

(3) Communications.

c) As-installed color-coded wiring diagrams.

d) Operating procedures:

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(1) Routine and normal operating instructions.

(2) Sequences required.

(3) Special operating instructions.

e) Maintenance procedures:

(1) Routine operations.

(2) Guide to "trouble-shooting."

(3) Disassembly, repair and reassembly.

f) Manufacturer's printed operating and maintenance instructions.

g) Original manufacturer's parts list, illustrations, current prices, recommended quantities to be maintained in storage, assembly drawings and diagrams required for maintenance.

(1) Predicted life of parts subject to wear.

(2) Items recommended to be stocked as spare parts.

C. Instructions of Owner's Personnel:

1. General: Work requiring instruction of Owner's personnel is specified in the individual Sections.

2. Instructional Meeting or Meetings: Schedule within 2 weeks after Operating and Maintenance Manuals have been accepted by the Architect.

3. Manufacturer's Representatives: Prior to final inspection, fully qualified manufacturers' representatives shall fully instruct Owner's designated operating and maintenance personnel in operation, adjustment and maintenance of equipment and systems.

4. Basis of Instruction: Operating and Maintenance Manual. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.

D. Warranties and Bonds:

1. General:

a. Submittals Required: Submit special warranties, bonds, service and maintenance contracts specified in the individual Sections.

b. Other Warranties: Warranties between Contractor and manufacturers, and Contractor and suppliers, shall not affect warranties between Contractor and Owner.

2. Form of Submittals:

a. Copies: Two original signed copies required for each submittal.

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b. Binding: Bind in commercial quality, 8-1/2 x 11-inch three-ring binders with hardback, cleanable, plastic covers.

c. Identification: Label cover of each binder with typed or printed title "Warranties and Bonds", with title of Project; name, address, and telephone number of Contractor and equipment supplier; and name of responsible principal.

d. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification Section in which specified, and the name of the product or work item.

e. Index Tab Sheets: Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

3. Preparation of Submittals:

a. General: Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item or work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Completion is determined.

b. Verification: Verify that documents are in proper form and contain full information.

c. Co-Execution: Co-execute submittals when required.

4. Time of Submittals:

a. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.

b. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.

c. For items of Work when acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

5. Form of Warranty: Submit the following written warranty, typed on the Contractor's letterhead for the entire Work, or special warranties typed on subcontractor's letterhead when required by a Specification Section:

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

(continued on next page)

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WRITTEN WARRANTY FOR _____

We hereby warrant that _____

which we have provided in _____

_____ has been completed in accordance with Specification Section _____ and Contract Documents requirements.

We agree to repair or replace any or all of our Work, together with any other adjacent Work which may be displaced or damaged by so doing, which may prove to be either patently defective in its workmanship or materials within the period of time prescribed by the law from date established in the Certificate of Substantial Completion of above named structure, ordinary wear and tear and unusual abuse or neglect excepted.

We also agree to repair any and all damages resulting from such defects.

In the event of our failure to comply with above-mentioned conditions within a reasonable time, but in no case longer than 14 calendar days after being notified in writing by the Owner, we collectively and separately, do hereby authorize the Owner to have said defective Work and damages repaired or replaced and made good at our expense, and will honor and pay the costs and charges therefor upon demand.

Signed_____
(Contractor's name, address, license number, and date of signing)
and
Signed_____
(Subcontractor's name, address, license number, and date of signing)

Countersigned_____
(Contractor's name, address, license number, and date of signing)

END OF SECTION

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01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. See Divisions 2 through 48 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.2 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
   1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
   2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
   3. Products: List products to be used and firms or entities that will perform the Work.
   4. Dates: Indicate when cutting and patching will be performed.
   5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
   6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
   7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.3 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that result in increased maintenance or decreased operational life or safety.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, and result in

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reducing their capacity to perform as intended, or that result in increased maintenance or decreased operational life or safety.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
   1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
   1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
   2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

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3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   4. Excavating and Backfilling: Comply with requirements in applicable Specifications Sections where required by cutting and patching operations.
   5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
   6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
   2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
   3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   4. Ceilings: Patch, repair, or re-hang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
   5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

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D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

-END OF SECTION-

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01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Emergency manuals.
   2. Operation manuals for systems, subsystems, and equipment.
   3. Maintenance manuals for the care and maintenance of products, materials, and finishes systems and equipment.

B. See Divisions 02 through 48 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.2 SUBMITTALS

A. Manual: Submit one copy of each manual in final form at least fifteen (15) days before final inspection. At discretion of Architect, initial submittals may be as PDF files with both hard copies and PDF files of final version. Architect will return copy with comments within fifteen (15) days after final inspection.
   1. Correct or modify each manual to comply with Architect's comments. Submit three (3) copies of each corrected manual within fifteen (15) days of receipt of Architect's comments.

PART 2 - PRODUCTS

2.1 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name, address, and telephone number of Contractor.
   6. Name and address of Architect.
   7. Cross-reference to related systems in other operation and maintenance manuals.

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C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
   1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
      a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
   2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
   3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
   4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
      a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
      b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for type of emergency, emergency instructions, and emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component for fire, gas leak, water leak, power failure, water outage, equipment failure, and chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include instructions on stopping, shutdown instructions for each type of emergency, operating instructions for conditions outside normal operating limits, and required sequences for electric or electronic systems.

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2.3 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.

B. Descriptions: Include the following:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Equipment identification with serial number of each component.
   4. Equipment function.
   5. Operating characteristics.
   6. Limiting conditions.
   7. Performance curves.
   8. Engineering data and tests.
   9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Color, pattern, and texture.
   4. Material and chemical composition.
   5. Reordering information for specially manufactured products.

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D. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:

D. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions, and demonstration and training videotape if available, that detail essential maintenance procedures:

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

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PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
   1. Do not use original Project Record Documents as part of operation and maintenance manuals.

F. Comply with applicable Specification Sections for schedule for submitting operation and maintenance documentation.

END OF SECTION-

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01 78 36 - WARRANTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for preparing warranties of products and installation.

B. All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:
1. General Conditions, including, without limitation, Warranty/Guarantee Information;
2. Special Conditions.

1.2 SUBMITTALS

A. Binders: Contractor shall use commercial quality, 8-1/2 by 11 inch, three-side rings, with durable plastic covers; two inch maximum ring size.

B. Cover: Contractor shall identify each binder with typed or printed title "WARRANTIES" and shall list title of Project.

C. Table of Contents: Contractor shall provide title of Project; name, address, and telephone number of Contractor and equipment supplier, and name of responsible principal. Contractor shall identify each item with the number and title of the specific Specification, document, provision, or section in which the name of the product or work item is specified.

D. Contractor shall separate each warranty with index tab sheets keyed to the Table of Contents listing, providing full information and using separate typed sheets as necessary. Contractor shall list each applicable and/or responsible Subcontractor(s), supplier(s), and/or manufacturer(s), with name, address, and telephone number of each responsible principal(s).

1.3 PREPARATION:

A. Contractor shall obtain warranties, executed in duplicate by each applicable and/or responsible subcontractor(s), supplier(s), and manufacturer(s), within ten (10) days after completion of the applicable item or work. Except for items put into use with City's permission, Contractor shall leave date of beginning of time of warranty until the date of completion is determined.

B. Contractor shall verify that documents are in proper form, contain full information, and are notarized, when required.

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C. Contractor shall co-execute submittals when required.

D. Contractor shall retain warranties until time specified for submittal.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

F. Comply with applicable Specification Sections for schedule for submitting operation and maintenance documentation.

-END OF SECTION-

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SECTION 018115

CALGREEN REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Included: CALGreen Requirements complete, as shown and specified. This Section includes requirements in accordance with the 2022 California Green Building Standards Code (CALGreen). Project shall comply with CALGreen Mandatory Requirements.

1.3 SUBSTITUTIONS

A. To substitute products that affect CALGreen, propose products that offer equivalent or increased environmental sensitivity and meet the intent of the Contract Documents. Substitutions that may affect CALGreen compliance shall be clearly identified.

B. Guidelines: Only one substitution for a CALGreen product will be considered. If the substitution is rejected, provide the specified product. Submit the following for review by Owner:

1. Product data, including manufacturer, website, and phone number.
2. Copy of VOC testing data.
3. Description of the differences between the proposed substitution and the specified product related to CALGreen requirements. Explain the environmental advantages of the proposed product as compared to the specified product.
4. The Contractor is responsible for re-submittals of calculations, documentation of products, or material substitutions that affect CALGreen. Do not submit products for substitution that do not meet these requirements.
5. Identify product substitution by Specification and CALGreen credit(s).
6. State effect of substitution on construction schedule and changes required in other work of products.

1.4 SUBMITTALS

A. General: Additional CALGreen submittals are specified in the technical specification sections.

B. CALGreen Actions Plans: Within seven days of Notice to Proceed, submit Action Plans indicating how the following will be met:

1. 5.504.3 Covering of duct openings and protection of mechanical equipment during construction, Construction indoor air quality management plan.

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C. CALGreen Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with CALGreen action plans for the following:

1. 5.504.3 Covering of duct openings and protection of mechanical equipment during construction. Construction Indoor Air Quality Management (IAQ) plan: During Construction.

D. CALGreen Documentation Submittals:

1. 5.504.3 Covering of duct openings and protection of mechanical equipment during construction:

   a. Provide a copy of the project's Indoor Air Quality (IAQ) Management Plan.

2. 5.504.4.1 Adhesives, Sealants, Caulks: Product Data and material safety data sheets (MSDS) for adhesives and sealants used on the project, indicating VOC content of each product used.

   a. Provide a listing of each adhesive, sealant and sealant primer product used on the project. Include the manufacture's name, product name, specific VOC data (in g/L less water) for each product, and the corresponding allowable VOC from the referenced standard.
   b. Provide a listing of each aerosol adhesive product used on the project. Include the manufacture's name, product name, specific VOC data (in g/L less water) for each product, and the corresponding allowable VOC from the referenced standard.

3. 5.504.4.3 Paints and Coatings: Product data and material safety data sheets (MSDS) for paints and coatings used on the interior of the building indicating VOC content of each product used.

   a. Provide a listing of each indoor paint and coating used on the project. Include the manufacturer's name, product name, specific VOC data (in g/L less water) for each product, and the corresponding allowable VOC from the referenced standard.
   b. Provide a listing of each aerosol paint and coating used on the project. Include the manufacturer's name, product name, specific VOC data (in g/L less water) for each product, and the corresponding allowable VOC from the referenced standard.

4. 5.504.4.4 Carpet Systems: Product data shall state one of the following:

   a. Carpet and Rug Institute's Green Label Plus Program
   b. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health Standard method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers, Version 1.1, February 2010 (also known as CDPH Standard Method V1.1 or Specification 01350).
   c. NSF/ANSI 140 at the Gold level of higher;
   d. Scientific Certifications Systems Sustainable Choice; or
   e. Compliant with the Collaborative for High Performance School California (2014 CA-CHPS) Criteria listed in the CHPS High Performance Product Database.
      1) 5.504.4.4.1 Carpet cushion. All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute Green Label program.

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2) 5.504.4.4.2 Carpet adhesive. All carpet adhesive shall meet the requirements of Table 5.504.4.1.

5. 5.504.4.5: Composite wood products. Product data for hardwood plywood, particleboard and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood (17 CCR 93120 et seq.). Those materials not exempted under the ATCM must meet the specified emission limits, as shown in Table 5.504.4.5.

   a. 5.504.4.5.3 Documentation. Verification of compliance with this section shall be provided as requested by the enforcing agency. Documentation shall include at least one of the following.

      1) Product certifications and specifications
      2) Chain of custody certifications
      3) Product labeled and invoiced as meeting the Composite Wood Products regulation (see CCR, Title 17, Section 93120, et seq.)
      4) Exterior grade products marked as meeting the PS-1 or PS-2 standards of the Engineered Wood Association, the Australian AS/NZS 2269 or European 636 3S standards.
      5) Other methods acceptable to the enforcing agency

6. 5.504.4.6 Product data for resilient flooring, showing compliance with at least one of the following:

   a. Certified under the Resilient Floor Covering Institute (RFCI) FloorScore program;
   b. Compliant with the VOC-emission limits and testing requirements specified in the California Dept. of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010;
   c. Compliant with the Collaborative for High Performance Schools California (2014 CA-CHPS) Criteria and listed in the CHPS High Performance Product DataBase; or
   d. Products certified under UL GREENGUARD Gold (formerly Greenguard Children's & Schools Program).

7. 5.504.5.3 Filters: Product data for filters used in the building. In mechanically ventilated buildings, provide regularly occupied areas of the building with air filtration media for outside and return air prior to occupancy that provides at least a MERV of 8.

1.5 QUALITY ASSURANCE

A. Contractor's CALGreen Representative: Contractor's CALGreen Representative shall oversee the environmental goals for the project, shall instruct workers concerning these goals, and shall be present on site when Work is in progress.

B. CALGreen Meetings: Schedule and conduct CALGreen meetings on a regular basis, but not less than twice a month. Meeting attendees shall include at least the following: Architect, Contractor's Project Manager, Contractor's CALGreen Representative, and Sub-Contractor Representatives as appropriate to stage of Work. Discuss CALGreen Certification at Pre-bid, Pre-construction, and regular job site meetings. Discuss CALGreen Certification goals and challenges at the following meetings:

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1. Preconstruction Meetings
2. Progress Meetings
3. Subcontractor Meetings
4. Monthly CALGreen Meetings

C. CALGreen Training Program: Provide environmental training for workers performing Work on the Project site. Training shall include the following:

1. Overview of environmental issues related to the building industry.
2. CALGreen Building System: Requirements for this project.

D. Regulatory Requirements: Comply with applicable requirements of laws, codes, ordinances and regulations of Federal, State and Municipal authorities having jurisdiction. Obtain necessary approvals from authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POLLUTANT CONTROL

A. 5.504.4.1 Adhesives, Sealants, Caulks:

1. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable or SCAQMD Rule 1168 VOC limits, as shown in the Table below:

Architectural Applications / VOC Limit (grams / liter)
Indoor carpet adhesives / 50
Carpet pad adhesives / 50
Outdoor carpet adhesive / 150
Wood flooring adhesive / 100
Rubber floor adhesive / 60
Subfloor adhesive / 50
Ceramic tile adhesive / 65
VCT and asphalt tile adhesive / 50
Drywall and panel adhesive / 50
Cove base adhesive / 50
Multipurpose construction adhesive / 70
Structural glazing adhesive / 100
Single-ply roof membrane adhesive / 250
Other adhesive not specifically listed / 50
Specialty Applications:
PVC welding / 510
CPVC welding / 490
ABS welding / 325
Plastic cement welding / 250
Contact adhesive / 80
Special purpose contact adhesive / 250
Structural wood member adhesive / 140
Top and trim adhesive / 250
Substrate Specific Applications:

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Metal to metal / 30
Plastic foams / 50
Porous material (except wood) / 50
Wood / 30
Fiberglass / 80

2. Aerosol adhesives and smaller unit sizes of adhesives and sealant or caulking compounds (in units of product, less packaging, which do not weigh more than one pound and do not consist of more than 16 fluid ounces) shall comply with statewide VOC standards and other requirements, including prohibitions on use of certain toxic compounds, of California Code of Regulations, Title 17, commencing with Section 94507.

B. 5.504.4.3 Paints and Coatings: Architectural paints and coatings shall comply with VOC limits in Table 1 of ARB Architectural Coatings Suggested Control Measure, as shown in Table 5.504.4.3 unless more stringent local limits apply. The VOC content limit for coatings that do not meet the definitions for the specialty coatings categories listed in Table 5.504.4.3 shall be determined by classifying the coating as a Flat, Nonflat or Nonflat-High Gloss coating, based on its gloss, as defined in Subsections 4.21, 4.36 and 4.37 of the 2007 California Air Resources Board Suggested Control Measure, and the corresponding Flat, Nonflat or Nonflat-High Gloss VOC limit in Table 5.504.4.3 shall apply.

1. 5.504.4.3.1 Aerosol paints and coatings. Aerosol paints and coatings shall meet the Product-Weighted MIR Limits for ROC in Section 94522(a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Sections 94522(c)(2) and (d)(2) of California Code of Regulations Title 17, commencing with Section 94520; and in areas under the jurisdiction of the Bay Area Air Quality Management District additionally comply with the percent VOC by weight of product limits of Regulation 8 Rule 49.
2. 5.504.4.3.2 Verification. Verification of compliance with this section shall be provided at the request of the enforcing agency. Documentation may include, but is not limited to, the following:
   a. Manufacturer's product specification.
   b. Field verification of on-site product containers.

C. 5.504.4.4 Carpet Systems: All carpet installed in the building interior shall meet at least one of the testing and product requirements:
1. Carpet and Rug Institute's Green Label Plus Program
2. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health Standard method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers, Version 1.1, February 2010 (also known as CDPH Standard Method V1.1 or Specification 01350).
3. NSF/ANSI 140 at the Gold level of higher;
4. Scientific Certifications Systems Sustainable Choice; or
5. Compliant with the Collaborative for High Performance School California (2014 CA-CHPS) Criteria listed in the CHPS High Performance Product Database.
   a. 5.5.4.4.4.1 Carpet Cushion. All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute Green Label program.
   b. 5.504.4.4.2 Carpet Adhesive. All carpet adhesive shall meet the requirements of Table 5.504.4.1.

D. 5.504.4.5 Composite wood products. Hardwood plywood, particleboard and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet

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the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood (17 CCR 93120 et seq.). Those materials not exempted under the ATCM must meet the specified emission limits, as shown in Table 5.504.4.5.

1. 5.504.4.5.3 Documentation. Verification of compliance with this section shall be provided as requested by the enforcing agency. Documentation shall include at least one of the following:

    a. Product certifications and specifications
    b. Chain of custody certifications
    c. Product labeled and invoiced as meeting the Composite Wood Products regulation (see CCR, Title 17, Section 93120, et seq.)
    d. Exterior grade products marked as meeting the PS-1 or PS-2 standards of the Engineered Wood Association, the Australian AS/NZS 2269 or European 636 3S standards.
    e. Other methods acceptable to the enforcing agency.

E. 5.504.4.6 Resilient Flooring. For 80 percent of floor area receiving resilient flooring, installed resilient flooring shall meet at least one of the following:

1. Certified under the Resilient Floor Covering Institute (RFCI) FloorScore program;
2. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010;
3. Compliant with the Collaborative for High Performance Schools California 2014 (CA-CHPS) Criteria and listed in the CHPS High Performance Product DataBase; or
4. Products certified under UL GREENGUARD Gold (formerly Greenguard Children's & Schools Program).
5. 5.504.4.6.1 Verification of compliance. Documentation shall be provided verifying that resilient flooring materials meet the pollutant emissions limits.

F. 5.504.5.3 Filters: In mechanically ventilated buildings, provide regularly occupied areas of the building with air filtration media for outside and return air that provides at least a Minimum Efficiency Reporting Value (MERV) of 13. MERV 13 filters shall be installed prior to occupancy, and recommendations for maintenance with filters of the same value shall be included in the operation and maintenance manual.

1. Exception: Existing mechanical equipment.
2. Labeling. Installed filters shall be clearly labeled by the manufacturer indicating the MERV rating.

G. 5.507.4 Acoustical control. Employ building assemblies and components with Sound Transmission Class (STC) values determined in accordance with ASTM E 90 and ASTM E 413, or Outdoor-Indoor Sound Transmission Class (OITC) determined in accordance with ASTM E 1332, using either the prescriptive or performance method in Section 5.507.4.1 or 5.507.4.2.

1. Exception: Buildings with few or no occupants or where occupants are not likely to be affected by exterior noise, as determined by the enforcement authority, such as factories, stadiums, storage, enclosed parking structures and utility buildings.
2. Exception (DSA-SS): For public schools and community colleges, the requirements of this section and all subsections apply only to new construction.
3. 5.507.4.1 Exterior noise transmission, prescriptive method. Wall and roof-ceiling assemblies exposed to the noise source making up the building or addition envelope or altered envelope shall meet a composite STC rating of at least 50 or a composite OITC rating of no less than 40, with exterior windows of a minimum STC of 40 or OITC of 30 in the following locations:
    a. Within the 65 CNEL noise contour of an airport.
        1) Exceptions:

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a) Ldn or CNEL for military airports shall be determined by the facility Air Installation Compatible Land Use Zone (AICUZ) plan.
b) Ldn or CNEL for other airports and heliports for which a land use plan has not been developed shall be determined the local general plan.

b. Within the 65 CNEL or Ldn noise contour of a freeway or expressway, railroad, industrial source or fixed-guideway source as determined by the Noise Element of the General Plan.
c. 5.507.4.1.1 Noise exposure where noise contours are not readily available. Buildings exposed to a noise level of 65 dB Leq-1-1hr during any hour of operation shall have building, addition or alteration exterior wall and roof-ceiling assemblies exposed to the noise source meeting a composite STC rating of at least 45 (or OITC 35), with exterior windows of a minimum STC of 40 (or OITC of 30).

4. 5.507.4.2 Performance method. For building located as defined in Section 5.507.4.1 or 5.507.4.1.1, wall and roof-ceiling assemblies exposed to the noise source making up the building or addition envelope or altered envelope shall be constructed to provide an interior noise environment attributable to exterior sources that does not exceed an hourly equivalent noise level (Leq-1Hr) or 50 dBA in occupied areas during any hour of operation.
   a. 5.507.4.2.1 Site features: Exterior features such as sound walls or earth berms may be utilized as appropriate to the building, addition or alteration project to mitigate sound migration to the interior.
   b. 5.507.4.2.2 Documentation of compliance. An acoustical analysis documenting complying interior sound levels shall be prepared by personnel approved by the Architect or Engineer of Record.
5. 5.507.4.3 Interior sound transmission. Wall and floor-ceiling assemblies separating tenant spaces and tenant spaces and public places shall have an STC of at least 40.

H. 5.508.1.1 Chlorofluorocarbons (CFCs). Install HVAC, refrigeration and fire suppression equipment that does not contain CFCs.

I. 5.508.1.2 Halons. Install HVAC, refrigeration and fire suppression equipment that do not contain Halons.

J. Insulation: Install insulation that complies with the following standards and contains no-added formaldehyde:
   1. Chapters 12-13 (Standards for Insulation Material) in Title 24, Part 12, the California Referenced Standards Code.
   2. The VOC-emission limits defined in 2009 CHPS criteria and listed on its High-Performance Products Database.
   3. California Department of Public Health 2010 Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February 2010 (also known as Specifications 01350).

PART 3 - EXECUTION

3.1 FIELD EXECUTION OF CALGREEN REQUIREMENTS

A. The Contractor is responsible for ensuring proper field execution of all CALGreen credits, and submittal requirements; communication with sub-contractors of all requirements; and submission of all documentation in a timely manner.

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B. Contractor shall notify Owner and Architect immediately of failure to meet any stated CALGreen pre-requisite or credit requirement.

3.2 PROTECTION

A. Protect stored on-site and installed absorptive materials from moisture damage. Where absorptive materials not intended for wet applications are exposed to moisture, immediately remove from site and dispose of properly.

B. Protect installed materials using methods that do not support growth of molds and mildews.

1. Immediately remove from site and properly dispose of materials showing signs of mold and signs of mildew, including materials with moisture stains.

END OF SECTION

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01 91 00 - GENERAL COMMISSIONING REQUIRMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
   1. Verify that the work is installed in accordance with Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Pre-functional Checklists executed by Contractor are utilized to achieve this.
   2. Verify and document that functional performance is in accordance with Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
   3. Verify that operation and maintenance manuals submitted to County are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
   4. Verify that the County's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.

B. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.

1.2 RELATED REQUIREMENTS

A. Section 01 77 00 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.

PART 2 – PRODUCTS

2.1 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of County.

B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
   1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F and resolution of plus/minus 0.1 degree F.
   2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.

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3. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.

C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to County; such equipment, tools, and instruments are to become the property of County.

D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of County.

PART 3 – EXECUTION

3.1 COMMISSIONING PLAN

A. Commissioning Authority has prepared the Commissioning Plan.
1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.

B. Contractor is responsible for compliance with the Commissioning Plan.

C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.

D. Commissioning Schedule:
1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
3. Pre-functional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.2 STARTUP PLANS AND REPORTS

A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.

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B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.

C. Submit directly to the Commissioning Authority.

3.3 PREFUNCTIONAL CHECKLISTS

A. A Pre-functional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
   1. No sampling of identical or near-identical items is allowed.
   2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
   3. Pre-functional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
      a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
      b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
      c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
      d. Serial number of installed unit.
      e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer’s start-up checklist items and minor testing.
      f. Sensor and actuator calibration information.

B. Contractor is responsible for filling out Pre-functional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
   1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
   2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
   3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
   4. If any Checklist line item is not relevant, record reasons on the form.
   5. Contractor may independently perform startup inspections and/or tests, at Contractor's option.

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6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
7. Submit completed Checklists to Commissioning Authority within two days of completion.

C. Commissioning Authority is responsible for furnishing the Pre-functional Checklists to Contractor.
1. Initial Drafts: Contractor is responsible for initial draft of Pre-functional Checklist where so indicated in Contract Documents.
2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in Contract Documents or not.
4. When asked to review the proposed Checklists, do so in a timely manner.

D. Commissioning Authority Witnessing: Required for:
1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
2. A sampling of non-primary equipment, as allowed by the commissioning plan.

E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to County.
1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.4 FUNCTIONAL TESTS

A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.

B. Contractor is responsible for execution of required Functional Tests, after completion of Pre-functional Checklist and before closeout.

C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.

D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to County; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with Contract Documents or does not perform properly.
2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the

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Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.

3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
4. Contractor shall bear the cost of County and Commissioning Authority personnel time witnessing re-testing.
5. Contractor shall bear the cost of County and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Pre-functional Checklist correctly; if the test failed for reasons that would not have been identified in the Pre-functional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.

E. Functional Test Procedures:
   1. Some test procedures are included in Contract Documents; where Functional Test procedures are not included in Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
   2. Examples of Functional Testing:
      a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
      b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
      c. Systems are run through all the HVAC control system's sequences of operation and components are verified to be responding as the sequence's state.
      d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.

F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

3.5 SENSOR AND ACTUATOR CALIBRATION

A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gauges, and all actuators (dampers and valves) on this

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piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.

B. Calibrate using the methods described below; alternate methods may be used, if approved by Commissioning Authority and Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Pre-functional Checklist or other suitable forms, documenting initial, intermediate and final results.

C. All Sensors:
   1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
   2. Verify that sensors with shielded cable are grounded only at one end.
   3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
   4. Tolerances for critical applications may be tighter.

D. Sensors Without Transmitters - Standard Application:
   1. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
   2. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
   3. If not, install offset, calibrate or replace sensor.

E. Sensors With Transmitters - Standard Application.
   1. Disconnect sensor.
   2. Connect a signal generator in place of sensor.
   3. Connect ammeter in series between transmitter and building automation system control panel.
   4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
   5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
   6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
   7. Record all values and recalibrate controller as necessary to comply with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
   8. Reconnect sensor.
   9. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
   10. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
   11. If not, replace sensor and repeat.
   12. For pressure sensors, perform a similar process with a suitable signal generator.

F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:

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1. Watthour, Voltage, Amperage: 1 percent of design.
2. Pressure, Air, Water, Gas: 3 percent of design.
3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F.
4. Relative Humidity: 4 percent of design.
5. Barometric Pressure: 0.1 inch of Hg.
6. Flow Rate, Air: 10 percent of design.
7. Flow Rate, Water: 4 percent of design.
8. AHU Wet Bulb and Dew Point: 2.0 degrees F.

G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.

H. Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
2. Set pump/fan to normal operating mode.
3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
4. Command valve/damper to open; verify position is full open and adjust output signal as required.
5. Command valve/damper to a few intermediate positions.
6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
2. Use an ultra-sonic flow meter to detect flow or leakage.

3.6 TEST PROCEDURES – GENERAL

A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.

C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
2. Sampling is not allowed for:
   a. Major equipment.

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b. Life-safety-critical equipment.
c. Pre-functional Checklist execution.

3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
7. If YY percent of the units in the second sample fail, test all remaining identical units.
8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.

D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the “observation”).

E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.

F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.

G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.

H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.

I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority’s request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
2. Other points will be monitored by the Commissioning Authority using dataloggers.
3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.

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4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
5. Graphical output is desirable and is required for all output if the system can produce it.
6. Monitoring may be used to augment manual testing.

3.7 OPERATION AND MAINTENANCE MANUALS

A. See Section 01 77 00 - Closeout Submittals for additional requirements.

B. Add design intent documentation furnished by Architect to manuals prior to submission to County.

C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.

D. Commissioning Authority will add commissioning records to manuals after submission to County.

- END OF SECTION -

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SECTION 024119

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.

B. Related Requirements:
1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

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B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building.

C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

D. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

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1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

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b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

3.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes for A/V services and other work, plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

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4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Remove paint where noted on Drawings. Contractor is to select best method to remove paint in accordance with requirements of Local Authorities Having Jurisdiction.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly. Comply with requirements Document 006223 "Recycling and Diversion of Debris from Construction and Demolition."

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed, Salvaged and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction. and recycle or dispose of them according to Document 006223 "Recycling and Diversion of Debris from Construction and Demolition."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Document 006223 "Recycling and Diversion of Debris from Construction and Demolition."

B. Burning: Do not burn demolished materials.

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3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

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SECTION 031000

CONCRETE FORMING AND ACCESSORIES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: All labor, materials and equipment and all operations required to complete all formwork as indicated on the drawings; to produce shapes and configurations as shown, as required; and as specified herein, including:

1. Forms, shores, bracing, removal and other operations as necessary for all cast-in-place concrete and masonry placed.
2. Setting and securing anchor bolts and other metal items embedded in concrete into formwork, using materials and layouts furnished and delivered to jobsite as specified under other sections.

B. Related Sections:

1. Pertinent Sections of Division 03 specifying concrete construction.
2. Pertinent Sections of other Divisions specifying work to be embedded in concrete or work penetrating concrete foundations and formwork.

1.2 REFERENCES

A. California Code of Regulations, Title 24, latest adopted edition (herein noted as CBC): Chapter 19 Concrete.

B. American Concrete Institute (ACI) PRC-347 "Guide to Formwork for Concrete".

C. American Plywood Association (APA) “Concrete Forming Guide”.

D. West Coast Lumberman Inspection Bureau (WCLIB) “Standard Grading Rules for West Coast Lumber”.

E. ACI MNL-066 “ACI Detailing Manual”.

F. ACI SPEC-301 “Specifications for Concrete Construction”.

G. Concrete Reinforcing Steel Institute (CRSI) “Manual of Standard Practice”.

1.3 DESIGN REQUIREMENTS

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A. Design, engineer, and construct formwork, shoring and bracing to conform to design and code requirements, resist imposed loads; resultant concrete to conform to required shape, line and dimension.

1.4 SUBMITTALS

A. Limitation of review: Structural Engineer's review will be required only where specifically requested for general architectural applications and features only. Contractor is responsible for structural stability, load-resisting characteristics and sufficiency of form work design.

1.5 QUALITY ASSURANCE

A. General: All form materials shall be new at start of work. Produce high quality concrete construction. Minimize defects due to joints, deflection of forms, roughness of forms, nonconforming materials, concrete or workmanship.

B. Reuse of Forms: Plywood forms may be reused, if thoroughly cleaned of all dirt, mortar, and foreign materials, and undamaged at edges and contact face. Reuse shall be subject to permission from the Architect without exception, and issued in writing. Reuse of any panel which will produce a blemish on exposed concrete, will not be permitted.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Form Materials:

1. Non-Exposed Surface Formwork Facing: Forms for concrete which is not exposed to view, may be of plywood as specified for exposed surfaces, or square edge 1x nominal Douglas Fir, Construction Grade, S4S.
2. Exposed Surface Formwork Facing:
   a. Forms for all exterior and interior concrete flat surfaces unless otherwise specified as board formed shall be new Douglas Fir Plywood (APA) ply, 5/8-inch, B-B Plyform, Class 1, Exterior Type, oiled and edged and edge-sealed conforming to U.S. Product Standard PS 1 in large sheet sizes to achieve joint patterns shown.
   b. All exposed concrete edges shall be chamfered 3/4" minimum or as noted on the drawings.
3. Exposed Surface Formwork - Special Pattern Form Liner:
   a. Forms for all exterior and interior concrete flat surfaces indicated shall be as designated by Architect.

B. Earth Forms: Allowed, subject to soil standing in excavations without ravel or caving.

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C. Form Release Agent: Spray-on compound, not affecting color, bond or subsequent treatment of concrete surfaces. Maximum VOC content shall comply with local requirements and California Green Building Code.

D. Accessories: Types recommended by manufacturers or referenced standards to suit conditions indicated;

1. Anchors, spacers, void in-fill materials: sized to resist imposed loads.
2. Form Ties: Prefabricated rod, flat band, or wire snap ties with 1" break-back or threaded internal disconnecting type with external holding devices of adequate bearing area. Ties shall permit tightening and spreading of forms and leave no metal closer than 1" to surface.

E. Corner Chamfers and Rustications: Filleted, wood strip or foam type; sizes and shapes as detailed, or 3/4 x 3/4 inch size minimum if not detailed; maximum possible lengths.

F. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

G. Foam Block Formwork: For use only where specified on drawings to create void space under or within concrete. ASTM D6817.

Use Case	InsulFoam Geofoam (or equivalent)	Maximum Density (pcf)	Compressive Resistance at 1% Deformation (psi)	Compressive Resistance at 5% Deformation (psi)	Compressive Resistance at 10% Deformation (psi)
1) Void formwork	EPS-15	0.90	3.6	8.0	10.2
2) Planters	EPS-19	1.14	5.8	13.1	16.0
3) Pedestrian Loads (<=100psf)	EPS-22	1.35	7.3	16.7	19.6
4) Vehicular Loads and Sidewalks (<= 250psf)	EPS-39	2.40	15.0	35.0	40.0

PART 3 – EXECUTION

3.1 EXAMINATION

A. Inspect the substrate and the conditions under which concrete formwork is to be performed. Correct conditions detrimental to timely and proper completion of the

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work. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work indicates acceptance of substrates and conditions.

B. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.2 EARTH FORMS

A. If natural soil or compacted fill can be accurately cut and maintained, foundations and grade beams may be poured against earth without forming. Provide positive protection of trench top corners.

B. Maintain earth forms free of water and foreign materials.

3.3 ERECTION – FORMWORK

A. General: Construct formwork in accordance with calculations, and recommendations of ACI PRC-347. Construct forms to the sizes, shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grades, level and plumb work in finished structure. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required. Use selected materials to obtain required finishes.

1. Schedule the work and notify other trades in ample time so that provisions for their work in the formwork can be made without delaying progress of the project. Install all sleeves, pipes, etc. for building services systems, or other work. Secure information about and provide for all openings, offsets, recessed nailing blocks, channel chases, anchors, ties, inserts, etc. in the formwork before concrete placement.
2. Deflection: Formwork and concrete with excessive deflection after concrete placement will be rejected. Excessive deflection is that which will produce visible and noticeable waves in the finished concrete.

B. Formwork Construction: Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI SPEC-301. Uniform, substantial and sufficiently tight to prevent leakage of concrete paste, readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials. Tie, brace, shore, and support to insure stability against pressures from any source, without failure of any component part and without excessive deflection. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.

C. Provide all openings, offsets, inserts, anchorages, blocking, and other features of the work as shown or required. See INSERTS, EMBEDDED PARTS, AND OPENINGS for detailed requirements.

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D. Warped, checked, or scuffed forms will be rejected.

E. Maintain membranes, reinforcing and other work free of damage; protect with plywood runway boards or other positive, durable means.

F. Align joints and make watertight. Keep form joints to a minimum.

G. Provide fillet and chamfer strips on external corners of exposed locations and as indicated to form patterns in finished work. Extend patterns around corners and into alcoves, on backs of columns and similar locations not otherwise shown.

1. Produce beveled, smooth, solid, unbroken lines, except as otherwise indicated to conform to patterns.
2. Form corners and chamfers with 3/4 inch x 3/4 inch strips, unless otherwise indicated, accurately formed and surfaced to produce uniformly straight lines and tight edge joints. Extend terminal edges to required limit and miter chamfer at changes in direction.

H. Unexposed corners may be formed either square or chamfered.

I. Ties and Spreaders: Arrange in a pattern acceptable to the Architect when exposed. Snap-ties may be used except at joints between pours where threaded internal disconnecting type shall be used.

J. Coordinate this section with other sections of work that require attachment of components to formwork.

K. Reglets and Rebates: Accurately locate, size, and form all reglets and rebates required to receive work of other trades, including flashing, frames, and equipment.

3.4 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not allow excess form coating material to accumulate in the forms or to come into contact with reinforcement or surfaces which will be bonded to fresh concrete.

D. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork will be rejected.

E. Leave no residue or stain on the face of the concrete, nor affect bonding of subsequent finishes or work specified in other sections.

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3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.

1. Provide openings in concrete formwork to accommodate work of other sections including those under separate contracts (if any). Size and location of openings, recesses and chases shall be in accordance with the section requiring such items. Accurately place and securely support items to be built into forms.

B. Construction Joints: Construct and locate generally as indicated on Drawings and only at locations approved by Structural Engineer, so as not to impair the strength of the structure. Form keys in all cold joints shown or required.

C. Locate and set in place items that will be cast directly into concrete.

D. Rough Hardware and Miscellaneous Metal: Set inserts, sleeves, bolts, anchors, angles, and other items to be embedded in concrete. Set embedded bolts and sleeves for equipment to template and approved shop drawings prepared by trades supplying equipment.

E. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

F. Wood Inserts and Nailers: Provide approved preservative-treated lumber. Set all required nailing blocks, grounds, and other inserts as required to produce results shown. Wood plugs shall not be used.

G. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

H. Piping: Do not embed piping in structural concrete unless locations specifically approved by Structural Engineer.

I. Conduit: Place conduit below slabs-on-grade and only as specifically detailed on structural drawings. Minimum clear distance between conduits shall be 3 diameters. Location shall be subject to Engineer's written approval and shall not impair the strength of the structure.

J. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

1. Provide openings for the introduction of vibrators at intervals necessary for proper placement.

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2. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

K. Install Form Liner inserts in accordance with manufacturer's recommendations, to produce patterns and textures indicated.

L. Install waterstops in accordance with manufacturer's recommendations to provide continuous waterproof barrier.

3.6 FORM CLEANING

A. Clean forms as erection proceeds, remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

1. Remove all dirt, chips, sawdust, rubbish, water and foreign materials detrimental to concrete.
2. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

3.7 FOOTINGS

A. Verify elevations and provide final excavation required for footings prior to placing of concrete.

3.8 EQUIPMENT BASES

A. Form concrete bases for all mechanical and electrical equipment in accordance with approved shop details furnished by other sections.

B. Sizes and locations as indicated and as required to produce results shown.

C. Provide coved base for all equipment bases placed on concrete slabs.

3.9 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI SPEC-301.

3.10 FOAM BLOCK FORMWORK

A. Blocks shall be placed on prepared leveling course for level bearing. Place adjacent blocks in tight contact together. Where placed in multiple layers, orient long axis of upper layer at 90° to lower layer, and so forth for subsequent layers. Anchor blocks as

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required to prevent movement prior to and during concrete placement. Do not expose to hydrocarbons, solvents, or coal tar.

3.11 FIELD QUALITY CONTROL

A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

B. Do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view. Do not patch formwork.

C. Clean and repair surfaces to be re-used in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork.

D. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.

3.12 FORM REMOVAL

A. Do not loosen or remove forms before minimum curing period has elapsed without employment of appropriate alternate curing methods, approved by the Architect in writing.

B. Remove forms without damage to the concrete using means to ensure complete safety of the structure and without damage to exposed beams, columns, wall edges, chamfers and inserts. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Do not remove forms until the concrete has hardened sufficiently to permit safe removal and the concrete has attained sufficient strength to safely support imposed loads. The minimum elapsed time for removal of forms after concrete has been placed shall be as follows:

1. Columns and Walls: 7 days, provided members are not subjected to overhead loads.
2. Retaining Walls: 21 days minimum.
3. Footings: 7 days minimum. If backfilled immediately, side forms may be removed 24 hours after concrete is placed.
4. Beams, elevated slab, and similar overhead conditions: 28 days unless adequate shoring is provided.

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D. Durations listed above are minimums and are subject to extension at the sole judgment of the Architect/Engineer.

E. Reshoring: Reshore members where and if required by Formwork Design Engineer.

F. Do not subject concrete to superimposed loads (structure or construction) until it has attained full specified design strength, nor for a period of at least 14 days after placing.

G. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

3.13 CLEANING

A. Remove excess material and debris associated with this work from the job site.

END OF SECTION

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SECTION 032000

CONCRETE REINFORCING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Reinforcing steel work for all concrete and masonry work as indicated on the drawings and specified herein.
2. Coordinate this work with other work affected by these operations, such as forms, electrical work, mechanical work, structural steel, masonry and concrete.

B. Related Sections:

1. Pertinent Sections of Division 01 specifying Quality Control and Testing Laboratory services.
2. Pertinent Sections of Divisions 03 specifying concrete construction.
3. Pertinent Sections of Divisions 04 specifying masonry construction.
4. Pertinent Sections of other Divisions specifying work to be embedded in concrete or work penetrating concrete work.

1.2 REFERENCE STANDARDS

A. California Code of Regulations, Title 24, latest adopted edition (herein noted as CBC) Chapter 19 Concrete.

B. American Concrete Institute (ACI) SPEC-301 “Specifications for Concrete Construction”.

C. ACI CODE-318 “Building Code Requirements for Structural Concrete and Commentary”.

D. ACI MNL-066 “ACI Detailing Manual”.

E. ASTM International (ASTM) A1064 “Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete”.

F. ASTM A615 “Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement”.

G. ASTM A706 “Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement”.

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H. American Welding Society (AWS) D1.4 – "Structural Welding Code - Steel Reinforcing Bars".

I. Concrete Reinforcing Steel Institute (CRSI) - "Manual of Standard Practice".

J. CRSI - "Placing Reinforcing Bars".

1.3 SUBMITTALS

A. Submit in accordance with pertinent sections of Division 01 specifying submittal procedures. Submit for review prior to fabrication.

B. Limitation of Review: Structural Engineer's review will be for general conformance with design intent as indicated in the Contract Documents and does not relieve Contractor of full responsibility for conformance with the Contract Documents. The General Contractor shall review and approve shop drawings prior to submittal to the Architect/Engineer.

C. Shop Drawings: Show complete fabrication and placing details of all reinforcing steel. Comply with requirements of ACI MNL-66. Include:

1. Bar sizes and schedules;
2. Shapes of bent bars, layout and spacing of bars, location of splices.
3. Stirrup spacing, arrangements and assemblies,
4. References to Contract Document detail numbers and designations.
5. Wall elevations corresponding to elevations shown in Contract Documents.

D. Product Data: Submit manufacturer's product data, specifications, location and installation instructions for proprietary materials and reinforcement accessories. Provide samples of these items upon request.

E. Certificates: Submit all certifications of physical and chemical properties of steel for each heat number as manufactured, including location of material in structure as specified below in Article titled QUALITY ASSURANCE. All materials supplied shall be tagged with heat numbers matching submitted Mill Test Report analyses.

F. Samples: Provide to the Owner's Testing laboratory as specified in Article SOURCE QUALITY CONTROL.

1.4 QUALITY ASSURANCE

A. Perform work of this Section in accordance with the CRSI "Manual of Standard Practice", CRSI "Placing Reinforcing Bars", ACI SPEC-301, and ACI CODE-318.

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B. Requirements of Regulatory Agencies, refer to pertinent Sections of Division 01 and CBC.

C. Certification and Identification of Materials and Uses: Provide Owner's Testing Agency with access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection and all material identification/test information listed below.

1. Provide manufacturer's Mill Test Reports for all materials. Include chemical and physical properties of the material for each heat number manufactured. Tag all fabricated materials with heat number.
2. Provide letter certifying all materials supplied are from heat numbers covered by supplied mill certificates. Include in letter the physical location of each grade of reinforcing and/or heat number in the project (i.e. foundations, walls, etc.).
3. Unidentified Material Tests: Where identification of materials by heat number to mill tests cannot be made, Owner's Testing Agency shall test unidentified materials as described below.

D. Testing and Inspection: Tests and Inspections required by Independent Testing Agency are specified below in Articles SOURCE QUALITY CONTROL and FIELD QUALITY CONTROL. Duties and limitations of Independent Testing Agency, test costs and test reports in conformance with pertinent Sections of Division 01.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent requirements of Division 01.

B. Deliver reinforcement to project site in bundles marked with durable tags indicating heat number, mill, bar size and length, proposed location in the structure and other information corresponding with markings shown on placement diagrams.

C. Handle and store materials above ground to prevent damage, contamination or accumulation of dirt or rust.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Reinforcing Steel: Deformed billet steel bars, ASTM A706 Grade 60 or ASTM A615 Grade 60.

1. Welded reinforcement shall be ASTM A706, or A615 meeting carbon requirements of AWS D1.4. Welding shall conform with AWS D1.4.
2. All reinforcement to be unfinished.

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3. ASTM A615 reinforcement at special structural concrete walls, concrete coupling beams, and special concrete moment frames shall have maximum yield stress of 78,000 psi and the tensile strength shall be greater than 125% of the actual yield strength. Test ASTM A615 reinforcement for conformance to these criteria prior to fabrication and/or installation.

B. Welded Wire Reinforcement: ASTM A1064.

C. Tie Wire: No. 16 AWG or heavier, black annealed.

D. Concrete Blocks: On-grade conditions only, as required to support reinforcing bars in position.

E. Reinforcing Supports: Plastic or galvanized steel chairs, bolsters, bar supports, or spacers sized and shaped for adequate support of reinforcement and construction loads imposed during concrete placement, meeting ACI and CRSI standards.

1. For use over formwork: Galvanized wire bar type supports complying with CRSI recommendations. Provide plastic tips where exposed to view or weather after removal of formwork. Do not use wood, brick, or other unacceptable materials.

F. Reinforcement Splice Couplers: For use only where specified on drawings. Submit other locations proposed for use to Engineer for review. "L-Series Bar Lock" Coupler Systems for Splicing Reinforcement Bars, UES ER-0319, by Dayton-Superior Corporation.

2.2 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4), unless specifically shown otherwise. Details not specifically shown or indicated shall conform to SP-066 and specified codes and standards.

1. Accurately shop-fabricate to shapes, bends, sizes, gauges and lengths indicated or otherwise required.
2. Bend bars once only. Discard bars improperly bent due to fabricating or other errors and provide new material; do not re-bend or straighten unless specifically indicated. Rebending of reinforcement in the field is not allowed.
3. Do not bend reinforcement in a manner that will injure or weaken the material or the embedding concrete.
4. Do not heat reinforcement for bending. Heat-bent materials will be rejected.

B. Unacceptable materials: Reinforcement with any of the following defects will not be permitted in the work.

1. Bar lengths, depths and bends exceeding specified fabrication tolerances.
2. Bends or kinks not indicated on Drawings or final shop drawings.

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3. Bars with reduced cross-section due to rusting or other cause.

C. Tag reinforcement with durable identification to facilitate sorting and placing.

D. Shop Fusion Welded Stirrup/Tie/Spiral Cages

1. Shop fusion welding of stirrup/tie/spiral cages is permitted to aid in fabrication and handling. The following requirements shall be met.
2. All reinforcing bars receiving weld shall be ASTM A706.
3. Longitudinal holding wires shall be ASTM A1064.
4. Shop welding shall be performed by machines under a continuous, controlled process.
5. Quality control tests shall be performed on shop-welded specimens and the test results shall be available, upon request, to the Architect/Engineer.
6. Tack welding of reinforcing steel is not permitted.
7. Welding of any type shall not occur at 90°, 135°, or 180° bends. Circular ties and spirals may be shop fusion welded outside of areas with 90°, 135°, or 180° hook bends.
8. Longitudinal bars shall not be welded to stirrups/ties/spirals.

2.3 SOURCE QUALITY CONTROL

A. The Testing Agency, as specified in the Article QUALITY ASSURANCE, will perform the following:

1. Material Testing:
   a. Identified Steel: When samples are taken from bundled steel identified by heat number, matched with accompanying mill analyses as delivered from the mill, supplemental testing of reinforcing steel is not required.
   b. Unidentified Steel: When identification of materials by heat number matched to accompanying mill analyses cannot be made, perform one tensile test and one bend test per each two and one-half tons or fraction thereof for each required size of reinforcing steel. Tests of unidentified steel shall be performed by the Owner's Testing Agency and costs for these tests shall be paid by the Contractor by deductive change order.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Inspect the conditions under which concrete reinforcement is to be placed. Do not proceed with the work until unsatisfactory conditions have been corrected.

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B. Coordinate with work of other sections to avoid conflicts or interference. Bring conflicts between reinforcement and other elements to Architect's attention. Resolve conflicts before concrete is placed.

C. Notify Architect, Structural Engineer, and Authority Having Jurisdiction for review of steel placement not less than 48 hours before placing concrete.

3.2 PLACEMENT

A. General: Comply with the specified codes and standards, and Concrete Reinforcing Steel Institute recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

B. Clean bars free of substances which are detrimental to bonding. Maintain reinforcement clean until embedded in concrete.

C. Place reinforcement to obtain the minimum coverages for concrete protection. Do not deviate from required position. Maintain required distance, spacing and clearance between bars, forms, and ground.

D. Location and Support: Provide metal chairs, runners, bolsters, spacers and hangers, as required.

E. Provide additional steel reinforcement as necessary or as directed, to act as spreaders or separators to maintain proper positioning.

F. Tying and Attachment: Securely tie at all intersections and supports with wire. Prevent dislocation or movement during placement of concrete. Direct twisted ends of wire ties away from exposed concrete surfaces.

G. Separate reinforcing from pipes or conduits with approved non-metallic separators. Do not use wood or steel form stakes or reinforcement used as stakes as support for reinforcement.

H. Accommodate placement of formed openings required by other sections.

I. Obstructions:

1. Where obstructions, block-outs, or penetrations (conduits, raceways, ductwork) prevent continuous placement of reinforcement as indicated, provide additional reinforcing as detailed and as directed by the Structural Engineer to supplement the indicated reinforcement around the obstruction.
2. Place additional trim bars, ties, stirrups, or other elements as detailed and as directed at all opening, sleeves, pipes or other penetrations through structural elements.

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J. Welded Wire Reinforcement: Reinforce slabs with 6"x 6"-W1.4 x W1.4 welded wire reinforcement reinforcing, unless otherwise noted on drawings.

1. Provide flat sheets only, no rolls. Straighten, cut to required size, and lay out flat in place.
2. Securely wire-tie reinforcement to other reinforcement at frequent intervals.
3. Extend reinforcement over supporting beams and walls, and to within 1 inch of edge of slabs, construction joints, and expansion joints.
4. Support reinforcement in mid-depth of slab.
5. Lift reinforcement at intervals as slab concrete is placed, ensure proper embedment.

3.3 REINFORCING SPACING AND COVERAGE

A. Spacing: Do not space bars closer than four (4) diameters of the largest of two adjacent bars, except at bar laps, which shall be placed such that a minimum of 2 bar diameters is clear between bars.

B. Where reinforcing in members is placed in two layers, the distance between layers shall not be less than four bar diameters of the largest bar and the bars in the upper layers shall be placed directly above those in the bottom layer, unless otherwise detailed or dimensioned.

C. Coverage of bars (including stirrups and columns ties) shall be as follows, unless otherwise shown:

1. Concrete cast against earth or grade: 3 inches.
2. Concrete exposed to weather or formed and exposed to earth:
   a. #5 & smaller: 1-1/2 inches.
   b. #6 & larger: 2 inches.
3. Concrete not exposed to earth or weather:
   a. #5 & smaller: 1 inch.
   b. #6 & larger: 1-1/2 inches.

3.4 DOWELS, SPLICES, OFFSETS AND BENDS

A. Provide standard reinforcement splices at splices, corners, and intersections by lapping ends, placing bars in contact, and tightly tying with wire at each end. Comply with details shown on structural drawings and requirements of ACI CODE-318.

B. Provide minimum 1-1/2 inch clearance between sets of splices. Stagger splices in horizontal bars so that adjacent splices will be 4 feet apart.

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C. Laps of welded wire reinforcement shall be at least two times the spacing of the members in the direction lapped but not less than twelve inches.

D. Splices of reinforcement shall not be made at points of maximum stress. Provide splice lengths as noted on the structural drawings, with sufficient lap to transfer the stress between bars by bond and shear.

E. Spacing:

1. Space bars minimum distance specified and all lapped bars 2 bar diameters (minimum) clear of the next bar.
2. Stagger splices of adjacent bars where possible and where required to maintain bar clearance.
3. Beam or slab top bars shall be spliced mid-span of column support and bottom bars spliced at column supports.
4. Request Architect/Engineer review prior to placement for all splices not shown on the drawings.

F. Reinforcement Couplers: Install at all locations indicated. Install couplers in accordance with manufacturer's recommendations.

3.5 WELDING

A. No reinforcing shall be welded unless specifically indicated. No reinforcing shall be welded without prior approval of the Structural Engineer and the Authority Having Jurisdiction.

B. Only when so approved for use as noted above, all welding shall conform to AWS D1.4, ACI CODE-318, and the following;

1. All welding performed by certified welders.
2. All reinforcement requires preheat prior to welding. All preheat and welding shall be continuously inspected by the Testing Agency.

3.6 MISPLACED REINFORCEMENT

A. Notify Architect/Engineer immediately if reinforcing bars are known to be misplaced after concrete has been placed.

B. Perform no correction or cutting without specific direction. Do not bend or kink misplaced bars.

C. Correct misplaced reinforcing only as directed in writing by the Architect/Engineer. Bear all costs of redesign, new, or additional reinforcing required because of misplaced bars at Contractor's expense.

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3.7 FIELD QUALITY CONTROL

A. The Testing Agency as specified in the Article QUALITY ASSURANCE, will inspect the work for conformance to contract documents before concrete placement.

1. Inspection: Provide inspection and verification of installed reinforcement. Confirm that the surface of the rebar is free of form release oil or other coatings.
2. Inspect all preheat and welding activities for steel reinforcement, when these occur.
3. Exception: Shallow foundations & non-structural slabs-on-grade supporting buildings of no greater than three stories and either of concrete design strength 2500psi (or greater) or supporting light-frame construction do not require special inspection. Non-structural patios, driveways, and sidewalks do not require special inspection.

3.8 CLEANING

A. Remove excess material and debris associated with this work from the job site.

END OF SECTION

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SECTION 03 3000

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: Provide all labor, materials, equipment and services to complete all concrete work required, including, but not limited to, the following:

1. Foundations, elevated slabs, slabs-on-ground, and walls.
2. Installation of all bolts, inserts, sleeves, connections, etc. in the concrete.
3. Joint devices associated with concrete work.
4. Miscellaneous concrete elements, including, but not limited to: equipment pads, light pole bases, flagpole bases, thrust blocks, and manholes.
5. Concrete curing.
6. Coordination with other sections:
   a. Make all preparations and do all work necessary to receive or adjoin other work. Install all bolts and anchors, including those furnished by other sections, into formwork and provide all required blocking.
   b. Install all accessories embedded in the concrete and provide all holes, blockouts and similar provisions necessary for the work of other sections. Provide all patching or cutting made necessary by failure or delay in complying with this requirement at the Contractor's expense.
   c. Coordinate with other sections for the accurate location of embedded accessories.

B. Related Sections:

1. Pertinent Sections of Division 01 specifying Quality Control and Testing Laboratory services.
2. Pertinent Sections of Division 03 specifying concrete construction.
3. Pertinent Sections of other Divisions specifying work to be embedded in concrete or work penetrating concrete.
4. Pertinent sections of other Divisions specifying floor finishes and sealants applied to concrete substrates.

1.2 REFERENCES

A. California Code of Regulations, Title 24, latest adopted edition (herein noted as CBC) Chapter 19 Concrete.

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B. American Concrete Institute (ACI) PRC-211.1 “Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete”

C. ACI PRC-213 “Guide for Structural Lightweight-Aggregate Concrete”.

D. ACI SPEC-301 “Specifications for Concrete Construction”.

E. ACI PRC-302.1 “Guide for Concrete Floor and Slab Construction”.

F. ACI PRC-304 “Guide for Measuring, Mixing, Transporting, and Placing Concrete”.

G. ACI SPEC-305.1 “Specification for Hot Weather Concreting”.

H. ACI SPEC-306.1 “Standard Specification for Cold Weather Concreting”.

I. ACI SPEC-308.1 “Specification for Curing Concrete”.

J. ACI CODE-318 “Building Code Requirements for Structural Concrete and Commentary”.

1.3 SUBMITTALS

A. Submit in accordance with pertinent sections of Division 01 specifying submittal procedures. The General Contractor shall review and approve shop drawings prior to submittal to the Architect/Engineer. Submittals that do not meet these requirements will be returned for correction without review. Submit for review prior to fabrication.

B. Limitation of Review: Structural Engineer's review will be for general conformance with design intent as indicated in the Contract Documents and does not relieve Contractor of full responsibility for conformance with the Contract Documents.

C. Product Data: Submit manufacturers' data on manufactured products and other concrete related materials such as bond breakers, cure/sealer, admixtures, etc. Demonstrate compliance with specified characteristics. Provide samples of items upon request.

D. Mix Designs: Submit Mix Designs for each structural concrete type required for work per requirements of articles CONCRETE MIXES and QUALITY ASSURANCE. Resubmit revised designs for review if original designs are adjusted or changed for any reason. Non-Structural mixes need not be submitted for review by Structural Engineer.

E. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.

F. Batch Plant Ticket: Include with delivery of each load of concrete. Provide ticket to the Testing Agency and the Architect/Engineer as separate submittals. Concrete delivered

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to the site without such ticket shall be rejected and returned to the plant. Each ticket shall include all information specified in Article SOURCE QUALITY CONTROL below.

G. Engineering Analysis: Prepared by a California-licensed Civil or Structural Engineer, justifying construction-imposed loads on slabs, beams, and walls which exceed those allowed by CBC for the specified use.

1. 2000 lbs maximum allowable construction load without analysis.
2. 10,000 lbs maximum allowable construction load with analysis.

H. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

1.4 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.

B. Concrete construction verification and inspection to conform to CBC 1705.3.

C. Common Sourcing: Provide each of the following materials from consistent sources for entire project.

1. Cement.
2. Fly ash.
3. Aggregate.
4. Slag Cement.

D. Follow requirements of ACI SPEC-305.1 when concreting during hot weather. Follow requirements of ACI SPEC-306.1 when concreting during cold weather.

E. Services by the Independent Testing Agency (includes "Special" Inspections) as specified in this Section and as follows:

1. Perform tests and inspections specified below in articles SOURCE QUALITY CONTROL and FIELD QUALITY CONTROL. Duties and limitations of Independent Testing Agency, test costs and reports to be in conformance with pertinent Sections of Division 01.

F. Contractor shall bear the entire cost of remediation, removal, and/or replacement of concrete determined defective or non-conforming, including Architect/Engineer fees for redesign.

1.5 DELIVERY, STORAGE, AND HANDLING

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A. Materials specified by brand name shall be delivered in unbroken packages bearing manufacturer's label and shall be brand specified or an approved equal.

B. Delivery, Handling and Storage of other materials shall conform to the applicable sections of the current editions of the various reference standards listed in this Section.

C. Protect materials from weather or other damage. Sort to prevent inclusion of foreign materials.

D. Specific Requirements:

1. Cement: Protect against dampness, contamination, and warehouse set. Store in weather tight enclosures.
2. Aggregates: Prevent excessive segregation, or contamination with other materials or other sizes of aggregates. Use only one supply source for each aggregate stock pile.
3. Admixtures:
   a. Store to prevent contamination, evaporation, or damage.
   b. Protect liquid admixtures from freezing and extreme temperature ranges.
   c. Agitate emulsions prior to use.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather (Freezing or near-freezing temperatures) per ACI SPEC-306.1:

1. Heat concrete materials before mixing, as necessary to deposit concrete at a temperature of at least 50°F but not more than 90°F.
2. Do not place concrete during freezing, near-freezing weather, snow, rain or sleet unless protection from moisture and/or cold is provided.
3. Protect from freezing and maintain at a temperature of at least 50°F for not less than seven days after placing. Take special precautions to protect transit-mixed concrete.
4. No salts, chemical protection or admixture are permitted without written approval of Architect/Engineer.
5. Contractor shall maintain an air temperature log for the first 7 days after placement with entry intervals not to exceed 8 hours.

B. Hot Weather per ACI SPEC-305.1:

1. Cool concrete materials before mixing, or add ice in lieu of mix water as necessary to deposit concrete at a temperature below 85°F.
2. Do not place concrete in hot/windy weather without Architect/ Engineer review of procedures.

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3. Provide sunshades and/or wind breakers to protect concrete during finishing and immediate curing operations. Do not place slab concrete at air temperature exceeding 90°F.
4. Provide modified mix designs, adding retarders to improve initial set times and applying evaporation reducers during hot/windy weather for review by Independent Testing Agency prior to use.

1.7 MOCK-UP

A. Construct and erect mock-up panel for architectural concrete surfaces indicated to receive special treatment or finish, as result of formwork.

1. Panel Size: Sufficient to illustrate full range of treatment.
2. Number of Panels: 2.
3. Locate as indicated on drawings.

B. If requested by Architect / Engineer, cast concrete against mock-up panel. Obtain acceptance of resulting surface finish prior to erecting formwork.

C. Accepted mock-up panel is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.

D. Mock-up may remain as part of the Work.

1.8 SCHEDULING AND SEQUENCING

A. Organize the work and employ shop and field crew(s) of sufficient size to minimize inspections by the Testing Agency.

B. Provide schedule and sequence information to Testing Agency in writing upon request. Update information as work progresses.

PART 2 – PRODUCTS

2.1 FORMWORK

A. Comply with requirements of Section 03 1000.

2.2 REINFORCEMENT

A. Comply with requirements of Section 03 2000.

2.3 MATERIALS

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A. General Requirements: All materials shall be new and best of their class or kind. All materials found defective, unsuitable, or not as specified, will be condemned and promptly removed from the premises.

B. Cementitious Materials:

1. Portland Cement: ASTM C150, Type II, low alkali conforming to CBC 1903.1.
2. Fly Ash (Pozzolan): ASTM C618, Class F.
3. Slag Cement: ASTM C989, Grade 100 or 120.

C. Concrete Aggregates:

1. Coarse and Fine Aggregates: ASTM C33; Stone aggregate and sand. Specific source aggregate and/or sand or shrinkage characteristics as required for class of concrete specified.
2. Lightweight aggregate: ASTM C330 and C332.
3. Source shall remain constant throughout the duration of the job. The exact portions of the fine aggregates and coarse aggregates to be used in the mix shall be determined by the mix design.
4. Recycled concrete products: Returned plastic concrete may not be used in a mix. Recycled Concrete Aggregate (RCA) is not permitted. Reclaimed coarse aggregate is permitted and shall comply with ASTM C33. Reclaimed fine aggregate is not permitted.

D. Water: ASTM C1602. Potable, clean, from domestic source.

E. Admixtures: All admixtures shall be used in strict accordance with the manufacturer's recommendations. Admixtures containing calcium chlorides or other accelerators shall not be used without the approval of the Architect/Engineer and the Owner's Testing Laboratory.

1. Normal or Mid Range Water Reducing Admixtures: ASTM C494 Type A, “MasterPozzolith” series or "MasterPolyheed" series by Master Builders Solutions, "WRDA" series by W.R. Grace, or equal.
2. Water Reducing Admixture and Retarder: ASTM C494 Type B or D, "MasterSet R” series or “MasterSet DELVO” series by Master Builders Solutions, "Plastiflow-R" by Nox-crete, or equal.
3. High Range Water-Reducing Admixtures: ASTM C494 Type F, "MasterRheoBuild 1000" or “MasterGlenium” series by Master Builders Solutions or equal.
4. Air Entraining Admixtures: ASTM C260, “MasterAir” series by Master Builders Solutions or equal.
5. Viscosity Modifiers: ASTM C494 Type S, “MasterMatrix VMA” series by Master Builders Solutions or equal..

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F. Slurry: Same proportion of cement to fine aggregates used in the regular concrete mix (i.e. only coarse aggregate omitted); well mixed with water to produce a thick consistency.

G. High Strength Grout: See section 05 1200 or 05 1100 for requirements.

H. Dry Pack: Dry pack (used only for cosmetic concrete repairs) shall consist of:

1. One part cement to 2-1/2 parts fine aggregate (screen out all materials retained on No.4 sieve), mixed with a minimum amount of water, added in small amounts.
2. Mix to consistency such that a ball of the mixture compressed in the hand will retain its shape, showing finger marks, but without showing any surface water.

2.4 ACCESSORIES

A. Bonding Agent: ASTM C881, Type II Grade 2 Class B or C. Do not allow epoxy to set before placing fresh concrete.

1. “MasterEmaco ADH 326” by Master Builders Solutions;
2. “Rezi-Weld 1000” by W.R. Meadows.

B. Chemical Hardener: Fluorosilicate solution designed for densification of cured concrete slabs. “MasterKure HD 300 WB” by Master Builders Solutions, "LIQUI-HARD" W.R. Meadows Co, or equal.

C. Moisture-Retaining Cover: ASTM C171, type 1, one of the following;

1. Regular Curing Paper, Type I, reinforced waterproof: Fortifiber Corporation "Orange Label Sisalkraft", "Pabcotite" paper, or equal.
2. Polyethylene Film: ASTM D 2103, 4 mil thick, clear or white color.
3. White-burlap-polyethylene sheet, weighing not less than 10 oz/per linear yd.

D. Liquid Curing Compound: ASTM C 309, Type 1, Class B, clear or translucent, 25% minimum solids, water base acrylic cure/sealer which will not discolor concrete and compatible with bonding of finishes specified in related sections. W.R. Meadows Co. “Vocomp 25” or equal. Maximum VOC content shall comply with local requirements and California Green Building Code.

E. Under Slab Water Vapor Retarder: Vapor retarder sheet to be ASTM E1745 Class A; 15 mil, single ply extruded polyolefin; permeance no greater than 0.01 U.S. Perms per ASTM E154, ASTM E96 procedure B or ASTM F1249.

1. “Stego Wrap Vapor Barrier (15mil)” by Stego Industries LLC.
2. “Vaporguard” by Reef Industries.

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3. Approved Equal.

F. Evaporation Reducer: "MasterKure ER 50", by Master Builders Solutions.

G. Permeability Reducer: Use only where specifically referred to.

1. ASTMC494 Type S.
2. Admixture Type: Xypex Chemical Corporation "XYPEX Admix C-500", Master Builders Solutions "MasterLife 300" series. Dosage: per manufacturer.
3. Surface-Applied Type: Xypex Chemical Corporation "XYPEX Concentrate. Brush application: 1.25-1.50lb/sq. yd., 5 parts powder to 2 parts water. Master Builders Solutions "MasterSeal 500". Slurry coat: one part water to 2.25-2.5 parts powder by volume.
4. Approved equal.

2.5 JOINT DEVICES AND MATERIALS

A. Waterstops: Resilient type, meeting Corps of Engineers CRD-C 572. Consult manufacturer for appropriate product for specific use. Submit for review. Install per manufacturers recommendation. Provide W. R. Meadows "Seal Tight" PVC waterstop, Sika "Greenstreak" PVC waterstop, or approved equal.

B. Expansion Joint Filler: ASTM D1751, Nonextruding, resilient asphalt impregnated fiberboard or felt, 3/8 inch thick and 4 inches deep; tongue and groove profile.

1. Products: "Serviced Products", W.R. Meadows, Inc., "National Expansion Joint Company", "Celotex Corporation", or equal.

C. Joint Filler: ASTM D944, Compressible asphalt mastic with felt facers, 1/4 inch thick and 4 inches deep.

D. Sealant and Primer: As specified in Section 07 9000.

E. Slab Joint Sealant: Compatible with floor finishes specified in related sections.

2.6 CONCRETE MIXES

A. General requirements for mix design and submittal of structural class concrete:

1. Provide Contractor submittals to Architect/Engineer not less than 15 days before placing concrete.
2. Contractor shall review mix designs and proposed placing requirements prior to submittal for compatibility to ensure that the concrete as designed can be placed in accordance with the drawings and specifications.

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3. Changes or revisions require re-submittal: All variations to approved mix designs, including changing type and/or quantity of admixtures shall be resubmitted to the Architect/Engineer for review prior to use.
4. Mix design(s) for all structural classes of concrete to be prepared by qualified person experienced in mix design. Allow for time necessary to do trial batch testing when required.
5. Preparer to provide backup data and certify in writing that mix design meets:
   a. Requirements of the specifications for concrete durability and quality;
   b. Requirements of the California Building Code and ACI CODE-318, including break histories, trial batching test results, and/or a mix designed by a California Registered Civil Engineer per ACI CODE-318 and bearing the Engineer's seal & signature.
6. Clearly note on mix designs with specified maximum W/CM if design permits addition of water on site, or clearly identify in the mix design that no water is to be added on site.
7. Deviations: Clearly indicate proposed deviations, and provide written explanation explaining how the deviating mix design(s) will provide equivalent or better concrete product(s) than those specified.
8. Include adjustments to reviewed mix designs to account for weather conditions and similar factors.

B. Proportioning - General: The following provisions apply to all mix designs:

1. Proportion concrete mixes to produce concrete of required average strength (as defined by ACI CODE-318). Select slump, aggregate sizes, shrinkage, and consistency that will allow thorough compaction without excessive puddling, spading, or vibration, and without permitting the materials to segregate, or allow free water to collect on the surface.
2. Select aggregate size and type to produce dense, uniform concrete with low to moderate shrinkage, free from rock pockets, honeycomb and other irregularities.
3. Mix designs may include water reducing and retarding admixtures to meet or exceed minimum set times (time required to place and finish) and to minimize Water-Cementitious Materials (W/CM). Minimum and maximum criteria presented in this section are guidelines and do not represent a specific mix design.
4. Cement Content: Minimum cement content indicates minimum sacks of cementitious material. Increasing cement content to increase early strengths or to achieve specified W/CM while maintaining water content is discouraged in order to minimize effects of shrinkage.
   a. Substitution of fly ash for Portland cement on an equivalent weight basis up to 25% replacement is permitted, except at high early strength concrete. Replacement in excess of 25% is not permitted unless part of a specified mix design that has been submitted for review.

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b. Substitution of slag cement for Portland cement on an equivalent weight basis up to 45% replacement is permitted, except at high early strength concrete. Replacement in excess of 45% is not permitted unless part of a specified mix design that has been submitted for review.
c. Such substitution requests may be denied by the Engineer.

5. Water Content: Mix designs with a specified maximum W/CM may be designed with a lower WCR than specified in order to allow addition of water at the site.
6. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI SPEC-301 and this section.
   a. For trial mixtures method, employ independent testing agency acceptable to Architect/Engineer for preparing and reporting proposed mix designs.
7. Placement Options: Mix designs may, at the Contractor's option, be designed for either pump or conventional placement with aggregate size, slumps, etc. to be maintained as specified in this section.

C. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations and this section.

D. Special mix design requirements for interior concrete floor slabs-on-ground:

1. Proportion concrete mixes per this specification, ACI PRC-211.1, and the requirements below:
2. Fly Ash, shall be substituted for cement on a 1 lb. per 1 lb. basis, with a minimum replacement of 25% and a maximum of 35%. Alternatively, slag cement, shall be substituted for cement on a 1 lb. per 1 lb. basis, with a minimum replacement of 30% and a maximum of 45%.
3. 200 lbs. of 3/8(-) aggregate shall be added to reduce total sand.
4. Reduce total sand to minimum practical.
5. Admixture dosage shall be per manufacturer’s recommendations. Dosage may be increased for workability as long as set times are not excessive for placement and finishing.

E. Special mix design requirements for high volume fly ash concrete:

1. Proportion concrete mixes per this specification, ACI PRC-211.1, and the requirements below:
2. Fly Ash shall be substituted for cement on a 1 lb. per 1 lb. basis, with a replacement of 50%.
3. Minimum strength at 28 days to be 2500 psi; minimum strength at 56 days to be 3000 psi.
4. Add 200-300 pounds 3/8” aggregate to replace portion of fine aggregate.

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5. Admixture dosage shall be per manufacturer's recommendations. Dosage may be increased for workability as long as set times are not excessive for placement and finishing.
6. Concrete shall be wet cured per CONCRETE CURING.

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F. Mix Design Minimum Requirements:

Concrete Class	Coarse Aggregate Size (Inches) & Fine Aggregate[3]	Maximum W/CM or Maximum Nominal Slump & Tolerance (Inches)[1,2]	Minimum 28-Day Design Strength	Minimum Cement Sacks/per yd[4]
NON-STRUCTURAL				
1) Lean Concrete (use only where specified)	---	---	---	3.0
STRUCTURAL				
2) Interior Curbs, MEP pads, & Wall Infill	1" x #4	W/CM = .45	3,000	6.1

1. The tolerance is the maximum deviation allowable without rejection. The mix design shall be based on the nominal value specified and is without water reducing mixtures. Slump to be measured at the end of the hose.
2. The maximum W/CM is limited at time of placement as noted. No water is to be added on site such that the specified W/CM or maximum slump is exceeded without approval of the testing laboratory and the Architect/Engineer. Workability is to be achieved utilizing an acceptable mid range to high range water reducing admixture.
3. Gradation of aggregate is per ACI CODE-318 and ASTM C33.
4. Minimum cement content includes all cementitious materials.
5. See Article 2.6E for additional requirements at interior slabs on ground.
6. See article 2.6F for additional requirements at high volume fly ash concrete.

2.7 MIXING CONCRETE

A. Batch final proportions in accordance with approved mix designs. All adjustments to approved proportions, for whatever reason, shall be reviewed by the Architect/Engineer prior to use.

B. Batch and mix concrete in accordance with ASTM C94, at an established plant. Site mixed concrete will be rejected.

C. Provide batch and transit equipment adequate for the work. Operate as necessary to provide concrete complying with specified requirements.

D. Place mixed concrete in forms within 1-1/2 hours from the time of introduction of cement and water into mixer or 300 revolutions of the drum whichever comes first. Use of, re-mixing, and/or tempering mixed concrete older than 1 hour will not be permitted.

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E. Do not add water at the site to concrete mixes with a maximum specified W/CM unless the water content at batch time provides for a W/CM less than specified and this provision, including the quantity of water which may be added at the site, is specifically noted on the mix design and certification by the mix preparer. See ASTM C94 for additional requirements.

2.8 SOURCE QUALITY CONTROL

A. Services by independent Testing Agency:

1. Batch Plant Certificates: Obtain the weighmaster's Batch Plant Certificate at arrival of truck at the site. If no batch plant certificate is provided, recommend to the General Contractor that the truckload of concrete be rejected. So note in daily log, along with the location of the load of concrete in the structure if the load is not rejected.
   a. Laboratory's inspector shall obtain for each transit mixer Batch Plant Certificates to verify mix design quantities and condition upon delivery to the site.
   b. Certificates to include: Date, time, ingredient quantities, water added at plant and on job, total mixer revolutions at time of placement, and time of departure.
   c. Concrete with specified water cement ratio: Add no water on site unless mix design and batch records each show additional water may be added. See ASTM C94 for additional requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

B. Verify work of other sections is complete and tested as required before proceeding.

3.2 PREPARATION

A. Observation, Inspection and Testing:

1. Architect/Engineer: Notify not less than 2 working days before each concrete placement, for observation and review of reinforcing, forms, and other work prior to placement of concrete.
2. Testing Agency: Notify not less than 24 hours before each placement for inspection and testing.

B. Placement Records: Contractor shall maintain records of time, temperature and date of concrete placement including mix design and location in the structure. Retain records

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until completion of the contract. Make available for review by Testing Agency and Architect/Engineer.

C. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

D. Verify location, position and inclusion of all embedded and concealed items.

E. Verify installation of vapor retarder under interior slabs on ground, as specified in related section, is complete.

F. Cleaning and Preparation:

1. Remove loose dirt, mud, standing water, and foreign matter from excavations and cavities.
2. Close cleanout and inspection ports securely.
3. Thoroughly clean reinforcement and other embedded items free from loose rust and foreign matter. Maintain reinforcing securely in place. Do not place concrete on hot reinforcing.
4. At cold joints, remove laitance from previously placed concrete surface.
5. Dampen form materials and substrates on which concrete is to be placed at least 1 hour in advance of placing concrete; repeat wetting as necessary to keep surfaces damp. Do not saturate. Do not place concrete on saturated material.
   a. Thoroughly wet wood forms (except coated plywood), bottom and sides of trenches, adjacent concrete or masonry and reinforcement.
   b. Concrete slabs on base rock, dampen rock.
   c. Concrete slabs on vapor retarder, do not wet vapor retarder.
6. Verify that metal forms are clean and free of rust before applying release agent.
7. Thoroughly clean metal decking. Do not place concrete on wet deck surface.
8. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

G. Drill holes in existing concrete at locations where new concrete is doweled to existing work. Insert steel dowels and prepare connections as detailed.

H. Do not overcut at existing concrete work to remain. Contractor is responsible for repair/replacement of overcut concrete to the Owner’s satisfaction.

3.3 PIPES AND CONDUITS IN CONCRETE

A. Slabs-on-Ground:

1. No pipe or conduit exceeding 1 inch outside diameter shall be embedded within the specified slab thickness except as specifically detailed.
2. Do not stack or abut pipes, maintain 3 inches minimum clearance.

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B. Sleeving and Wrapping:

1. Foundations: Sleeve or wrap all individual pipe penetrations, minimum 1-1/2 inches clear to reinforcing all around.
   a. Sleeves: PVC. Provide 1 inch minimum clear all around O.D. pipe to I.D sleeve, UNO at ends, fill void space with mastic or plastic bituminous cement.
   b. Wrapped Vertical Pipes: Provide 1/8 inch nominal sheet foam with three wraps minimum, UNO.
   c. Wrapped Horizontal Pipes: Provide 1/8 inch nominal sheet foam with eight wraps minimum, UNO.
   d. Underground Fire Lines 4" and Larger: At sleeves provide 2 inch minimum clear all around O.D. pipe to I.D sleeve. At wrapped pipes, provide 1/8 inch nominal sheet foam with sixteen wraps minimum.
2. Slabs or Curbs: Wrap pipes as described above.

C. Space groups of pipes/conduits at least 3 sleeve diameters apart, do not interrupt specified concrete and reinforcement.

1. Provide block-outs as detailed when grouping of pipes/conduits in foundation or other structural member prevents spacing as described. Notify Architect/Engineer for review of any conditions not conforming to details.
2. Center pipe/conduit penetrations in the depth and/or thickness of foundations.
3. Maximum size of pipe/conduit penetrations shall not exceed the least dimension of concrete divided by 3.

D. Do not embed pipes/conduits in concrete slabs on metal deck.

E. Provide the following at pipes/conduits detailed to be embedded in a concrete beam, wall or column:

1. Place as near as possible to center of member with reinforcing as specified on each side.
2. Where reinforcing is located near or at center of member, place pipe or conduit 1 inch minimum clear from reinforcing and provide #3 at 12 inches on center perpendicular to the pipe/conduit. Reinforcing to extend 12 inches minimum past pipe/conduit each side.
3. Maintain ¾ inch clear minimum from added reinforcing to face of concrete where not exposed to weather and 1-1/2 inches clear where exposed to weather.
4. Space embedded items (groups of pipe/conduit, junction boxes or other elements) minimum 3 inches apart.

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5. Provide reinforcing in walls, beams, columns as detailed for groups of pipe/conduit. Provide minimum replacement reinforcement of same size and number for interrupted or displaced reinforcement for the full height, length, width of the wall, beam, and/or column on each side of the “effective opening.”

3.4 CONCRETE PLACEMENT

A. Transporting:

1. Provide clean, well-maintained equipment of sufficient quantity and capacity to execute the work and produce concrete of quality specified.
2. Handle and transport concrete from mixer to final deposit location as rapidly as practicable. Prevent separation or loss of ingredients.

B. Perform concrete placement by methods which will not puncture, damage or disturb vapor retarder membrane. Repair all damage to vapor retarder membrane before covering.

C. Placement - General: Placement, once started, shall be carried on as a continuous operation until section of approved size and shape is completed. Provide construction joints as detailed on the drawings. Engineer's written approval required for all deviations.

1. Deposition:
   a. Deposit concrete to maintain an approximately horizontal plastic surface until the completion of the unit placement.
   b. Deposit as neatly as practicable in final position, minimize re-handling or flow.
   c. Do not drop concrete freely where reinforcing bars, embeds, or obstructions occur that may cause segregation. Provide spouts, elephant trunks, or other means to prevent segregation during placement.
2. Depth: Layered placement in columns and walls shall not exceed ten feet vertical depth.
   a. Place concrete in minimum 32 inch horizontal lifts.
   b. Schedule placement to ensure that concrete will not take initial set before placement of next lift.
   c. No horizontal cold joints are allowed in columns or walls.
3. Progress Cleaning: Remove all concrete spilled on forms or reinforcing steel in portions of structure not immediately concreted. Remove completely before concrete sets.
4. Interruptions: Shut down placement operations and dispose of all remaining mixed concrete and concrete in hoppers or mixers following all interruption in placement longer than 60 minutes.

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a. If such interruption occurs, provide new or relocate existing construction joints as directed by Engineer.
b. Cut concrete back to the designated line, cleaning forms and reinforcing as herein specified.
c. Prepare for resumption of placement as for new unit when reason for interruption is resolved.

D. Placement - Elevated Structural Systems: Place as noted for "General" above and as follows:

1. Metal Decking and Structural Steel Beam Systems that are not to be shored: Locate screed lines on primary structural members. Review proposed screed line locations and expected structural deflections with the Architect/Engineer prior to placement of concrete.
2. Place screed lines to match camber of primary girders made of material other than concrete. Locate screeds to provide the minimum specified thickness of concrete at all locations.
3. Compensate for deflection of intermediate structural members and decking by placement of additional concrete.
4. Adjust embedded items to compensate for camber and deflection. Maintain locations within specified tolerances.

E. Consolidation:

1. Consolidate all concrete thoroughly during placement with high-speed mechanical vibrators and other suitable tools. Perform manual spading and tamping to work around reinforcement, embedded fixtures, and into corners of formwork as required to obtain thorough compaction.
   a. Provide vibrators with sufficient amplitude for adequate consolidation.
   b. Use mechanical vibrators at each point of concrete placement.
   c. Keep additional spare vibrators, in addition to those required for use, at the site for standby service in case of equipment failure.
2. Consolidate each layer of concrete as placed.
   a. Insert vibrators vertically at points 18 to 30 inches apart; work into top area of previously placed layer to reconsolidate, slowly withdraw vibrator to surface.
   b. Avoid contact of vibrator heads with formwork surfaces.
   c. Systematically double back and reconsolidate wherever possible. Consolidate as required to provide concrete of maximum density with minimized honeycomb.

F. Unacceptable Materials:

1. Do not place concrete that has started to set or stiffen. Dispose of these materials.

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2. Do not add water on site to concrete except as specified in the approved mix design, see PART 2 above.

G. Protection of installed work:

1. Do not introduce any foreign material into any specified drainage, piping or duct systems.
2. Contractor shall bear all costs of work required to repair or clean affected work as a result of failure to comply with this requirement.

3.5 CONCRETE JOINTS

A. Structural Joints (Construction/Cold Joints):

1. Locate joints only where shown, or as approved.
2. Review Required: Joints not indicated on the plans shall be located to meet the minimum requirements below, shall not impair the strength of the structure and shall be submitted to Architect/Engineer for review prior to placement of concrete.
   a. Indicate proposed location(s) of construction/cold/expansion joints on shop drawing submittals for review prior to placing concrete.
3. Clean and roughen all surfaces of previously placed concrete at construction joints by washing and sandblasting to expose aggregate to 1/4 inch amplitude.
4. Slabs-On-Ground: Maximum Length of continuous placement shall not exceed 60 feet without special review by the Architect/Engineer. Alternate or stagger placement sections.
5. Foundations, Beams, Elevated Slabs and Joists: Maximum Length of continuous placement shall not exceed 200 foot increments. Provide “keyed” shut-off locations made up with form boards. Extend reinforcing one lap length or more through shut-off.
   a. All reinforcement shall be continuous through construction/cold joint, lapping to adjacent reinforcing in future placement.
   b. Construction Joints in Elevated Slabs: Review all proposed locations with Architect/Engineer.
   c. Construction Joints in Slabs on Metal Decking: Review all proposed locations with Architect/Engineer. Do not locate closer than 48 inches of centerline of beam.
6. Retaining and Basement Walls: Maximum Length of continuous placement shall not exceed 100 foot increments. Provide “keyed” shut-off locations made up with form boards to limit the length of continuous placement and at abrupt changes in wall thickness. Extend reinforcing one lap length or more through shut-off.
   a. Review all proposed locations with Architect/Engineer
   b. Horizontal construction joints are not allowed unless approved by the Engineer

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7. Horizontal Construction Joints: Place 2 inch slurry (specified concrete mix less coarse aggregate) at beginning of pour at the bottom of walls unless a prior review of a mock-up section demonstrates that segregation of aggregate will not occur.

B. Expansion/Construction Joints (Dowel Joints and Control Joints):

1. Interior and Exterior Slabs-on-Ground:
   a. Expansion/Construction Joints: Provide dowel joints or control joints at a maximum dimension (in feet) of three times the slab thickness (in inches) in each direction unless noted otherwise (15'-0" maximum). Install joints to match slab level and in straight lines. Locate joints at all reentrant corners including blockouts.
   b. Proportions: Install joints to divide slab into rectangular areas with long dimensions less than 1.5 times short dimension.
2. Exterior Concrete Slabs-on-Ground (walkways, patios):
   a. Expansion/ construction joints: Provide a 2 inch deep troweled groove or asphalt impregnated joint material embedded 50 percent of the slab depth at 12 feet on center, maximum.
   b. Proportions: Place no section with a length larger than two times width. Additionally, place joints at all inside corners and at all intersections with other work.
3. Elevated Structural Slabs: Locate construction joints as specifically indicated on the drawings. All additional proposed locations shall be reviewed by the Architect/Engineer prior to placement.
4. Retaining and Basement Walls:
   a. Contraction Joints: Provide ¾ inch wide beveled wood strips attached to inside face of formwork on each side of the wall. Wood strips shall extend 1/8 times the wall thickness into the wall. Cut 50% of the horizontal reinforcing bars at contraction joint locations
   b. Proportions: Place joints at 2 times the height of the wall on center max, but not less than 10'-0". Joints shall not exceed 25'-0" on center.
   c. Review all proposed locations with Architect/Engineer

C. Joint Types:

1. Dowel Joint: A keyed joint with smooth dowels passing through to allow unrestricted movement due to contraction and expansion. Joints are as specified on the drawings.
2. Control Joint(s): Shrinkage crack control joints may be of the following types when shown on the drawings. Install joints in a straight line between end points with edges finished appropriate to type. Depth shall be 25% of the slab thickness, unless noted otherwise. Fill joints with sealant as shown on the drawings or as required by related sections.
   a. 1/4 inch wide troweled joint.

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b. Keyed joint: Only at locations where concealed by other finishes.
c. Masonite Strip, 1/8 inch: Only at locations where concealed by other finishes.
d. Saw Cut, 1/8 inch: Must be performed within eight hours of completion of finishing. Do not make saw cuts if aggregate separates from cement paste during cutting operation. Prevent marring of surface finish. Fill with flexible sealant.

3.6 VAPOR RETARDER

A. Vapor Retarder Installation: Install as specified in PART 2, ASTM E1643, and per manufacturer's recommendations including taping and lapping of seams, sealing of penetrations, and repair of damage. Do not extend vapor retarder below footings.

3.7 FLATWORK

A. General Requirements for All Concrete Formed & Finished Flat:

1. Edge Forms and Screeds: Set accurately to produce indicated design elevations and contours in the finished surface, edge forms sufficiently strong to support screed type proposed.
2. Jointing: Located and detailed as indicated.
3. Consolidation: Concrete in slabs shall be thoroughly consolidated.

B. Flatwork Schedule:

1. Exterior Slabs-On- Ground: Place concrete directly over sub-base as indicated.
   a. Sub-Base: Clean free-draining, crushed base rock, 4 inch minimum thickness, thoroughly compacted.
2. Interior Concrete Slabs-On- Ground:
   a. Sub-Base: Clean free-draining, crushed base rock, 4 inch minimum thickness, thoroughly compacted.
   b. Vapor Retarder: Install over sub-base.

3.8 FORMED SURFACES

A. Form all concrete members level and plumb, except as specifically indicated. Comply with tolerances specified in ACI CODE-318, ACI SPEC-301, and this specification, except that maximum permissible deviation is 1/4 inch end-to-end for any single member.

B. Cambers: Provide all cambers indicated in the formwork construction. Set screeds to produce specified cambers in the finished concrete.

3.9 CONCRETE FINISHES

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A. Flatwork Finishing:

1. Perform with experienced operators.
2. Finish surfaces monolithically. Establish uniform slopes or level grades as indicated. Maintain full design thickness.
3. In areas with floor drains, maintain design floor elevation at walls; slope surfaces uniformly to drains as indicated on drawings.
4. Flatwork Finish Types:
   a. Wood Float Finish: Surfaces to receive quarry tile, ceramic tile, or cementitious terrazzo with full bed setting system, or wood frame for raised finished floors.
   b. Steel Trowel Finish: Surfaces to receive carpeting, resilient flooring, seamless flooring, thin set terrazzo, thin set tile or similar finishes specified in related sections. Trowel twice, minimum.
   c. Broom Texture Finish: Exterior surfaces as indicated or for which no other finish is indicated. Finish as for steel trowel finish, except immediately following first troweling, (depending on conditions of concrete and nature of finish required) provide uniform surfaces texture using a medium or coarse fiber broom.

B. Other Concrete: Provide as required to achieve appearance indicated on structural and architectural drawings and related sections.

1. Repair surface defects, including tie holes, immediately after removing formwork.
2. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
3. Exposed Form Finish: Finish concrete to match forms. Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
   a. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
   b. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap, and keep moist for 36 hours.
   c. Cork Floated Finish: Immediately after form removal, apply grout with trowel or firm rubber float; compress grout with low-speed grinder, and apply final texture with cork float.
4. Intermediate joint and score marks and edges: Tool smooth and flush unless otherwise indicated or as directed by the Architect.
5. Use steel tools of standard patterns and as required to achieve details shown or specified. All exposed corners not specified to be chamfered shall have radiused edges.

3.10 TOLERANCES

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A. Minimum Flatwork Tolerances: Measure flatness of slabs with in 48 hours after slab installation in accordance with ACI PRC-302.1 and ASTM E1155 and to achieve the following FF and FL tolerances:

1. Exterior surfaces: 1/8 inch minimum per foot where sloped to drain. Level otherwise. FF20 and FL15.
2. Interior surfaces not otherwise shown or required: Level throughout. FF25 and FL20
3. Interior surfaces required to be sloped for drainage: 1/8 inch in 10 ft.
4. Finish concrete to achieve the following tolerances:
   a. Under Glazed Tile on Setting Bed: FF30 and FL20.
   b. Under Resilient Finishes: FF35 and FL25.
   c. Flooring manufactureer and pertainent section of Division 9.

B. Formed Surface Tolerances:

1. Permanently Exposed Joints and Surfaces: Provide maximum differential height within two feet of, and across construction joints of 1/16 inch.
2. Vertical Elevations: Elevation of surfaces shall be as shown or approved.

3.11 SEPARATE FLOOR TOPPINGS

A. Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.

B. Place required dividers, edge strips, reinforcing, and other items to be cast in.

C. Apply bonding agent to substrate in accordance with manufacturer's instructions.

D. Apply sand and cement slurry coat on base course, immediately prior to placing toppings.

E. Place concrete floor toppings to required lines and levels. Place topping in checkerboard panels not to exceed 20 feet in either direction.

F. Screed toppings level, maintaining surface tolerances per above.

3.12 CONCRETE CURING

A. Curing - General: Cure in accordance with ACI SPEC-308.1. Maintain concrete water content for proper hydration and minimize temperature variations. Begin curing immediately following finishing.

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B. Protection During Curing: Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury. The General Contractor is responsible for the protection of the finished slab from damage.

1. Avoid foot traffic on concrete for minimum of 24-hours after placement.
2. Protect concrete from sun and rain.
3. Maintain concrete temperature at or above 50 degrees F. during the first 7 days after placement. See Article ENVIRONMENTAL REQUIREMENTS.
4. Do not subject concrete to design loads until concrete is completely cured, and until concrete has attained its full specified 28-day compressive strength or until 21 days after placement, whichever is longer.
5. Protect concrete during and after curing from damage during subsequent building construction operations. See Article PROTECTION.

C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

1. Normal concrete: Not less than 7 days.
2. High early strength concrete: Not less than 4 days.

D. Begin curing immediately following finishing.

E. Surfaces Not in Contact with Forms:

1. Start initial curing as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than 3 days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
2. Begin final curing after initial curing but before surface is dry.
   a. Moisture-retaining cover: Seal in place with waterproof tape or adhesive.
   b. Curing compound: Apply in two coats at right angles, using application rate recommended by manufacturer.
3. In addition, see specific conditions noted below.

F. Slabs on Ground: Cure by one of the following methods:

1. Water Cure (Ponding): Maintain 100 percent coverage of water over floor slab areas, continuously for minimum 7 calendar days.
2. Spraying: Spray water over floor slab areas and maintain wet for 7 days.
3. Moisture-Retaining Film or Paper: Lap strips not less than 6 inches and seal with waterproof tape or adhesive; extend beyond slab or paving perimeters minimum 6 inches and secure at edges; maintain in place for minimum 7 days.

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4. Absorptive Moisture-Retaining Covering: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides and extend beyond slab or paving perimeters 6 inches minimum; maintain in place for minimum 7 days.
5. Liquid Membrane-forming Curing Compound: Provide only when subsequent concrete treatments or finish flooring specified in related sections will not be affected by cure/sealer. Apply curing compound in accordance with manufacturer's instructions at the maximum recommended application rate in two coats, with second coat applied at right angles to first.

G. Elevated Slabs: Cure by one of the following methods.

1. Moisture-Retaining Sheet: As specified for Slab on Ground above.
2. Water Cure: As specified above for minimum 14 days.
3. Apply Membrane Curing Compound as specified above after initial curing period.

H. Concrete on Metal Decking: Moisture-Retaining Sheet method as specified above.

I. Formed Concrete Members: Cure by moist curing with forms in place for full curing period.

1. Protect free-standing elements from temperature extremes.
2. Maintain forms tight for minimum 7 days. Maintain exposed surfaces continuously damp and completely covered by sheet materials thereafter.
3. Maintain all shoring in place. Refer to related sections specifying formwork.
4. Membrane Curing Compound: Apply compound in accordance with manufacturer's instructions in one coat.

J. Foundations: Apply curing compound immediately after floating.

3.13 CONCRETE HARDENER

A. Apply hardener to all floor slabs not receiving other finishes after 30 days minimum curing. Clean slabs of non-compatible cure/sealers or other foreign material(s) and apply in strict accordance with the manufacturer's directions.

3.14 GROUTING AND DRY PACK

A. Set steel plates on concrete or masonry with high strength grout bed, completely fill all voids; thoroughly compact in place. See Section 05 1200 or 05 1100.

B. Bolts or inserts dry packed or grouted in place shall cure for minimum 7 days before tensioning.

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3.15 FIELD QUALITY CONTROL

A. Testing and Inspections by Independent Testing Agency: Provided verification and inspection of concrete per CBC Table 1705.3. Provide written reports for to Engineer, Architect, Contractor and Building Official for the following tests and inspections:

B. Testing & Inspection: Provide periodic inspection of reinforcing steel. Provide continuous inspection during placement of structural class concrete, 3000 psi or more. Non-structural class concrete with a design strength of 2500 psi or less to have periodic inspection on a 150 cubic yard basis as required to assure conformance.

1. Provide periodic inspection of bolts in concrete prior to and during placement where so noted on the construction documents.
2. Structural Concrete Cylinder Tests: Form in accordance with ASTM C31.
    a. Take four standard 6 inch x 12 inch (or five 4 inch x 8 inch) cylinder specimens on the site, of each class of concrete as specified in PART 2, not less than once a day or for each 150 cubic yards or 5000 sq ft or fraction thereof placed each day.
    b. Record the location of each concrete batch in the building in a log and also note on each specimen.
    c. Perform standard compression test of cylinders in accordance with ASTM C39, one at 7 days and two (three for 4x8 cylinders) at 28 days.
    d. Hold fourth (fifth) cylinder untested until specified concrete strengths are attained.
3. Structural Concrete Slump Test and Air Tests: Perform slump in accordance with ASTM C143 and air content in accordance with C231 or C173 at the time of taking test cylinders, and/or at one-hour intervals during concrete placing.
4. Measure and record concrete temperature in accordance with ASTM C1064 upon arrival of transit mixers and when taking specimens. Note weather conditions and temperature.
5. Determine concrete density in accordance with ASTM C138 at the time of forming test cylinders.
6. Propose adjustments to reviewed mix designs for Architect / Engineer review to account for variations in site or weather conditions, or other factors as appropriate.
7. Water Vapor Transmission Tests: Floors receiving floor finishes specified in related sections will be tested prior to installation of flooring systems. Refer to sections specifying floor finishes for related requirements.

C. Services by Contractor:

1. Rejection of Concrete Materials: Do not use the following without prior written approval of the Architect/Engineer;
    a. Materials without batch plant certificates.
    b. Materials not conforming to the requirements of these specifications.

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3.16 ADJUSTING

A. Inspect all concrete surfaces immediately upon formwork removal. Notify Architect/Engineer of identified minor defects. Repair all minor defects as directed.

B. Surface and Finish Defects: Repair as directed by the Architect/Engineer, at no added expense to the Owner. Repairs include all necessary materials; reinforcement grouts, dry pack, admixtures, epoxy and aggregates to perform required repair.

1. Repair minor defective surface defects by use of drypack and surface grinding. Specific written approval of Architect/Engineer is required. Submit proposed patching mixture and methods for approval prior to commencing work.
2. Slabs-on- Ground, Elevated Slabs and on Slabs on Metal Deck: Review for "curled" slab edges and shrinkage cracks prior to installation of other floor finishes. Grind curled edges flush, fill cracks of 1/16 inch and greater with cementitious grout.
3. Grind high spots, fins or protrusions caused by formwork; Fill-in pour joints, voids, rock pockets, tie holes and other void not impairing structural strength. Provide surfaces flush with surrounding concrete.

3.17 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required compressive strength, lines, details, dimensions, tolerances, finishes or specified requirements; as determined by the Architect/Engineer.

B. Repair or replacement of defective concrete will be determined by the Architect/Engineer who may order additional testing and inspection at his option. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

C. Specific Defects:

1. "Low-Strength"; Concrete Not Meeting Specified Compressive Strength after 28 days:
   a. Concrete with less than 25% Fly Ash or 35% Slag as cementitious material: Test remaining cylinder(s) at 56 days. If strength requirements are met, concrete strength is acceptable.
   b. Concrete with 25% or more Fly Ash or 35% or more Slag as cementitious material: Test remaining cylinder(s) at 70 days. If strength requirements are met, concrete strength is acceptable.
2. Excessive Shrinkage, Cracking, Crazing or Curling; Defective Finish: Remove and replace if repair to acceptable condition is not feasible.
3. Lines, Details, Dimensions, Tolerances: Remove and replace if repair to acceptable condition is not feasible.

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4. Slab sections not meeting specified tolerances for trueness/flatness or lines/levels: Remove and replace unless otherwise directed by the Architect/Engineer. Minimum area for removal: Fifteen square feet area unless directed otherwise by the Architect/Engineer.
5. Defective work affecting the strength of the structure or the appearance: Complete removal and replacement of defective concrete, as directed by the Architect/Engineer.

3.18 CLEANING

A. Maintain site free of debris and rubbish. Remove all materials and apparatus from the premises and streets at completion of work. Remove all drippings; leave the entire work clean and free of debris.
B. Slabs to Receive Floor Finishes Specified in other sections: Remove non-compatible cure/sealers or other foreign material(s) which may affect bonding of subsequent finishes. Leave in condition to receive work of related sections.

3.19 PROTECTION

A. Protect completed work from damage until project is complete and accepted by Owner.

B. Construction Loads: Submit engineering analysis for equipment loads (including all carried loads) specified in article submittals.

C. Keep finished areas free from all equipment traffic for a minimum of 4 additional days following attainment of design strength and completion of curing.

D. Protection of Drainage Systems:

1. Care shall be taken not to introduce any foreign material into any specified drainage, piping or duct system.
2. Cost of work to repair or clean drainage system as a result of failure to comply with this requirement will be back charged to the contractor.

E. Cover traffic areas with plywood sheets or other protective devices; maintain protection in place and in good repair for as long as necessary to protect against damage by subsequent construction operations.

END OF SECTION

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SECTION 035416

HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Polymer-modified, self-leveling, hydraulic cement underlayment, that can be applied in minimum uniform thickness of 1/4 inch and that can be feathered at edges to match adjacent floor elevations, for application below interior floor coverings.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.
   1. Place hydraulic cement underlayment only when ambient temperature and temperature of substrates are between 50 and 80 deg F.

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PART 2 - PRODUCTS

2.1 HYDRAULIC CEMENT UNDERLAYMENTS

A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/4 inch and that can be feathered at edges to match adjacent floor elevations.
   1. Manufacturers: Ardex Americas, The Euclid Chemical Co., USG Corp., or equal.
      a. Basis-of-Design: Ardex “K-15 Self-Leveling Underlayment Concrete”.
   2. Cement Binder: ASTM C150/C150M, Portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C219.
   3. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C109/C109M.
   4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.

B. Water: Potable and at a temperature of not more than 70 deg F.

C. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Prepare and clean substrate according to manufacturer's written instructions.

   1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
   2. Fill substrate voids to prevent underlayment from leaking.

B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.

C. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.2 APPLICATION

A. General: Mix and apply underlayment components according to manufacturer's written instructions.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply underlayment to produce uniform, level surface.

   1. Feather edges to match adjacent floor elevations.

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D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.

E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.3 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION

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SECTION 051100

STRUCTURAL AND MISCELLANEOUS STEEL

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: All labor, materials, equipment and operations required to complete structural and miscellaneous metals in shapes and configurations indicated; including:

1. Structural steel columns, beams, bracing, base plates, bolts, joist hangers, and stud bolts welded to structural steel.

2. Miscellaneous structural steel and connections; fabricated connectors and hangers installed by related sections.

3. Anchor bolts and steel inserts embedded in concrete or masonry, installed by related sections.

4. Fabricated steel items embedded in concrete or masonry installed by related sections.

5. Supervision of anchor bolt setting, leveling and elevations to ensure required fit of steel work.

6. Shop priming and field touch-up, galvanizing.

7. Bracing, Shoring, Fabrication and Erection.

B. Related Sections:

1. Pertinent sections of Division 01 specifying Quality Control and Testing Agency services.

2. Pertinent Sections of other Divisions specifying concrete reinforcement, formwork, concrete, structural and miscellaneous metal fabrications, steel joists, metal decking, cold-formed metal framing, rough carpentry.

1.2 REFERENCES

A. California Code of Regulations, Title 24, latest adopted edition (herein noted as CBC): Chapter 22 Steel.

B. American Institute of Steel Construction (AISC) 303 “Code of Standard Practice for Steel Buildings and Bridges”.

C. AISC 360 “Specification for Structural Steel Buildings”.

D. American Welding Society (AWS) D1.1 “Structural Welding Code - Steel”.

E. Underwriters Laboratories (UL) FRD “Fire Resistance Directory”.

1.3 SUBMITTALS

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A. Submit in accordance with pertinent sections of Division 01 specifying submittal procedures. The General Contractor shall review and approve shop drawings prior to submittal to the Architect/Engineer. Submittals that do not meet these requirements will be returned for correction without review.

B. Limitation of Review: Structural Engineer's review will be for general conformance with design intent as indicated in the Contract Documents and does not relieve Contractor of full responsibility for conformance with the Contract Documents.

C. Product Data: Submit manufacturer's product data, specifications, location and installation instructions for proprietary materials and reinforcement accessories. Provide samples of these items upon request.

D. Shop drawings: Submit each building as a complete unit. Do not mix components from multiple buildings or units of work in a submittal. Include all of the following;

1. Profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.

2. Fabrication tolerances for all steel.

3. Connections: All, including type and location of shop and field connections.

4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths, type, size, and sequence. Designate demand critical welds.

5. Cross-reference all shop drawing detail references to contract document detail references.

6. Secure all field measurements as necessary to complete this work prior to submitting shop drawings for review.

7. Provide holes, welded studs, etc. as necessary to secure work of other sections.

8. Provide the following as separate submittals for each building or unit of work:

a. Bolt and anchor setting plans.

b. Layout, fabrication and erection drawings.

E. Certifications:

1. Steel Materials: Submit the following for identified materials.

a. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.

b. Mill Test Reports: Indicate structural strength, destructive test analysis, and non-destructive test analysis.

c. Contractor's affidavit certifying that all identified steel materials provided are of the grades specified and match the certificates supplied.

2. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification per AWS D1.1.

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F. Samples: Provide samples to the Testing Agency as specified in Article SOURCE QUALITY CONTROL, at no additional costs.

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies, refer to pertinent sections of Division 01 and CBC Chapter 17.

B. All tests shall be performed by a recognized testing agency as specified in pertinent sections of Division 01.

C. Certification and Identification of Materials and Uses: Provide Testing Agency with access to fabrication plant to facilitate inspection of steel. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection and all material identification/test information listed below.

1. Test all steel as required by ASTM A6.

2. Provide manufacturer's Mill Test Reports for all materials. Include chemical and physical properties of the material for each heat number manufactured. Tag all fabricated materials with heat number.

3. Provide letter certifying all materials supplied are from heat numbers covered by supplied mill certificates. Include in letter the physical location of each material type and/or heat number in the project (i.e. walls, braced frames etc.).

4. Unidentified Material Tests: Where identification of materials by heat number or mill tests cannot be made, Owner's Testing Agency shall test unidentified materials.

5. Provide all certification, verifications, and other test data required to substantiate specified material properties at no additional cost to the Owner.

D. Testing and Inspection: Tests and Inspections performed by Independent Testing Agency are specified below in Articles SOURCE QUALITY CONTROL and FIELD QUALITY CONTROL. Duties and limitations of Independent Testing Agency, test costs and test reports in conformance with pertinent sections of Division 01.

E. The following standards are the minimum level of quality required. Provide higher quality work as specifically indicated in the Contract Documents.

1. Workmanship and details of structural steel work shall conform to the CBC and AISC 360.

2. The quality of materials and the fabrication of all welded connections shall conform to AWS D1.1.

3. Comply with Section 10 of AISC 303 for architecturally exposed structural steel.

F. The Testing Agency will review all submittals and testing of materials.

G. All re-inspections made necessary by non-conforming work shall be at the Contractor's expense.

1.5 DELIVERY, STORAGE AND HANDLING

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A. Deliver materials to project site in bundles marked with durable tags indicating heat number, mill, member size and length, proposed location in the structure and other information corresponding with markings shown on placement diagrams.

B. Handle and store materials above ground to prevent damage, contamination or accumulation of dirt or rust.

1.6 SCHEDULING AND SEQUENCING

A. Organize the work and employ shop and field crew(s) of sufficient size to minimize inspections by the Testing Agency.

B. Provide schedule and sequence information to Testing Agency in writing upon request. Update information as work progresses.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel W Shapes: ASTM A992 Gr. 50 or ASTM A572 Gr. 50.

B. Structural Steel Plates: ASTM A36 or ASTM A572 Gr. 50 or ASTM A529 Gr. 50

C. Structural Steel Channels, Angles: ASTM A36 or ASTM A572 Gr. 50.

D. HSS (Hollow Structural Sections):

1. Round: ASTM A500, Gr. C.

2. Rectangular or Square: ASTM A500, Gr. C.

E. Pipe: ASTM A53, Grade B.

F. Bolts, Nuts, and Washers: ASTM A307 Grade A machine bolts with ASTM A563 Grade A nuts and ASTM F844 washers to match. See FINISHES section for galvanization, where required.

G. Anchor Bolts/Rods, Nuts, and Washers: ASTM F1554 Gr. 36 or 55 with ASTM A563 Grade A nuts and ASTM F436 Type 1 washers. Grade DH nuts where Grade 105 rod is specified. No upset thread allowed.

H. Arc-Welding Electrodes: AWS Standards E70 or equivalent, except no E70T-4 allowed.

I. Other Welding Materials: AWS D1.1; type required for materials being welded.

J. Welded Headed/Threaded Studs: AWS D1.1 Type B.

K. Deformed Bar Anchors: ASTM A1064.

2.2 ACCESSORIES

A. High Strength Grout: ASTM C1107, non-shrink, premixed compound consisting of aggregate, cement, and water reducing plasticizing agents. Minimum compressive strength f'c = 7000 psi at 28 days, placed in a "fluid" state. Non-metallic where exposed to view. BASF "MasterFlow 928" or equivalent.

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B. Building Structural Steel Primers: Comply with local VOC limitations of authorities having jurisdiction and the California Green Building Code. Verify compatibility with finish coats specified in other sections. Follow manufacturers printed instructions. Apply one coat unless otherwise directed.

1. Type A: Self-Crosslinking Hydrophobic Acrylic passing 2000 hours ASTM D4585 and 7000 hours ASTM D5894. "Series 115 Uni-Bond DF" by Tnemec (2.0 to 4.0 mils DFT).

2. Type B: Organic Zinc-Rich Urethane passing 50,000 hours ASTM B117 and 15000 hours ASTM G85. "Series 90-97 Tneme-Zinc" by Tnemec (2.5 to 3.5 mils DFT) or "Series 94-H20 Hydro-Zinc" by Tnemec (2.5 to 3.5 mils DFT).

3. Type C: MIO-Zinc Filled Urethane passing 10,000 hours ASTM B117 and 5000 hours ASTM D4585. "Series 394 PerimePrime" by Tnemec (2.5 to 3.5 mils DFT).

C. Galvanizing: ASTM A153 and A123.

D. Touch-Up Primer for Galvanized Surfaces: Type B primer.

2.3 FABRICATION

A. Shop fabricate to greatest extent possible.

B. Continuously seal built up members by continuous welds where exposed to weather.

C. Fabricate connections for bolt, nut, and washer connectors.

D. Protect all materials, before and after fabrication, from rust, corrosion, dirt, grease, and other foreign matter.

E. Fabricate framing members free from twists or bends. Form holes, cut and sheared edges neatly without kinks, burrs, or warped edges.

F. Exposed Steel: Straight, smooth, free of nicks, scars or dents.

G. Gas Cutting: Gas cutting of holes in a member shall not be permitted.

H. Splicing of members: Members requiring splicing due to length requirements may be spliced using full penetration butt welds when such welds and procedures are inspected and certified by the Testing Agency, in conformance with AWS and AISC standards. The location of splices shall be approved by the Architect/Engineer in writing prior to fabrication.

I. Welding: Welding of structural steel connections shall be performed by qualified welders in accordance with AWS Standards. All weld sizes shall match those shown on the drawings.

1. Preparation: Clean all surfaces free of rust, paint and all foreign matter. Remove paint or scale by brushing, chipping or hammering as required. Chip clean and wire brush burned or flame cut edges before welding. Space and alternate welds, clamping as necessary to prevent warp or misalignment.

2. Sequence Welding: When welds enclose, or partially enclose, the perimeter or portion of the surface of a member, make weld bead in sequence, or staggered. Minimize internal stresses. Weld groups of members occurring in a single line in staggered sequence to minimize distortion of the structural frame.

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3. Faulty and Defective Welding: Welds failing to meet AWS standards and the Contract Documents shall be rejected and remade at Contractor expense. All welds showing cracks, slag inclusion, lack of fusion, bad undercut or other defects, ascertained by visual or other means of inspection shall be removed and replaced with conforming work.

4. Minimum Weld Strengths: All welds shall match the minimum weld sizes recommended by AISC. Details of fabrication not specifically shown shall match similar details which are specifically shown. All bevel and groove welds shall be full penetration unless size is noted otherwise.

5. Threaded studs, headed studs, and deformed bar anchors shall be full-fusion welded conforming to ASW D1.1.

J. Camber: Fabricate all beams cambered as indicated on the drawings.

1. Fabricate beams without camber for installation with any "natural" crown up.

2. Exception: Fabricate cantilever beams with "crown" down.

K. Grinding: Grind smooth the following structural steel and connections;

1. Exposed cut ends of structural and fabricated shapes.

2. All welds exposed to view.

3. Mitered and fit-up corners and intersections.

L. Back-Up Bars: Required for all complete penetration welds.

M. Bolt Holes: Edge, end distances and spacing shall conform to dimensions shown on the drawings, and as follows;

1. Round: Size indicated and 1/16 inch maximum oversize, except 1 inch and larger bolts may have 1/8 inch maximum oversize.

2. Slotted: At locations specifically noted on the drawings, provide size indicated and 1/16 inch by 1/4 inch oversize slotted in direction perpendicular to applied loads.

3. Holes in base plates for anchor bolts may be 1/8 inch oversize.

N. Comply with Section 10 of AISC 303 for architecturally exposed structural steel (AESS). See architectural & structural drawings for locations of AESS.

2.4 FINISHES

A. Steel exposed to inclement atmospheric conditions or weather (such as coastal moisture or seasonal rain) shall be sufficiently primed or otherwise protected against corrosion. If condition of steel is suspect due to weathering/corrosion, Contractor shall bear cost of inspection to determine if excessive corrosion is present and if steel member(s) requires repair or replacement. Contractor shall bear cost of repair or replacement.

B. Prepare and finish structural and miscellaneous steel component surfaces as follows, unless a higher standard-of-care is determined necessary per item A:

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1. Unpainted, interior, dry exposure surfaces need not be primed.

2. Finished painted, interior, dry exposure surfaces:

   a. Surface Preparation: SSPC-SP2 Hand-Tool and/or SP3 Power-Tool Cleaning. Apply Primer Type A. Field touchup with same primer.

   b. Where jobsite exposure is expected to exceed 6 months, SSPC-SP6 / NACE No. 3 Commercial Blast-Cleaning is required. Apply Primer Type B or C. Field touchup with same primer.

3. Finish painted surfaces with exterior exposure, interior exposure subject to wet conditions or fumes, or surfaces to receive high performance finish coatings (for example epoxy or urethane coatings.

   a. Surface Preparation: SSPC-SP6 / NACE No. 3 Commercial Blast-Cleaning to create a dense, uniform angular surface profile of 2.0 mils minimum. For severe (immersion) exposure, SSPC-SP10 / NACE No. 2 Near-White Blast-Cleaning is required.

   b. Apply Primer Type B. Field touchup with same primer.

4. Surfaces to be fire proofed need not be primed unless required by the fireproofing manufacturer or if jobsite exposure is expected to be inclement per item A. Where unprimed steel is to receive fireproofing, prepare steel surface as required by fireproofing manufacturer. If fireproofed surfaces are to be primed, provide primer as follows:

   a. Surface Preparation: SSPC-SP3 Power-Tool Cleaning.

   b. Apply Primer Type C. Field touchup with same primer.

5. Exterior exposed (unpainted) surfaces and as otherwise indicated to receive galvanizing:

   a. Galvanize per ASTM A123 Class 55 minimum. Passivation agents are not permitted on galvanized metal that is to be painted. Provide vent holes per ASTM A385 at closed sections (such as HSS). Submit proposed location of vent holes for review by Engineer.

   b. Connection hardware shall be hot-dip galvanized per ASTM A153 or F2329. Mating bolts and nuts shall receive the same zinc-coating process.

   c. Repair all uncoated, damaged, or altered galvanized surfaces per ASTM A780.

C. Do not prime the following surfaces unless otherwise indicated:

   1. Connections to be field welded.

   2. Steel in contact with concrete.

   3. Surfaces to receive welded metal decking.

D. Do not cover up work with finish materials until inspection is complete and work is approved by the Testing Agency.

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2.5 SOURCE QUALITY CONTROL

A. An independent Testing Agency will perform source quality control tests and submit reports, as specified in pertinent sections of Division 01.

B. Steel Materials Testing:

1. No testing is required for materials identified in accordance with CBC 2202.1 (heat number, grade stencil, etc.).

2. Unidentified steel- General: Test all structural shapes. In addition, test to verify Fy and Fu values when engineering requirements exceed Fy = 25 ksi for design.

C. Shop Welding Inspection:

1. Testing Agency shall inspect and certify all structural welds, unless the fabricating shop has been accredited in conformance with CBC requirements. Submit certification to the Architect/Engineer for review and the Building Official for approval.

2. Welder Qualifications: Welding inspector shall verify that all the welders are properly qualified prior to steel fabrication and state the qualifications of each welder in the welding inspection report.

3. Welding Inspection: Continuous inspection required unless otherwise noted below. Comply with requirements of AWS D1.1.

a. Welding Inspector shall check all welds, materials, equipment and procedures.

b. Welding Inspector shall provide reports certifying the welding is as required and has been done in conformity with the plans, specifications and codes.

c. Welding Inspector shall use radiographic, ultrasonic, magnetic particle, or any other necessary aid to visual inspection to assure adequacy of welds.

4. Periodic Inspection Acceptable:

a. Single pass fillet welds not exceeding 5/16 inch.

D. Bolts, Nuts, and Washers: Provide samples to Testing Agency for required testing, at no additional cost.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.2 ERECTION

A. Erect structural steel in compliance with AISC 303.

B. Framing:

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1. Erect all structural steel true and plumb.

2. Verify proper final alignment prior to making final connections.

C. Field Connections:

1. Workmanship of field bolted and welded connections shall conform in all respects to methods and tolerances specified for fabrication.

2. Field weld components indicated on shop drawings. Sequence field welds to minimize built-up stress and distortion of the structural frame. Verify sequence with Engineer. Coordinate field welding schedule with Testing Laboratory.

3. Welded Studs: Install in accordance with manufacturer's instructions and structural welding code AWS D1.1.

D. Templates: Provide bolt setting templates for all anchor bolts. Provide instructions for the setting of anchors and bearing plates, verify these items are set correctly as work progresses.

E. Column base plates: Set level to correct elevations, support temporarily on steel wedges, shims, or leveling nuts where shown, until the supported members are plumbed and base plate is grouted.

1. Grout solid the full bearing area under base plates prior to installation of floor and/or roof decks.

2. Comply with manufacturer's instructions for high strength grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees, or form edges vertical 1in-2in away from base plate edges. Top of grout outside of base plate footprint shall not extend higher than bottom of base plate.

F. Bolting:

1. Inspect mating surfaces to ensure that bolt head and nut will have full bearing and that metal plies will mate flush between bolts.

2. Install bolts in matching holes. Do not distort metal or enlarge holes by drifting during assembly. Remake mismatched components to achieve tolerances indicated.

3. Holes mismatched in excess of 1/8 inch will be rejected.

4. Holes mismatched less than 1/8 inch may be reamed to the next larger size bolt.

5. Do not enlarge holes by flame cutting or air/arc (“plasma“) cutting.

6. Provide flat washer(s) at over-size holes.

7. Provide washer at bolt head and nut where connected part is less than ¼ inch thick.

8. Provide ASTM F436 beveled washers when the slope of the surfaces of parts in contact with the bolt head or nut is greater than 1:20.

9. Do not install bolts with damaged threads.

10. Threads shall commence outside of the shear plane.

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11. Machine Bolts (MB): Install and tighten to a snug condition (ST) such that laminated surfaces bear fully on one another, using an impact wrench or “full effort” of an installer using a standard spud wrench.

G. Supports, Shoring and Bracing: Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing. Conform to requirements of all applicable laws and governing safety regulations. Resist imposed loads, including those of stored materials and equipment.

1. Provide all temporary supports, shoring and bracing necessary to achieve work of tolerances indicated.

2. Provide all necessary temporary flooring, planking and scaffolding required for erection of steel, and support of erection machinery.

3. Construction Loading: Do not overload the structure or temporary supports with stored materials, equipment or other loads.

4. Maintain temporary bracing and shoring until work is complete, and longer as required to ensure stability and safety of structure.

H. Do not make final connections until structure is aligned to meet specified tolerances.

3.3 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. The independent Testing Agency will perform field quality control tests, as specified in pertinent sections of Division 01.

B. Field Welding Inspection: Conform to all requirements of section SOURCE QUALITY CONTROL.

1. Inspect mating surfaces.

2. Test all materials prior to use. Use only materials meeting specified requirements.

3.5 ADJUSTING

A. Touch-up damaged finishes with compatible specified primer.

B. Replace defective or damaged work with conforming work. Replace all defective work at Contractor's expense.

C. Straighten materials by means that will not injure the materials.

D. Replace defective or damaged work which cannot be corrected in the field with new work, or return defective items to the shop for repair.

E. Architect/Engineer shall review all proposals for the repair or replacement of damaged, defective, or missing work.

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F. Pay expenses incurred by Owner for Architect/Engineer's costs for (re-)design and obtaining approvals of Authorities Having Jurisdiction (AHJ) necessitated by incomplete, inefficiently scheduled, improperly performed, defective or nonconforming work, as specified in pertinent sections of Division 01.

G. Pay expenses due to re-testing and re-inspection necessitated by incomplete, inefficiently scheduled, improperly performed, defective or nonconforming work, as specified in pertinent sections of Division 01.

3.6 CLEANING AND PROTECTION

A. Clean all surfaces upon completion of erection; leave free of grime and dirt. Remove unused materials, tools, equipment and debris from the premises and leave surfaces broomed clean.

B. Protect work from damage by subsequent operations.

END OF SECTION

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SECTION 054000

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. All design and other services, material, labor and equipment as necessary for the fabrication, erection and completion of all cold formed metal framing including all bracing and shoring required for erection, miscellaneous metal, and related work.

B. Related Sections:

1. Pertinent Sections of Division 01 Specifying Quality Control and Testing Agency Sections.

2. Pertinent Sections of Division 05 Specifying Structural Steel.

1.2 REFERENCE STANDARDS

A. California Code of Regulations, Title 24, latest adopted edition (herein noted as CBC): Chapter 22 Steel.

B. American Iron and Steel Institute (AISI) S100 “North American Specification for the Design of Cold-Formed Steel Structural Members”.

C. AISI S200 “North American Standard for Cold-Formed Steel Framing – General Provisions”.

D. AISI D100 “Cold-Formed Steel Design Manual.

E. American Welding Society (AWS) D1.3 “Structural Welding Code – Sheet Steel”

F. American Society for Testing and Materials (ASTM):

1. ASTM A307 “Stand Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength”.

2. ASTM A606 “Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance”.

3. ASTM A653 “Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process”.

4. ASTM A780 “Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings”.

5. ASTM A1003 “Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members”.

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6. ASTM A1008 “Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable”.

7. ASTM A1011 “Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength”.

8. ASTM C645 “Standard Specification for Nonstructural Steel Framing Members”.

9. ASTM C754 “Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products”.

10. ASTM C955 “Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases”.

11. ASTM C1007 “Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories”.

12. ASTM C1513 “Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections”.

G. The Society for Protective Coatings (SSPC) SSPC-Paint20 “Zinc-Rich Coating (Inorganic or Organic)”.

H. National Institute of Standards and Technology (NIST) / Engineered Wood Association (APA) “PS 1 - Voluntary Product Standard for Structural Plywood”.

I. NIST / APA “PS 2 - Performance Standard for Wood-Based Structural-Use Panels”.

1.3 SUBMITTALS

A. Manufacturer's Literature:

1. Descriptive data illustrating cold-formed framing system components including framing members, fasteners, and accessories, including ICC-ES reports.

2. Erection instructions containing sequence of operations.

B. Samples: Provide adequate samples of unidentified material to the Owner's Testing Laboratory for testing purposes.

1.4 QUALITY ASSURANCE

A. Erector Qualifications:

1. Minimum of three years successful experience on comparable cold-formed metal framing projects.

2. Welders qualified in accordance AWS D1.3.

B. Cold form carbon and low alloy steel used for structural purposes shall be identified per CBC Section 2202.1.

C. Welding inspections shall conform to AWS D1.3 and CBC 1705.2.

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D. Wood product quality standards:

1. All wood products to comply with article REFERENCES.

2. Factory-mark each piece of sheathing with type, grade, mill, and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.

3. Sheathing panels to be marked by APA (The Engineered Wood Association).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent requirements of Division 01.

B. Delivery: Time delivery and installation of carpentry products to avoid delaying other trades whose work is dependent on or affected by this section and to comply with moisture content, protection and storage requirements.

C. Keep materials dry at all times. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and sheathing panels to prevent deformation and provide air circulation within stacks.

1. Store materials for which a maximum moisture content is specified only in areas where relative humidity has been reduced to a level where specified moisture content can be maintained.

2. Handle and store materials above ground to prevent damage, contamination, or accumulation of dirt or foreign materials.

D. Provide special protection for horizontal sheathing panels. Deformation of panels due to moisture is not acceptable.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Framing System:

1. All stud and/or joist framing members shall be of the type & size as shown on the plans and reviewed shop drawings. Framing member section properties (thickness, dimensions, area, section modulus, and moment of inertia) shall match those per AISI D100 unless noted otherwise on drawings.

2. All runner and end tracks, bridging, and non-load bearing studs shall be of the type & size shown on the plans.

3. All studs, joists, and tracks 54 mils or greater in thickness shall be formed from steel that corresponds to the requirements of ASTM A1003 (Grade ST50H or ST50L) with a minimum yield of 50,000 psi.

4. All studs, joists, track, bridging, U-channel, (hat) furring (F) channels, and accessories 43 mils or thinner in thickness shall be formed from steel that corresponds to the requirements of ASTM A1003 (Grade ST33H or ST33L) with a minimum yield of 33,000 psi.

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5. All stud and joist components shall be formed from steel having a minimum G-60 galvanized coating (equivalent coatings such as “G60e” are not acceptable), unless noted otherwise, or shall be primed with paint meeting the performance requirements SSPC-Paint20, where noted.

6. Welding Electrodes: Shall conform to AWS D1.3. E60 or E70. Touch up all welds with zinc-rich paint in compliance with ASTM A780.

7. Primer: SSPC-Paint20.

B. Screws shall be per ASTM C1513.

C. Machine bolts shall be per ASTM A307.

D. Power Actuated Fasteners (PAF): Hilti X-U, ICC ESR-2269. For use only where specified by the drawings.

E. Accessories: Cold-formed metal framing manufacturer's standard.

F. Structural Sheathing Panels:

1. Plywood: Structural sheathing shall conform to product standard PS-1 or PS-2. All panels shall have a minimum bond classification of “Exposure 1” and bear the trademark of the Engineered Wood Association (APA) or other qualified agency. Grades shall be “Rated Sheathing” or “Structural 1” as required on the drawings.

G. Oriented Strand Board (OSB): All structural OSB shall be grade marked by a qualified agency for conformance with Product Standard PS-2 and shall be fabricated with exterior glue. Grades shall be as required on the drawings.

2.2 FABRICATION

A. Form members to manufacturer's standard shapes meeting design criteria.

B. Cut right angle connections of framing components to fit squarely against abutting members.

C. Prime un-galvanized steel to 1.5 mil (0.038) minimum dry film thickness.

PART 3 - EXECUTION

3.1 ERECTION

A. Clean surfaces that will be in contact after assembly.

B. Position members plumb, square and true to line.

C. Seat studs squarely in track with stud web and flange abutting track web with maximum 1/8 inch gap.

D. Connect members together by welding and/or fasteners in accordance with the drawings.

E. Do not splice studs. Provide "headers" and "trim studs" at openings as required. Studs shall be securely attached to tracks at all exterior walls except as noted below.

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F. Provide for expansion and contraction between floors at solid wall sections of two stories or more by providing a slip joint between stud and track at one end. This connection shall be capable of transmitting lateral loads to the structure.

G. Provide and install bridging, fire blocking, etc. per manufacturer's recommendations, the plans, and code requirements.

H. Perform welding in accordance with AWS D1.3

I. Remove erection bolts and screws used in welded construction.

J. Do not use gas cutting for field correction of fabrication without concurrence of Architect/Engineer.

K. Touch-up field connections and breaks in shop coating with same primer used for shop priming.

3.2 STRUCTURAL SHEATHING

A. General:

1. Sheathing screwing shall be as required on the drawings. Do not overdrive (Do not break skin of sheathing face sheet). Over driving will be cause for rejection.

B. Roof and Floor Sheathing: lay with face grain perpendicular to roof rafters, roof trusses or floor joists. Stagger sheets. Block all unsupported sheet edges with 54 mils material unless noted otherwise.

C. Wall Sheathing: Lay with face grain either parallel or perpendicular to studs. Exposed bottom edges shall be sealed as recommended by manufacturer. Block all unsupported sheet edges with 54 mils materials unless noted otherwise.

3.3 DEFECTIVE WORK AND MATERIALS

A. Work found to be defective, missing or damaged shall be immediately replaced with proper work. Such replaced work and the inspection for same shall be at the expense of the Contractor.

B. Straightening of any materials, if necessary, shall be done by a process and in a manner that will not injure the materials, and which is approved by the Architect. Sharp kinks or bends shall be cause for rejection. Heating will not be allowed.

C. If defects or damaged work cannot be corrected in the field, the material shall be returned to the shop or new parts furnished, as the Architect directs; the Contractor shall replace all work at his own expense.

3.4 CLEANING

A. After erection, all surfaces shall be cleaned and left free of all grime and dirt. Remove unused materials, tools, equipment and debris from the premises and leave broom clean.

END OF SECTION

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SECTION 055000

METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes Contractor-Engineered Systems:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.

B. Related Sections:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 079200 “Joint Sealants.”
3. Section 099600 “High Performance Coatings.”

1.3 PERFORMANCE REQUIREMENTS

A. Contractor-Engineered Systems: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

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1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Show adjacent construction including adjacent finishes.

C. Samples: For each finish specified. Minimum 4 in. square.

D. Contractor-Engineered Submittal: For all metal fabrication items and assemblies, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.7 PROJECT CONDITIONS

A. Review all available Contract Documents and coordinate with relevant trades and ongoing work for proper fabrication and installation of Work.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

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PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Material: Cold-rolled steel, ASTM A 1008/A 1008M, structural steel, Grade 33; 0.0966-inch minimum thickness; hot-dip galvanized after fabrication.

2.3 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 2.

D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Eyebolts: ASTM A 489.

F. Machine Screws: ASME B18.6.3.

G. Plain Washers: Round, ASME B18.22.1.

H. Lock Washers: Helical, spring type, ASME B18.21.1.

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I. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

J. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

K. Post-Installed Anchors: Torque-controlled expansion anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.

E. Dissimilar Materials: Separate dissimilar metals with coating of dielectric separator. Do not extend coating onto exposed or finished surfaces.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Metal surface preparation to be SSPC SP-6 “Commercial Blast Cleaning.”

F. Weld corners and seams continuously to comply with the following:

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1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, welds to be NOMMA #1 finish – no evidence of welded joint.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

H. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

I. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

J. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

2.8 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

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2.9 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

C. Field paint all exterior metals in accordance with Section 09 96 00 “High Performance Coatings.”

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

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3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099100 “Painting and Coating.”

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

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SECTION 057000

DECORATIVE METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Custom State Seal of California plaques.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 101400 “Signage.”

1.3 COORDINATION

A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Shop Drawings: Show fabrication and installation details for decorative metal.

1. Include plans, elevations, component details, and attachment details.
2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

C. Patterns, Models, or Plaster Castings: Made from proposed patterns for each design of custom casting required.

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D. Samples for Verification: For each type of sign, include the following Samples to verify color selected.

1. Full-size Samples of castings and forgings.
   a. For custom castings, submit finished Samples showing ability to reproduce detail, cast-metal color, and quality of finish.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Installer Qualifications: Fabricator of products.

1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups for the following types of decorative metal:

   a. Custom State Seal plaque.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

B. Deliver and store cast-metal products in wooden crates surrounded by enough packing material to ensure that products are not cracked or otherwise damaged.

1.10 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

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PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Use materials with smooth, flat surfaces unless otherwise indicated. Use materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.2 FASTENERS AND ACCESSORIES

A. Fastener Materials: Unless otherwise indicated, provide the following:
   1. Aluminum Items: Aluminum, Type 316 stainless steel fasteners.

B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.

C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless otherwise indicated.

D. Mounting Methods: Use concealed fasteners for metal signage, fabricated from materials that are not corrosive to sign material and mounting surface.

2.3 FABRICATION, GENERAL

A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly.

   1. Disassemble units only as necessary for shipping and handling limitations.
   2. Clearly mark units for reassembly and coordinated installation.
   3. Use connections that maintain structural value of joined pieces.

B. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

D. Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.

E. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

F. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.

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G. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.

H. Provide castings that are sound and free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

2.4 FABRICATION OF CUSTOM STATE SEAL OF CALIFORNIA PLAQUE

A. Custom State Seal of California Plaque:
   1. Cast Aluminum.
   2. Size: 32 inches diameter.
   3. Thickness: 3/4-inch.
   4. Raised areas to be satin aluminum.
   5. Recessed areas to be black texture finish.
   6. Mounting: Concealed, flush-mounted.
   7. ADA Clearance: To main ADA clearance, mounted depth not to exceed 4 inches.

2.5 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.6 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Clear Anodic Finish: AAMA 611, or thicker.

C. Color Anodic Finish: AAMA 611, or thicker, with a satin directionally textured mechanical finish.
   1. Color: As selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION, GENERAL

A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.

B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.

C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.

D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

E. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.

F. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.

1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.

3.3 CLEANING AND PROTECTION

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

B. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.

C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

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SECTION 057300

DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Stainless steel decorative railings.

B. Related Requirements:
   1. Section 061000 "Rough Carpentry" for wood blocking for anchoring railings.

1.3 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data:
   1. Fasteners.
   2. Post-installed anchors.
   3. Handrail brackets.
   4. Wood rails.
   5. Shop primer.
   6. Intermediate coats and topcoats.
   7. Nonshrink, nonmetallic grout.
   8. Anchoring cement.

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9. Metal finishes.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters
2. Fittings, end caps, and brackets.
3. Welded connections.
4. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and guard infill. Sample need not be full height.

a. Show method of connecting and finishing members at intersections.

E. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For delegated design professional engineer.

B. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

F. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

G. Preconstruction test reports.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
1. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

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1. Build mockups for each form and finish of railing, consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches in length.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

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2.3 STAINLESS STEEL DECORATIVE RAILINGS

A. Source Limitations: Obtain stainless steel decorative railing components from single source from single manufacturer.

B. Tubing: ASTM A554, Grade MT 316.

C. Flat Bar: ASTM A666, Type 316.

2.4 FASTENERS

A. Fastener Materials:
   1. Stainless Steel Railing Components: Type 316 stainless steel fasteners.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.
   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Handrail Brackets: Cast stainless steel, center of handrail 3-1/8 inches from face of railing.

   1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
   2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.

B. Wood Rails:

   1. Clear, straight-grained hardwood rails secured to exposed metal subrail.

      a. Species: Solid White oak to match wainscot.
      b. Finish: As selected by Architect.
      c. Staining: As selected by Architect.
      d. Profile: As shown on Drawings.

C. Epoxy Zinc-Rich Primer: Compatible with topcoat.

D. Intermediate Coats and Topcoats: Provide products that comply with Section 099600 "High-Performance Coatings."

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E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

F. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.6 FABRICATION

A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.

1. Clearly mark units for reassembly and coordinated installation.
2. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

F. Connections: Fabricate railings with welded connections unless otherwise indicated.

G. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.

H. Form changes in direction as follows:

1. As detailed.

I. Brackets, Flanges, Fittings, and Anchors: Provide flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other Work unless otherwise indicated.

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J. Provide inserts and other anchorage devices for connecting railings to concrete or masonry Work.

1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
2. Coordinate anchorage devices with supporting structure.

K. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. When polishing is completed, passivate and rinse surfaces.
2. Remove embedded foreign matter and leave surfaces chemically clean.

C. Stainless Steel Tubing Finishes:

1. 180-Grit Polished Finish: Uniform, directionally textured finish.
2. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

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3.2 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of 1/16 inch in 3 feet .
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet \.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

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C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

D. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
   1. For stainless steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

3.5 REPAIR

A. Touchup Painting:

   1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

      a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

   2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports. Payment for these services will be made by Owner.

B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings in accordance with ASTM E894 and ASTM E935 for compliance with performance requirements.

C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.

D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.7 CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

B. Clean wood rails by wiping with a damp cloth and then wiping dry.

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3.8 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

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SECTION 061000

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wood furring and grounds.

2. Plywood backing panels.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”

2. Section 099100 “Painting and Coating” for field painting of plywood backerboards.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

2. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.

3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

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1. Fire-retardant-treated wood.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack wood flat with spacers beneath and between each bundle to provide air circulation. Protect wood from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 FIRE-RETARDANT-TREATED MATERIALS

A. General: Use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.

C. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Application: Treat all rough carpentry unless otherwise indicated.

1. Plywood backing panels.

2.2 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.

2. Nailers.

3. Cants.

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4. Furring.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber:

1. Western woods; WCLIB or WWPA.

2.3 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, AC, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness. Panels shall not contain added urea-formaldehyde. Panels shall be pre-painted, color: white.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

B. Power-Driven Fasteners: NES NER-272.

C. Lag Bolts: ASME B18.2.1.

D. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

E. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, blocking, and similar supports to comply with requirements for attaching other construction.

B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

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3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

END OF SECTION

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SECTION 062023

INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior standing and running trim.
2. Solid wood cap.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
3. Section 064023 "Interior Architectural Woodwork."
4. Section 064216 “Flush Wood Paneling” for veneer wainscot.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

B. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

C. Samples for Verification:
1. For each species and cut of lumber and panel products with nonfactory-applied finish, with half of exposed surface finished; 50 sq. in. for lumber and 8 by 10 inches for panels.

D. First In-Place Mock-Up:
1. Provide the following mock-ups of solid wood cap and wainscot assembly.
2. Prior to general installation of any given typical portion or system of the Work, erect on the building a representative first in-place mock-up for the Architect’s and Owner’s approval.
3. Propose the scope and location of first in-place mock-up for the Architect’s approval.

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4. Notify the Architect and the Owner well in advance of each such first in-place mock-up. If approved, this portion of the work shall become part of the final installation.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

B. Deliver interior finish carpentry materials only when environmental conditions meet requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and the following grading rules:

1. WWPA: Western Wood Products Association, "Western Lumber Grading Rules."
2. Factory mark each piece of lumber with grade stamp of grading agency.
3. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.

B. MDF Base Material: ANSI A208.2, Grade 130; made with binder containing no ureaformaldehyde resin; provide one of the following

1. SierraPine Sustainable Flame Retardant MDF.
2. SierraPine Medite FR2, interior grade wood-based composite panels manufactured from softwood fibers with minimum 90% pre-consumer recycled wood combined with formaldehyde-free synthetic resin, with clear sealer.
3. Thickness: As indicated on Drawings.

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4. Height: As indicated on Drawings.

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: For applications indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction, and comply with testing requirements; testing by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
   1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent respectively.

C. For exposed items indicated to receive a stained or natural finish, use organic resin chemical formulations that do not contain colorants, and provide materials that do not have marks from spacer sticks on exposed face.

D. Do not use material that does not comply with requirements for untreated material or is warped or discolored.

2.3 SOLID WOOD CAP [WD-2]

A. Provide shaped and laminated wood cap at wainscot, treated with Flamestop, Class A, fire-rated treatment.
   1. Species: White oak.
   2. Configuration: As shown on Drawings.
   3. Finish: Match adjacent veneer wall panels at wainscot [WD-1].

2.4 ACCESSORIES

A. Fasteners: Provide pre-finished nails in color to match where face nailing is unavoidable.

B. Anchors, Nails, and Screws: Select the material, type, size and finish required by each substrate for secure anchorage; provide toothed steel or lead expansion bolt screws for drilled-in-place anchors.

C. Wood Putty: Standard industry grade for use in plugging fastener holes where required on Drawings, of color to match finish; paintable where applicable.

D. Glue: Aliphatic- or phenolic-resin wood glue recommended by manufacturer for general carpentry use.

2.5 SHOP FINISHING

A. Finish carpentry items at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

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B. Prime woodwork for opaque finish with one coat of wood primer compatible with specified topcoats.

C. Interior Opaque Finish: Comply with requirements indicated below for grade, finish system, color, effect, and sheen, with sheen measured on 60-degree gloss meter per ASTM D523:

1. WI Finish System 7b.: Opaque pigmented lacquer.
2. Colors: Match Architect's samples.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, too small to fabricate with proper jointing arrangements, or with defective surfaces, sizes, or patterns.

B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
4. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

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3.4 STANDING AND RUNNING TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.

1. Install trim after gypsum-board joint finishing operations are completed.
2. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 ADJUSTING

A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.6 CLEANING

A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.

3.7 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

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SECTION 064023

INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic laminate cabinets.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 079200 “Joint Sealants.”
3. Section 092216 “Non-Structural Metal Framing” for backing strips.
4. Section 123660 “Solid Surfacing Assemblies.”

1.3 ACTION SUBMITTALS

A. Shop Drawings: Meeting the requirements of Architectural Woodwork Standards. Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate casework.
4. Apply a WI Certified Compliance Program label to the first page of the Shop Drawings.

B. Samples for Verification:

1. 6 in. square sample of each exposed finish.
2. Cabinet door or drawer face with all surfaces including edge treatment and exposed hardware and accessories, one unit for each type and finish. Minimum 12” square.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

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B. Product Certificates: For the following:

1. Composite wood and agrifiber products.

C. Woodwork Quality Standard Compliance Certificates: WI Quality Certification Program certificates.

1.5 QUALITY ASSURANCE

A. Quality Standard: North American Architectural Woodwork Standards, (NAAWS), latest edition, jointly published by Woodwork Institute, Architectural Woodwork Institute, and the Architectural Woodwork Manufacturers Association of Canada.

1. If there is a conflict between the requirements of the NAAWS and the Drawings and/or Specifications, the Drawings and specifications shall govern.

B. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is licensee of the Woodwork Institute Certified Compliance Program.

C. Installer Qualifications: A licensee of Woodwork Institute's Certified Compliance Program and Certified Seismic Installation Program. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver casework until painting and similar operations that could damage woodwork have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinetwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.

B. Field Measurements: Where casework is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate field-verified measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

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1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that Architectural Woodwork can be supported and installed as indicated.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087110 "Door Hardware" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "North American Architectural Woodwork Standards" for grades of architectural plastic-laminate casework indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade: Custom.

C. Core: MDF, ANSI 208.2 Grade 130.

D. Type of Construction: Frameless.

E. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.

F. Exposed Interior Surfaces: High-Pressure Decorative Laminate.

G. Semi-Exposed Surfaces: Melamine.

H. Edge Band: ABS matching the color and pattern of the exposed laminate.

I. Dust Panels: Provide1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Drawer Sides: Seven or nine ply hardwood plywood with no internal voids, or solid hardwood.
2. Drawer Bottoms: Hardwood Plywood.
3. Construction method: Dowels or dovetails.

K. Colors, Patterns, and Finishes: As shown on Drawings

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

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B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
4. Mill lumber before treatment and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of architectural cabinets.

2.4 HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087001 "Door Hardware."

B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch-thick metal, and as follows:

1. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.

D. Pulls: Back mounted, stainless steel, as selected by Architect.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

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F. Drawer Slides: BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.
2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 2.
4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
6. For computer keyboard shelves, provide Grade 1.
7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-100.
8. Provide self-closing soft-close door slides at all drawers.

G. Door Locks: BHMA A156.11, E07121.

H. Drawer Locks: BHMA A156.11, E07041.

I. Exposed Hardware Finishes: Satin stainless steel.

J. For concealed hardware, provide manufacturer's standard painted finish or stainless steel finish.

2.5 MISCELLANEOUS MATERIALS

A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.6 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

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PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition casework to average prevailing humidity conditions in installation areas.

B. Before installing casework, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install casework to comply with same grade as item to be installed.

B. Assemble casework and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install casework level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut casework to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Casework: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install casework with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws or toggle bolts through metal backing or metal framing behind wall finish.

F. Touch up finishing work specified in this Section after installation of woodwork.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective casework, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean casework on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

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SECTION 064216

FLUSH WOOD PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood veneer wall panels.
2. Wood furring, blocking, shims, and hanging strips for installing flush wood paneling unless concealed within other construction before paneling installation.
3. Shop finishing of flush wood paneling.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing paneling and that are concealed within other construction before paneling installation.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: Show location of paneling, large-scale details, attachment devices, and other components. Include dimensioned plans and elevations.

1. Show details full size.
2. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
3. For paneling produced from premanufactured sets, show finished panel sizes, set numbers, sequence numbers within sets, and method of cutting panels to produce indicated sizes.
4. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
5. Apply a WI Certified Compliance Program label to the first page of the Shop Drawings.

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6. Show locations and sizes of cutouts and holes for electrical, lighting, AV and other devices in wood veneer ceilings and walls.

C. Samples for Verification:

1. Lumber for transparent finish, not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished paneling.
3. Veneer-faced panel products for transparent finish, 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.

1.4 INFORMATIONAL SUBMITTALS

A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates or WI Certified Compliance Program certificates.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop shall be a certified participant in AWI's Quality Certification Program or WI Certified Compliance Program.

B. Installer Qualifications: Fabricator of products.

C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

D. Provide the following upon request:
1. Qualification Data: For Fabricator.
2. Product Certificates: For each type of product.
3. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

E. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of typical paneling as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver paneling until painting and similar operations that could damage paneling have been completed in installation areas. If paneling must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

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1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed and indicate measurements on Shop Drawings.

C. Established Dimensions: Where paneling is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

PART 2 - PRODUCTS

2.1 PANELING FABRICATORS

A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of paneling, wood-veneer-faced architectural cabinets, wood trim, wood frames, and wood doors faced with veneers from same flitches as paneling.

2.2 PANELING, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of flush wood paneling (wood-veneer wall surfacing) indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.3 WOOD VENEER CEILING PANELS & WOOD VENEER WALL PANELS

A. Grade: Premium.

B. Wood Species and Cut: Figured Sycamore to match sample, not less than 0.06 inch. Non-perforated, custom millwork.

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C. Matching of Adjacent Veneer Leaves: Blueprint match.

D. Matching within Panel Face: Center-balance match.

E. Matching of Adjacent Veneer Leaves and within Panel Face: Blueprint match.

G. Panel-Matching Method: Made-to-order, blueprint-matched panels and components within each separate area.

H. Vertical Panel-Matching Method: Continuous end match; veneer leaves of upper panels are continuous of veneer leaves of lower panels.

I. Exposed Panel Edges: Inset solid-wood or wood-veneer matching faces.

J. Assemble panels by gluing and concealed fastening.

K. Seams: For wood veneer wall panels: seams shall be 9-ft. on center.

L. Panels shall be directly applied to the substrate, without any voids between the wood paneling and substrate.

2.4 WOOD MATERIALS

A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

B. Wood Moisture Content: 5 to 10 percent.

C. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
   1. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with CARB II compliant binder containing no urea formaldehyde.
   2. Particleboard: ANSI A208.1, Grade M-2, made with CARB II compliant binder containing no urea formaldehyde.
   3. Softwood Plywood: DOC PS 1, medium-density overlay.
   4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.

2.5 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

   1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
   2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.

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3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
3. Implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.

C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.

1. For panels 3/4 inch thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi ; modulus of elasticity, 300,000 psi ; internal bond, 80 psi ; and screw-holding capacity on face and edge, 250 and 225 lbf , respectively.
2. For panels 13/16 to 1-1/4 inches thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi ; modulus of elasticity, 250,000 psi ; linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf , respectively.
3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. SierraPine; Encore FR.

D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work incluce, but are not limited to, the following:

   a. Panel Source International, Inc; Pyroblock Platinum.
   b. SierraPine; Medite FR.

2.6 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

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B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.

C. VOC Limits for Installation Adhesives: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Multipurpose Construction Adhesives: 70 g/L.
3. Contact Adhesive: 80 g/L.
4. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, rubber, or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.

2.7 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Arrange paneling in shop or other suitable space in proposed sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.

1. Lay out one elevation at a time if approved by Architect.
2. Notify Architect seven days in advance of the date and time when layout will be available for viewing.
3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by Architect.
4. Rearrange paneling as directed by Architect until layout is approved.
5. Do not trim end units and other nonmodular-size units to less than modular size until after University’s Representative's approval of layout. Indicate trimming by masking edges of units with nonmarking material.
6. Obtain Architect’s approval of layout before start of assembly. Mark units and Shop Drawings with assembly sequence numbers based on approved layout.

C. Complete fabrication, including assembly and finishing, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times paneling fabrication will be complete.

D. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.8 FINISHING

A. General: Finish system for wood paneling shall be: NAAWS Finish System 10: UV Curable, Water Based. Defer only final touchup, cleaning, and polishing until after installation.

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PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation condition paneling to average prevailing humidity conditions in installation areas

B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install paneling to comply with same grade as paneling to be installed.

B. Install paneling level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches . Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.

C. Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening unless covered by trim.
   1. Mount paneling assembly with z-clips on continuous wall mounted rails fastened to metal reinforcement or directly to wall studs in accordance with clip manufacturer's instructions. Space fasteners and rails to accommodate loads with screw failure.

D. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed.
   1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective paneling, where possible, to eliminate defects; where not possible to repair, replace paneling. Adjust for uniform appearance.

B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

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SECTION 066400

PLASTIC PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Glass-Fiber-Reinforced Polyester Panels.

B. Related Requirements:
   1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
   2. Section 061000 "Rough Carpentry" for wood furring for installing paneling.
   3. Section 079200 “Joint Sealants.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For paneling and trim accessories, in manufacturer's standard sizes.

1.4 QUALITY ASSURANCE

A. Testing Agency: Acceptable to authorities having jurisdiction.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain paneling and trim accessories from single manufacturer.

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B. Refer to Finish Schedule found on Drawings for additional product information.

2.2 SHEET PANELING

A. Glass-Fiber-Reinforced Polyester Panels: Fiberglass reinforced thermosetting polyester resin panel sheet complying with ASTM D5319.
   1. Basis-of-Design: Marlite, “S100 S/2/S.”
      a. Color: White.
      b. Size: Full height, mount from top of coved base to finish ceiling.
   2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 200 or less.
      b. Smoke-Developed Index: 450 or less.
   3. Nominal Thickness: Not less than 3/32-inch nominal.

2.3 ACCESSORIES

A. Trim Accessories: Manufacturer's standard vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
   1. Color: To match fiber-reinforced paneling.

B. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

C. Adhesive: As recommended by paneling manufacturer.

D. Sealant: Refer to Section 079200 “Joint Sealants.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

B. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

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C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

D. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.
   1. Mark plumb lines on substrate at panel joint locations for accurate installation.

3.3 INSTALLATION

A. Install paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

D. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

E. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.

F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

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SECTION 072100

BUILDING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Glass-fiber blanket insulation.
   2. Interior acoustic batt insulation

B. Related Sections:
   1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product..

B. Plans and Elevations indicating extent of each type of exterior insulation

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

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1.7 FIELD CONDITIONS

A. Environmental Limitations: Apply adhesives or sealants within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.

1. Do not apply adhesives or sealants to a damp or wet substrate or when substrate and ambient air temperatures are less than 40 deg F (4 deg C) above dew point.

B. Maintain adequate ventilation during application and curing of adhesives or sealants materials.

PART 2 - PRODUCTS

2.1 CALIFORNIA ENERGY CODE REQUIREMENTS

A. Manufacturers shall certify that insulting materials comply with *California Quality Standards for Insulating Materials* (CCR, Title 24, Part 12, Chapters 12-13), which ensure that insulation sold in the state performs according to stated R-values and meets minimum quality, health, and safety standards. Builders may not install insulating materials, unless the product has been certified by the Department of Consumer Affairs, Bureau of Home Furnishing and Thermal Insulation. Builders and enforcement agencies shall use the Department of Consumer Affairs *Directory of Certified Insulation Material* to verify the certification of the insulating material.

B. Exposed installations of faced mineral fiber and mineral aggregate insulations shall use fire retardant facings that have been tested and certified not to exceed a flame spread of 25 and a smoke development rating of 450. Insulating facings that do not touch a ceiling, wall, floor surface, and faced batts on the underside of roofs with an air space between the ceiling and facing are considered exposed applications.

2.2 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket, Unfaced: ASTM C665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.
1. Basis of Design: Subject to compliance with requirements, provide products by one of the following, or equal:
a. Johns Manville, “Formaldehyde-Free Insulation Enhanced with Bio-Based Binder.”
b. Owens Corning, “EcoTouch Flame Spread 25 Fiberglass Insulation.”
c. CertainTeed, “Sustainable Insulation, Fiber Glass Building Insulation.”
d. Knauf Insulation, “EcoBatt Insulation with ECOSE Technology.”

2.5

2.5 INTERIOR ACOUSTICAL BATT INSULATION

A. Sound Attenuation Blankets: Provide in accordance with the Partition Schedule indicated on the drawings. ASTM C665, Type I unfaced blanket insulation with water-resistant binders produced by combining fiberglass with thermosetting resins, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM 84. Provide R-11 batt insulation.

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1. Basis of Design: Subject to compliance with requirements, provides products by the one of the following, or equal:
   a. CertainTeed, “Sustainable Insulation.”
   b. Knauf Insulation “EcoBatt Insuation.”

2.8 ACCESSORIES

A. Tape: Polyethylene self-adhering type for Kraft faced insulation and bright aluminum self-adhering type for foil faced insulation.

B. Mechanical Insulation Fasteners: FM approved, corrosion resistant, size required to suit application.

C. Wire Mesh: Galvanized steel, hexagonal wire mesh.

D. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

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B. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
   4. For metal-framed wall cavities where cavity heights exceed 96 inches , support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
   5. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

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SECTION 072500

WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Weather barriers, complete, as shown and specified.

B. Related Requirements:

1. Section 079200 “Joint Sealants.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

B. Shop Drawings: Show details of building [paper] [wrap] at terminations, openings, and penetrations. Show details of flexible flashing applications.

C. Shop Drawings: Submit for Architect’s action. Submit shop drawings for the fabrication and installation of the Work. Prepare details at not less than 3 in. = 1 ft. scale. Show details for intersections, penetrations, inside and outside corners, terminations, expansion joints, and interface with adjacent materials.

D. Samples: Submit for Architect’s action. Submit 6 in. square samples of self-adhesive membrane, self-adhesive flashing, and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Document Review: Submit a written statement signed by the Contractor and the Applicator stating that the Contract Documents, shop drawings and product data have been reviewed with qualified manufacturer representatives. The statement shall certify

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that selected materials are proper, compatible with contiguous materials and adequate for the application shown.

2. Installer's Qualifications.

1.5 CLOSEOUT SUBMITTALS

A. Warranties.

1.6 QUALITY ASSURANCE

A. Qualified Installer: Installer to have 5 years experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer. Installation of weather barriers, flashing, and sealant shall be the responsibility of the membrane applicator to ensure undivided responsibility.

B. Qualified Manufacturer: Weather barrier systems shall be manufactured and marketed by a firm with a minimum of 15 years experience in the production and sales or waterproofing and air barrier products.

C. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHUs.

D. Pre-Installation Meetings: Before the start of Work, meet at the Project site to review methods and sequence of installation, special details and conditions, quality standards, testing and quality control requirements, job organization and other pertinent topics related to the Work. The meeting shall include the Owner, Architect, Architect's consultants, Contractor, and subcontractors whose work is relevant to this Specification Section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Products delivered to the job site shall be in the original unopened containers or wrappings.

B. Storage and Protection: Handle all materials to prevent damage. Place all materials on pallets and fully protected from moisture with canvas tarpaulins.

1.8 PROJECT CONDITIONS

A. Proceed with weather barriers installation only after substrate preparation is complete. Obtain acceptance from the weather barriers manufacturer's representative of substrate surface before proceeding with installation. Weather barriers contractor is responsible to ensure substrate is adequately prepared to receive weather barriers system. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials used.

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1.9 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of weather barrier system that fail in materials within specified warranty period.
   1. Warranty Period: Ten (10) years from date of Substantial Completion.

B. Special Project Warranty: Submit weather barrier Installer's warranty, without monetary limitation, on installer's customized form, signed by Installer, covering the Work of this Section, including all components of the weather barrier system, as specified herein
   1. Warranty Period: Twenty (20) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous weather barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.2 MATERIALS, GENERAL

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.3 SELF-ADHERING SHEET AIR AND WATER BARRIER, VAPOR PERMEABLE

A. Modified Bituminous Sheet: 40-mil- thick, self-adhering sheet consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick, cross-laminated polyethylene film with release liner on adhesive side and formulated for application with primer that complies with VOC limits of authorities having jurisdiction.
   1. Basis of Design: GCP Applied Technologies, "Perm-A-Barrier VPS," or equal.
   2. Physical and Performance Properties:
      a. Air Permeance, ASTM E2178: Not to exceed 0.004 cfm/sq. ft. under a pressure differential of 0.3 in. water. (1.57 psf) (equal to 0.02L/sq. m @ 75 Pa).
      b. Assembly Air Permeance, ASTM E2357: Not to exceed 0.04 cfm/sq.ft. under a pressure differential of 0.3 in. water (1.57 psf) (equal to 0.2 L/sq.m @ 75 Pa).
      c. Water Vapor Permeance, ASTM E96: Not less than 13.9 perms.
      d. Water Resistance, AATCC-127: No less than 5 hrs at 55 cm/21 inch.
      e. Breaking Force, ASTM D5034: 55 lbf MD, and 44 lbf CD.
      f. Pull Adhesion, ASTM D4541: min. 15 psi to primed glass faced gypsum sheathing, min.
      g. Peel Strength, ASTM D903: 1.5 lb/in.
      h. Water Penetration Resistance Around Nails, ASTM D1970 Modified: Pass.

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i. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.4 ACCESSORY MATERIALS (for Bituminous Sheet)

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier membrane.

B. Modified Self-Adhering Flashing Bituminous Strip: Vapor retarding, 40 mils thick, smooth surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick, cross-laminated polyethylene film with release liner backing; Grace “Perm-a-Barrier Detail Membrane,” or equal.
1. Location: For use with air-barrier membrane except where otherwise shown or noted.
2. Water Vapor Transmission, ASTM E96, Method B: 2.9 ng/m2sPa (0.05 perms) max.
3. Air Permeance at 75Pa (0.3 in. water) pressure difference: 0.0006 L/(s.m2) (0.00012 cfm/ft2) max.
4. Puncture Resistance, ASTM E154: 178 N (40 lbs.) min.
5. Lap Adhesion at -4ºC (25ºF), ASTM D1876: 880 N/m (5.0 lbs./in.) of width
6. Low Temperature Flexibility, ASTM D1970: Unaffected to -43ºC (-45ºF)
7. Tensile Strength, ASTM D412, Die C Modified: min. 2.7 MPa (400 psi) 8
8. Elongation, Ultimate Failure of Rubberized Asphalt, ASTM D412, Die C: min. 200.

C. Foil-Faced Self-Adhered Detail Membrane: 35 mils of self-adhesive rubberized asphalt integrally bonded to 5 mils of aluminum film to provide a minimum 40 mils thick membrane, Grace “Perm-a-Barrier Aluminum Flashing,” or equal.

D. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade. Grace “Bituthene Liquid Membrane,” or equal.

E. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

F. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

G. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 "Joint Sealants.”

H. Small Penetration Flashing: Sheet metal collars with integral flanges; QuickFlash Waterproofing Products, Inc., “Quick-Flash,” or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.

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B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Fill voids, gaps, and spalled areas in substrate to provide a sound and even plane.

D. Curing compounds or release agents used in concrete construction must be resin based without oil, wax, or pigments

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
   1. Install modified bituminous strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.

E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

F. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.2 INSTALLATION

A. General: Install modified bituminous sheets and accessory materials according to air-barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.
   1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F.

B. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
   1. Install modified bituminous strips centered over vertical inside corners. Install 3/4-inch fillets of termination mastic on horizontal inside corners.

C. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.

D. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.
   1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

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E. Apply and firmly adhere modified bituminous sheets horizontally over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.
   1. Apply sheets in a shingled manner to shed water without interception by any exposed sheet edges.
   2. Roll sheets firmly with a manufacturer approved hand roller to enhance adhesion to substrate.

F. Apply continuous modified bituminous sheets over modified bituminous strips bridging substrate cracks, construction, and contraction joints.

G. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch- wide, modified bituminous strip.

H. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with compatible sealant.

I. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.

J. Connect and seal exterior wall air-barrier membrane continuously to exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

K. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply modified bituminous transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
   1. Modified Bituminous Transition Strip: Roll firmly with a manufacturer approved hand roller to enhance adhesion.
   2. Seal around all penetrations with air-barrier sealant.

L. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.

M. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

N. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches beyond repaired areas in all directions.

O. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

P. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

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3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
   1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
   2. Continuous structural support of air barrier system has been provided.
   3. Site conditions for application temperature and dryness of substrates have been maintained.
   4. Maximum exposure time of materials to UV deterioration has not been exceeded.
   5. Surfaces have been primed.
   6. Laps in self-adhering flashing have complied with minimum requirements and have been shingled in the correct direction with no fish-mouths.
   7. Air-barrier sealant has been applied on cut edges.
   8. Self-adhering flashing been firmly adhered to substrate.
   9. Compatible materials have been used.
   10. Transitions at changes in direction and structural support at gaps have been provided.
   11. Connections between assemblies, including membrane and sealants, have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
   12. All penetrations have been sealed.

C. Tests: Testing to be performed will be determined by Owner's testing agency from among the following tests:
   1. Qualitative Testing: Air barrier assemblies will be tested for evidence of air leakage according to ASTM E1186, smoke pencil with pressurization or depressurization.

D. Remove and replace deficient air barrier components and retest as specified above.

3.4 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
   1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 30 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
   2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

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SECTION 072616

CONCRETE VAPOR TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Liquid applied two-component polymer (non-silicate) based system.
   2. Underslab vapor barrier.

B. Related Requirements:

   1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
   2. Section 033000 “Cast-in-Place Concrete.”
   3. Section 096519 “Resilient Tile Flooring.”
   4. Section 096813 “Tile Carpeting.”

1.3 ACTION SUBMITTALS

A. Product Data: Submit for Architect’s action. Submit copies of specifications, standard installation details, installation instructions, and general recommendations by manufacturer of vapor retarder materials.

B. Shop Drawings: Show details for special conditions not covered by manufacturer's standard published details.

1.4 INFORMATIONAL SUBMITTALS

A. Test Reports: Independent laboratory testing to support specified ASTM performance.

B. Certificates:

   1. Installer’s Qualifications

1.5 CLOSEOUT SUBMITTALS

A. Warranties.

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1.6 QUALITY ASSURANCE

A. Qualified Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten (10) years verified experience. Manufacturer shall make available factory-trained representatives for consultation at Project site at no additional cost to the Owner.

B. Qualified Installer: Installer to have 5 years' experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.

C. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHJs.

1.7 PROJECT CONDITIONS

A. Pre-Installation Meetings: Before the start of Work, meet at the Project site to review methods and sequence of installation, special details and conditions, quality standards, testing and quality control requirements, job organization and other pertinent topics related to the Work. The meeting shall include the Owner, Architect, Architect's consultants, Contractor, and subcontractors whose work is relevant to this Specification Section.

B. Notification: Notify Architect 2 calendar days prior to jobsite meeting, starting Work, and if Work is done intermittently, before restarting Work.

C. Schedule Coordination: Schedule work such that membrane will not be left exposed to weather for longer than that recommended by the manufacturer.

D. Perform all mandatory ASTM E1745 testing on a single production roll per ASTM E1745 Section 8.1.

E. Environmental Conditions: Install system treatments when concrete surface temperatures exceed 60ºF and rain is not expected during scope.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Deliver packaged materials to the project site in manufacturer's original, unopened containers with seals unbroken and labels indicating brand names, colors, patterns, and quality designations legible and intact.

B. Storage and Protection: Do not open containers or remove labels until materials have been inspected and accepted.

1.9 WARRANTY

A. Performance Warranty: Application of preventative system shall yield a water vapor emission rate of not more than 2.5 (±0.50) per ASTM F1869 and an alkaline value of less than 9.0pH. In the event flooring systems are installed with the use of the corrective system, warranty shall extend to the finished flooring materials for a period of fifteen (15) years. Warranty to include repair or replacement of flooring damaged by moisture vapor emission rates above specified

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rates at no cost to Owner. Issuance of warranty shall not remove 2.5 (±0.50) performance requirement.

B. Flooring Warranty: Product warranty shall apply to the sustainability of flooring products, adhesion and moisture resistance. In the event flooring products are damaged during a fifteen (15) year period by substrate by water vapor emission rates exceeding 2.5 (±0.50) and alkaline value greater than 9.0pH, manufacturer and installer shall include replacement of flooring materials, adhesives, water vapor emission and alkalinity control systems, and labor costs for removal and replacement of those products.

1. Warranty shall not exclude concrete cracking.
2. Warranty shall be transferable and non-prorated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Underslab Vapor Barrier: Provide where indicated or at slabs on grade to receive applied floor finishes. ASTM E1745, Class A. Water vapor transmission rate shall be no greater than 0.01 gr./ft^2/hr, when tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1.
1. Maintain permeance of less than 0.01 Perms after mandatory conditioning tests per ASTM E154 Sections 8,11,12, and 13.
2. Tensile Strength: Minimum 70 pounds/inch per ASTM E154 Section 9 (Method D882).
3. Puncture Resistance: Minimum 2400 grams, complying with ASTM D1709, Method B.
4. Thickness: 15 mils.

2.2 MANUFACTURERS

A. Basis-of-Design Products: The design for water vapor emission and alkalinity control systems is based on a two-coat polymer-resin-based (non-silicate) system. “Synthetic 30” (Synthetics International) www.SyntheticsIntl.com, “VRS” (Diamond Stone Products) www.DiamondStoneProducts.com, “Vapor Seal 309” (Floor Seal Technology, Inc.) www.Floorseal.com, or equal.

2.3 CONCRETE VAPOR TREATMENT

A. Liquid applied two-component polymer (non-silicate) based penetrating treatment. Two-coat application for the suppression of moisture, alkaline salts, crack resistance and flooring compatibility.

B. Physical Properties:

1. Product Color: White or clear
2. Application: Two (2) coat
3. Film Forming: Polymer (non-silicate) based
4. Flooring Ready: 10 - 24 hours
5. Foot Traffic: 8 hours

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6. Compatibility: All Flooring Systems
7. Film Thickness: 6 – 10 mill total
8. Solid Content: 36 to 60 percent
9. Spread Rate: 160 - 200 square feet total
10. Crack Control: Two-coat application for crack bridging properties
11. VOC Content: Refer to Section 01 81 13 “LEED Requirements.”
12. Environmental: Solvent free, non-corrosive
13. Vapor Reduction: 75 - 95% per ASTM E96 (30.0 lbs. to 2.0 lbs. per ASTM F1869)
14. Alkali Resistance: Resistant to 30 day exposure to 4pH per ASTM D1308
15. Potassium Hydroxide: Resistant to 30 day exposure to 35% per ASTM D1308
16. Concrete Adhesion: 500 - 600psi per ASTM D4541
17. Relative Humidity: 100% suppression per ASTM F2170
18. Alkalinity Control: 14pH per ASTM F710

2.4 ACCESSORIES

A. Concrete Moisture Kits: Commercially packaged anhydrous calcium chloride test kits by American Moisture Test, Inc. (866) 670-9700 www.DomeTest.com

B. Cement Topcoat: Self leveling cement based product meeting a compressive strength of 4,000psi and approved by treatment manufacturer.

1. Non-porous primer as required for direct adhesion to treatment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Applicator present.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare and scarify concrete surfaces not less than 90 days prior to moisture testing and installation of resilient flooring and carpet.

B. Preparation: Grind down high spots and protrusions; clean concrete of debris and dust; and fill cracks, cavities, and low spots with a cement-based compound. Gypsum-based underlayment and filler materials not permitted.

C. Concrete Surface: Shot- or bead-blast to scarify surface.

3.3 APPLICATION

A. General: Provide vapor control membrane at following locations when scheduled to receive resilient flooring or carpet or wood flooring.

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1. Concrete slabs at or below grade.
2. Suspended concrete slabs which do not comply with acceptable moisture emission criteria, as specified in the flooring Section or as required by the flooring manufacturer to provide the specified warranty.

B. Apply by lint free nap roller at a rate of 200 - 250 square feet per gallon and allow to cure for 12 hours.

C. Re-apply product at a rate of 200 - 250 square feet per gallon for improved crack resistance, moisture vapor reduction and film thickness.

3.4 FIELD QUALITY CONTROL

A. Perform moisture testing directly to control system surface at a rate of one (1) test, for each 1,000 square feet of finished floor covering per ASTM F1869.

B. Re-apply control system in areas where concrete testing exceeds vapor emissions tolerances.

END OF SECTION

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SECTION 074213.19

INSULATED METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulated aluminum wall panels.

B. Related Requirements:

1. Section 079200 “Joint Sealants.”
2. Section 085653 “Security Windows.”
3. Section 089119 “Fixed Louvers.”
4. Section 099600 “High-Performance Coatings.”

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

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1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical metal panel assembly as shown on Drawings including supports, attachments, and accessories.
2. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration according to AAMA 501.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

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1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: _____ years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: Twenty (20) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E72:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: No greater than L/180.

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B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. Seismic Performance: Comply with ASCE 7, Section 13, “Seismic Design Requirements for Non-Structural Components”. Panels shall be hard-fastened to structure along one edge only such that lateral slippage between panels can occur in the event of seismic activity.

F. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics, as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E119.
2. Radiant Heat Exposure: No ignition when tested according to NFPA 268.
3. Potential Heat: Acceptable level when tested according to NFPA 259.
4. Surface-Burning Characteristics: Provide wall panels with a flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E84.

2.2 INSULATED METAL WALL PANELS

A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

1. Aluminum Sheet: Fabricate panel with exterior and interior facings of same material and thickness. Provide facings of aluminum coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
   a. Panel Thickness: As shown on Drawings.
   b. Size: To match existing opening dimensions.
   c. Surface: Corrugated.
2. Core Material: Manufacturer’s standard.

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a. Polyisocyanurate Insulation: Closed cell, modified polyisocyanurate foam using a non-CFC blowing agent, board type, with a maximum flame-spread index of 25 and a smoke-developed index of 450.

3. Clips: Manufacturer's standard one piece, formed from stainless steel.
4. Gaskets: Extruded, dry seal silicone.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

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2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Panels and Accessories: Refer to Section 09 96 00 “High-Performance Coatings.”
1. Color: As selected by Architect.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:
1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

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C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal wall panel manufacturer.

1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.

3.4 INSULATED METAL WALL PANEL INSTALLATION

A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.

1. Fasten foamed-insulation-core metal wall panels to supports with fasteners at each lapped joint at location and spacing and with fasteners recommended by manufacturer.
2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
3. Provide metal-backed washers under heads of exposed fasteners on weather side of insulated metal wall panels.
4. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
5. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
6. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.

B. Foamed-Insulation-Core Metal Wall Panels: Fasten metal wall panels to supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.

1. Install clips to supports with self-tapping fasteners.

C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.

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1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

D. Metal wall panels will be considered defective if they do not pass test and inspections.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 078100

APPLIED FIRE PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes sprayed fire-resistive materials.

1.3 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Framing plans or schedules, or both, indicating the following:

1. Extent of fireproofing for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of fireproofing after application.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Product Certificates: For each type of fireproofing.

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C. Evaluation Reports: For fireproofing, from ICC-ES.

D. Preconstruction Test Reports: For fireproofing.

E. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Source Limitations: Obtain fireproofing for each fire-resistance design from single source.

C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

D. Asbestos: Provide products containing no detectable asbestos.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS

A. General: Provide manufacturer's standard products complying with requirements indicated for material composition and physical properties representative of installed products.

B. Standard Durability SFRM Interior Locations, Concealed Conditions: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-

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resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application.

1. Basis-of-Design Product: Subject to compliance with requirements, provide GCP Applied Technologies Inc.; Grace Construction Products; Monokote MK-6 Series or a comparable product by one of the following:
   a. Carboline Company; a subsidiary of RPM International.
   b. Isolatek International.

2. Bond Strength: Minimum 200-lbf/sq. ft. (9.58-kPa) cohesive and adhesive strength based on field testing according to ASTM E 736.
3. Density: Not less than 15 lb/cu. ft. (240 kg/cu. m) and as specified in the approved fire- resistance design, according to ASTM E 605.
4. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch (9 mm).
5. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 0.
   b. Smoke-Developed Index: 0.

6. Compressive Strength: Minimum 10 lbf/sq. in. (68.9 kPa) according to ASTM E 761.
7. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
8. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
9. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
10. Air Erosion: Maximum weight loss of 0.0 g/sq. ft. (0.0 g/sq. m) in 24 hours according to ASTM E 859.
11. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21.
12. Finish: Spray-textured finish.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:

1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E736.

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C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

D. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.

E. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.

1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

B. Verify that concrete work on steel deck is complete before beginning fireproofing work.

C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning fireproofing work.

D. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Clean substrates of substances that could impair bond of fireproofing.

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C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.

1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Metal Decks:

1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, is completed.
2. Do not apply fireproofing to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fireproofing.

E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

F. Spray-apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

G. Extend fireproofing in full thickness over entire area of each substrate to be protected.

H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.

I. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.

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J. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.

K. Cure fireproofing according to fireproofing manufacturer's written instructions.

L. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

M. Finishes: Where indicated, apply fireproofing to produce the following finishes:

1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
2. Spray-Textured Finish: Finish left as spray applied with no further treatment.
3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.
4. Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.
5. Skip-Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray-applied finish to smooth out the texture, eliminate surface markings, and square off edges.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the applicable building code.

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.

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C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.

D. Repair fireproofing damaged by other work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION

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SECTION 078413

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 078445 "Joint Firestopping" for joints in or between fire-resistance-rated construction, in smoke barriers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

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B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.8 WARRANTY

A. General Warranty Requirements are specified in 01 78 36 - Warranties. Minimum 2-Year warranties per 01 78 36 shall be provided for all installed material and equipment unless more stringent requirements are noted in this section. Standard Manufacturer Warranties shall be provided where they exceed minimum warranty requirements.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.10 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MATERIALS

A. Provide products and materials complying with Section 01 60 00 – Materials and Equipment. Provide products from listed acceptable manufacturers and, where applicable, from listed acceptable products. Alternate equivalent products may be provided with submission and

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approval of a proper Request for Product Substitution per Section 01 62 00 – Request for Substitutions.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

    a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

        1) UL in its "Fire Resistance Directory."
        2) Intertek Group in its "Directory of Listed Building Products."
        3) FM Global in its "Building Materials Approval Guide."

2.3 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any. Provide the following, or equal:

1. A/D Fire Protection Systems Inc.
2. Grace Construction Products.
3. Hilti, Inc.
4. Johns Manville.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.

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1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.4 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

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2.5 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

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1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Special Inspector shall perform tests and inspections according to ASTM E 2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

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B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Where Intertek ETL SEMKO-Listed systems are indicated, they refer to design numbers in Intertek ETL SEMKO's "Directory of Listed Building Products" under "Firestop Systems."

C. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."

END OF SECTION

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SECTION 078443

JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.
2. Joints in smoke barriers.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.
3. Section 092216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

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B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."

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2.2 JOINT FIRESTOPPING SYSTEMS

A. Manufacturers: Provide the following, or equal.

1. A/D Fire Protection Systems Inc.
2. Grace Construction Products.
3. Hilti, Inc.
4. Johns Manville.

B. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

C. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.
1. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.

E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.

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3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

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B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION

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SECTION 079200

JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Acoustical and fire joint sealants.
5. Compressible filler at concrete.

B. Related Sections:
1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 088000 "Glazing" for glazing sealants.
3. Section 092900 "Gypsum Board" for sealing perimeter joints.
4. Section 093000 "Tiling" for sealing tile joints.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

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1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

C. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

E. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

F. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.
   1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
   2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

E. Preinstallation Conference: Conduct conference at Project site after approval of a complete submittal.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
   1. Use manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
   2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
   3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

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4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:
   a. Each kind of sealant and joint substrate indicated.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

   a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

      1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

C. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

D. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.7 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

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B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.9 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
   1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
   2. Disintegration of joint substrates from natural causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Provide required joint sealants as recommended by Composite Architectural Panel Fabricator for two lines of sealant.

B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
   1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

E. Colors of Exposed Joint Sealants: Provide custom sealants to match Architect’s sample.

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2.2 SILICONE JOINT SEALANTS

A. For Exterior Storefronts, Transoms, Sidelights: Structural Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
   1. Products: Provide the following, or equal:

      a. Dow Corning Corporation; 995.

B. Weather barrier sealant at exterior glazing: Dow Corning Corporation; 795.

2.3 URETHANE JOINT SEALANTS

A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
   1. Products: Subject to compliance with requirements, provide the following, or equal :

      a. Sika Corporation, Construction Products Division; Sikaflex - 15LM.
      b. Tremco Incorporated; Vulkem 921.

2.4 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
   1. Products: Subject to compliance with requirements, provide one of the following, or equal:

      a. BASF Building Systems; Sonolac.
      b. Pecora Corporation; AC-20+.
      c. Tremco Incorporated; Tremflex 834.

2.5 ACOUSTICAL AND FIRE JOINT SEALANTS

A. Acoustical and Fire Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
   1. Manufacturers: GE Construction Sealants, Hilti, Inc., Pecora Corp., Tremco Inc., USG Corp., or equal.
   2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.6 PREFORMED JOINT SEALANTS

A. Preformed Silicone Joint Sealants: Manufacturer's standard sealant consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.

B. Products: Subject to compliance with requirements, provide the following, or equal:
   1. Dow Corning Corporation; 123 Silicone Seal.
   2. GE Advanced Materials - Silicones; UltraSpan US1100.

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2.7 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type B (bicellular material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
   1. Provide closed-cell material at all exterior joint applications.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 COMPRESSIBLE FILLER AT CONCRETE

A. Product: W.R. Meadows “Deck-O-Foam”, or equal. Flexible, lightweight, non-staining, polyethylene closed-cell expansion joint filler. Top with urethane sealant.

2.9 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXTENT, PER CALIFORNIA ENERGY EFFICIENCY STANDARDS

A. All joints and other openings in the building envelope that are potential sources of air leakage shall be caulked, gasketed, weather-stripped, or otherwise sealed to limit air leakage into or out of the building. This applies to penetrations for pipes and conduits, ducts, vents, and other openings. All gaps between wall panels, around doors, and other construction joints shall be well sealed. Ceiling joints, lighting fixtures, plumbing openings, doors and windows shall be considered as potential sources of unnecessary loss due to infiltration.

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3.2 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
   2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Remove laitance and form-release agents from concrete.
   3. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.4 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

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D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
   4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
   5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

      a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.5 INSTALLATION OF ACOUSTICAL AND FIRE JOINT SEALANTS

A. Comply with joint sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. Fire-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of fire sealant. Install in accordance with requirements to meet requirements for Fire-Rated Assemblies.

C. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

D. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.6 FIELD QUALITY CONTROL

A. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

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3.7 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.8 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

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SECTION 081113

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes hollow-metal work and flush door jambs.

B. Related Requirements:
1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 083473 “Sound Control Door Assemblies.”
3. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:
1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

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C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
   1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:
   1. Amweld International, LLC.
   2. Ceco Door Products; an Assa Abloy Group company.
   3. Curries Company; an Assa Abloy Group company.
   4. Door Components, Inc.
   5. Steelcraft; an Ingersoll-Rand company.
   6. Stiles Custom Metal, Inc.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 DOOR JAMB AT FLUSH CONDITIONS

A. Frameless Door Jamb at Mechanical Closets: 18 gauge, EzyJamb Single Rabbet (SRC) Door Jamb System or the following equal alternate:
   1. CR Laurence
   2. Or equal.

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2.3 INTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Standard-Duty Doors and Frames: ANSI/SDI A250.8, Level 1; ANSI/SDI A250.4, Level C.
   1. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches
      c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum G60A60 coating.
      d. Edge Construction: Continuously welded with no visible seam.
      e. Core: Steel stiffened.
      f. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.
   2. Frames:
      a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum G60A60 coating.
      b. Construction: Full profile welded, no visible seam.
      c. Face Profile: 2-1/4" to match existing frames.
   3. Exposed Finish: Prime.

2.4 FRAME ANCHORS

A. Jamb Anchors:
   1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
   2. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.5 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

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1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

H. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

J. Glazing: Comply with requirements in Section 088000 "Glazing."

K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:
1. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
2. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
3. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.

C. Hollow-Metal Frames: Shop fabricate fully welded frames.
1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
3. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      1) Three anchors per jamb up to 60 inches high.
      2) Four anchors per jamb from 60 to 90 inches high.
      3) Five anchors per jamb from 90 to 96 inches high.
      4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

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b. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

4. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
2. Provide loose stops and moldings on inside of hollow-metal work.
3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.7 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

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B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
   1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
      b. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      c. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
      d. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
   2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
   3. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
      a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
   4. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
   5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
   6. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
      a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
      b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
      c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
      d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
   1. Non-Fire-Rated Steel Doors:
      a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
      b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
      c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch.
      d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
   2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.

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3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

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SECTION 081116

INTERIOR ALUMINUM FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes interior aluminum frames for doors installed in gypsum board partitions.

B. Related Sections:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 079200 “Joint Sealants.”
3. Section 081416 "Flush Wood Doors" for wood doors installed in interior aluminum frames.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Include the following:

1. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
2. Locations of reinforcements and preparations for hardware.
3. Details of each different wall-opening condition.
4. Details of anchorages, joints, field splices, and connections.
5. Details of accessories.
6. Details of conduits and preparations for power, signal, and control systems.

C. Samples for Initial Selection: For units with factory-applied finishes.

1. Include similar Samples of seals, gaskets, and accessories involving color selection.

D. Samples for Verification: For interior aluminum frames, prepared on Samples of size indicated below:

1. Framing Member: 12 inches long.
2. Corner Fabrication: 12-by-12-inch- long, full-size window corner, including full-size sections of extrusions with factory-applied color finish.

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E. Schedule: For interior aluminum frames. Use same designations indicated on Drawings. Coordinate with door hardware schedule.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For interior aluminum frames to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain interior aluminum frames from single source from single manufacturer.

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Build mockup of typical wall area as shown on Drawings.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver interior aluminum frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic. Store interior aluminum frames under cover at Project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:

   1. Basis-of-Design: RACO Interior Products, Inc.
   2. Wilson Partitions.
   3. Western Integrated Materials, Inc.

B. Basis of Design: Wilson Partitions “Snap-On Trim with 1-1/2 inch Profile”. Contractor shall provide correct series to fit partition. Provide “Positive Pressure Fire Rated Frame” at rated conditions shown on Drawings.

   1. Where shown, provide assembly with butt-glazed vertical at internal joints. Vertical and horizontal edges to have aluminum frames.

2.2 COMPONENTS

A. Aluminum Framing: ASTM B 221, Alloy 6063-T5 or alloy and temper required to suit structural and finish requirements, not less than 0.062 inch thick.

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B. Door Frames: Extruded aluminum, reinforced for hinges, strikes, and closers.

C. Ceiling Tracks: Extruded aluminum.

D. Trim: Extruded aluminum, not less than 0.062-inch thick, with removable snap-in casing trim, and door stops without exposed fasteners.

2.3 ACCESSORIES

A. Fasteners: Aluminum, nonmagnetic, stainless steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.

B. Door Silencers: Manufacturer's standard continuous mohair, wool pile, or vinyl seals; grey color.

C. Hardware: Comply with requirements in Section 087100 "Door Hardware".

2.4 FABRICATION

A. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted or mitered connections.

B. Factory prepare interior aluminum frames to receive templated mortised hardware; include cutouts, reinforcements, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 08 71 00 "Door Hardware."

C. Fabricate components to allow secure installation without exposed fasteners.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer’s written instructions for cleaning, conversion coating, and applying finish.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and ceilings, with Installer present, for conditions affecting performance of the Work.

B. Verify that wall thickness does not exceed standard tolerances allowed by throat size indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install interior aluminum frames plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.

B. Set frames accurately in position and plumbed, aligned, and securely anchored to substrates.

C. Install frame components in the longest possible lengths; components up to 72 inches long shall be one piece.

1. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
2. Secure clips to extruded main-frame components and not to snap-in or trim members.
3. Do not leave screws or other fasteners exposed to view when installation is complete.

3.3 CLEANING

A. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended by frame manufacturer and according to AAMA 609 & 610.

B. Touch up marred frame surfaces so touchup is not visible from a distance of 24 inches Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

3.4 FIELD QUALITY CONTROL

A. Partitions and office fronts may be tested for acoustic performance by the Acoustic Consultant according to the current version of ASTM E336. This testing shall be undertaken upon substantial completion of the full partition assemblies, including all doors, sealant, gaskets and void barriers as per approved construction documents and/or shop drawings. Should any acoustically rated assemblies fail to meet project NIC targets due to deficiencies in Contractor installation, Contractor shall provide a) remediation necessary to meet NIC criterion and b) post-remediation acoustic testing at no cost to Owner.

END OF SECTION

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SECTION 081416

FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section,

1.2 SUMMARY

A. Section Includes

1. Solid-core doors with transparent finish.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Sections:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 081116 “Interior Aluminum Frames.”
3. Section 083473 “Sound Control Door Assemblies.”
4. Section 087100 “Door Hardware”.
5. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples: For factory-finished doors.

1. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.

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1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:

1. Masonite International
2. Oregon Door

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

B. WDMA I.S.1-A Performance Grade:

1. Heavy Duty unless otherwise indicated.
2. Extra Heavy Duty: Level 1 Large Meeting and Training Rooms, multiple user toilets, assembly spaces, corridors and exits, break rooms.

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

D. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

E. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde.

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2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
3. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

F. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.
   a. Screw Withdrawal, Face: 700 lbf.
   b. Screw Withdrawal, Edge: 400 lbf.

G. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade AA faces.
2. Species: Douglas fir to match Architect's wood veneer sample as specified in Section 064023.
3. Cut, Match between Veneer Leaves: Rift cut, slip-matched veneers. Where door occurs in wood paneled partition, match door to adjacent wood veneer panels. Doors visible in one space are to match each other.
4. Premium-grade doors.
5. Exposed Vertical and Top Edges: Same species as faces or a compatible species - edge Type A.
6. Core: Douglas Fir, glued wood stave, no joints at stile to rail connections.
7. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
8. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.4 LIGHT FRAMES AND LOUVERS

A. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

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1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.6 FINISHING

A. General: Comply with “Premium” Grade requirements of Section 5 of the NAAWS with shop applied coatings applied in accordance with manufacturer's written instructions.

B. Transparent Finish:

1. Finish: WDMA I.S. 1A TR-6 Catalyzed Polyurethane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.
3. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

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D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION

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SECTION 083113

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Access doors and frames for walls and ceilings.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail fabrication and installation of access doors and frames for each type of substrate.

C. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

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1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 MANUFACTURERS

A. Basis-of-Design: Subject to compliance with requirements, provide products by the following, or equal: Acudor, Karp.

2.3 TYPES

A. Interior Flush GFRG Access Doors with Concealed Flanges:
1. Description: Face of concealed-hinge door flush with frame, with concealed flange for gypsum board installation.
2. Door Size: As shown on Drawings.
3. Door Type: As shown on Drawings.
4. Latch and Lock: As indicated on Drawings.
5. Fire-Resistance Rating: Not less than that indicated.
6. Finish and Color: Paint to match adjacent gypsum board ceiling.

B. Stainless Steel type at Tile Substrates.

2.4 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 316. Remove tool and die marks and stretch lines, or blend into finish.

C. Stainless Steel Flat Bars: ASTM A666, Type 316. Remove tool and die marks and stretch lines, or blend into finish.

D. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063.

E. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

F. Frame Anchors: Same material as door face.

G. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.5 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

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C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder locks, furnish two keys per lock and key all locks alike.

E. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

E. Stainless-Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

a. Run grain of directional finishes with long dimension of each piece.
b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
c. Directional Satin Finish: No. 4.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

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SECTION 083473

SOUND CONTROL DOOR ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Section Includes: Sound control door and frame assemblies.

B. Related Sections:

1. Section 081113 “Hollow Metal Doors and Frames.”
2. Section 081416 “Flush Wood Doors.”
3. Section 087100 “Door Hardware.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include sound ratings, construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of sound-control seals, door bottoms, and thresholds.
3. Details of doors, including vertical and horizontal edge details and metal thicknesses.
4. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
5. Locations of reinforcement and preparations for hardware.
6. Details of each different wall opening condition.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.
10. Details of conduit and preparations for power, signal, and control systems.

C. Samples for Verification:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
2. Doors: Include section of vertical-edge, top, and bottom construction; door bottom gasket; core construction; glazing; and hinge and other applied hardware reinforcement.

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3. Frames: Include profile, corner joint, floor and wall anchors, and seals. Include separate section showing fixed sound panels if applicable.

D. Schedule: Provide a schedule of sound-control door assemblies prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with the Door Hardware Schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer.

B. Product Certificates: For each type of sound-control door assembly, from manufacturer.

C. Product Test Reports: Test Reports: Performed and issued by a qualified independent testing agency including acoustical performance data in the form of up-to-date test reports indicating the doors to be provided will have the specified Sound Transmission Class (STC) rating (per ASTM E-90/ASTM E 413). Refer to door schedule for the required STC ratings.

D. Field quality-control reports.

E. Warranty: Samples of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sound-control door assemblies to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain sound-control door assemblies, including doors, frames, sound-control seals, hinges (when integral for sound control), thresholds, and other items essential for sound control, from single source from single manufacturer.

C. Sound Rating: Provide sound-control door assemblies identical to those of assemblies tested as sound-retardant units by a qualified independent acoustical testing agency, and have the following minimum rating:

1. STC Rating: 43, as required per construction documents, and as determined by ASTM E 413 when tested in an operable condition according to ASTM E 90 and ASTM E 1408.

D. Preinstallation Conference: Conduct conference at Project site.

1. Review required field quality-control procedures.
2. Review procedures for coordinating frame and anchor installation with wall construction.
3. Review frame grouting procedures.

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1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished wood doors.

B. Shipping Spreaders: Deliver welded frames with two removable spreader bars across bottom of frames, tack welded or mechanically attached to jambs and mullions.

C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high, wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.

1. If wrappers on doors become wet, remove cartons immediately. Provide a minimum of 1/4-inch space between each stacked door to permit air circulation.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install sound-control doors until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate installation of anchorages for sound-control door assemblies. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.10 WARRANTY

A. Performance Warranty: A minimum Noise Isolation Class (NIC) rating (ASTM-E413) within 5 points of the published laboratory STC rating shall be guaranteed against defective workmanship and/or installation for one year from date of acceptance by Owner.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. At a minimum, acoustic door materials and hardware shall be guaranteed against defective workmanship for one year from date of shipment. Manufacturer's warranty is in addition to, and does not limit, other rights the Owner may have under the Contract Documents.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Certified test reports indicating that the acoustical performance of the door assemblies meets the STC (Sound Transmission Class) performance as called out on the door schedule. Testing shall have been conducted in accordance with ASTM E90-90 or later and rated in accordance with ASTM E413 by an accredited independent acoustical laboratory that is a member of NVLAP (National Volunteer Laboratory Accreditation Program). Reports shall be submitted on single and pairs of doors and frames identical to the type to be supplied. The complete door/frame assembly, if tested in the field, shall meet the FSTC ASTM E336-97 within 6 dB of the specified STC rating.

2.2 MANUFACTURERS

A. Source Limitations: Obtain steel sound control door assemblies, including doors, frames, sound control seals, hinges, thresholds, and other items essential for sound control, from single source from single manufacturer.

B. Manufacturer: Subject to compliance with requirements, provide products by the following, or equal:
   1. Basis-of-Design: IAC Acoustics, “Noise-Lock STC 43 Steel Acoustic Door.”
      a. Door Leaf Thickness: 1-3/4 inches.

2.3 STEEL SOUND CONTROL DOORS

A. Doors: Flush-design sound control doors, 1-3/4 inches thick of seamless construction; with manufacturer's standard sound-retardant core as required to provide STC and fire rating indicated. Construct doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges. Fabricate according to NAAMM-HMMA 865.

   1. Interior Doors: Fabricate from cold-rolled steel sheet unless otherwise indicated, 0.048-inch nominal thickness or thicker as required to achieve STC rating indicated.
   2. Core: Manufacturer's standard sound control core.
   3. Loose Stops for Glazed Lites in Doors: Same material as face sheets.
   4. Top and Bottom Channels: Closed with continuous channels of same material as face sheets, spot welded to face sheets not more than 6 inches (152 mm) o.c.
   5. Hardware Reinforcement: Same material as face sheets.

B. Materials:

   1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
   2. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
   3. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B, with G60 zinc (galvanized) or A40 zinc-iron-alloy (galvannealed) coating designation.
   4. Glazing: As required by sound control door assembly manufacturer to comply with sound control and fire-rated-door labeling requirements.

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C. Finishes:

1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

   a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2. Factory-Applied Paint Finish: Manufacturer's standard primer and finish coats, complying with SDI A250.3 for performance and acceptance criteria.
   a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.4 SOUND-CONTROL FRAMES

A. Description: Fabricate sound-control split door frames with corners mitered, reinforced, and continuously welded full depth and width of frame. Fabricate according to ANSI/NAAMM-HMMA 865.

1. Weld frames according to NAAMM-HMMA 820.
2. Interior Frames: Fabricate from 14 gauge cold rolled, galvannealed steel with an A60 coating weight, or thicker as required to provide STC rating indicated.
3. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 865 of same material as face sheets.
4. Jamb Anchors:
   a. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter, metallic-coated steel bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

5. Floor Anchors: Not less than 0.079-inch nominal thickness metallic-coated steel, and as follows:

   a. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
   b. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

6. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch-wide uncoated steel unless otherwise indicated.

B. Materials:

1. Cold-Rolled Steel Sheet: ASTM A653 galvannealed steel, suitable for exposed applications.
2. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
3. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329.
4. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching sound-control door frames of type indicated.

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5. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.

C. Finishes:

1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2. Factory-Applied Paint Finish: Manufacturer's standard primer and finish coats, complying with SDI A250.3 for performance and acceptance criteria.

a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.5 SOUND-CONTROL HARDWARE

A. Description: Provide manufacturer's standard sound-control system, including head, jamb, and door bottom seals, cam-lift hinges, and thresholds, as required by testing to achieve STC and fire rating indicated.

1. Compression Seals: One-piece units; consisting of closed-cell sponge neoprene seal held in place by metal retainer; with retainer cover of same material as door frame; attached to door frame with concealed screws.
2. Magnetic Seals: One-piece units; consisting of closed-cell sponge neoprene seal and resiliently mounted magnet held in place by channel integral to fabricated door frame.
3. Door Bottom Seals: Continuous, adjustable fixed seal that shall compress against the threshold as the door is closed.
4. Cam-Lift Hinges: Full-mortise template type that raises door 1/2 inch when door is fully open; with hardened pin; fabricated from stainless steel.
5. Thresholds: Flat, smooth, unfluted type as recommended by manufacturer; fabricated from stainless steel.

B. Other Hardware: Comply with requirements in Section 087100 "Door Hardware."

2.6 FABRICATION

A. Door to be pre-hung at the factory. Assembly and adjustment of door leaf, frame, acoustic seals, hinges and associated finish hardware shall take place at the factory. The entire manufactured assembly shall be shipped to the job site ready to install and operate.

B. Sound-Control Steel Door Fabrication: Sound-control doors to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.

1. Seamless Edge Construction: Fabricate doors with faces joined at vertical edges by welding; welds shall be ground, filled, and dressed to make them invisible and to provide a smooth, flush surface.

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2. Hardware Preparation: Factory prepare sound-control doors to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 08 7100 "Door Hardware."

    a. Reinforce doors to receive nontemplated mortised and surface-mounted door hardware.
    b. Locate door hardware as indicated, or if not indicated, according to NAAMM-HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

3. Tolerances: Fabricate doors to tolerances indicated in ANSI/NAAMM-HMMA 865.

C. Sound-Control Frame Fabrication: Fabricate sound-control frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
4. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches in height.
        2) Four anchors per jamb from 60 to 90 inches in height.
        3) Five anchors per jamb from 90 to 96 inches in height.
        4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.
        5) Two anchors per head for frames more than 42 inches wide and mounted in metal stud partitions.

    b. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

5. Head Reinforcement: For frames more than 48 inches wide, provide continuous head reinforcement for full width of opening, welded to back of frame at head.
6. Hardware Preparation: Factory prepare sound-control frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 08 7100 "Door Hardware."

    a. Reinforce frames to receive nontemplated mortised and surface-mounted door hardware.
    b. Locate hardware as indicated, or if not indicated, according to NAAMM-HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

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7. Tolerances: Fabricate frames to tolerances indicated in ANSI/NAAMM-HMMA 865.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of sound-control door assemblies.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of sound-control door frame connections before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation and with installation spreaders in place, adjust and securely brace sound-control door frames to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install sound-control door assemblies plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.

B. Frames: Install sound-control door frames in sizes and profiles indicated.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set.

a. At fire-rated openings, install frames according to NFPA 80.
b. At openings requiring smoke and draft control, install frames according to NFPA 105.

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c. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, and dress; make splice smooth, flush, and invisible on exposed faces.
d. Install sound-control frames with removable glazing stops located on secure side of opening.
e. Remove temporary braces only after frames or bucks have been properly set and secured.
f. Check squareness, twist, and plumbness of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
g. Pack door frames with glass fiber. Seal airtight between frame and wall on both sides.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.

a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors, if so indicated and approved on Shop Drawings.

3. In-Place Concrete Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
4. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
5. Installation Tolerances: Adjust sound-control door frames for squareness, alignment, twist, and plumbness to the following tolerances:

a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Doors: Fit sound-control doors accurately in frames, within clearances indicated below. Shim as necessary.

1. Non-Fire-Rated Doors: Fit non-fire-rated doors accurately in frames with the following clearances:

a. Jambs: 1/8 inch.
b. Head with Butt Hinges: 1/8 inch.
c. Head with Cam-Lift Hinges: As required by manufacturer, but not more than 3/8 inch.
d. Sill: Manufacturer's standard.
e. Between Edges of Pairs of Doors: 1/8 inch.

2. Fire-Rated Doors: Install fire-rated doors with clearances according to NFPA 80.

D. Thresholds: Set thresholds in full bed of sealant complying with requirements in Section 079200 "Joint Sealants."

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3.4 FIELD QUALITY CONTROL

A. Upon completion of this portion of work, and prior to its acceptance by the Owner, a qualified representative of the manufacturer of the acoustical door system(s) shall visit the jobsite to confirm that installation is in conformance with the manufacturer's recommendations.

B. Doors may be selected for in situ verification testing of the acoustical performance (ASTM E-336). Provide in-situ adjustments and modifications as required to achieve a minimum Noise Isolation Class (NIC) rating (ASTM-E413) within 5 points of the published laboratory STC rating. Contractor shall remedy all defects without expense to the Owner. Any additional testing required to verify that repaired/adjusted door/frame assemblies perform as specified above, will be at the expense of the contractor.

3.5 ADJUSTING AND CLEANING

A. Final Adjustments: Check and adjust seals, door bottoms, and other sound-control hardware items right before final inspection. Leave work in complete and proper operating condition.

B. Remove and replace defective work, including defective or damaged sound seals and doors and frames that are warped, bowed, or otherwise unacceptable.

1. Adjust gaskets, gasket retainers, and retainer covers to provide contact required to achieve STC rating.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

D. Metallic-Coated Surfaces: Clean abraded areas of doors and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

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SECTION 085653

SECURITY WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior security windows.

B. Related Sections:

1. Section 074213.19 “Insulated Metal Wall Panels.”
2. Section 079200 “Joint Sealants.”
3. Section 08800 “Glazing.”
4. Section 089119 “Fixed Louvers.”

1.3 COORDINATION

A. Coordinate installation of anchorages for security windows. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in adjacent construction.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, weights and finishes for window units.

B. Shop Drawings: For security windows.

1. Include plans, elevations, sections, and attachment details.

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2. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
3. Location of weep holes.
4. Hardware for sliding window units.
5. Glazing details.

C. Samples for Initial Selection: For frame members with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:

1. Framing: 12-inch- long sections of frame members.

E. Cutaway Sample: Corner of security window, made from 12-inch lengths of full-size components, and showing details of the following:

1. Joinery.
2. Anchorage.
3. Glazing.
4. Flashing and drainage.

F. Delegated Design Submittal: For security windows indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Welding certificates.

C. Product Test Reports: For each type of security window and accessory indicated as ballistics resistant, for tests performed by a qualified testing agency.

D. Configuration Disclosure Drawing: For each type of forced-entry-resistant security window, complying with ASTM F1233.

E. Examination reports documenting inspections of substrates, areas, and conditions.

F. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

G. Field quality-control reports documenting inspections of installed products.

1. Field quality-control certification signed by Contractor.

H. Sample Warranty: For special warranty.

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1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project.

B. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Pack security windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.

B. Label security window packaging with drawing designation.

C. Store crated security windows on raised blocks to prevent moisture damage.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace security windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including deflections exceeding 1/4 inch.
b. Failure of welds.
c. Excessive air leakage.
d. Faulty operation of sliding window hardware.
e. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: _____ years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Attack Resistance: Provide units identical to those tested for compliance with requirements indicated, and as follows:

1. Ballistics Resistance, UL 752: Listed and labeled as Level 3 in accordance with UL 752.

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B. Structural Loads: Security windows withstand the effects of wind loads, with no permanent deformation or breakage of components within window assembly when tested in accordance with ASTM E330/E330M.

1. Wind Loads: As indicated on Drawings.

C. Air Leakage, Fixed Glazing and Framing: Provide windows with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested in accordance with ASTM E283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft.

D. Water Penetration under Static Pressure, Fixed Glazing and Framing: Provide windows that do not evidence water penetration through fixed glazing and framing areas when tested in accordance with ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

E. Energy Performance: Provide windows with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below and certified and labeled in accordance with NFRC:

1. Thermal Transmittance (U-Factor): Glazing and framing areas as a whole have U-factor of not more than 0.80 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
2. Solar Heat-Gain Coefficient (SHGC): Glazing and framing areas as a whole have SHGC of no greater than 0.6 as determined in accordance with NFRC 200.

2.2 VISION SECURITY WINDOWS

A. Provide vision security windows with framing on four sides and no operable sash or ventilator.

B. Manufacturer: Subject to compliance with requirements, provide products by the following, or equal:

1. Basis of Design: Norshield Architectural Security Products, “NS7000 Series Aluminum Windows.”

C. Framing: Fabricate perimeter framing, mullions, and glazing stops from aluminum as follows:

1. Profile: Manufacturer's standard with minimum face dimension indicated.

a. Minimum Face Dimension: As indicated on Drawings.

2. Depth: As indicated on Drawings.
3. Provide thermally broken construction for aluminum framing.

D. Glazing and Glazing Materials: Comply with requirements in Section 088000 "Glazing."

E. Materials:

1. Aluminum Extrusions: ASTM B221. Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength.

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2. Aluminum Sheet and Plate: ASTM B209.

F. Finish and Color: As selected by Architect.

2.3 FABRICATION

A. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.

1. Provide units that are reglazable from the secure side without dismantling the attack side of framing.
2. Prepare security windows for field glazing unless preglazing at the factory is indicated.

B. Provide weep holes and internal water passages for exterior security windows to conduct infiltrating water to the exterior.

C. Thermally Broken Construction: Fabricate framing with an integral, concealed, low-conductance thermal barrier, located between exterior materials and members exposed on interior in a manner that eliminates direct metal-to-metal contact.

D. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.

1. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for security windows to comply with ballistics-resistance performance indicated.

E. Glazing Stops: Finish glazing stops to match security window framing.

1. Attack-Side (Exterior) Glazing Stops: Welded or integral to framing.
2. Secure-Side (Interior) Glazing Stops: Removable, coordinated with glazing indicated.

F. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

G. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

H. Factory-cut openings in glazing for speaking apertures.

I. Preglazed Fabrication: Preglaze window units at factory, where required for applications indicated. Installation orientation of glazing to meet performance requirements. Comply with requirements in Section 088000 "Glazing."

J. Weather Stripping: Factory applied.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

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B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.6 ACCESSORIES

A. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.

B. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to **four** times the load imposed, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified testing agency; of type indicated below.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A27/A27M cast steel or ASTM A47/A47M malleable iron. Provide bolts, washers, and shims as required; hot-dip galvanized in accordance with ASTM A153/A153M or ASTM F2329/F2329M.

C. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum 3/16 inch thick; with minimum 1/2-inch- diameter, headed studs welded to back of plate.

D. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.

E. Glazing Strips and Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Molded EPDM or neoprene gaskets complying with ASTM D2000, Designations 2BC415 to 3BC620; molded PVC gaskets complying with ASTM D2287; or molded, expanded EPDM or neoprene gaskets complying with ASTM C509, Grade 4.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric backing.

F. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers and with a proven record of compatibility with surfaces contacted in installation.

1. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.

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2. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.
3. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

G. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B633; provide sufficient strength to withstand design pressures indicated.

H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

I. Sealants: For sealants required within fabricated security windows, provide type recommended by manufacturer for joint size and movement. Sealant remains permanently elastic, nonshrinking, and nonmigrating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of security windows.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of security window connections before security window installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of security windows.

D. Inspect built-in and cast-in anchor installations, before installing security windows, to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
2. Perform additional inspections to determine compliance of replaced or additional work. Prepare anchor inspection reports.

E. For factory-installed glazing materials whose orientation (secure or attack side) is critical for performance, verify installation orientation.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other security window anchors whose installation is specified in other Sections.

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1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.

3.3 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing security windows to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.

1. Install an attached or integral flange to secure side of security windows extending over rough-in opening gap so that gap has same ballistics-resistance performance as security window.

B. Glazed Framing: Provide sealant-glazed framing. Comply with installation requirements in Section 088000 "Glazing."

C. Removable Glazing Stops and Trim: Fasten components with security fasteners.

D. Fasteners: Install security windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials.

E. Sealants: Comply with requirements in Section 079200 "Joint Sealants" for installing sealants, fillers, and gaskets.

1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.

F. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.4 FIELD QUALITY CONTROL

A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

C. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

3.5 ADJUSTING

A. Remove and replace defective work, including security windows that are warped, bowed, or otherwise unacceptable.

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3.6 CLEANING AND PROTECTION

A. Clean surfaces promptly after installation of security windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.

B. Clean glass of preglazed security windows promptly after installation. Comply with requirements in Section 088000 "Glazing" for cleaning and maintenance.

C. Provide temporary protection to ensure that security windows are without damage at time of Substantial Completion.

END OF SECTION

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SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions of Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.

B. This Section includes the following, but is not necessarily limited to:

1. Door Hardware, including electric hardware.
2. Storefront and Entrance door hardware.
3. Gate Hardware.
4. Digital keypad access control devices.
5. Hold-open closers with smoke detectors.
6. Wall or floor-mounted electromagnetic hold-open devices.
7. Power supplies for electric hardware.
8. Low-energy door operators plus sensors and actuators.
9. Thresholds, gasketing and weather-stripping.
10. Door silencers or mutes.

C. Related Sections: The following sections are noted as containing requirements that relate to this Section, but may not be limited to this listing.

1. Division 8: Section - Steel Doors and Frames.
2. Division 8: Section - Wood Doors.
3. Division 8: Section - Aluminum Storefront
4. Division 28: Section - Fire/Life-Safety Systems & Security Access Systems.

1.03 REFERENCES (USE DATE OF STANDARD IN EFFECT AS OF BID DATE.)

A. 2022 California Building Code, CCR, Title 24.

B. BHMA – Builders' Hardware Manufacturers Association

C. CCR – California Code of Regulations, Title 24, Part 2, California State Accessibility Standards.

D. DHI – Door and Hardware Institute

E. NFPA - National Fire Protection Association.

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1. NFPA 80 - Fire Doors and Other Opening Protectives
2. NFPA 105 - Smoke and Draft Control Door Assemblies

F. UL - Underwriters Laboratories.

1. UL 10C - Fire Tests of Door Assemblies
2. UL 305 - Panic Hardware

G. WHI - Warnock Hersey Incorporated

H. SDI - Steel Door Institute

1.04 SUBMITTALS & SUBSTITUTIONS

A. General: Submit in accordance with Conditions of the Contract and Division 1 Specification sections.

B. Submit product data (catalog cuts) including manufacturers' technical product information for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

C. Submit schedule organized vertically into “Hardware Sets” with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:

1. Include a Cover Sheet with;
   a. Job Name, location, telephone number.
   b. Architects name, location and telephone number.
   c. Contractors name, location, telephone number and job number.
   d. Suppliers name, location, telephone number and job number.
   e. Hardware consultant's name, location and telephone number.

2. Job Index information included;
   a. Numerical door number index including; door number, hardware heading number and page number.
   b. Complete keying information (referred to DHI hand-book "Keying Systems and Nomenclature"). Provision should be made in the schedule to provide keying information when available; if it is not available at the time the preliminary schedule is submitted.
   c. Manufacturers' names and abbreviations for all materials.
   d. Explanation of abbreviations, symbols, and codes used in the schedule.
   e. Mounting locations for hardware.
   f. Clarification statements or questions.
   g. Catalog cuts and manufacturer’s technical data and instructions.

3. Vertical schedule format sample:

Heading Number 1 (Hardware group or set number – HW-1)					
			(a) 1 Single Door #1 - Exterior from Corridor 101	(b) 90°	(c) RH
			(d) 3' 0"x7' 0" x 1-3/4" x (e) 20 Minute (f) WD x HM		

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(g) 1	(h)	(i) ea		(j) Hinges - (k) 5BB1HW 4.5 x 4.5 NRP (l) ½ TMS	(m) 626	(n) IVE
2	6AA	1 ea		Lockset - ND50PD x RHO x RH x 10-025 x JTMS	626	SCH

(a) - Single or pair with opening number and location. (b) - Degree of opening (c) - Hand of door(s) (d) - Door and frame dimensions and door thickness. (e) - Label requirements if any. (f) - Door by frame material. (g) - (Optional) Hardware item line #. (h) - Keyset Symbol. (i) - Quantity. (j) - Product description. (k) - Product Number. (l) - Fastenings and other pertinent information. (m) - Hardware finish codes per ANSI A156.18. (n) - Manufacture abbreviation.

D. Make substitution requests in accordance with Division 1. Substitution requests must be made prior to bid date. Include product data and indicate benefit to the project. Furnish samples of any proposed substitution.

E. Wiring Diagrams: Provide product data and wiring and riser diagrams for all electrical products listed in the Hardware Schedule portion of this section.

F. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.

G. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

H. Furnish as-built/as-installed schedule with close-out documents, including keying schedule and transcript, wiring/riser diagrams, manufacturers' installation and adjustment and maintenance information.

I. Fire Door Assembly Testing: Submit a written record of each fire door assembly to the Owner to be made available to the Authority Having Jurisdiction (AHJ) for future building inspections.

J. LEED Certification Points: Submit information and certifications necessary to achieve maximum points for LEED certification; coordinate and cooperate with Owner and Architect in providing information necessary for required LEED rating.

1.05 QUALITY ASSURANCE

A. Obtain each type of hardware (latch and lock sets, hinges, closers, exit devices, etc.) from a single manufacturer.

B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.

1. Responsible for detailing, scheduling and ordering of finish hardware.

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2. Meet with Owner to finalize keying requirements and to obtain final instructions in writing. To maintain the integrity of patented key systems provide a letter of authorization from the specified manufacturer indicating that supplier has authorization to purchase the key system directly from the manufacturer.
3. Stock parts for products supplied and are capable of repairing and replacing hardware items found defective within warranty periods.

C. Hardware Installer: Company specializing in the installation of commercial door hardware with five years documented experience.

D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not.

1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".

E. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.

F. Product packaging to be labelled in compliance with CA Prop 65, Safe Drinking Water and Toxic Enforcement Act of 1986.

1.06 DELIVERY, STORAGE AND HANDLING

A. Coordinate delivery of packaged hardware items to the appropriate locations (shop or field) for installation.

B. Hardware items shall be individually packaged in manufacturers' original containers, complete with proper fasteners. Clearly mark packages on outside to indicate contents and locations in hardware schedule and in work.

C. Provide locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, etc.

D. Contractor to inventory door hardware jointly with representatives of hardware supplier and hardware installer until each all are satisfied that count is correct.

1.07 WARRANTY

A. Provide warranties of respective manufacturers' regular terms of sale from day of final acceptance as follows:

1. Mechanical Locksets: Ten (10) years.
2. Electro-mechanical locksets: Three (3) years
3. Closers: Thirty (30) years
4. Mechanical exit devices: Ten (10) years
5. Electro-mechanical exit devices: Five (5) years
6. All other hardware: Three (3) years.

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1.08 MAINTENANCE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.09 PRE-INSTALLATION CONFERENCE

A. Convene a pre-installation conference at least one week prior to beginning work of this section.

B. Attendance: Architect, Construction Manager, Contractor, Security Contractor, Hardware Supplier, Installer, Key Owner Personnel, and Project Inspector.

C. Agenda: Review hardware schedule, products, installation procedures and coordination required with related work. Review Owner's keying standards.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

Item	Manufacturer	Acceptable Substitutes
Hinges	Ives	Hager, Stanley, McKinney
Cam Lift Hinges	By STC door MFR	Or Approved Equal
Locks, Latches	Schlage	Or Approved Equal
Cylinders	By Contractor	Or Approved Equal
Exit Devices	Von Duprin	Or Approved Equal
Closers	LCN	Or Approved Equal
Push, Pulls & Protection Plates	Ives	Trimco, BBW, DCI
Flush Bolts	Ives	Trimco, BBW, DCI
Dust Proof Strikes	Ives	Trimco, BBW, DCI
Coordinators	Ives	Trimco, BBW, DCI
Stops	Ives	Trimco, BBW, DCI
Overhead Stops	Glynn-Johnson	Or Approved Equal
Thresholds	Zero	Pemko, National Guard
Seals & Bottoms	Zero	Pemko, National Guard

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2.02 MATERIALS

A. Hinges: Exterior out-swinging door butts shall be non-ferrous material and shall have stainless steel hinge pins. All doors to have non-rising pins.

1. Hinges shall be sized in accordance with the following:
   a. Height:
      1) Doors up to 42" wide: 4-1/2" inches.
      2) Doors 43" to 48" wide: 5 inches.
   b. Width: Sufficient to clear frame and trim when door swings 180 degrees.
   c. Number of Hinges: Furnish 3 hinges per leaf to 7'-5" in height. Add one for each additional 2 feet in height.
   d. Cam lift hinges supplied by the STC door manufacturer.

2. Furnish non-removable pins (NRP) at all exterior out-swing doors and interior key lock doors with reverse bevels.

B. Continuous Hinges: As manufactured by Ives, an Allegion Company. UL rated as required.

C. Heavy Duty Cylindrical Locks and Latches: Schlage "ND" Series as scheduled with "Rhodes" design, fastened with through-bolts and threaded chassis hubs.

1. Provide cylindrical locksets exceeding the ANSI/BHMA A156.2 Grade 1 performance standards for strength, security, and durability in the categories below:
   a. Abusive Locked Lever Torque Test – minimum 3,100 inch-pounds without gaining access
   b. Offset lever pull – minimum 1,600 foot pounds without gaining access
   c. Vertical lever impact – minimum 100 impacts without gaining access

2. Cycle life - tested to minimum 16 million cycles per ANSI/BHMA A156.2 Cycle Test with no visible lever sag or use of performance aids such as set screws or spacers
3. UL 10C for 4'-0" x 10'-0" 3-hour fire door.
4. Cylinders: Refer to "KEYING" article, herein.
5. Provide solid steel anti-rotation through bolts and posts to control excessive rotation of lever.
6. Provide lockset that allows lock function to be changed to over twenty other common functions by swapping easily accessible parts.
7. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw capable of UL listing of 3 hours on a 4' x 10' opening. Provide proper latch throw for UL listing at pairs.
8. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
9. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
10. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
11. Provide wired electrified options as scheduled in the hardware sets.
    a. 12 through 24 volt DC operating capability, auto-detecting
    b. Selectable EL (fail safe)/EU (fail secure) operating mode via switch on chassis
    c. 0.230A (230mA) maximum current draw
    d. 0.010A (10mA) holding current
    e. Modular / "plug in" request to exit switch

12. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.

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D. Deadlocks: Rotating cylinder trim rings of attack-resistant design. Mounting plates and actuator shields of plated cold-rolled steel. Mounting screws of ¼" diameter steel and protected by drill-resistant ball bearings. Steel alloy deadbolt with hardened steel roller. Strike alloy deadbolt with reinforcer and two 3" long screws. ANSI A156.5, 2001 Grade 1 certified.

E. Exit devices: Von Duprin as scheduled.

1. Provide certificate by independent testing laboratory that device has completed over 1,000,000 cycles and can still meet ANSI/BHMA A156.3 - 2001 standards.
2. All internal parts shall be of cold-rolled steel with zinc dichromate coating.
3. Mechanism case shall have an average thickness of .140".
4. Compression spring engineering.
5. Non-handed basic device design with center case interchangeable with all functions.
6. All devices shall have quiet return fluid dampeners.
7. All latchbolts shall be deadlocking with ¾" throw and have a self-lubricating coating to reduce friction and wear.
8. Device shall bear UL label for fire and or panic as may be required.
9. All surface strikes shall be roller type and utilize a plate underneath to prevent movement.
10. Lever Trim: "Breakaway" design, forged brass or bronze escutcheon with a minimum of .130" thickness, match lockset lever design.
11. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key.
12. Furnish glass bead kits for vision lites where required.
13. All Exit Devices to be sex-bolted to the doors.
14. Panic Hardware shall comply with CBC Section 11B.404.2.7 and shall be mounted between 34" and 44" above the finished floor surface.
    a. Provide exit devices UL certified to meet maximum 5 pound requirements according to the California Building Code section 11B-309.4, and UL listed for Panic Exterior Fire Exit Hardware.

F. Closers: LCN as scheduled. Place closers inside building, stairs, room, etc.

1. Door closer cylinders shall be of high strength cast iron construction with double heat treated pinion shaft to provide low wear operating capabilities of internal parts throughout the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory. A written certification showing successful completion of a minimum of 10,000,000 cycles must be provided.
2. All door closers shall be fully hydraulic and have full rack and pinion action with a shaft diameter of a minimum of 11/16 inch and piston diameter of 1 inch to ensure longevity and durability under all closer applications.
3. All parallel arm closers shall incorporate one piece solid forged steel arms with bronze bushings. 1-9/16" steel stud shoulder bolts, shall be incorporated in regular arms, hold-open arms, arms with hold open and stop built in. All other closers to have forged steel main arms for strength, durability, and aesthetics for versatility of trim accommodation, high strength and long life.
4. All parallel arm closers so detailed shall provide advanced backcheck for doors subject to severe abuse or extreme wind conditions. This advanced backcheck shall be located to begin cushioning the opening swing of the door at approximately 45 degrees. The intensity of the backcheck shall be fully adjustable by tamper resistant non-critical screw valve.

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5. Closers shall be installed to permit doors to swing 180 degrees.
6. All closers shall utilize a stable fluid withstanding temperature range of 120 degrees F. to -30 degrees F. without requiring seasonal adjustment of closer speed to properly close the door.
7. Provide the manufactures drop plates, brackets and spacers as required at narrow head rails and special frame conditions. NO wood plates or spacers will be allowed.
8. Maximum effort to operate closers shall not exceed 5 lbs., such pull or push effort being applied at right angles to hinged doors. Compensating devices or automatic door operators may be utilized to meet the above standards. When fire doors are required, the maximum effort to operate the closer may be increased but shall not exceed 15 lbs. when specifically approved by fire marshal. All closers shall be adjusted to operate with the minimum amount of opening force and still close and latch the door. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position. Per 11B-404.2.8.1, door shall take at least 5 seconds to move from an open position of 90 degrees to a position of 12 degrees from the latch jamb.

G. Flush Bolts & Dust Proof Strikes: Automatic Flush Bolts shall be of the low operating force design. Utilize the top bolt only model for interior doors where applicable and as permitted by testing procedures.

1. Manual flush bolts only permitted on storage or mechanical openings as scheduled.
2. Provide dust proof strikes at openings using bottom bolts.

H. Door Stops:

1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
2. Do not install floor stops more than four (4) inches from the face of the wall or partition (CBC Section 11B-307).
3. Overhead stops shall be made of stainless steel and non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.

I. Protection Plates: Fabricate either kick, armor, or mop plates with four beveled edges. Provide kick plates 10" high and 2" LDW. Sizes of armor and mop plates shall be listed in the Hardware Schedule. Furnish with machine or wood screws of bronze or stainless to match other hardware.

J. Thresholds: As Scheduled and per details.

1. Thresholds shall not exceed 1/2" in height, with a beveled surface of 1:2 maximum slope.
2. Set thresholds in a full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements in Division 7 “Thermal and Moisture Protection”.
3. Use ¼” fasteners, red-head flat-head sleeve anchors (SS/FHSL).
4. Thresholds shall comply with CBC Section 11B-404.2.5.

K. Seals: Provide silicone gasket at all rated and exterior doors.

1. Fire-rated Doors, Resilient Seals: UL10C Classified complies with NFPA 80 & NFPA 252. Coordinate with selected door manufacturers' and selected frame manufacturers' requirements.

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2. Fire-rated Doors, Intumescent Seals: Furnished by selected door manufacturer. Furnish fire-labeled opening assembly complete and in full compliance with UL10C Classified complies with NFPA 80 & NFPA 252. Where required, intumescent seals vary in requirement by door type and door manufacture -- careful coordination required.
3. Smoke & Draft Control Doors, Provide UL10C Classified complies with NFPA 80 & NFPA 252 for use on "S" labeled Positive Pressure door assemblies.

L. Door Shoes & Door Top Caps: Provide door shoes at all exterior wood doors and top caps at all exterior out-swing doors.

M. Silencers: Furnish silencers for interior hollow metal frames, 3 for single doors, 2 for pairs of doors. Omit where sound or light seals occurs, or for fire-resistive-rated door assemblies.

2.03 KEYING

A. Furnish a Proprietary Schlage masterkey system as directed by the owner or architect. Key system to be designated and combinated by the Schlage Master Key Department even if pinned by the Authorized Key Center, Authorized Security Center or a local authorized commercial dealer.

B. A detailed keying schedule is to be prepared by the owner and/or architect in consultation with a representative of Allegion or an Authorized Key Center or Authorized Security Center. Each keyed cylinder on every keyed lock is to be listed separately showing the door #, key group (in BHMA terminology), cylinder type, finish and location on the door.

C. Cylinder should be supplied by the Owner.

2.04 FINISHES

A. Finish to be confirmed by Owner.

2.05 FASTENERS

A. Screws for strikes, face plates and similar items shall be flat head, countersunk type, provide machine screws for metal and standard wood screws for wood.

B. Screws for butt hinges shall be flathead, countersunk, full-thread type.

C. Fastening of closer bases or closer shoes to doors shall be by means of sex bolts and spray painted to match closer finish.

D. Provide expansion anchors for attaching hardware items to concrete or masonry.

E. All exposed fasteners shall have a phillips head.

F. Finish of exposed screws to match surface finish of hardware or other adjacent work.

G. All Exit Devices and Lock Protectors shall be fastened to the door by the means of sex bolts or through bolts.

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PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that doors and frames are square and plumb and ready to receive work and dimensions are as instructed by the manufacturer.

B. Beginning of installation means acceptance of existing conditions.

C. Fire-Rated Door Assembly Inspection: Upon completion of the installation, all fire door assemblies shall be inspected to confirm proper operation of the closing device and latching device and that only the manufacturer's furnished fasteners are used for installation and that it meets all criteria of a fire door assembly per NFPA 80 (Standard for Fire Doors and Other Opening Protectives) 2016 Edition. A written record shall be maintained and transmitted to the Owner to be made available to the Authority Having Jurisdiction (AHJ). The inspection of the swinging fire doors shall be performed by a certified FDAI (Fire Door Assembly Inspector) with knowledge and understanding of the operating components of the type of door being subjected to the inspection. The record shall list each fire door assembly throughout the project and include each door number, an itemized list of hardware set components at each door opening, and each door location in the facility.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and requirements of DHI.

B. Use the templates provided by hardware item manufacturer.

C. Mounting heights for hardware shall be as recommended by the Door and Hardware Institute. Operating hardware will to be located between 34" and 44" AFF.

D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

F. Set thresholds for exterior doors in full bed of butyl-rubber sealant.

G. If hand of door is changed during construction, make necessary changes in hardware at no additional cost.

H. Hardware Installer shall coordinate with security contractor to route cable to connect electrified locks, panic hardware and fire exit hardware to power transfers or electric hinges at the time these items are installed so as to avoid disassembly and reinstallation of hardware.

I. Hardware Installer shall also be present with the security contractor when the power is turned on for the testing of the electronic hardware applications. Installer shall make adjustments to solenoids, latches, vertical rods and closers to insure proper and secure operation.

J. All wiring for electro-mechanical hardware mounted on the door shall be connected through the power transfer and terminated in the interface junction box specified for in the Electrical Section.

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K. Conductors shall be minimum 18 gage stranded, multicolored. A minimum 12 in. loop of conductors shall be coiled in the interface junction box. Each conductor shall be permanently marked with its function.

L. If a power supply is specified in the hardware sets, all conductors shall be terminated in the power supply. Make all connections required for proper operation between the power supply and the electro-mechanical hardware. Provide the proper size conductors as specified in the manufacturer's technical documentation.

3.03 ADJUST AND CLEAN

A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

B. Clean adjacent surface soiled by hardware installation.

C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy, return to that work area and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

D. Instruct Owner's Personnel in proper adjustment and maintenance of hardware finishes, during the final adjustment of hardware.

E. Continued Maintenance Service: Approximately six months after the completion of the project, the Contractor accompanied by the Architectural Hardware Consultant, shall return to the project and re-adjust every item of hardware to restore proper functions of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.04 HARDWARE LOCATIONS

A. Conform to CCR, Title 24, Part 2; and ADAAG; and the drawings for access-compliant positioning requirements for the disabled.

3.05 FIELD QUALITY CONTROL

A. Contractor is responsible for providing the services of an Architectural Hardware Consultant (AHC) or a proprietary product technician to inspect installation and certify that hardware and its installation have been furnished and installed in accordance with manufacturers' instructions and as specified herein.

3.06 SCHEDULE

A. The items listed in the following schedule shall conform to the requirements of the foregoing specifications.

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B. While the hardware schedule is intended to cover all doors, and other movable parts of the building, and establish type and standard of quality, the contractor is responsible for examining the Plans and Specifications and furnishing proper hardware for all openings whether listed or not. If there are any omissions in hardware groups in regard to regular doors they shall be called to the attention of the Architect prior to bid opening for instruction; otherwise, list will be considered Complete. No extras will be allowed for omissions.

C. The Door Schedule on the Drawings indicates which hardware set is used with each door.

Manufacturers Abbreviations (Mfr.)

Abbreviation	Name
B/O	By Others
BEA	B.E.A., Inc.
GLY	Glynn-Johnson Corp
IVE	H.B. Ives
LCN	LCN Commercial Division
SCE	Schlage Electronic Security
SCH	Schlage Lock Company
VON	Von Duprin
ZER	Zero International Inc

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Hardware Group No. (E)

For use on Door #(s):

01	02	03	04	05	06
07	08				

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	MFR
		EXISTING HARDWARE TO REMAIN.	

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Hardware Group No. 01

For use on Door #(s):
102A 130D

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	DELAYED PANIC HARDWARE	CXPA-98-L-M996-06-FSE 24 VDC	VON
1	EA	RIM CYLINDER	BY CONTRACTOR	
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	LCN
1	EA	GASKETING	188SBK	ZER
1	EA	DOOR SWEEP	253A	ZER
1	EA	THRESHOLD	PER DETAIL	ZER
			POWER SUPPLY - WORK OF DIVISION 28	

Hardware Group No. 02

For use on Door #(s):
102B 130C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	DELAYED PANIC HARDWARE	CXPA-98-L-M996-06-FSE 24 VDC	VON
1	EA	RIM CYLINDER	BY CONTRACTOR	
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	LCN
1	EA	FLOOR STOP	FS439	IVE
1	EA	GASKETING	188SBK	ZER
1	EA	DOOR SWEEP	253A	ZER
1	EA	THRESHOLD	PER DETAIL	ZER
			POWER SUPPLY - WORK OF DIVISION 28	

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Hardware Group No. 03

For use on Door #(s):
125A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	DELAYED FIRE EXIT HARDWARE	CXPA-98-L-F-M996-06-FSE 24 VDC	VON
1	EA	RIM CYLINDER	BY CONTRACTOR	
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	LCN
1	EA	FLOOR STOP	FS439	IVE
1	EA	GASKETING	188SBK	ZER
1	EA	DOOR SWEEP	253A	ZER
1	EA	THRESHOLD	PER DETAIL	ZER
			POWER SUPPLY - WORK OF DIVISION 28	

Hardware Group No. 04

For use on Door #(s):
107B 111 119 125B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5	IVE
1	EA	PANIC HARDWARE	PA-AX-98-L-BE-06	VON
1	EA	SURFACE CLOSER	4040XP EDA	LCN
1	EA	FLOOR STOP	FS439	IVE
1	EA	GASKETING	188SBK	ZER

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Hardware Group No. 05

For use on Door #(s):
123

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	STOREROOM LOCK	ND80LD RHO	SCH
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	SURFACE CLOSER	4040XP	LCN
1	EA	FLOOR STOP	FS439	IVE
1	EA	GASKETING	188SBK	ZER

Hardware Group No. 06

For use on Door #(s):
109

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	STOREROOM LOCK	ND80LD RHO	SCH
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	SURFACE CLOSER	4040XP	LCN
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	IVE
1	EA	FLOOR STOP	FS439	IVE
1	EA	GASKETING	188SBK	ZER

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Hardware Group No. 07

For use on Door #(s):
126 127

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	STOREROOM LOCK	ND80LD RHO	SCH
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	SURFACE CLOSER	4040XP	LCN
1	EA	FLOOR STOP	FS439	IVE
1	EA	GASKETING	188SBK	ZER
1	EA	DOOR SWEEP	253A	ZER
1	EA	THRESHOLD	PER DETAIL	ZER

Hardware Group No. 08

For use on Door #(s):
112

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	STOREROOM LOCK	ND80LD RHO	SCH
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	OH STOP	410S	GLY
1	EA	SURFACE CLOSER	4040XP ST-1630	LCN
1	EA	MOUNTING PLATE	4040XP-18	LCN
1	EA	GASKETING	188SBK	ZER

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Hardware Group No. 09

For use on Door #(s):
118A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	STOREROOM LOCK	ND80LD RHO	SCH
1	EA	OCCUPIED INDICATOR	10LEDSOUNDER	BEA
1	EA	PUSH TO LOCK BUTTON	10PTLBUTTON	BEA
1	EA	LOGIC MODULE	BR3-X (1 PER RESTROOM)	BEA
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	ELECTRIC STRIKE	6211 FS 12/16/24/28 VAC/VDC	VON
1	EA	SURFACE CLOSER	4040XP EDA	LCN
1	EA	FLOOR STOP	FS439	IVE
1	EA	GASKETING	188SBK	ZER
1	EA	DOOR SWEEP	253A	ZER
1	EA	THRESHOLD	PER DETAIL	
1	EA	DOOR CONTACT	10SWITCH1084	BEA
1	EA	POWER SUPPLY	PS904 900-4RL 120/240 VAC (1 PER RESTROOM)	SCE

DOORS NORMALLY UNLOCKED AND OUTSIDE INDICATOR IS NOT LIT. PUSHING BUTTON ON WALL ON INSIDE LOCKS BOTH DOOR AND LIGHTS BOTH OUTSIDE INDICATORS. EXITING THROUGH EITHER DOOR UNLOCKS BOTH DOORS AND RESETS INDICATOR

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Hardware Group No. 10

For use on Door #(s):
118B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	CAM LIFT HINGE	BY ACCOUSTIC DOOR/FAME MFR	B/O
1	EA	STOREROOM LOCK	ND80LD RHO	SCH
1	EA	OCCUPIED INDICATOR	10LEDSOUNDER	BEA
1	EA	PUSH TO LOCK BUTTON	10PTLBUTTON	BEA
1	EA	LOGIC MODULE	BR3-X (1 PER RESTROOM)	BEA
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	ELECTRIC STRIKE	6211 FS 12/16/24/28 VAC/VDC	VON
1	EA	SURFACE CLOSER	4040XP	LCN
1	EA	FLOOR STOP	FS439	IVE
1	SET	SEAL	BY STC DOOR MFR	
1	EA	DOOR BOTTOM	BY STC DOOR MFR	
1	EA	THRESHOLD	PER DETAIL	
1	EA	DOOR CONTACT	10SWITCH1084	BEA
1	EA	POWER SUPPLY	PS904 900-4RL 120/240 VAC (1 PER RESTROOM)	SCE

DOORS NORMALLY UNLOCKED AND OUTSIDE INDICATOR IS NOT LIT. PUSHING BUTTON ON WALL ON INSIDE LOCKS BOTH DOOR AND LIGHTS BOTH OUTSIDE INDICATORS. EXITING THROUGH EITHER DOOR UNLOCKS BOTH DOORS AND RESETS INDICATOR

Hardware Group No. 11

For use on Door #(s):
140B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5	IVE
1	EA	CLASSROOM LOCK	ND70LD RHO	SCH
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	OH STOP	410S	GLY
1	EA	SURFACE CLOSER	4040XP ST-1630	LCN
1	EA	GASKETING	188SBK	ZER

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Hardware Group No. 12

For use on Door #(s):
107A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	CLASSROOM LOCK	ND70LD RHO	SCH
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	SURFACE CLOSER	4040XP EDA	LCN
1	EA	FLOOR STOP	FS439	IVE
1	EA	GASKETING	188SBK	ZER

Hardware Group No. 13

For use on Door #(s):
140A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5	IVE
1	EA	CLASSROOM LOCK	ND70LD RHO	SCH
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	OH STOP	410S	GLY
1	EA	SURFACE CLOSER	4040XP EDA	LCN
1	EA	GASKETING	188SBK	ZER

Hardware Group No. 14

For use on Door #(s):
116 129

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	CAM LIFT HINGE	BY ACCOUSTIC DOOR/FAME MFR	B/O
1	EA	CLASSROOM LOCK	ND70LD RHO	SCH
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	SURFACE CLOSER	4040XP	LCN
1	EA	FLOOR STOP	FS439	IVE
1	SET	SEAL	BY STC DOOR MFR	
1	EA	DOOR BOTTOM	BY STC DOOR MFR	
1	EA	THRESHOLD	PER DETAIL	ZER

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Hardware Group No. 15

For use on Door #(s):
104 105 120

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50LD RHO	SCH
1	EA	ENTRANCE/OFFICE LOCK	ND50LD RHO	SCH
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	FLOOR STOP	FS439	IVE
1	EA	GASKETING	188SBK	ZER
1	EA	DOOR SWEEP	253A	ZER
1	EA	THRESHOLD	PER DETAIL	ZER

Hardware Group No. 16

For use on Door #(s):
103

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	CAM LIFT HINGE	BY ACCOUSTIC DOOR/FAME MFR	B/O
1	EA	ENTRANCE/OFFICE LOCK	ND50LD RHO	SCH
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	FLOOR STOP	FS439	IVE
1	SET	SEAL	BY STC DOOR MFR	
1	EA	DOOR BOTTOM	BY STC DOOR MFR	
1	EA	THRESHOLD	PER DETAIL	ZER

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Hardware Group No. 17

For use on Door #(s):
114 121

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	CAM LIFT HINGE	BY ACCOUSTIC DOOR/FAME MFR	B/O
1	EA	ENTRANCE/OFFICE LOCK	ND50LD RHO	SCH
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	SURFACE CLOSER	4040XP	LCN
1	EA	FLOOR STOP	FS439	IVE
1	SET	SEAL	BY STC DOOR MFR	
1	EA	DOOR BOTTOM	BY STC DOOR MFR	
1	EA	THRESHOLD	PER DETAIL	ZER

Hardware Group No. 18

For use on Door #(s):
113 124

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	PASSAGE SET	ND10S RHO	SCH
1	EA	SURFACE CLOSER	4040XP	LCN
1	EA	FLOOR STOP	FS439	IVE
1	EA	GASKETING	188SBK	ZER

Hardware Group No. 19

For use on Door #(s):
122

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC	SCH
1	EA	OH STOP	410S	GLY
1	EA	GASKETING	188SBK	ZER
1	EA	DOOR SWEEP	253A	ZER
1	EA	THRESHOLD	PER DETAIL	ZER

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Hardware Group No. 20

For use on Door #(s):
117

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC	SCH
1	EA	SURFACE CLOSER	4040XP CUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-NH-A	IVE
1	EA	GASKETING	188SBK	ZER
1	EA	DOOR SWEEP	39A	ZER
1	EA	THRESHOLD	PER DETAIL	ZER

Hardware Group No. 21

For use on Door #(s):
128

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-NH-A	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	GASKETING	188SBK	ZER
1	EA	DOOR SWEEP	253A	ZER
1	EA	THRESHOLD	PER DETAIL	ZER

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Hardware Group No. 22

For use on Door #(s):
115

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC	SCH
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	GASKETING	188SBK	ZER
1	EA	DOOR SWEEP	253A	ZER
1	EA	THRESHOLD	PER DETAIL	ZER

Hardware Group No. 23

For use on Door #(s):
101B 130B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5	IVE
1	EA	PANIC HARDWARE	PA-AX-9850WDC-EO-LBL-SNB	VON
1	EA	PANIC HARDWARE	PA-AX-9850WDC-L-06-LBL-SNB	VON
1	EA	RIM CYLINDER	BY CONTRACTOR	
2	EA	SURFACE CLOSER	4040XP	LCN
2	EA	FLOOR STOP	FS439	IVE
1	EA	GASKETING	188SBK	ZER
1	SET	MEETING STILE	328AA-S	ZER
2	EA	DOOR SWEEP	253A	ZER
1	EA	THRESHOLD	PER DETAIL	ZER

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Hardware Group No. 24

For use on Door #(s):
130A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5	IVE
1	EA	PANIC HARDWARE	PA-AX-9850WDC-EO-LBL-SNB	VON
1	EA	PANIC HARDWARE	PA-AX-9850WDC-L-06-LBL-SNB	VON
1	EA	RIM CYLINDER	BY CONTRACTOR	
2	EA	SURFACE CLOSER	4040XP CUSH	LCN
1	EA	GASKETING	188SBK	ZER
1	SET	MEETING STILE	328AA-S	ZER
2	EA	DOOR SWEEP	253A	ZER
1	EA	THRESHOLD	PER DETAIL	ZER

Hardware Group No. 25

For use on Door #(s):
101A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5	IVE
1	EA	PANIC HARDWARE	PA-AX-9850WDC-EO-LBL-SNB	VON
1	EA	PANIC HARDWARE	PA-AX-9850WDC-L-06-LBL-SNB	VON
1	EA	RIM CYLINDER	BY CONTRACTOR	
2	EA	SURFACE CLOSER	4040XP EDA	LCN
2	EA	FLOOR STOP	FS439	IVE
1	EA	GASKETING	188SBK	ZER
1	SET	MEETING STILE	328AA-S	ZER
2	EA	DOOR SWEEP	253A	ZER
1	EA	THRESHOLD	PER DETAIL	ZER

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Hardware Group No. 26

For use on Door #(s):
108

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
8	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	AUTO FLUSH BOLT	FB41P	IVE
1	EA	DUST PROOF STRIKE	DP2	IVE
1	EA	STOREROOM LOCK	ND80LD RHO	SCH
1	EA	MORTISE CYLINDER	BY CONTRACTOR	
1	EA	COORDINATOR	COR X FL	IVE
2	EA	SURFACE CLOSER	4040XP	LCN
2	EA	FLOOR STOP	FS439	IVE
1	EA	GASKETING	188SBK	ZER
1	EA	ASTRAGAL	44SP OR BY HM DOOR MFR	ZER

END OF SECTION

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SECTION 088000

GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Glazing.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”

2. Section 079200 “Joint Sealants.”

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.

3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.

4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

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1.5 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

1. Insulating glass.

2. Tempered laminated glass.

C. Glazing Accessory Samples: For gaskets, sealants, and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations as indicated on Drawings.

E. Contractor-Engineered Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Professional Engineer shall be licensed in the State of California.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installers and manufacturers of insulating-glass units with sputter-coated, low-e coatings.

B. Product Certificates: For glass and glazing products, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for coated glass and insulating glass.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Warranties: Sample of special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

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D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Source Limitations for Glass: Obtain coated float glass, and insulating glass from single source from single manufacturer for each glass type.

F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Glazing Manual."

2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."

3. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

I. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

J. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

2. Review temporary protection requirements for glazing during and after installation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

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1.10 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Contractor-Engineered Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As required by California Building Code and Local Authorities Having Jurisdiction.

2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.

3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.

4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

5. Provide tempered or laminated glazing where required to meet safety glazing requirements of Local Authorities Having Jurisdiction (AHJ).

6. Thickness of glass, where indicated, is minimum thickness. Contractor is responsible for engineering glass and providing thicker glass, where required by calculations.

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2.2 GLASS TYPES

A. As indicated on Drawings.

2.3 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength: Provide glass products to meet local building codes. Where safety glass is required, provide tempered glass or laminated glass. Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.

2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.

3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.

4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.

5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.4 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2. For uncoated glass, comply with requirements for Condition A.

3. For coated vision glass, comply with requirements for Condition C (other coated glass).

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2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.

2. Spacer: Aluminum with black, color anodic finish.

3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.

2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated. Provide types indicated in glass types.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.8 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product

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manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

2. Presence and functioning of weep systems.

3. Minimum required face and edge clearances.

4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

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E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

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G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

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C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

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SECTION 088300

MIRRORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:

1. Annealed monolithic glass mirrors – frameless.

B. Related Sections:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 088000 “Glazing.”
3. Section 102813 "Toilet Accessories."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.

C. Samples: For each type of the following:

1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
2. Mirror Clips: Full size.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of mirror, from manufacturer.

C. Warranty: Sample of special warranty.

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1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.

C. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.

D. Glazing Publications: Comply with the following published recommendations:

1. GANA's "Glazing Manual" unless more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.
2. GANA Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

E. Safety Glazing Products: For film-backed mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: One year from date of Substantial Completion for workmanship.
2. Warranty Period against Spoilage: Ten years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRRORS

A. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.

B. Clear Glass: Mirror Select Quality.

1. Nominal Thickness: 3mm.

2.2 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

1. Manufacturers: Subject to compliance with requirements, provide products by the following, or equal:

a. Laurence, C.R. Co., Inc.
b. Liquid Nails Adhesive.

2.3 MIRROR HARDWARE

A. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.4 FABRICATION

A. Mirror Sizes: To suit Project conditions, cut mirrors to final sizes and shapes.

B. Mirror Edge Treatment: Flat polished.

1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.

C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

B. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. Wall Mounted Mirrors: Install mirrors with mirror hardware and adhesive. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

3.4 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

D. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

END OF SECTION

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SECTION 089119

FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed louvers.

B. Related Requirements:

1. Section 074213.19 “Insulated Metal Wall Panels.”
2. Section 079200 “Joint Sealants”.
3. Section 085653 “Security Windows.”

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).

C. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing according to AMCA 500-L.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

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C. Samples: For each type of metal finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Sample Warranties: For manufacturer's special warranties.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 WARRANTY

A. Manufacturer’s Warranty: Manufacturer agrees to repair or replace louvers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of welds.
b. Excessive air leakage.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

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B. Wind Loads: Determine loads based on pressures as indicated on Drawings.

C. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

E. Water Penetration Resistance: Louver assemblies shall contain internal gutters and sill flashing that collect and drain water to the exterior.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

G. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

H. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.2 MANUFACTURERS

A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Subject to compliance with requirements, provides by the following, or equal:
   1. Basis-of-Design: Ontario Specialty Architectural Products.

2.3 FIXED EXTRUDED-ALUMINUM LOUVERS – EXHAUST LOUVERS

A. Exhaust Louvers: Horizontal, extruded-aluminum construction; frame with channel profile; corner joints mitered and mechanically fastened, with continuous recessed caulking channel each side; intermediate mullions matching frame; gutters; rated for air performance and water penetration in accordance with AMCA 500-L.

   1. Basis-of-Design: Ontario Specialty Architectural Products, “Model DL-660, High-Performance Standard Louver.”
      a. Size: As shown on Drawings.
      b. Blade Depth: 158 mm, horizontal fixed drainable blade
      c. Frame Depth: 158 mm.
      d. Metal Thickness:
         1) Frame: 0.081 inch.
         2) Blades: 0.081 inch.
      e. Net Free Area: 55%, minimum.
      f. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
      g. Finish and Color: As selected by Architect.

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2.4 FIXED EXTRUDED-ALUMINUM LOUVERS – INTAKE LOUVERS

A. Intake Louvers: Horizontal, extruded-aluminum construction; frame with channel profile; corner joints mitered and mechanically fastened, with continuous recessed caulking channel each side; intermediate mullions matching frame; gutters; rated for air performance and water penetration in accordance with AMCA 500-L.

1. Basis-of-Design: Ontario Specialty Architectural Products, "Model SL-440, High-Performance Rain Defense Louver"
   a. Size: As shown on Drawings.
   b. Blade Depth: 102 mm, horizontal fixed drainable blade.
   c. Frame Depth: 106 mm.
   d. Metal Thickness:
      1) Frame: 0.081 inch.
      2) Blades: 0.081 inch.
   e. Net Free Area: 57%, minimum.
   f. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
   g. Finish and Color: As selected by Architect.

2.5 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Rewirable frames with a driven spline or insert.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions. Fasteners shall be concealed, unless approved by Architect.

1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

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2.7 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide subsills made of same material as louvers.

F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. Clear Anodic Finish: AAMA 611, or thicker.

C. Color Anodic Finish: AAMA 611, or thicker.

D. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

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3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

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SECTION 092116

GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Gypsum board shaft wall assemblies.

B. Related Requirements:
1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 079200 “Joint Sealants.”
3. Section 092216 “Non-Structural Metal Framing.”
4. Section 092900 “Gypsum Board.”

1.3 ACTION SUBMITTALS

A. Product Data: For each component of gypsum board shaft wall assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For shaft wall assemblies, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.

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PART 2 - PRODUCTS

2.1 GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. Studs: Manufacturer's standard profile for repetitive members, corner and end members. ClarkDietrich “CT Stud”, or equal.
   1. Depth: As indicated.
   2. Minimum Base-Metal Thickness: 0.033 inch.

B. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
   1. Minimum Base-Metal Thickness: Matching steel studs.

C. Insulation: Sound attenuation blankets.

2.2 PANEL PRODUCTS

A. Product: Georgia-Pacific “DensGlass Shaftliner”, or equal. Fiberglass reinforced gypsum shaft liner board. Shaftliner panels shall be classified as “Type X” in accordance with ASTM C 1658.

B. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

C. Minimum Surface Density: 4 lbs/sf.

2.3 NON-LOAD-BEARING STEEL FRAMING

A. Steel Framing Members: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
   1. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized unless otherwise indicated.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with manufacturer's written recommendations.

B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
   1. Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.

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2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing according to ASTM E 1190 conducted by a qualified testing agency.

E. Sound Attenuation Blankets: As specified in Section 072100 “Building Insulation.”

F. Acoustical Sealant: As specified in Section 079200 “Joint Sealants.”

G. Joint Treatment Materials: As specified in Section 092900 “Gypsum Board.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 078100 "Applied Fireproofing."

B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.

B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment,

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services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

1. Fully detail elevator hoistway openings in shaft wall assemblies. Manufacturers' written recommendations for framing elevator hoistway-entrance door openings differ. Revise to suit Project and assemblies selected. Insert requirements for other openings to suit Project.
2. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
3. Reinforcing: Where handrails directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with 0.033-inch minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.

D. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels.

E. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect.

F. Cant Panels: At projections into shaft exceeding 4 inches, install 1/2- or 5/8-inch- thick gypsum board cants covering tops of projections.

1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.
2. Where steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft wall framing.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

END OF SECTION

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SECTION 092216

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. The Work in this section includes Contractor-Engineered Systems.

2. Non-load-bearing steel framing systems for interior gypsum board assemblies.

3. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”

2. Section 092900 “Gypsum Board”.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include spacings, sizes, thicknesses, and types of non-structural metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners.

2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Contractor-Engineered Submittal: For non-structural metal framing. Stamped and signed by a Professional Engineer registered in the State of California.

1. Requirements: The Contract Documents show the design intention for non-structural metal-framed walls and other gypsum board construction. The Contractor is responsible for providing structural engineering for the non-structural metal-framed wall systems consistent with: the design intention, including applicable details in the drawings; all building codes; and the requirements of all authorities having jurisdiction. Requirements

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include, but are not limited to: adequately framing and structuring; providing bracing in accordance with seismic code requirements; backing and/or blocking as required for millwork, equipment and other items mounted to non-structural metal-framed walls.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Load and Deflection Criteria:

1. Design Pressures: Design and construct non-structural metal framing walls to withstand a lateral loading of minimum 5 psf positive and negative pressure, except where more stringent requirements are indicated.

2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
   a. Horizontal deflection of Gypsum Board: L/240.
   b. Horizontal deflection of Ceramic Tile: L/360.
   c. Horizontal deflection at Stone: L/720.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.

2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated. No other coating is acceptable.

B. Standard Studs and Runners: ASTM C 645.

1. Steel Studs and Runners:

   a. Minimum Base-Metal Thickness: 25 gauge, unless otherwise indicated on Drawings.

C. Slip-Type Head Joints: Provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner

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and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.

2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

   a. Products: Subject to compliance with requirements, provide the following, or equal:

      1) ClarkDietrich Building Systems; BlazeFrame DSL Slotted Deflection Track
      2) MBA Building Supplies; FlatSteel Deflection Track.
      3) Steel Network Inc. (The); VertiTrack VTD Series.
      4) Superior Metal Trim; Superior Flex Track System (SFT).

D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Products: Subject to compliance with requirements, provide the following, or equal:

   a. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
   b. Grace Construction Products; FlameSafe FlowTrak System.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

F. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.

1. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 25 gauge, unless otherwise indicated on Drawings.

2. Depth: 7/8 in. unless otherwise indicated on Drawings.

3. Product: Clark Dietrich.

H. Furring Channel Resilient Attachment: Kinetics Noise Control Isomax resilient sound reduction clip.

I. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: As indicated on Drawings.

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2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.

3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch, and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

a. Type: Postinstalled, expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Flat Hangers: Steel sheet, in size indicated on Drawings.

E. Carrying Channels, typical at Gypsum Board Ceilings, unless otherwise indicated on Drawings: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges. 1 ½ in. deep and spaced at 48 in. on center, unless otherwise indicated on Drawings.

F. Furring Members:

1. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep. 25 gauge, fastened and perpendicular to carrying channels at 16 in. on center, typical, at gypsum board ceilings unless otherwise indicated on Drawings.

G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock. Provide where indicated on Drawings.

1. Products: Subject to compliance with requirements, provide the following, or equal:

a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. Chicago Metallic Corporation; Drywall Grid System.

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c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

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3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.

2. Multilayer Application: 16 inches o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

   a. Install two studs at each jamb unless otherwise indicated.
   b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

D. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. Z-Furring Members:

1. Erect insulation, specified in Section 072100 "Building Insulation," vertically and hold in place with Z-furring members spaced 24 inches o.c.

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2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches o.c.

2. Carrying Channels (Main Runners): 48 inches o.c.

3. Furring Channels (Furring Members): 16 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.

4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

5. Do not attach hangers to steel roof deck.

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6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.

7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.

8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

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SECTION 092900

GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Moisture-resistant gypsum board.
3. Fire and Acoustical Sealant.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 072100 “Building Insulation” for Sound Attenuation Blankets.
3. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

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1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide the following, or equal:

1. American Gypsum.

2. CertainTeed Corp.

3. Georgia-Pacific Gypsum LLC.

4. National Gypsum Company.

5. USG Corporation.

6. Saint Gobain.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.

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2. Long Edges: Tapered.

3. Minimum Surface Density: 2.2 lbs/sf.

C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.

2. Long Edges: Tapered.

3. Minimum Surface Density: 2.2 lbs/sf.

D. Water Resistant Gypsum Board: Glass-Mat Gypsum Board (Siliconized Gypsum Board) (SGB) – Exterior and Perimeter Wall Locations: ASTM C1177M, gypsum based board with water-resistant treated core, fully embedded glass fiber mats on both sides with a polymer modified gypsum surface and acrylic face coating, 1200 wide by longest lengths practicable. Thickness unless specified otherwise-16 mm thickness; ends square cut, tapered.

1. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2. Exposure Warranty: Manufacturers standard 12-month warranty.

3. Product: DensGlass Fireguard sheathing by Georgia-Pacific Gypsum LLC.

4. Acceptable Alternate Products: Subject to the requirements of this article 'CGC Securock Glass-Mat Sheathing Type X' manufactured by CGC Inc. or 'GlasRoc Sheathing Type X 5/8" ' by CertainTeed Corp.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.

2. Shapes:

a. Cornerbead.

b. LC-Bead: J-shaped; exposed long flange receives joint compound.

c. L-Bead: L-shaped; exposed long flange receives joint compound.

d. U-Bead: J-shaped; exposed short flange does not receive joint compound.

e. Expansion (control) joint.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, provide the following, or equal:

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a. Fry Reglet Corp.

b. Gordon, Inc.

c. Pittcon Industries.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.

3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.

4. Finish Coat: For third coat, use setting-type, sandable topping compound.

5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound

D. Joint Compound for Tile Backing Panels:

1. Tile Backer Units: As recommended by backer unit manufacturer.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

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B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Fire and Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, provide the following, or equal:

a. Pecora Corporation; AC-20 FTR .

b. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.

c. USG Corporation; Sheetrock (per USG) Acoustical Sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

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D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.

2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD AND WATER-RESISTANT GYPSUM BOARDS

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.

2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

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B. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.

2. LC-Bead: Use at exposed panel edges.

3. L-Bead: Use where indicated.

4. U-Bead: Use at exposed panel edges.

C. Aluminum Trim: Install in locations indicated on Drawings.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

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D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

2. Level 2: Panels that are substrate for tile.

3. Level 3: Where indicated on Drawings.

4. Level 4: Where indicated on Drawings and at panel surfaces that will be exposed to view unless otherwise indicated.

5. Level 5: Where indicated on Drawings, and as accent, graphics and specialty walls.

a. Primer and its application to surfaces are specified in Section 099100 "Painting."

3.6 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

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SECTION 093000

TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Porcelain and Ceramic tile.
   2. Tile wall base.
   3. Waterproof membrane.

B. Related Sections:
   1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
   2. Section 092900 “Gypsum Board” for tile backer board.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

A. Dynamic Coefficient of Friction: > 0.42 when tested in accordance with ANSI A137.1.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

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C. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

D. Samples for Verification:
1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory for each color and finish required.
4. Metal edge strips in 6-inch lengths.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product, signed by product manufacturer.

D. Material Test Reports: For each tile-setting and -grouting product and special purpose tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
1. Waterproof membrane.
2. Metal edge strips.

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1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store liquid materials in unopened containers and protected from freezing.

D. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

A. Porcelain and Ceramic Tile: Refer to products found on Finish Schedule on Drawings.

2.3 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

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B. Fluid-Applied Waterproofing: Single component, self-curing liquid rubber polymer that forms a flexible, seamless waterproofing membrane.
   1. Products: Subject to compliance with requirements, provide the following, or equal: Laticrete “Hydro Ban.”

2.4 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide the following, or equal:
      a. Custom Building Products.
      b. Laticrete International, Inc.
      c. MAPEI Corporation.
   2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
   3. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
   4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

B. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
   1. Latex Additive: Manufacturer's standard acrylic resin water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed Portland cement and aggregate mortar bed.

2.5 GROUT MATERIALS

A. Polymer-Modified Tile Grout: ANSI A118.7.
   1. Provide the following, or equal:
      a. Custom Building Products.
      b. Laticrete International, Inc.
      c. MAPEI Corporation.
   2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

2.6 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Section 079200 "Joint Sealants."
   1. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
   1. Products: Subject to compliance with requirements, provide the following, or equal:
      a. Dow Corning Corporation; Dow Corning 786.

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b. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
c. Laticrete International, Inc.; Latasil Tile & Stone Sealant.
d. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
e. Tremco Incorporated; Tremsil 600 White.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic, designed specifically for flooring applications; white zinc alloy exposed-edge material. Provide metal edge strips from Schluter Systems, or equal. PVC or neoprene parts are not acceptable.

C. Metal Edge/Transition Strips: Provide transition strips, of profile and width shown, of height required to protect exposed edge of tile, and of maximum lengths to minimize running joints. Provide metal edge/transition strips from Schluter Systems, or equal.
1. Size: As required to trim exposed edges of the specified tile and setting material thickness.
2. Material, Color and Finish: As shown on Drawings.
3. Provide metal edge/transition strips at inside corners of floor tile to wall tile, and as shown on Drawings.

D. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F per ASTM D 87.
2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

E. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

F. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.
1. Products: Subject to compliance with requirements, provide the following, or equal:
a. Bonsal American; an Oldcastle company; Grout Sealer.
b. Bostik, Inc.; CeramaSeal Grout & Tile Sealer.
c. C-Cure; Penetrating Sealer 978.
d. Custom Building Products; Surfaceguard Grout and Tile Sealer.

2.8 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

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C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
   1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
   2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
   3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
   4. Do not commence installation of flooring materials until floor substrate is within the following tolerances in all directions. If substrate is not within tolerance, level the substrate using a method and a product(s) that is compatible with and acceptable to the setting materials manufacturer.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
   1. Furnish the same lots, batches, etc. within the same contiguous areas of the site (i.e. corridors on the same floors, common rooms which adjoin each other, etc.).

D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation

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methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
   a. Tile floors in wet areas.
   b. Tile floors composed of tiles 8 by 8 inches or larger.
   c. Tile floors composed of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Maximum porcelain tile grout width: 3/16 in. (confirm with selected products).

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

A. Finished Surfaces: Unless otherwise accepted in the sample installation(s), if any, finished surfaces shall present a flat, even appearance, free from waver, projections, and depressions.

B. Movement (Contraction, Control, Expansion, and Isolation Joints) Joints: Locate sealant filled movement joints where recommended by the manufacturer of mortar and grout materials, but not less than the requirements of TCNA EJ171 which follows, and as accepted by the Architect. Form movement joints and other sealant-filled joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles. Where movement joints are to be butted, the ends shall touch and align.

C. Spacing Guidelines:

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1. 20 to 25 feet in each direction where interior tile work is not exposed to direct sunlight or moisture.
2. 8 to 12 feet in each direction where interior tile work is exposed to direct sunlight and moisture.
3. Where tilework abuts restraining surfaces such as perimeter walls, dissimilar floors, curbs, columns, pipes, ceilings, and where changes occur in backing materials, but not at drain strainers.
4. In the joint between tiles making up the inside corner of planes.
5. All contraction, control, expansion, isolation, seismic and cold joints in the horizontal structure and vertical surfaces shall continue through the tile surfaces, but not through membranes.
6. Vertical and Horizontal Joints Widths: Widths for quarry tile and paver tile shall be the same as the grout joint but not less than 1/4 inch or the width of the contraction, control, expansion, seismic, isolation joint whichever is greater; widths for ceramic tile and glazed wall tile shall not be less than 1/8 inch or the width of the control, expansion, seismic, joint whichever is greater.
7. Keep movement joints free from dirt, debris, grout, mortar, and setting bed materials. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

D. Metal Edge Strips: Install where exposed edge of wall tile meets other wall finishes that finish flush with or below face of tile and the manufacturer of the field tile does not manufacture a tile edge transition trim. Where metal edge strips are indicated and full length single units are not available, joints are to be butted, ends shall touch and align.

E. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.
1. Do not install tile over waterproofing until waterproofing has cured, and at each horizontal installation, has been tested for water tightness. Test waterproofing membrane for watertightness by damming the floor drain, and creating a dam at the perimeter of the waterproofed basin followed by filling the basin with water, marking the height, and verifying the same height after 48 hours. Repair leaks before continuing with the installation of subsequent tile.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
1. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

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3.6 FLOOR TILE INSTALLATION

A. Thinset Tile over Concrete Slabs (Where noted): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.

B. Concrete Subfloors, Interior: TCNA F113.
   1. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturer's recommendations.
   2. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
   3. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100 percent coverage to thickness of not less than 1/16-inch.
   4. Place tiles onto mortar bed, maintaining 1/8-inch wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponge. Rake out joints to depth required to receive grout as tile units are set.
   5. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
   6. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. For typical installations, comply with latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.

C. Thinset Tile over Crack Isolation Membrane (Janitor's Closet): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.

D. Concrete Subfloors, Interior: TCNA F125-Full.
   1. Apply the mortar to crack isolation membrane covered slab with the flat side of the trowel.
   2. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturer's recommendations.
   3. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
   4. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100 percent coverage to thickness of not less than 1/16-inch.
   5. Place tiles onto mortar bed, maintaining 1/8-inch wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponges. Rake out joints to depth required to receive grout as tile units are set.
   6. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
   7. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to

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grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.

E. Concrete Subfloors, Interior: TCNA F205 (on-ground slabs) and TCNA F205A (above ground slabs) except apply LHT bed in thickness of 3/4" unless otherwise indicated.
   1. Where required by the conditions indicated, apply underlayment using methods and within time limits recommended by the mortar manufacturer.
   2. With a trowel, having notches sized as recommended by the mortar manufacturer, place and comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturers recommendations.
   3. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
   4. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100% coverage to thickness of not less than 1/16-inch.
   5. Place tiles onto mortar bed, maintaining 1/8-inch wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponges. Rake out joints to depth required to receive grout as tile units are set.
   6. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
   7. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.

F. Thickset Tile (Toilet Rooms): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply. Thickness of mortar bed: Between 1-1/4-inch and 2-inches.

G. Mortar and Bond Coat:
   1. Latex-Portland Cement Mortar: ANSI A108.1A (Wet Set Method).
   2. Latex-Portland Cement Bond Coat: ANSI A108.5.
   3. Concrete Subfloors, Interior: TCNA F121.
   4. Apply the mortar to waterproofed slab with the flat side of the trowel.
   5. Apply half of the mortar bed to slab and place reinforcing wire fabric. After placing mesh, apply balance of mortar bed. The mortar shall be rodded and compacted with a steel trowel.
   6. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying bond coat to tiles
   7. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile sheets for 100 percent coverage to thickness of not less than 1/16-inch.
   8. Place tile onto the green mortar bed, maintaining 1/8-inch wide joints for typical tile units and 1/4-inch wide joints for quarry tile units if any, and true accurate pattern as shown. Tamp tile with wood block and rubber mallet to produce finish levels of tile matching adjacent tile surfaces. Beating shall take place prior to mortar taking and initial set.

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Exercise care to quickly remove spillage from faces of tile using water. Rake out joints to depth required to receive grout as tile units are set. Maintain fully plastic bed throughout tile installation.

9. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
10. Grout Installation Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. For typical installations, comply with latex Portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.

H. Thresholds: Install thresholds in one piece, notched to fit neatly at door jambs; set in same type of setting bed as abutting field tile in accordance Manufacture's recommendations and TCNA Method TR61.

3.7 WALL TILE INSTALLATION

A. Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for ANSI setting bed methods, TCNA installation methods related to types of construction, and grout ANSI installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.

B. Latex Portland Cement Mortar Installation (using specified latex Portland cement mortar material): ANSI A108.5.

C. Gypsum Wallboard, Interior (Latex Portland Cement Mortar) Method: TCNA W243, place tiles maintaining 1/8-inch wide joints, and true accurate pattern as shown.

D. Cementitious Backerboard (Latex Portland Cement Mortar) Method: TCNA W244C, place tiles maintaining 1/8-inch wide joints, and true accurate pattern as shown.

E. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.

3.8 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove epoxy and latex Portland cement grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

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3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work. Replace all cracked, chipped, and broken tile units with matching tile units; patched tile units will not be permitted.

C. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

D. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

E. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION

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SECTION 095113

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Acoustical ceiling tiles and exposed suspension systems for interior ceilings.
2. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Three sets of 8 inch x 11 inch Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch-long Samples of each type, finish, and color.
3. Clips: Full-size seismic clips.

D. Shop Drawings: Submit to the Architect of record, three (3) complete sets of CAD generated shop drawings prepared by the manufacturer showing all necessary details and dimension requirements which will subsequently be field verified and revised as required by the Architect.

E. Delegated-Design Submittal: For seismic restraints for ceiling systems.

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1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Certification: Submit to the owner a certificate of compliance to specified acoustical and fire performance criteria as stated in Part 2 of this specification, signed by an officer of the panel manufacturer and attach independent laboratory test results for each product used, showing that the products supplied as components and complete assemblies, meet or exceed the specified requirements..

G. Manufacturers Approval: The manufacturer shall have the right to approve the selection of the installing contractor and to verify that said contractor has sufficient experience and expertise to complete the project in a satisfactory manner.

H. Single Source: It is the clear intent of this specification to provide a complete, fully integrated system, supplied by a single company. “Stick built” parts and pieces from various and different manufacturers will not be accepted. All custom acoustical wall and ceiling panels shall be purchased from a single supplier.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.

    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:

    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Access panels.
    g. Perimeter moldings.

7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/4 inch = 1 foot.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed a qualified testing agency.

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D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.8 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical ceiling area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

B. Manufacturer & Installer: Firm manufacturing the specified product shall have adequate capacity required for projects listed and have successfully completed similar projects for a period of not less than five years. The Installer should be approved by the Manufacturer as qualified to perform work required.

C. Reference Standards: Conform to all governing laws, building codes, and the following performance criteria:
1. Fire Performance Characteristics: Provide ceiling panels with surface-burning characteristics as determined by testing finished composite panel in accordance with ASTM E84 test procedures (building code requirements may necessitate composite panel testing using identical materials and construction representative of a typical installation, using the specified finish(es).
   a. ASTM E-84 Classification Class "A" or "1"
   b. Flame Spread: 25 or less
   c. Smoke Developed: 450 or less
2. Acoustical Performance Characteristics: Provide ceiling panels with acoustical absorption characteristics as indicated in Part 2, which have been determined by testing fully assembled production material in accordance with ASTM C-423 (Type "E400" mounting as defined by ASTM E-795) by a testing organization acceptable to authorities having jurisdiction. Approved testing organization must be independent of the manufacturer.

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3. Seismic Performance: Seismically test per procedures prescribed in Chapter 13 of the ASCE 2010 and the relevant ICC-ES standards. Shake table testing of ceiling systems using ICC-ES AC156 (ICC-ES 2015) protocol must be conducted, witnessed and documented by third party practicing structural engineers expert at an accredited laboratory and pass the most severe level of shaking prescribed in the building codes without any damage.
4. Ceiling panels shall have toxicity characteristics which have been determined by testing full assemblies (component tests are not acceptable) of identical materials and construction in accordance with section 27-348 of the New York State uniform fire prevention and building code MEA division. MEA Acceptance Number MEA 327-00-M.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Prior to panel installation, the site must be free of all wet and dusty trades and the climatic conditions stabilized to normal operational levels. Panels shall be allowed to stabilize on site 24 hours prior to installation.

C. Panels must only be handled by persons wearing clean light-weight gloves. It is very important that personnel installing hardware (clips, ceiling suspension members/systems, springs etc.) do not handle the panels before putting the clean lightweight gloves on.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.11 WARRANTY

A. Furnish to the Architect in the Owner's name, the manufacturers written guarantee covering the products supplied against defects in materials and workmanship under normal operating conditions for a period of one year from the date of shipment. Submit certificates of compliance showing warranty period by dates for each project completed to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

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2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.

B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E1264.
2. Smoke-Developed Index: 450 or less.

D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL CEILING TILES

A. Acoustical Tile Standard: Provide manufacturer’s standard tiles of configuration indicated that comply with ASTM E1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

B. Acoustical Ceiling Tiles: ASTM E84, Class A. Refer to products found on the Finish Schedule on the Drawings.

2.4 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.

1. Suspended ceiling system with fully assembled panels as indicated shall be tested to the maximum level of the building code (SDS of 2.00g). There is to be no damage to the ceiling grid members or to the panels, with no panels dislodging after the maximum test level has been reached; per the requirements of the International (or California) Building Code and ASTM standards to be certified for all regions with high seismicity activity.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

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B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Installation shall be by use of torsion springs, field engaged into factory supplied spring retainers, and field installed on the back of the panel on the coated extruded aluminum panel edge. This panel assembly is then lifted into place, and the torsion springs are engaged into the factory supplied “butterflies” which have been field installed during the assembly of the suspended factory supplied extruded aluminum grid. The panel is then gently lifted into place as the torsion springs take the load. All grid suspension hardware, hanger wires, rods, anchors, moldings, etc., are to be supplied by the installing contractor.

C. Installation shall be in accordance with local code requirements, manufacturer’s instructions, and as shown on approved shop drawings. Installer shall provide for adjustments as required to maintain consistent alignment of panels and of finished panel faces, and to ensure unstressed clip locations.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

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B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.

1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

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SECTION 096120

CONCRETE FLOOR SEALER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete floor sealer for interior concrete.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 FIELD CONDITIONS

A. Traffic Control: Maintain access for pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Slip Resistance: Dynamic coefficient of friction of installed flooring and paving shall be as follows, when measured in accordance with ANSI A137.1.

1. Level Surfaces: Not less than 0.42.

2.2 SEALED CONCRETE MATERIALS

A. Sealed Concrete: Prosoco “Consolideck LS”, ECOS Concrete Sealer or equal. Clear concrete hardener and dustproofer. System shall be California VOC compliant and shall reduce dusting and simplify maintenance.

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1. Active Ingredients: 100-percent
2. Type: Siliconates
3. Flash Point: None
4. Specific Gravity: 1.155
5. VOC/gmL: 0.
6. Solids Minimum: 30-percent

PART 3 - EXECUTION

3.1 APPLICATION OF SEALED CONCRETE

A. General: Apply concrete sealer in accordance with manufacturer's recommendations.

B. Apply two coats of concrete sealer, unless otherwise directed by Architect.

3.2 CLEANING AND REPAIR

A. The premises shall be kept clean and free of debris.

B. Remove spatter from adjoining surfaces.

C. Repair damages to surface caused by cleaning operations.

3.3 PROTECTION

A. Protect finished work until fully cured in accordance with manufacturer's recommendations.

B. Use floor covering/protection immediately following sealing and maintain through substantial project completion.

END OF SECTION

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SECTION 096513

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient rubber wall base.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 096519 “Resilient Tile Flooring”.
3. Section 097813 “Tile Carpeting.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups in place, of initial installation, to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.

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1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Resilient Rubber Wall Base: Refer to Finish Schedule found on Drawings for product information.

1. Height: 4 inches
2. Thickness: 0.125 inches, ASTM F386
3. Color: TBD.
4. Flammability: ASTM E648 (CRF), Class 1
5. Flame Spread/Smoke Density: ASTM E84, Class B < 450 smoke

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints. Schlueter strips, or equal. Feather with epoxy mortar or thin set during installation, as shown on Drawings.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Do not install resilient products until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

C. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

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G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

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SECTION 096519

RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient Tile Flooring.
2. Static Dissipative Flooring.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 072616 “Concrete Vapor Treatment.”
3. Section 096513 “Resilient Base and Accessories.”

1.3 ACTION SUBMITTALS

A. Product Data: Submit product data for each type of product indicated.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples: Full-size units of each color and pattern of floor tile required.

D. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

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1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

B. Mockups: Build mockups in place, of initial installation, to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for floor tile including resilient base and accessories.

a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm

2.2 MANUFACTURERS

A. Resilient Tile Flooring: Subject to compliance with requirements, provide products by the following, or equal:

1. Basis of Design: Refer to products found on Finish Schedule.

B. Static Dissipative Flooring: Subject to compliance with requirements, provide products by the following, or equal:

1. Basis of Design: Armstrong Flooring.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of floor tile indicates acceptance of surfaces and conditions.

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3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range recommended by flooring manufacturer.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations.

C. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

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3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

D. Cover floor tile until Substantial Completion.

END OF SECTION

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SECTION 096813

TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes modular, carpet tile.

B. Related Requirements:

1. Section 072616 “Concrete Vapor Treatment.”
2. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include installation recommendations for each type of substrate.

B. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

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1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups at locations and in sizes agreed to with Architect.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

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1.9 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.10 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, loss of face fiber, and delamination.
3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Refer to Finish Schedule found on Drawings for product information.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Metal Edge/Transition Strips: Finish, profile and width as indicated on drawings, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints. Provide metal edge/transition strips from Schluter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

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B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloor finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

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F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:
   1. Remove yarns that protrude from carpet tile surface.
   2. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

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SECTION 098410

ACOUSTICAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
   1. Acoustical wall panels.

B. Related Sections:
   1. Section 092216 “Non-Structural Metal Framing” for wall backing.
   2. Section 092900 "Gypsum Board" for finishing of substrate.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of facing, panel edge, core material, and mounting indicated.

B. Shop Drawings: Include mounting devices and details; details at panel head, base, joints, and corners; and details at floor base, and wall intersections. Indicate panel edge and core materials.
   1. Include elevations showing panel sizes and direction of pattern matching (as applicable).

C. Samples for Initial Selection: For each type of wall panel manufacturer's full range.

D. Samples for Verification: For the following products, prepared on Samples of size indicated below:
   1. Face Sheet: Full-width by approximately 12-inch-long Sample.
   2. Panel Edge: 12-inch-long Sample(s) showing each edge profile, corner, and finish.
   3. Core Material: 12-inch-square Sample at corner.
   4. Mounting Devices: Full-size Samples.
   5. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Electrical outlets, switches, and thermostats.

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2. Items penetrating or covered by wall panels including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Alarms.
   e. Sprinklers.
   f. Access panels.
3. Show operation of hinged and sliding components covered by or adjacent to wall panels.

B. Product Certificates: For each type of wall panel, from manufacturer.

C. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wall panels to include in maintenance manuals. Include manufacturers' written cleaning and stain-removal recommendations.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fabric: For each fabric, color, and pattern installed, provide length equal to 10 percent of amount installed, but no fewer than 10 yards.
2. Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than five devices, including unopened adhesives.

1.7 QUALITY ASSURANCE

A. Source Limitations:
1. Obtain wall panels from single source from single manufacturer.

B. Fire-Test-Response Characteristics: Provide wall panels meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 or NFPA 286.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials, fabrication, and installation.
1. Build mockup of typical wall area as shown on Drawings. Include intersection of wall, corners, and perimeters.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

D. Preinstallation Conference: Conduct conference at Project site.

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1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with wall panel manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

B. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not install wall panels until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Lighting: Do not install wall panels until a permanent level of lighting is provided on surfaces to receive fabric-wrapped wall panels.

C. Air-Quality Limitations: Protect wall panels from exposure to airborne odors such as tobacco smoke and install panels under conditions free from odor contamination of ambient air.

D. Field Measurements: Verify locations of wall panels and actual dimensions of openings and penetrations by field measurements before fabrication.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of wall panels that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Sagging, distorting, or releasing from panel edge.
      b. Warping of core.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain systems from single source from single manufacturer.

B. Refer to Finish Schedule found on Drawings for product information.

2.2 ACOUSTICAL WALL PANELS

A. General Requirements for Acoustical Wall Panels: Panels shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for

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the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Acoustical Wall Panels: Manufacturer's standard panel construction consisting of facing material stretched over front face, edges, and back edge border of core.

2.3 FABRICATION

A. General: Use manufacturer's standard construction except as otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.

B. Glass-Fiber Board Cores: Chemically harden core edges and areas of core where mounting devices are attached.

C. Facing Material: Apply fully covering visible surfaces of panel; with material straight, on the grain, tight, square, and free from blisters, seams, adhesive, or other visible distortions or foreign matter.

D. Dimensional Tolerances of Finished Panels: Plus or minus 1/16 inch for the following:
1. Thickness.
2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.
5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fabricated panels, substrates, areas, and conditions, for compliance with requirements, installation tolerances, and other conditions affecting performance of wall panels.

B. Verify building is enclosed and under standard occupancy conditions (60 - 85°F and not more than 70% relative humidity) prior to start of installation. Commencement of installation constitutes Installer's acceptance of surfaces and conditions.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with wall panel manufacturer's written instructions for installation of panels using type of mounting devices indicated. Mount panels securely to supporting substrate.

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C. Align and level pattern and grain, if applicable, among adjacent panels.

3.3 ACOUSTICAL WALL PANELS

A. Prior to installation, ensure substrate surfaces are smooth, clean and level, free of dust, dirt and other residues or contaminants which could inhibit a strong bond to develop.

B. Comply with manufacturer's instructions for installation of acoustical wall panels.

C. Lay out pattern as indicated on Drawings.

D. Cut adhesive tube tips back to produce 1/4-inch diameter bead flow.

E. Use clean, thin white cotton gloves to handle panels.

F. Apply adhesive to panel backs per manufacturer's recommended "X" pattern and installation instructions; press panels firmly into place and smooth evenly across them to ensure a strong, lasting bond; adhesive tack should be immediate.

G. Install panels true to lines, position and plane as indicated Drawings.

3.4 CLEANING

A. Touch-up, repair or replace damaged units until satisfactory results are obtained.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

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SECTION 099100

PAINTING AND COATING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SYSTEM DESCRIPTION

A. General: Paint every surface, except as otherwise shown or as follows:

B. Surfaces Not to be Painted:

1. Factory-finished items specified in various Sections.
2. Prefinished wall, ceiling, and floor coverings.
3. Painting specified elsewhere and included in respective Sections, including but not necessarily limited to, shop priming.
4. Code-Required Labels: Keep equipment identification and fire rating labels free of paint.
5. Surfaces concealed in walls and above ceilings except as specifically indicated otherwise.
6. Ducts, piping, conduit, and equipment concealed in walls and ceilings, unless specifically indicated otherwise.

C. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s literature and installation instructions for each material and accessory, clearly notating specified requirements.

B. Samples: Furnish sufficient samples to establish full range of colors and textures for materials exposed in the finished Work. Label samples to indicate product and location in the Work. Samples will be reviewed for appearance only. Compliance with other requirements is the responsibility of the Contractor.

1. Opaque Colors and Finishes: Submit samples, using materials accepted for Project, of each color and paint finish selected with texture to simulate actual conditions. Prepare three samples, 8-1/2 inches by 11 inches, with required number of paint coats clearly visible.
2. Transparent and Stained Finishes: Prepare samples on species and quality of wood to be used in the Work. Resubmit as requested until acceptable sheen, color, and texture are achieved. Label and identify each sample as to location and application.

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1.4 INFORMATIONAL SUBMITTALS

A. Quality Assurance/Quality Control Submittals:

1. Certificates:

a. Document Review: Submit a written statement signed by the Contractor and the Applicator stating that the Contract Documents, shop drawings and product data have been reviewed with qualified manufacturer representatives. The statement shall certify that selected materials are proper, compatible with contiguous materials and adequate for the application shown.
b. Installer's Qualifications

1.5 QUALITY ASSURANCE

A. Qualified Installer: Installer to have 5 years' experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.

B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs), including the Air Quality Management District. Obtain necessary approvals from AHJs.

C. Visual Mock-Up(s): As directed by the Architect, apply on actual wall surfaces where designated, samples of each and any color selected for final review.

1. On at least 100 square feet of surface as directed, provide full-coat finish samples until required sheen, color and texture are obtained.
2. Duplicate painted finishes of prepared samples.
3. Simulate finished lighting conditions for review of in-place work.

D. Labeling: Include following on label of each container:

1. Manufacturer's name and product name.
2. Generic type of paint.
3. Manufacturer's stock number.
4. Color.
5. Instructions for reducing, where applicable.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Deliver material in sealed containers with labels legible and intact.

B. Storage and Protection:

1. Store only acceptable Project materials on Project site.
2. Restrict storage to paint materials and related equipment.

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1.7 PROJECT/SITE CONDITIONS

A. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be stored and applied.

B. Do not apply finish in areas where dust is being generated.

1.8 MAINTENANCE

A. Extra Materials: At completion of Work, deliver to Owner extra stock of paint of one gallon of each color used of each coating material used. Tightly seal and clearly label containers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Benjamin Moore, Sherwin Williams, or equal.

B. Substitutions: For consideration, accompany substitution request, with manufacturer's data and current statement from a recognized independent testing agency stating that each substitution for finish coat is equal to or better than specified product.

2.2 MATERIALS

A. General: Materials selected for each paint system shall be products of the same manufacturer, and shall be compatible with each other. Materials selected shall be products of the manufacturer’s highest quality line.

B. Unsuitability of Specified Products: Claims concerning unsuitability of any materials specified will not be entertained, unless such claim is made in writing to the Architect before Work is started.

2.3 COLORS AND SHEENS

A. Mixing: Deliver paints and stains ready mixed to Project site.

B. Provide Flat sheen at ceiling locations, unless otherwise noted. Provide eggshell sheen at wall locations and wood, unless otherwise noted. Provide semi-gloss sheen at metal substrates, unless otherwise noted.

2.4 PAINT SYSTEMS

A. Schedule: Only major areas are scheduled. Treat miscellaneous and similar items and areas within room or space with similar system.

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B. Number of Coats: Where number of coats is specified, it is only as a minimum requirement. Apply additional coats, at no additional cost to Owner, if necessary to completely hide base material, produce uniform color, and provide satisfactory finish result. Unless otherwise specified, provide the following:
   1. Primer: One (1) coat.
   2. Finish: Two (2) coats.

C. Systems Specifications: These specifications are a guide and are meant to establish procedure and quality. Confer with Architect to determine exact finish desired.

D. Acceptance of Final Colors: Do not apply final coats of paint for interior systems until colors have been accepted by Architect.

E. Exterior Painting Systems:

   1. High Performance Polyurethane Enamel Coating System:
      a. Prime Coat: Shop-applied under other applicable Sections.
         1) Touch up shop primer where needed with Ameron Amerlock VOC.
         2) Benjamin Moore/Corotech #V155 High Solids Epoxy Pre-Primer.
         3) Touch up shop primer Sherwin-Williams Macopoxy 646-100 Fast Cure Epoxy (B58-620) as a primer.
      b. Finish Coats:
         1) Ameron Amershield VOC.
         2) Benjamin Moore/Corotech #V500 Acrylic Urethane Gloss.
         3) Sherwin-Williams Water-Based Acrolon 100 Polyurethane, 5 mils dry film thickness.

   2. Galvanized Steel, Zinc-Rich Painted Steel, and Aluminum:
      a. Prime Coat:
         1) Benjamin Moore HP04 Acrylic Metal Primer.
         2) Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, (B66-310 Series).
      b. Body Coat:
         1) Benjamin Moore N449 Ultra Spec EXT Gloss 100% Acrylic Gloss.
         2) Sherwin Williams, Pro Industrial Acrylic Semi-gloss, (B66W651).
      c. Finish Coat:
         1) Benjamin Moore N449 Ultra Spec EXT Gloss 100% Acrylic Gloss.
         2) Sherwin Williams, Pro Industrial Acrylic Semi-gloss, (B66W651).

F. Interior Painting Systems:

   1. Gypsum Board:
      a. Prime Coat:
         1) Benjamin Moore Ultra Spec 500 Interior Primer 534 OR Fresh Start Multi Purpose Primer 023.
         2) Sherwin-Williams Pro Mar 200 Zero VOC Primer (B28W2600).
      b. Body Coat:
         1) Benjamin Moore Ultra Spec 500 Interior Latex Eggshell Finish 538 or Benjamin Moore Ultra Spec 500 Interior Latex Semi-Gloss Finish 539 OR the following:
            Natura Interior Latex Eggshell Finish 513 or Benjamin Moore Natura Interior Latex Semi-Gloss Finish 514.
            Aura Interior Latex Eggshell Finish 524 or Benjamin Moore Aura Interior Latex Semi-Gloss Finish 528.

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2) Sherwin-Williams Pro Mar Zero VOC Interior Eg-shel (B20-2600 Series) or Sherwin-Williams Pro-Mar 200 Zero VOC Semi-gloss Enamel (B31-2600 Series).

c. Finish Coat:

1) Benjamin Moore Ultra Spec 500 Interior Latex Eggshell Finish 538 or Benjamin Moore Ultra Spec 500 Interior Latex Semi-Gloss Finish 539. Natura Interior Latex Eggshell Finish 513 or Benjamin Moore Natura Interior Latex Semi-Gloss Finish 514. Aura Interior Latex Eggshell Finish 524 or Benjamin Moore Aura Interior Latex Semi-Gloss Finish 528.

2) Sherwin-Williams Pro Mar Zero VOC Interior Eg-shel (B20-2600 Series) or Sherwin-Williams Pro-Mar 200 Zero VOC Semi-gloss Enamel (B31-2600 Series).

2. Metal:

a. Prime Coat:

1) Shop-applied under other applicable Section.

a) Benjamin Moore HP04 D.T.M. Acrylic Metal Primer (if compatible).

b) Sherwin-Williams Pro Industrial Pro- Cryl Universal Primer (B66-1300 Series).

b. Body Coat:

1) Benjamin Moore HP04 D.T.M. Acrylic Metal Primer (if compatible). OR Natura Interior Latex Semi-Gloss Finish 514. Aura Interior Latex Eggshell Finish 524 or Benjamin Moore Aura Interior Latex Semi-Gloss Finish 528.

2) Sherwin-Williams Pro-Mar 200 Zero VOC Semi-gloss Enamel (B31-2600 Series).

c. Finish Coat:

1) Benjamin Moore Ultra Spec 500 Interior Latex Semi-Gloss Finish 539.

2) Natura Interior Latex Semi-Gloss Finish 514. Aura Interior Latex Eggshell Finish 524 or Benjamin Moore Aura Interior Latex Semi-Gloss Finish 528.

3) Sherwin-Williams Pro-Mar 200 Zero VOC Semi-gloss Enamel (B31-2600 Series).

3. Concrete:

a. Prime Coat:

1) Benjamin Moore: #608 Acrylic Masonry Sealer.

2) Sherwin-Williams Loxon Exterior Acrylic Masonry Primer (LX02W0050 Series).

b. Body Coat:

1) Benjamin Moore: Benjamin Moore Ultra Spec 500 Interior Latex Semi-Gloss Finish 539. OR the following:
Natura Interior Latex Semi-Gloss Finish 514. Aura Interior Latex Eggshell Finish 524 or Benjamin Moore Aura Interior Latex Semi-Gloss Finish 528.

2) Sherwin-Williams A-100 Exterior Exterior Latex Flat (A6-150 Series).

c. Finish Coat:

1) Benjamin Moore: Benjamin Moore Ultra Spec 500 Interior Latex Semi-Gloss Finish 539. Natura Interior Latex Semi-Gloss Finish 514. Aura Interior Latex Eggshell Finish 524 or Benjamin Moore Aura Interior Latex Semi-Gloss Finish 528-- 3/26/20.

2) Sherwin-Williams A-100 Exterior Latex Flat (A6-150 Series).

4. Wood:

a. Enamel:

1) Prime Coat:

a) Benjamin Moore 023 Fresh Start All Purpose 100% Acrylic Primer.

b) Sherwin-Williams Pro Mar 200 Zero VOC Primer (B28W2600).

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2) Body Coat:
a) Benjamin Moore Natura Interior Latex Semi-Gloss Finish 539. Aura Interior Latex Semi-Gloss Finish 528.
b) Sherwin-Williams Pro-Mar 200 Zero VOC Semi-gloss Enamel (B31-2600 Series).
3) Finish Coat:
a) Benjamin Moore Natura Interior Latex Semi-Gloss Finish 539. Aura Interior Latex Semi-Gloss Finish 528.
b) Sherwin-Williams Pro-Mar 200 Zero VOC Semi-gloss Enamel (B31-2600 Series).

b. Clear Finish:
1) Prime Coat:
a) Benjamin Moore/Lenmar Waterborne Stain #1WB1300.
b) Old Masters Penetrating Stain.
c) Minwax PS Wood Stain 250.
2) Body Coat:
a) Benjamin Moore Benwood Stays Clear Acrylic Polyurethane.
b) Old Masters Clear Polyurethane.
c) Minwax Fast Dry Poly Varnish.
3) Finish Coat:
a) Benjamin Moore Benwood Stays Clear Acrylic Polyurethane.
b) Old Masters Clear Polyurethane.
c) Minwax Fast Dry Poly Varnish.

G. Miscellaneous Interior Painting Systems:

1. Ductwork at Grilles and Diffusers: Apply to visible interior surfaces of ductwork.
a. Body Coat:
1) Benjamin Moore D.T.M. HP29 Semi-Gloss Finish.
2) Sherwin-Williams Pro Industrial Multi-Surface Acrylic Eg-shel (B66-1560 Series).
b. Finish Coat:
1) Benjamin Moore D.T.M. HP29 Semi-Gloss Finish.
2) Sherwin-Williams Pro Industrial Multi-Surface Acrylic Eg-shel (B66-1560 Series).

2. Exposed Non-Insulated Pipes and Ductwork: Including conduit.
a. Prime Coat:
1) Benjamin Moore 027 Sure Seal Primer Sealer. Omit sealer where glass fabric jackets are used.
2) Sherwin-Williams Pro Industrial Multi-Surface Acrylic Eg-shel (B66-1560 Series).
b. Finish Coat:
1) Benjamin Moore: As specified for exposed non-insulated pipes, conduits, and ductwork.
2) Sherwin-Williams Pro Industrial Multi-Surface Acrylic Eg-shel (B66-1560 Series) or Pro Industrial Multi-Surface Acrylic Semi-gloss (B66-1550 Series).

3. Factory Finished Equipment: Satisfactorily refinish surfaces damaged before, during, or after installation as directed.
a. Benjamin Moore Ultra Spec 500 Semi-Gloss Finish 539.
b. Benjamin Moore Natura 539 or Aura 528 Semi-Gloss Finish.
c. Sherwin-Williams Pro Industrial Multi-Surface Acrylic Semi-gloss (B66-1550 Series).

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4. Finish Hardware: Specified with USP finish under Section 087000, paint as specified for metal. Color and gloss to match doors and frames as applicable, unless otherwise specified.

5. Plywood Backing: In Telephone and Electric Closets; provide one coat
   a. Benjamin Moore: One coat 023 Fresh Start All Purpose 100% Acrylic Primer and one coat Benjamin Moore Ultra Super 500 Eggshell 538. Benjamin Moore Natura 513 or Aura 524 in Eggshell.
   b. Sherwin-Williams Pro-Mar 200 Zero VOC Eg-shel (B20-2600 Series).

H. Pipe Identification:

1. General: Per ANSI A13.1; buried pipe, electrical conduit, and pipe in concealed spaces such as furred spaces and shafts not included.
2. Color Scheme: ANSI Z53.1 in combination with legend and flow markers; intermittent displays. Locate and space as specified for legend and flow markers. Safety colors as specified under applicable mechanical Section.
3. Legend: Stencil letters of colors, type, and sizes per ANSI A13.1. Tags for identification of pipes less than 3/4 inch overall outside diameter, including valves and fittings; provided under applicable mechanical Section.
4. Flow Markers: Provide each type with appropriate size arrows to indicate flow direction in pipe; same color as legend.
5. Visibility: Locate legend and flow markers for easy visibility from operating floor; space not over 20 feet with at least one per room.

PART 3 - EXECUTION

3.1 GENERAL

A. Manufacturer's Instructions: Prepare substrates, apply primers and apply the work, including components and accessories in accordance with the manufacturer's instructions, except where more stringent requirements are shown or specified. Examine the areas to receive the Work and remedy detrimental conditions.

3.2 SURFACE PREPARATION

A. General: Remove scale, dirt, dust, grit, rust, wax, grease, efflorescence, loose material, and other foreign matter detrimental to proper adhesion of paint.

B. Cementitious Surfaces:

1. General: Remove oil, grease, loose particles, bond breaker coating and other foreign materials.
2. Cracks: Greater than 1/32-inch-wide; rout out to not less than 1/4-inch-wide and 1/4-inch-deep; fill groove with gun grade sealant and cap with buttering grade sealant. Cracks less than 1/33-inch-wide; cap with buttering grade sealant. Repair minor cracks and holes; roughen when necessary to assure good adhesion.
3. Alkali Conditions: Test surfaces for presence of alkali. If present, neutralize as recommended by paint manufacturer, after drying remove precipitate by brushing. Do not paint if pH is above 12.

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C. Gypsum Board:

1. Narrow, Shallow Cracks and Small Holes: Fill with spackling compound.
2. Deep, Wide Cracks and Deep Holes: Rake out, dampen with clear water, and fill with thin layers of gypsum board joint compound.
3. Curing: Allow to dry.
4. Sanding: Sand smooth after drying; do not raise nap of paper on gypsum board.

D. Metals:

1. Chipped or Abraded Areas in Shop Coatings: Touch-up using appropriate primer.
2. Galvanized Surfaces: Apply a wash coat of Jasco's Prep 'n' Prime. Allow to dry completely.
3. Stainless Steel: Scarify surfaces before applying prime coat.

E. Wood:

1. General: If required, sandpaper surfaces smooth before applying primer. Thoroughly clean knots; apply thin coat of knot sealer over surfaces shown to receive opaque finish. Old chipped paint at wood flagpole and similar items shall be properly scraped and sanded prior to priming.
2. Back Priming: Back prime surfaces installed against cementitious surfaces; give particular attention to sealing cross-grained surfaces.
3. Puttying:
   a. General: Fill nail holes, cracks, and other depressions flush with putty after prime coat application. Allow putty to dry; sandpaper smooth before applying body coat.
   b. For Opaque Finish: Linseed oil type putty.

F. Protection:

1. General: Properly protect floors and other adjacent work by drop cloths or other suitable coverings. In areas scheduled for painting, maintain wrappings and factory-applied protection provided by other trades.
2. Hardware and Other Obstructions: Remove or protect factory finished items such as hardware, plates, lighting fixtures, grilles, and similar items placed prior to painting. Reposition or remove protection upon completion of each space. Equipment adjacent to surfaces requiring paint disconnected, moved, reset, and reconnected by respective trades.
3. Fire Precautions: At end of each work day, place in metal containers or remove from premises, solvent soaked cloths, waste, and other materials which constitute a fire hazard.

G. Moisture Content: Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer.

3.3 APPLICATION

A. General: Apply paint per manufacturer's instructions and as specified. Thoroughly stir paint and keep at uniform consistency during application. Apply paint evenly, free from drops, ridges, waves, laps, and brush marks; finished surface uniform in sheen, color, and texture. Apply succeeding coats to unscarred and completely integral base coats; slightly vary color of undercoats to distinguish them from preceding coat. Allow sufficient time between coats to assure proper drying. Sandpaper smooth interior finishes between coats.

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B. Prime Coat: Do not thin primers in excess of manufacturer's printed directions. Apply by brush, unless otherwise specified, within 8 hours after cleaning.

C. Body and Finish Coats: Do not thin; apply by brush, roller or spray.

D. Drying Time: Comply with recommendations of product manufacturer for drying time between succeeding coats.

E. Moldings and Ornaments: Leave clean and true to details with no undue amount of paint in corners and depressions.

F. Edges of Paint: Where adjoining other materials or colors, make clean and sharp with no overlapping.

G. Refinishing: Refinish entire wall where portion of finish is deemed not acceptable.

H. Precaution: Do not paint over fusible links, UL labels, or sprinkler heads.

I. Exposed Plumbing and Mechanical Items: Finish items without factory finish such as conduits, pipes, access panels, and items of similar nature to match adjacent wall and ceiling surfaces, unless otherwise directed.

3.4 CLEANING

A. General: Touch up and restore finish where damaged. Remove spilled, splashed, or spattered paint from surfaces. Do not mar surface finish of item being cleaned.

B. Storage Space: Leave clean and in condition required for equivalent spaces in Project.

END OF SECTION

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SECTION 099600

HIGH PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Included:

1. High Performance Coatings, complete as shown and specified.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”

1.3 ACTION SUBMITTALS

A. General: Submit the following in conjunction with submittals required for substrates, specified in other Sections.

B. Product Data: Submit manufacturer’s literature, specifications and application instructions describing the general properties of each material and accessory to be used in the Work.

C. Samples: Provide in accordance with Section 051100 “Structural and Miscellaneous Steel”, Section 055000 “Metal Fabrications”, and other Sections that reference this Section. Label samples to indicate product and location in the Work. Samples will be reviewed for color and appearance only. Compliance with other requirements is the responsibility of the Contractor.

1.4 INFORMATIONAL SUBMITTALS

A. Quality Assurance/Quality Control Submittals:

1. Certificates:

a. Document Review: Submit a written statement signed by the Contractor and the Applicator stating that the Contract Documents, shop drawings and product data have been reviewed with qualified manufacturer representatives. The statement shall certify that selected materials are proper, compatible with contiguous materials and adequate for the application shown.

b. Applicator Qualifications

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1.5 QUALITY ASSURANCE

A. Qualified Applicator: Applicator to have 5 years experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.

B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHJs.

1.6 WARRANTY

A. Warranty for Fluoropolymer Coatings on Aluminum and Steel: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

B. Warranty for Coating on Exterior Steel Substrates: Submit for Owner's documentation. Warranty shall be for a 15 year period, signed by the Contractor, manufacturer, and installer, against the loss of film integrity, chalking, fading, non-uniformity, corrosion and the overall performance of color of the resinous coatings. Make repairs and replacements upon notification of defects.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Color and Sheen: Match Architect's sample.

B. Shop-Applied Fluoropolymer Coatings at Aluminum and Coil Coatings at Steel: High-Performance Organic Finish: 3 -coat fluoropolymer finish complying with AAMA 2605, AAMA 620 or AAMA 621, and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

C. Coatings for Interior Steel:

1. Surface Preparation: SSPC-SP6.
2. Shop Primer: Tnemec 27WB Typoxy. Apply at 3.0 to 5.0 mils DFT. Or PPG PAINTS Multiprime 4160. Apply at 2.5-3.0 mils DFT.
3. Touch all damaged or bare spots per SSPC-SP 15 (feather-in all edges) and spot prime with Tnemec 27WB at 3.0-4.0 mil DFT.
4. Finish Coat, applied in Field:

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a. Steel Stairs: Tnemec 1029 Endurathone low semi-gloss. Apply at 2.0 – 3.0 mils DFT. Or PPG Paints Devflex 4216HP Low Semi-Gloss at 2.0-4.0 mils DFT.

D. Coatings for Exposed Steel at Exterior. Provide two-coat system from one manufacturer, over galvanized steel. Provide the following, or equal:

1. Galvanized Steel, as specified in other Sections.
2. Field Applied Intermediate Coat: Tnemec Series 1075. 2.5 mils DFT. OR PPG Paints Coraflon ADS Epoxy Primer 573 at 3.0-5.0 mils DFT for BARE Steel. PPG Paints Coraflon ADS Epoxy Primer 510 at 2-0-4.0 mils DFT for Steel previously coated with PVDF.
3. Field Applied Finish Coat: Tnemec 1072 V Fluoronar. 2-3 mils DFT. OR PPG Paints Coraflon ADS Intermix Fluoropolymer Finish at 1.8-2.2 mils DFT. ** Metallic or Mica Colors in EXTERIOR applications must also have a Barrier Coat of ADS564.

E. Coatings for Exposed Ferrous at Exterior OPTION 2; A 2 Coat System for Solid Colors.

1. Field Applied PPG Paints Amercoat 68HS Zinc Rich Primer. 2-5 mils DFT.
2. Field Applied PPG Paints PSX-805 Polysiloxane Satin Finish 3-6 mils DFT.

PART 3 - EXECUTION

3.1 PREPARATION

A. Substrate Acceptability: Commencement of installation shall constitute acceptance of substrate conditions by the Installer.

3.2 COATINGS FIELD APPLICATION

A. General: Use applicator and techniques best suited for substrates and type of material being applied. Apply materials at not less than recommended spreading rate to establish a total dry film thickness as indicated or, if not indicated, as recommended.

B. Mix materials thoroughly before application to produce a mixture of uniform density; strain if necessary, before using. Do not mix surface film into material. If necessary, remove surface film and re-strain material before using. Do not adulterate ready-mixed materials except in accordance with the manufacturer's printed instructions. Use only approved thinners and only within recommended limits.

C. Apply materials with care to a uniform and proper film thickness, showing no runs, holidays, sags, crawls or other defects. Apply with a minimum of brush marks. Finish surfaces shall be uniform in sheen, color and texture.

END OF SECTION

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SECTION 101400

SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Signage, complete, as shown and specified.

B. Related Sections:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 057000 “Decorative Metal” for custom State Seal of California plaque.

1.2 SYSTEM DESCRIPTION

A. General: Provide, complete with text and attachment devices, interior signs of the following types:

1. Toilet Room Door Signs: Provide for every toilet room door.

2. Electric Equipment Room and Closet Signs: Provide per National Electric Code requirements.

3. Stairway Signs: Provide per applicable code requirement.

4. Room Signs: Provide for main entrance door to every room.

5. Occupancy Signs: Provide per applicable code requirement.

6. Tactile Exit Signs: Provide per applicable code requirement.

7. Alarmed Exit Signs: Provide per applicable code requirement.

8. Door to Remain Open During Business Hours Signs: Provide per applicable code requirement.

1.3 SUBMITTALS

A. Product Data: Submit for Architect’s action. Manufacturer's specifications, catalog cuts, standard details, and installation instructions.

C. Shop Drawings: Submit for Architect’s action. Show materials; construction; special details; and type, location, and attachment of hardware and accessories.

D. Samples: Submit for Architect’s action.

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1. Signs: Full-sized, complete, example of each sign type specified. Undamaged signs may be returned for use in project.

E. Closeout Submittals: Submit for Owner's documentation.

1. Maintenance Data.

1.4 QUALITY ASSURANCE

A. Qualified Installer: Installer to have 5 years' experience in the installation of specified materials on comparable projects. The firm shall have the approval of the materials manufacturer.

B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, and regulations of Authorities Having Jurisdiction (AHJs). Obtain necessary approvals from AHJs.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials in original protective packaging, with each package clearly identified with manufacturer's name, type and name of product, color, and location for installation.

B. Storage: Store materials in manner to prevent twisting, bending, or other damage.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Typical Signage: "Evolution Custom Office Signs " (Seton Architectural Sign Systems), "Aspen" (InPro Corp.), or equal.

2.2 MISCELLANEOUS MATERIALS

A. Fasteners and Adhesive: Type recommended by manufacturer for intended use.

2.3 FABRICATION

A. General:

1. Signs: Laminated colored plastic, with core color contrasting to exterior face color and texture, or acrylic plastic, with inset symbols.

2. Total Thickness: Minimum 0.25-inch.

3. Toilet Room Signs:

a. Men's Room: 12-inch equilateral triangle, vertex pointing up.

b. Ladies' Room: 12-inch-diameter circle.

c. All-Gender Room: 12-inch-diameter circle with equilateral triangle within.

d. Other Toilet Rooms: As required.

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4. Other Sign Types, including Exit Path Signage, Utility Rooms, and Other Code Requirements:

   a. Plaques: Sizes as required by code.

5. Colors: To be selected by Architect.

6. Symbols. As selected by Architect from manufacturer's standard symbols.

7. Attachment: Concealed type as recommended by sign manufacturer for type of substrate involved.

PART 3 - EXECUTION

3.1 GENERAL

A. Manufacturer's Instructions: Prepare substrates and install the work, including components and accessories in accordance with the manufacturer's instructions, except where more stringent requirements are shown or specified. Examine the areas to receive the Work and remedy detrimental conditions.

3.2 INSTALLATION

A. General: Install signs only after surfaces on which they are to be mounted are painted and finished. Install signs plumb, level, true, square and securely attached per manufacturer's recommendations.

B. Location: Mount signs centered at 60 inches above finished floor and on centerline door.

C. Attachment: Concealed type as recommended by sign manufacturer for type of substrate involved.

3.3 CLEANING AND PROTECTION

A. General: Clean soiled surfaces per manufacturer's recommendations.

B. Protection: Protect the Work during erection and construction to avoid non-uniformity of appearance or other defects in the Work. Remove protection when no longer required.

END OF SECTION

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SECTION 102600

WALL PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Door kick plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
   2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.

B. Shop Drawings: For each type of wall protection showing locations and extent.
   1. Include plans, elevations, sections, and attachment details.

C. Samples for Verification: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified, including accent strips and accessories to verify color selection. For each type of exposed finish on the following products, prepared on Samples of size indicated below:
   1. Door Kick Plates: 12 inches long.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

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1. Include recommended methods and frequency of maintenance for maintaining best condition of metal covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
   1. Maintain room temperature within storage area at not less than 70 deg F during the period metal materials are stored.
   2. Keep metal materials out of direct sunlight.
   3. Store metal wall- and door-protection components for a minimum of 72 hours, or until metal material attains a minimum room temperature of 70 deg F.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
      b. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

B. Refer to Drawings for additional product information.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

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1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 DOOR KICK PLATES

A. Door Kick Plates: Subject to compliance with requirements, provide products by the following, or equal:
1. Basis of Design: Construction Specialties, “Acrovyn Kick and Push Plates.”
a. Size: As shown on Drawings.
b. Finish: Stainless Steel or Bronze; to be selected by Owner.
c. Mounting: Adhesive.

2.4 MATERIALS

A. Metal Materials: Chemical- and stain-resistant, high-impact-resistant metal with integral color throughout; extruded and sheet material as required; thickness as indicated.

B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

C. Adhesive: As recommended by protection product manufacturer.

2.5 FABRICATION

A. Fabricate wall protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of the Work.

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
   1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install protection in locations and at mounting heights indicated on Drawings

C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
   1. Provide anchoring devices and suitable locations to withstand imposed loads.
   2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and metal covers at different locations along the run, but no closer than 12 inches apart.

3.4 CLEANING

A. Immediately after completion of installation, clean metal covers and accessories using a standard ammonia-based household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

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SECTION 102641

BULLET-RESISTANT PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes bullet resistant fiberglass panels.

B. Related Requirements:

1. Section 064216 “Flush Wood Paneling.”
2. Section 085653 “Security Windows.”
3. Section 092900 “Gypsum Board.”

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

B. Shop Drawings: Details of installation of bullet resistant fiberglass panels.

C. Certificates: Submit printed data to indicate compliance with following requirements.

1. UL Listing Verification and UL752 Current Test Results as provided by Underwriters Laboratories.
2. ASTM E 119.
3. ASTM F 1233.
4. ASTM E 1332.
5. Manufacturer's third-party certificate of registration with ISO 9001:2008.
6. Manufacturer's U.S. Dept. of State ITAR Statement of Registration.
7. Manufacturer's SBA Profile verifying small business status by the SBA

D. Samples for Verification: For each finish product specified, two samples, minimum size 6 inches (150 mm) square representing actual product, color, and patterns.

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1.4 CLOSEOUT SUBMITTALS

A. Warranty as specified.

1.5 WARRANTY

A. Manufacturer's Standard Warranty: Manufacturer's standard form agreeing to repair or replace units that fail in material or workmanship within the specified warranty period.

1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: ArmorCore by Waco Composites, or equal.

2.2 BULLET RESISTANT PANELS

A. General:

1. Bullet Resistant Fiberglass Panels shall be "non-ricochet type" to permit the encapture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration.
2. Bullet resistance of joints: Equal to that of the panel.

B. Product: Panels shall be fabricated of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets as manufactured by Waco Composites.

C. Panel Product: ArmorCore Bullet Resistant Fiberglass Panels.
1. UL752 Level: Level 3.
2. Panel Size: As shown on Drawings.
3. Nominal Thickness: 7/16-inch.
4. National Institute of Ballistics Standards NIJ008.01 – Level IIIA.
5. One Hour Fire Rating per ASTM E119-98.
6. Class IV Forced Entry Protection Rating per ASTM F1233.98.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Prior to starting installation, verify work of related trades required in contract documents and architectural drawings is complete to the point where work of this Section may properly commence.

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C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction.

B. Reinforce joints with a back-up layer of bullet resistive material. Minimum width of reinforcing layer at joint shall be 4 inches (102 mm), centered on panel joints.

C. Install panels in accordance with manufacturer's printed recommendations and as required by contract documents.

D. Secure armor panels using screws, bolts, or an industrial adhesive.

E. Method of application shall install panels minimizing vulnerabilities by fitting tightly to adjacent surfaces including concrete floor slab, concrete roof slab, bullet resistive door frames, bullet resistive window frames, and other assemblies.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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SECTION 102813

TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Toilet Accessories.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”

C. Coordination:

1. Contractor shall provide thicker partitions where recessed accessories are indicated to be installed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.
6. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
7. Identify products using designations indicated.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

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B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

C. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Schedule of Accessories: Refer to Schedule found on the Drawings.

2.3 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

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B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

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SECTION 104400

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Fire extinguisher and cabinets.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For each type of exposed finish required, prepared on samples 6 by 6 inches square.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

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1.5 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers, fire hoses, hose valves, and hose racks indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 FIRE-PROTECTION CABINET

A. Provide rated fire extinguisher cabinets at fire rated partitions.

B. Cabinet Type: Suitable for hose, rack, valve, and extinguisher.

C. Manufacturers: Provide cabinet from Larsens Manufacturing, Potter Roemer, or equal.

D. Cabinet Construction: Nonrated.

E. Cabinet Material: Cold-rolled steel sheet.

1. Shelf: Same metal and finish as cabinet.

F. Recessed Cabinet:

1. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.

G. Cabinet Trim Material: Steel sheet.

H. Door Material: Steel sheet.

I. Door Style: Flush opaque panel, frameless, with no exposed hinges.

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

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1. Provide projecting lever handle with cam-action latch.
2. Concealed hinge.

K. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Coordinate type and location with Owner to match Building Standards.

L. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
c. Color: As selected by Architect from manufacturer's full range.

2.4 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Miter corners and grind smooth.
3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.
5. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

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B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for hose valves and racks and cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification:

1. Apply lettering at locations indicated. Coordinate with Owner to match building standards.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

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D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 113013

PANTRY APPLIANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Pantry Appliances.

B. Related Requirements:

1. Division 22 for plumbing requirements.
2. Division 26 for electrical requirements.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

C. Product Schedule: For appliances. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of appliance.

C. Field quality-control reports.

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D. Sample Warranties: For manufacturers' special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintains, within 50 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

1.8 DELIVERY

A. Deliver appliances only after utility rough-in is complete and construction in spaces to receive appliances is substantially complete and ready for installation.

1.9 WARRANTY

A. Special Warranties: Provide Special Extended Service Agreement in addition to Manufacturer’s standard warranty, in which the manufacturer agrees to repair or replace appliance that fails in materials and workmanship within specified warranty period for the intended light commercial use.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Accessibility: Where pantry appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and the California Building Code (currently adopted edition) with and local amendments.

C. AHAM Standards:
1. Refrigerators and Freezers: Total volume and shelf area ratings certified according to ANSI/AHAM HRF-1.

D. UL and NEMA Compliance: Provide electrical components required as part of pantry appliances that are listed and labeled by UL and that comply with applicable NEMA standards.

E. Energy Ratings: Provide appliances that carry labels indicating energy-cost analysis

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(estimated annual operating costs) and efficiency information as required bythe FTC Appliance Labeling Rule.

1. Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

2.2 MANUFACTURERS

A. Provide products as listed in the Equipment Schedule as shown on Drawings.

2.3 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

C. Examine walls, ceilings, and roofs for suitable conditions where microwave ovens with vented exhaust fans will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install appliances according to manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

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D. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After installation, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

C. An appliance will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING AND CLEANING

A. Test each item of appliances to verify proper operation. Make necessary adjustments.

B. Verify that accessories required have been furnished and installed.

C. Remove packing material from appliances and leave units in clean condition, ready for operation.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION

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SECTION 122413

ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Manually- and motor-operated roller shades with single rollers.

B. Related Sections:
   1. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
   2. Section 092900 “Gypsum Board” for coordination with gypsum board assemblies for installation of shade pockets, closures and related accessories.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.

B. Preinstallation Meeting: One week prior to commencing work related to this section. Require attendance of all affected installers.

C. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken with finished conditions in place. "Hold to" dimensions are not acceptable.
   2. Do not install shades until final surface finishes and painting are complete.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer's catalog pages and data sheets for products specified including materials, finishes, dimensions, profiles, mountings, and accessories.
   1. Preparation instructions and recommendations.
   2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes, accessories, and operating instructions.
   3. Storage and handling requirements and recommendations.
   4. Mounting details and installation methods.
   5. Manufacturer's Instructions: Include storage, handling, protection, examination, preparation, and installation.

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6. Project Record Documents: Record actual locations of control system components and show interconnecting wiring.
7. Operation and Maintenance Data: Component list with part numbers, and operation and maintenance instructions.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.
2. Roller shade pockets: Finished to match adjacent ceiling materials, in profiles as indicated on Drawings.

C. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.

D. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements.
1. Shadecloth Sample: Mark face of material to indicate interior faces.
a. Test reports indicating compliance with specified fabric properties.
b. Verification Samples: 10 inches square, representing actual materials, color and pattern.

E. Maintenance Data: Bill of materials for all components with part numbers. Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material.

C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

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1.8 QUALITY ASSURANCE

A. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

B. Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of ten years experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section.

C. Installer for Roller Shade System - Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.

D. Fire-Test-Response Characteristics: Passes NFPA 701 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

E. Environmental Certification: Submit written certification from the manufacturer, including third party evaluation, recycling characteristics, and perpetual use certification as specified. Initial submittals, which do not include the Environmental Certification will be rejected. Materials that are simply 'PVC free' without identifying their inputs shall not qualify as meeting the intent of this specification and shall be rejected.

F. Third Party Evaluation: Provide documentation stating the shade cloth has undergone third party evaluation for all chemical inputs, down to a scale of 100 parts per million, that have been evaluated for human and environmental safety. Identify any and all inputs, which are known to be carcinogenic, mutagenic, teratogenic, reproductively toxic, or endocrine disrupting. Also identify items that are toxic to aquatic systems, contain heavy metals, or organohalogens. The material shall contain no inputs that are known problems to human or environmental health per the above major criteria, except for an input that is required to meet local fire codes.

G. Recycling Characteristics: Provide documentation that the shade cloth can, and is part of a closed loop of perpetual use and not be required to be down cycled, incinerated or otherwise thrown away. Scrap material can be sent back to the mill for reprocessing and recycling into the same quality yarn and woven into new material, without down cycling. Certify that this process is currently underway and will be utilized for this project.

H. Perpetual Use Certification: Certify that at the end of the useful life of the shade cloth, that the material can be sent back to the manufacturer for recapture as part of a closed loop of perpetual use and that the material can and will be reconstituted into new yarn, for weaving into new shade cloth. Provide information on each shade band indicating that the shade band can be sent back to the manufacturer for this purpose.

I. Mock-up: Provide one mock-up of each shade type assembly for evaluation of mounting, appearance and accessories.
   1. Locate mock-up in window designated by Architect.
   2. Mockup Size: Full size.
   3. Mockup Size (WxH): 3 x 3 feet (0.94 x 0.94 m) minimum.
   4. Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
   5. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
   6. Do not proceed with remaining work until, mock-up is accepted by Architect.
   7. Retain mock-up during construction as a standard for comparison with completed work.
   8. Do not alter or remove mock-up until work is completed or removal is authorized.
   9. Full-sized mock-up may become part of the final installation.

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1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in Window Treatment Schedule.

B. Store and handle products per manufacturer's recommendations.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.11 WARRANTY

A. Roller Shade Hardware and Chain Warranty: Manufacturer's standard non-depreciating warranty for interior shading.
   1. Shade Hardware: 10 years unless otherwise indicated.
      a. Mecho/7 including bead chain with ThermoVeil, EuroVeil, EuroTwill, Soho, Equinox, Midnite, Chelsea, or Classic Blackout shade fabric: 25 years.
   2. Ecoveil Shadecloth: Manufacturer's standard ten year warranty.
   3. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas, which are deemed owner’s responsibility.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design: Mecho Shade Co., or equal.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
   1. Heavy-duty, 1/8” steel mounting bracket and integrated steel brake, clutch and sprocket assembly rigidly affix the shade support and user control to the building structure fully independent of the roller tube components.
   2. Permanently lubricated maintenance-free brake assembly employs an oil-impregnated steel hub with wrapped spring clutch.
   3. Brake must withstand minimum pull force of 50 pounds (22.7 kg) in the stopped position.

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4. Direct drive clutch requires no interstitial gear stages or plastic parts between the building structure and clutch ensuring reliable operation across the full range of shade sizes.
5. Urethane dampened clutch protects bead chain and clutch from failure due to high shock loads during shade operation minimizing down time.
6. Maximum shade hanging weight of 50 pounds (22.7 kg).
7. Clutch shall be upgradable to motorized drive on compatible tubes without requiring change in mounting attachment method/location, roller tube or fabric band.
8. Motorized drive options available require no additional wiring to be added for power or communication capability for switch or automated operation.

B. Drive Chain: Continuous loop T304 stainless steel beaded ball chain, 100 pound (45 kg) minimum breaking strength warranted from breaking for the life of the shade system hardware under prescribed operation. Provide upper and lower limit stops.
1. Chain Retainer: Chain tensioning device complying with WCMA A100.1.
2. Limit stops: Bead stops affixed to the chain maintain consistent shadeband alignment at the top and bottom of shade travel across multiple shades, and help prevent shade damage resulting from unmanaged user control.

C. UrbanShade, Managed Lift Force, Hardware: Lifts single band or multiband shade assemblies:
1. Lifting Force: 3 to 8.5 pounds (1.4 to 3.9 kg) max pull force to lift shade assemblies with a shade band hanging weight, not including mounting hardware, of up to 50 pounds (22.7 kg).
2. Direct drive clutch with Managed Lift Force provides the best user experience by managing the user pull force while using the fewest number of chain pulls to position a shade.
3. Backward compatible to Mecho/5 components including fascia, regular and reverse roll, pockets, and wall-mounting accessories.
4. Includes offset drive capability, left/right, front, or back to allow for utilization of blackout channels.
5. Allows for ease of operation when obstructions do not allow for direct drive chain access.
6. Offset chain drive shall not cause an increase of friction or pull force when operated up to a 26 degree angle from vertical.

D. Fascia:
1. Fascia: Removable extruded aluminum fascia, size as required to conceal shade mounting, attachable to brackets without exposed fasteners.
   a. Finish: Baked enamel.
      1) Color: Black.

E. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
1. Roller Drive-End Location: As indicated on Drawings.
2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.

F. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

G. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

H. Installation Accessories:

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1. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
   a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than height indicated on Drawings.
   b. Provide pocket with lip at lower edge to support acoustical ceiling panel.
2. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
3. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
4. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
5. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 MOTOR-OPERATED ROLLER SHADES

A. Motorized Operating System: ElectroShade with WhisperShade IQ2-D2 furnished with EDU. As manufactured by MechoShade Systems LLC. Motor operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.

B. Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

C. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   1. Electric Motor: Manufacturer's standard tubular, enclosed in roller.
   2. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for [surface] [recessed or flush] mounting. If retaining "Crank-Operator Override" Subparagraph below, verify availability with manufacturers.
   3. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.
   4. Operating Features:
      a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
      b. Capable of accepting input from building automation control system.
      c. Override switch.

D. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
   1. Material: Extruded aluminum.
   2. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
   3. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.

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4. Roller tubes to be capable of being removed and reinstalled without affecting roller shade limit adjustments.

E. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

F. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers that are operated by one roller drive-end assembly.

G. Installation Accessories:

1. ElectroShade with Electro/1 bracket and #4133 pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
   a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than height indicated on Drawings.
   b. Provide pocket with lip at lower edge to support acoustical ceiling panel.

2. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
3. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
4. Room-Darkening Channels: Extruded aluminum side and center channels with brush pile edge seals, SnapLoc mounting base, and concealed fasteners. Channels to accept one-piece exposed blackout hembar to assure side light control and sill light control.
5. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
6. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.4 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating:
1. Provide flame resistance ratings test reports from an independent testing agency in accordance with NFPA 701, -Small Scale Test stating that the shade material passes NFPA 701 and is washable, dimensionally stable and resistant to ultra-violet deterioration.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
1. Source: Roller shade manufacturer. Selection to be made by Architect from manufacturer’s full range.
2. Fabric: EcoVeil Sheer 6750 and 6850 Series.
3. Color: As shown on Drawings.

C. Hembars: Designed to maintain bottom of shade straight and flat.
1. Style: Full wrap fabric-covered bottom bar, flat profile with heat sealed closed ends.
2. Style: Exposed aluminum bottom bar with matching finials. (Required with Ecoveil fabric)
3. Color: As selected by Architect from manufacturer's full range.

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2.5 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
   1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
   2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.

2.6 INTELLIGENT ENCODED ELECTRONIC DRIVE SYSTEM

A. Electronic Drive Unit (EDU) System - General Requirements.
   1. System to be certified and labelled as a UL 325 listed solution. Recognized component certification is not acceptable in lieu of system testing. Listing label and motor rating to be readily visible for inspection without requiring dismounting of shade assembly for motor or EDU to be removed from shade roller tube.
   2. EDU size and configuration to be as recommended by manufacturer for the type, size, and arrangement of shades to be operated.
   3. Conceal EDU inside shade roller tube.
   4. Use EDU's rated at the same nominal speed for shades in the same room.
   5. Total hanging weight of shade band not to exceed 80 percent of rated lifting capacity of shade EDU and tube assembly.
   6. Provide EDU with capability of upgrading firmware from anywhere on network without touching the motor.

B. 24 VDC low voltage:
   1. Basis of Design: MechoShade Systems LLC; WhisperShadeIQ2 System; www.mechoshade.com/#sle.
   2. Description: Tubular, asynchronous (non-synchronous), with integral AC motor and reversible capacitor operating at 120 VAC, single phase, 60 Hz; temperature Class B, thermally-protected, totally enclosed, maintenance-free; powered by line voltage power supply connection equipped with locking disconnect plug assembly furnished with EDU.
   3. Audible Noise: 46 dBA or less measured 3 feet from the motor unit, depending on motor torque.
   4. Nominal Speed: Minimum of 34 RPM; does not vary due to load/lift capacity.
   5. EDU to provide isolated, low voltage power supply for powering external accessories connected to either the dry contact port or the network port. Products that require accessories to be powered by a plug-in or externally-supplied power supply are not acceptable.

C. Modes of Operation:
   1. Uniform Mode: Allows for shades to move only to defined intermediate stop positions in order to maintain aesthetic uniformity.
   2. Normal Mode: Allows for shades to move to defined intermediate stop positions plus any position between defined upper and lower limits.
   3. Maintenance Mode: Prevents shade from moving to newly commanded positions via dry contact or network control commands until EDU has been serviced and/or Maintenance Mode has been cleared/disabled.

D. Control Methods: Support both local isolated dry contact input and network control.
   1. Local Isolated Dry Contact Inputs:

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a. Supports local switch control and third party system integration without separate interface.
b. Supports moving EDU/shade to upper and lower limits and to local switch preset positions.
c. Allows for configuration of upper and lower limits, custom presets, and key modes of operation without requiring a PC or similar microprocessor-based tools.
d. Supports configuration under protected sequences to prevent changes by casual user.
e. Switch Personalities: Allows for configuration of the dry contact control port over network such that virtually any type of dry contact keypad/third-party interface and actuation methodology (maintained and/or momentary actuation) can be used to operate shade. Dry contact control connection options to include:
    1) 1-button.
    2) 2-button.
    3) 3-button with ability to support configuring limits, presets, and key operating modes (default).
    4) 3-button without configuration capability in order to prevent accidental changes in settings.

E. Alignment Positions:
1. Each EDU to support positioning commands from 0 to 100 percent in 1 percent increments and 32 customizable presets, including three intermediate dry contact presets resulting in repeatable and precisely aligned shade positions and limits.
2. Shades on the same switch circuit or with the same network group address with the same opening height to align at each limit or preset (intermediate stopping position) when traveling from any position, up or down.
3. Shades of differing heights to be capable of custom, aligned intermediate stop positions when traveling from any position, up or down.
4. Alignment of standard shade bands mechanically aligned on the same EDU not to exceed plus/minus 0.125 inch (3.175 mm) when commanded to the same alignment position.
5. Alignment of standard shades on adjacent EDU's not to exceed plus/minus 0.25 inch (6.35 mm) when commanded to the same alignment position.

F. Local Switch Presets:
1. Provide a minimum of three customizable preset positions accessible over the local dry contact control inputs and over the network connection.
2. Preset positions to be customizable to any position between and including the defined upper and lower limits (initially defaults to 25, 50, and 75 percent of shade travel).
3. Support configuration of custom preset positions using either a handheld removable program module/configurator or a local switch.

2.7 MOTOR CONTROLS

A. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.

B. Provide all components and connections necessary to interface with other systems as indicated.

C. Low-Voltage Wall Controls; IQ Switch:
1. Momentary dry contact switch enables manual local control or network control of any individual shade motor or shade group/sub-group on MechoNet network.

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2. Control Functions:
   a. Open: Automatically open controlled shade(s) to fully open position when button is pressed.
   b. Close: Automatically close controlled shade(s) to fully closed position when button is pressed.
   c. Presets: For selection of predetermined shade positions.
   d. Dual Stations: For individual control of two shades/groups.
3. Finish: White.
4. Products:
   a. Single station, 5-button (open, close, and three intermediate stop positions).
   b. Double station, 10-button (open, close, and three intermediate stop positions for each of two shades/groups).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Start of installation shall be considered acceptance of substrates.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

C. Coordinate with window installation and placement of concealed blocking to support shades.

3.3 INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

B. Install shades level, plumb, square, and true per manufacturer's instructions and approved shop drawings. Locate so shade band is at least 2 inches from interior face of glass. Allow proper clearances for window operation hardware. Use mounting devices as indicated.

C. Replace shades exceeding specified tolerances at no extra cost to Owner.

D. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric.

E. Clean roller shade surfaces after installation, per manufacturer's written instructions.

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F. Demonstrate operation and maintenance of window shade system to Owner's personnel.

G. Manufacturer's authorized personnel are to train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as a reference, supplemented with additional training materials as required.

3.4 PROTECTION AND CLEANING

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.
   1. Clean soiled shades and exposed components as recommended by manufacturer.
   2. Replace shades that cannot be cleaned to "like new" condition.

END OF SECTION

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SECTION 123660

SOLID SURFACING ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid-surfacing assemblies.

B. Related Requirements:

1. Document 006223 “Recycling and Diversion of Debris from Construction and Demolition.”
2. Section 064023 “Interior Architectural Woodwork” for accompanying casework.

1.3 ACTION SUBMITTALS

A. Product Data: For solid-surfacing assemblies.

B. Shop Drawings: For solid surfacing assemblies.

1. Show materials, finishes, edge profiles, methods of joining.
2. Include plans, elevations, sections and attachment to other work including blocking and reinforcements required for installation.
3. Indicate types and sizes of casework.
4. Show fabrication details, including types and locations of hardware.
5. Indicate locations and type of service fittings.

C. Samples for Initial Selection: For each type of material exposed to view.

D. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.
2. One full-size solid-surface-material countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

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1.5 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

1.6 COORDINATION

A. Coordinate locations of utilities that will penetrate horizontal or vertical solid surfacing materials.

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL ASSEMBLIES

A. Refer to Finish Schedule found on Drawings for Product information.

B. Solid Surface Material: Homogenous solid sheets of filled plastic resin complying with ANSI SS1.

C. Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes, unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

2.2 MISCELLANEOUS MATERIALS

A. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue, made with binder containing no urea formaldehyde.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

C. Adhesives: Adhesives shall not contain urea formaldehyde.

D. Sealant: Comply with applicable requirements in Section 079200 “Joint Sealants.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material assembly and conditions under which assembly will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assmembly.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION

A. Install countertops over subtops with full spread of water-cleanable epoxy adhesive.

B. Install countertops level to a tolerance of 1/8 inch in 8 feet.

C. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

1. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
2. Seal edges of cutouts in particleboard subtops by saturating with varnish.

END OF SECTION

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SECTION 13 42 75

INTEGRATED INTERIOR ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A . Section Includes:

1. Delegated design of integrated interior assemblies.
2. Structure.
3. Finish panels.
4. Doors and frames.
5. Door hardware.
6. Electrical.
7. Factory integrated components.
8. Site integrated components.

B . Related Requirements:

1. 08 71 00 - Doors and Frames for site integrated components.
2. 08 71 00 - Door Hardware for site integrated components.

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3. Division 26 - Electrical for site integrated components and commissioning.

4. Division 27 - Communications for site integrated horizontal cabling.

5. Division 28 - Electronic Safety and Security for site integrated components.

1.2 DEFINITIONS

A . Finish Panel: Site installed panels with factory applied final finish and cutouts for accommodation of mechanical, electrical and plumbing components.

B . Conventional back box: Standard NEC device metallic back box.

C . Specialty back box: Proprietary back box required for devices other than those specified in this section.

D . Factory Integrated Components: Materials or components specified in other sections for factory assembly within integrated interior assemblies.

E . Site Integrated Components: Materials or components specified in other sections for site assembly within integrated interior assemblies.

1.3 SUBMITTALS

A . Submit the following in accordance with Section 01 33 00 Submittal Procedures.

B . Submittals must be reviewed and approved by the Contractor before sending to the Architect for review.

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C . Sample: Submit two samples for verification of selected finish as scheduled upon request unless noted otherwise. All wood veneer and non-standard custom finishes must be reviewed and approved by the Architect.

1. Anodized: 3 x 6 inch (76mm x 153mm) on metal.

2. Chroma coat:

   a. Standard Color: 2 x 2 inch (51mm x 51mm) paint chip.

   b. Custom Color: 4 x 6 (102mm x 153mm) inch on MDF.

3. Powder Coat: 2 x 4 inch (51mm x 102mm) on metal.

4. Glass: 4 x 4 inch (102mm x 102mm).

5. Thermofoil: As provided by thermofoil manufacturer.

D . Product Data: Provide manufacturers standard tech sheets as applicable to the project for the following: Structure, Finish Panels, Doors and Frames, Door Hardware, Electrical, and Accessories.

E . Pre-Manufacture Submittals: Provide the following information to the manufacturer prior to development of shop drawings.

1. Field measurements of existing construction, future construction, finished width and height of walls and associated components, as well as design team provided plans and elevations.

   a. Where field measurements are not possible, hold-to and control dimensions must be coordinated and agreed upon by all parties who interface with the integrated interior assemblies through the Shop Drawing process before manufacturing begins.

2. Wall hung items: Include make, model, size, configuration and any additional pertinent product data for wall hung items such as furniture, fixtures, equipment and casework.

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3. Structure: Seismic Calculations and site specific connection to be generated

4. Finish Panels: Include finishes and configurations.

5. Doors and Frames: Include finishes, frames, and operations.

6. Door Hardware: Include manufacturers standard hardware and site integrated component hardware.

    a. One sample of each type of Site Integrated Door Hardware that is to be installed in doors included in this section shall be sent to manufacturer for review and approval.

7. Electrical: Include device type and location, schedules indicating electrical device specifications, amperage, ground pin orientation, type of solution, wiring configuration, receptacle, faceplate and trim ring colors and styles, and any Factory or Site Integrated Components.

8. Factory Integrated Components: Provide make, model, size, configuration, materials and any additional pertinent product data for factory assembly.

9. Site Integrated Components: Provide make, model, size, configuration and any additional pertinent product data for site installation.

F . Shop Drawings: Submit shop drawings for review prior to commencing any fabrication of the integrated interior assemblies. Coordinate as required until scope is confirmed by all affected stakeholders. Include manufacturer provided plans, elevations, sections, schedules and applicable notes per the following:

1. Prior to shop drawing submittal review the drawings for obvious drafting and detailing errors.

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2. Indicate material descriptions, dimensions and profiles of adjacent components and assemblies interfacing with the integrated interior assemblies.

3. Indicate field measurements of existing construction, future construction, finished width and height of assemblies and associated components.

4. Structure: Indicate reveal type, profile type, finishes and attachment to base building.

5. Finish Panels: Indicate finishes, cores, glazing, accessories and configurations.

6. Doors, Frames and Hardware: Include elevations indicating glazing and finishes, schedules indicating door tags, styles, dimensions, handing, hardware and finishes.

7. Electrical (By Electrical Subcontractor):

   a. Coordinate electrical components specified herein with the documents provided by the electrical engineer of record.

   b. Indicate types and locations of wiring devices, outlet, junction and pull boxes, copper conductors and cables, conduit, electrical branch circuiting, amperage, ground pin orientation, wiring diagrams, and faceplate, receptacle and trim ring colors and styles.

8. Factory and Site Integrated Components: Indicate device type and location.

G . Delegated Design Submittals: Provide structural analysis data and calculations for installed products to demonstrate code compliance with design loads, signed and sealed by licensed professional engineer registered in the jurisdiction of the project.

1. Include engineering calculations for floor & wall connections and seismic conditions.

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H. Manufacturer's Installation Instructions: Indicate any special preparation of base building conditions, installation and attachment methods.

I. Operation and Maintenance Data: Provide maintenance data for incorporation into operation and maintenance manuals.

J. Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

K. Closeout Submittals: Submit copy of packing slip for shipment of re-usable packaging "cookies" and modular electrical dust caps back to manufacturer.

L. Installer Performed Testing: Submit documentation of installer performed tests and certification for submission to the Authority Having Jurisdiction.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section, of the quality and complexity required for this project for a minimum 10 years. Show production facilities capable of meeting contract requirements for single-source responsibilities and warranty.

2. Designer Qualifications: Professional structural engineer with 3 years of documented experience in design of this work and licensed in the location of the project.

3. Wall Installer Qualifications: Company trained and certified by manufacturer and specializing in performing the work of this section.

4. Integrated Electrical Components Installer Qualifications: Connections to the base building electrical system and all field installed electrical components, devices, and accessories require installation by an

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electrical contractor licensed in the jurisdiction of the project in accordance with applicable building and electrical codes and standards. Such work shall be performed under permit, tested, and inspected to confirm adequacy of final installations to the satisfaction of the Authority Having Jurisdiction.

B . Source Limitations: Obtain integrated interior assemblies from a single source.

1.5 DELIVERY, STORAGE, AND HANDLING

A . Do not deliver or install integrated interior assemblies until spaces are enclosed and weather-tight, wet work is complete and dry, work above ceilings is substantially complete, and HVAC system is operational and able to maintain ambient temperature and humidity conditions between 60 and 90 degrees Fahrenheit (15.5 and 32.2 Celsius) with Relative Humidity maintained between 25 and 60 percent.

B . Do not allow packaging to get wet or develop condensation.

C . Comply with the manufacturer’s requirements for a warrantable installation of the installed products to meet the Performance and Design Criteria.

D . Collect and return re-usable packaging "cookies" and modular electrical dust caps to manufacturer.

1.6 WARRANTY

A . Manufacturer Warranty: Provide 10 year warranty on walls, doors, door frames and electrical for failures in materials or workmanship as indicated by the manufacturer standard warranty.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A . Construction Solutions/Division of Pivot Interiors
Address: 3355 Scott Boulevard, Ste 110, Sant Clara, CA 95054
Contact: Faisal Majdalawe
Phone: 650.999.6699

2.2 DESCRIPTION

A . Factory assembled, site installed, integrated interior assemblies, including Structure, Finish Panels, Doors and Frames, Door Hardware, Electrical, and Factory and Site Integrated components.

2.3 PERFORMANCE AND DESIGN CRITERIA

A . Provide integrated interior assemblies that are factory sub-assembled, and site installed to integrate with the base building structure, shell, mechanical, electrical and plumbing systems.

B . Integrated Interior Assembies shall be non-progressive in method of installation so that frame modules within an elevation can be removed, added or changed without affecting adjacent frame modules.

C . Walls shall utilize factory finish site installed panels that mechanically fasten to a factory finished and assembled aluminum structural frame module. Finish panels may be monolithic or segmented with the ability to span off-module, or across multiple frames in segments or monoliths, vertically and horizontally.

D . Assembly shall allow for independent configuration of structure, finishes and functions relative to each side of the wall.

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E . Assembly shall be comprised of components which can be disassembled, relocated and field cut and substantially reused for future reconfigurations allowing for adaptability and retrofitting of the Structure, Finish panels, Doors and Frames, Door Hardware & Electrical.

F . Integrated interior assembly shall enable access of the internal cavity from either side without the addition of an access panel or need for repairing of finishes.

G . Provide integrated interior assembly with a continuous open cavity vertically and horizontally free of structural impediments for the routing of mechanical, electrical and plumbing components.

H . Provide integrated interior assemblies capable of accommodating up to a 1-inch (25 mm) gap between the top, bottom and side edges of the prefabricated assembly and base building elements.

I . Provide an integrated interior assembly system capable of accepting pressure fit extrusions and co-extrusions to fill voids between finish panels, at ceiling connections, and other base building connections.

J . Structural Performance:

1. Capable of withstanding the effects of loads and stresses within limits allowable by the local authority having jurisdiction and under conditions indicated (TBD based of structural calculations)

Assembly UL Ratings:

2. UL QQXX; Sections and Units per 2017 NFPA 70 National Electrical code.

3. UL QQYZ; Wiring Assemblies.

4. UL 183; Standard for Safety for Manufactured Wiring Systems.

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5. UL 498; Standard for Safety for Attachment Plugs and Receptacles.

6. UL 507; Component Fans, Electric.

7. UL 514A; Standard for Safety for Metallic Outlet Boxes.

8. UL 514 B; Standard for Conduit Cable and Fittings.

9. UL 514C; Standard for Safety for Non; Metallic Outlet Boxes, Flush; Device Boxes, and Covers.

10. UL 514D; Standard for Safety for Cover Plates for Flush; Mounted Wiring Devices.

11. UL 723; Standard for Test for Surface Burning Characteristics of Building Materials

12. UL 1784; Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives.

2.4 STRUCTURE

A . Two-sided wall: Fully assembled non-bearing structural frame module with site installed finish panels on both sides.

1. Reveal Type and Size: Classic 0.354 inches (9 mm)

2. Material: Aluminum extrusions, 6063-T6 aluminum alloy classified as noncombustible in accordance with ASTM E136 per 2018 IBC 703.5.1.

   a. Thickness: As required to meet performance requirements.

3. Wall Thickness: Actual 4 inch (102mm) or 6 inch 152mm) or 6 to 12 inch (152mm to 305mm) parametric expandable wall in locations indicated by drawings.

4. Bracing: as required to meet structural performance requirements

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5. Bottom Track: Integral with modular frames.

    a. Provide frame bases with continuous adjustment mechanism for 1-1/2 inch (38mm) height adjustment to accommodate floor slab variances.

6. Accessories: Seismic floor anchor attachment

7. Vertical Element Spacing: As required to meet performance requirements within a minimum of 6 inches (152mm) and a maximum of 48 inches (1219mm).

8. Blocking Bracket: Adjustable factory mounted [4 inch (102mm)] and [6 inch (152mm)] concealed structural blocking fabricated of 12 gauge or 16 gauge galvanized steel in a horizontal or vertical orientation between aluminum extrusions for wall mounted components, if necessary.

9. Insulation: manufacturers standard non-woven, unfaced recycled denim batt insulation containing cotton fibers and proprietary materials with a flame spread index of 25 or less and smoke developed index of 450 or less when tested in accordance with ASTM E84 and has been evaluated for corrosiveness, fungi-resistance, and moisture absorption by testing in accordance with ASTM C739.

B . Glazed wall: Fully assembled non-bearing structural frame module with glass infill and/or Site assembled non-bearing structural frame module with glass infill.

1. Reveal Type and Size: Classic 0.354 inches (9 mm)

2. Extrusion Profile: Rectilinear

3. Material: Aluminum extrusions, 6063-T6 aluminum alloy classified as noncombustible in accordance with ASTM E136 per 2018 IBC 703.5.1.

    a. Thickness: As required to meet performance requirements.

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4. Wall Thickness: Actual 4 inch (102mm).

5. Top Track: Continuous, with intermittent breaks for structural components.

6. Bracing: as required to meet structural performance requirements

7. Bottom Track: Integral with modular frames.

    a. Provide frame bases with continuous adjustment mechanism for 1-1/2 inch (38mm) height adjustment to accommodate floor slab variances.

    b. Accessories: seismic floor anchor attachment.

8. Vertical Element Spacing: As required to meet performance requirements within a minimum of 6 inches (152mm) and a maximum of 60 inches (1524mm).

    a. Vertical Element spacing may exceed 60 inches (1524mm) with manufacturer review and approval.

9. Glazing Finish Panel: Per Schedule Below.

10. Glazing Gasket Color: black/charcoal/silver.

C . Structure Exposed Finishes:

1. Clear Anodized Aluminum: AAMA 611, AAM12C22A31, Class I

2. Powder coat:

    a. Finish: Per Finish Schedule below.

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2.5 FINISH PANELS

A . Factory Finished Panel: Finish panels shall meet the finish classification requirement per International Building code for the proposed location in the building.

1. Core Material: Medium Density Fiberboard Core (MDF).

    a. Features:

        1. No Added Formaldehyde (NAF MDF) and TSCA Title VI compliant

2. Finish Material: Manufacturer standard options shall be classified in accordance with ASTM E84. See Finish Schedule below for additional information.

    a. ChromacoatPlus (PNT-#): Manufacturers standard no Volatile Organic Compounds (VOC) water-based paint sprayed onto substrate with cleanable clear topcoat.

        1. Maximum Size: 60 x 120 inches (1524mm x 3048mm).

        2. Finish Classification: Class C with NAF MDF core

    b. Thermofoil (THRM-#): 3D laminate film vacuum formed to substrate.

        1. Maximum Size: 48 x 120 inches (1219mm x 3048mm).

        2. Finish Classification: [Class B with NAF MDF core] [Class A with FR MDF core].

3. Mounting: Face Mounted.

4. Thickness:

    a. Typical: 1/2 inch (13mm).

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b. With integral base: 3/8 inch (9.5mm).

B . Glass Finish Panel:

1. Glazing Material:

a. Tempered glass (GLS-#): Architectural flat glass per ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type 1, Class 1 (transparent), Quality q3. Complies with CPSC-16 CFR Part 1201 Category II per IBC 2018.2406.2.

1. Features: Meets ANSI Z97.1 Safety Glazing Material standards.

2. Thickness: [1/4 inch (6mm)] [3/8 inch (10mm)]

3. Finish: Per Finish Schedule below.

2. Mounting: Center Mounted for glazed walls and doors/

a. Face Mounted Features:

1. Aluminum mounting rails to maintain alignment with adjacent finishes.

2. Where specified 1/4 inch (6mm) tempered glass has a maximum size of: 60 x 120 inches (1524mm x 3048mm).

C . Solid Surface Finish Panel (CRN-#):

1. Thickness: 1/2 inch (12mm)

2. Finish: Per Finish Schedule below.

3. Mounting: [Center Mounted] [Face Mounted].

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2.6 DOORS AND FRAMES

A . Coordinate ADA, ANSI, Access Control and Fire Life Safety requirements with drawings and schedules prior to the development of shop drawings per Pre-Manufacture Submittal requirements.

B . Hardware Preparation and Reinforcement: Factory milled, reinforced, drilled and taped doors and frames by manufacturer to receive Integrated Hardware Components as scheduled.

1. Factory milled doors and frames with hinge locations and sizes as determined by integrated interior assembly manufacturer; including factory installed steel backer plates.

C . Aluminum Framed Glass Doors:

1. Operation: off-center pivot

2. Door Thickness: 1-11/16 inch (43mm) thick.

3. Door Size: As indicated on Door Schedule.

4. Stile Width 6 inch (152mm) as indicated by Door Type on Door Schedule.

5. Top Rail Height: 6 inch 152mm) as indicated by Door Type on Door Schedule.

6. Bottom Rail Height: 10 inch (254mm) as indicated by Door Type on Door Schedule.

7. Glazing: (GLS-#) Tempered [[1/4 inch (6mm)

8. Finish:

a. Clear Anodized Aluminum: AAMA 611, AAM12C22A31, Class I

b. Powder coat grade 2

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1. Color: Per schedule below.

9. Adjustability: Provide door skirt to accommodate varying floor levels.

D. Door Frames:

1. Architectural grade structural aluminum factory finished and integrated with wall structure.

2. Door frames capable of reconfiguration without part replacement or damage to wall components.

3. Frames are shipped knocked down and assembled on site.

4. Jambs shipped over length by 2 inches (50 mm) in height, for field cutting to suit opening height for proper alignment with adjacent frames.

5. Extrusion Profile: Rectilinear

6. Configuration: As required by door operation or function.

7. Size: As required for doors sizes indicated on Door Schedule.

8. Standard Frame Depth: 4 inches (102mm)

9. Finish:

a. Clear Anodized Aluminum: AAMA 611, AAM12C22A31, Class I

b. Powder coat grade 2

1. Color: Per Finish Schedule below.

2.7 DOOR HARDWARE

A. Site Integrated Components: Provide in accordance with Division 08 Openings and Division 28 Electronic Safety and Security.

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B . All Hardware indicated in this section to be provided by the manufacturer or the manufacturers distribution partner and installed on site unless indicated otherwise.

C . General Door Hardware:

1. Cylindrical Series Hardware:

a. Schlage “ND” Series Cylindrical Hardware:

1. Lever Style: Rhodes

2. Concealed Overhead Closers: Manufacturers standard adjustable 90º concealed closer

3. Strike: Electrified Strike Plate – Spec TBD.

4. Floor Stops: Dome.

5. Acoustical Seals: Manufacturers Standard to accommodate door operation.

6. Aluminum Framed Glass Door Gasket Color: Black/Charcoal/Silver.

D . Hardware Finishes: BHMA Standard finishes provided as follows unless indicated otherwise:

1. 626 - Satin Chrome: lever sets, flush bolt, dead bolt, metal roller catch, bolt, strike plate, dome floor stop and peg floor stop.

E . Keying: Provided by owner.

2.8 ELECTRICAL (BY ELECTRICAL SUBCONTRACTOR)

A . Copper Conductors and Cables:

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1. Armored Cable (Type AC): Multi conductor Type AC with 3, 5 or 8 insulated copper conductors in size #12 AWG factory assembled from the pre-terminated device with an additional 10 feet (3.05 m) extending from the top or bottom edge of the frame.

    a. Features:

        1. Conventional Wiring: Pig Tail conventional hard wire connection to base building branch circuit conductor per Division 26 requirements.

        2. Modular Wiring: Quick connect pre-terminated modular system for wiring modular devices per shop drawings.

        3. Extender Cable: Quick connect pre-terminated at both ends modular system for wiring modular devices per shop drawings.

        4. Power Whip: Manufacturer standard modular connector at one end and Pig Tail conventional hard wire connection at opposite end for connection to base building branch circuit conductor per drawings and Division 26 requirements.

2. Flexible Conduit Cable: Manufacturers standard UL listed multi conductor fabricated of lightweight NEC Type FMC, high-strength aluminum alloy with 3, 5, or 8 insulated copper conductors in size #12 AWG factory assembled from the pre-terminated device.

    a. Features:

        1. Modular Wiring: Quick connect pre-terminated modular system for wiring modular devices per shop drawings.

        2. Extender Cable: Quick connect pre-terminated at both ends modular system for wiring modular devices per shop drawings.

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3. Power Whip: Manufacturer standard modular connector at one end and Pig Tail conventional hard wire connection at opposite end for connection to base building branch circuit conductor per drawings and Division 26 requirements.

3. Express Line Modular Cable: UL listed cable assembly for connecting Modular Panel Manager to pre-terminated modular assemblies. Composed of manufacturers standard lightweight NEC Type FMC, high-strength aluminum alloy with 3, 5 or 8 insulated copper conductors in size #10 AWG.

   a. Features:

      1. Length: Up to 150 feet (45.72 m).

4. Modular Splitter: Modular cable quick connect device for power distribution to be secured to wall, floor or above ceiling per shop drawings.

5. Conventional Cable: Power conductors and cables not provided by manufacturer are provided in accordance with division 26.

B . Conduit:

1. Electric Metal Tubing (EMT): Conduit pathways [1/2 inch (13 mm)] [3/4 inch (19 mm)] factory mounted within the integrated interior assembly structure, from outlet junction box to top or bottom of assembly to permit wiring installation and connections as specified in Divisions 26, 27, and 28.

   a. Material: Coated steel.

   b. Feature: Provide with manufacturers standard plastic grommet at one end.

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2. Flexible Metal Conduit: Provide UL listed flex conduit per ANSI/UL-1, NEC Type FMC fabricated of lightweight, high-strength aluminum alloy.

3. Refer to Division 26, 27, and 28 for additional conduit raceway and pull-string requirements.

C . Outlet Junction Box

1. Conventional back box and mounting bracket: Factory mounted.

2. Manufacturers standard back box and mounting bracket: Factory mounted.

3. Specialty Back Box: Provide to manufacturer for factory mount.

D . Face Plates and Trim Rings:

1. Manufacturer standard faceplates: Factory provided, Factory installed

   a. Color: [White] [Ivory] [Grey] [Black] [Stainless Steel]

   b. Construction: 2 adjustment screws at top and bottom for flush installation.

2. Manufacturer standard trim rings: Factory provided, site installed.

   a. Color: [White] [Ivory] [Grey] [Black]

3. Conventional face plates: Provide in accordance with division 26 requirements.

4. Engraving/Identification: Provide in accordance with division 26 requirements.

E . Wiring Devices

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1. Pre-terminated 15 or 20 amp receptacle factory assembled in outlet junction box.

    a. Color: White except as follows: [Red for emergency circuits] [Ivory] [Orange] [Grey] [Blue] [Black]

    b. Ground Pin Orientation: [Down] [Up] [Left] [Right]

    c. USB charging port as located per drawings: Type A, 5 amp, 5 volt

F . Electrical Branch Circuiting:

1. Modular Zone Distribution: Modular Zone boxes designed to hold 12 circuits (independent neutrals) or 16 circuits (shared neutrals) site installed per shop drawings.

    a. Connections from modular devices to modular zone box with site installed modular splitters and extender cables.

    b. Connection of modular zone boxes to conventional panel: Home run connections provided in accordance with requirements of Division 26 Electrical and manufacturers installation instructions.

2. Modular Panel Manager Distribution: Electrical distribution panel with 24 or 42 circuits installed inside or just outside the electrical room per shop drawings for full modular power distribution.

    a. Connections from modular devices to modular panel manager with modular splitters and Express Line modular cables in accordance with manufacturers installation instructions and shop drawings.

    b. Connection of modular panel manager to conventional panel provided in accordance with Division 26 Electrical, manufacturers installation instructions and shop drawings.

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2.9 SITE INTEGRATED COMPONENTS

A . Door Hardware – per division 08 and 28

B . (DF-1) Door Frame

2.10 ACCESSORIES

A . All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

B . Manufacturer's accessories required by the project:

1. Manufacturer Standard Wall Base: Mechanically fastened recessed and adjustable Santoprene base.

    a. Color: Silver/Black

PART 3 - EXECUTION

3.1 EXAMINATION

A . Verify existing conditions meet the manufacturer's requirements before starting work.

1. Floor Levelness:

    a. Contiguous wall lengths less than 40 feet: Base building sub-floor shall be level within 3/8 inch over 10 feet.

    b. Contiguous wall lengths greater Than 40 feet: Base building sub-floor shall not exceed a maximum total floor flatness deviation greater than 1-1/2 inches.

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2. Vertical leading edge of assembly structure to base building: Where partitions attach to adjacent walls, the finish face shall be plum within 1/2 inch over 10 feet.

3. Top of assembly structure to base building: Where partitions attach to bulkhead or soffit, the finish face shall be level within 1/2 inch over 10 feet.

4. Lay in Ceilings: Where partitions attach to lay-in ceiling grid, the grid shall be level within 1/4 inch over 10 feet.

B . Verify field or hold-to control dimensions before fabrication of integrated interior assemblies. Coordinate fabrication schedule with construction schedule and progress to avoid delay in the work.

C . Examine all adjoining work including work by others.

D . Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A . Prepare surfaces to receive work in accordance with manufacturer's instructions.

B . Locations to receive integrated interior assemblies shall be inspected for compliance with manufacturers requirements.

C . Survey floor to determine the nature of floor level and determine where special conditions exist beyond manufacturer’s standard leveling capabilities of 1-1/2 inch (38mm) total variation in floor level.

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D . Field conditions and pre-existing installations by others which may adversely affect installation or exceed the manufacturers limitations shall be corrected before installing walls.

3.3 INSTALLATION

A . General: Install all materials in accordance with manufacturer's instructions based on conditions present and pre-installation meeting.

B . All building services shall be installed and connected to the base building systems by licensed subtrades. All building services shall be inspected by authorized trade representatives and Authority Having Jurisdiction in the presence of a manufacturer representative. Coordinate with all affected parties as required.

C . Doors and frames

1. Install sliding doors plumb, level, square, and in proper alignment.
2. Install doors to close against walls without gaps
3. Install doors to open and close smoothly.
4. Anchor sliding doors securely to supports.

D . Electrical (By Electrical Subcontractor):

1. Electrical testing requirements provided in accordance with Division 26 Electrical.
2. Inspect all electrical installations as part of conventional electrical scope prior to installation of finish panels.
3. Installation sequence as determined by the certified installer and coordinated with the General Contractor based on project conditions.

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3.4 FIELD QUALITY CONTROL

A . Electrical:

1. All building services shall be inspected by authorized trade representatives and the local building authority prior to installation of finishing panels. Refer to Shop Drawings for location of components incorporated into prefabricated walls.

2. In general, installation locations and dimensions are installed a typical distance from prefabricated wall edges, refer to Shop Drawings for more information.

3.5 ADJUSTING

A . Adjust and lubricate hardware for proper operation in accordance with manufacturer’s instructions.

B . Doors and Frames

1. Adjust for smooth and balanced door movement in accordance with manufacturer's instructions.

2. Adjust and lubricate hardware for proper operation.

3.6 CLEANING

A . Upon completion of installation clean finishes in accordance with the manufacturer’s instructions. Avoid alkaline or abrasive agents. Avoid scratching or marring finishes.

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3.7 PROTECTION

A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

3.8 DEMONSTRATION

A. Manufacturer's representative will be responsible to provide general product training to the Owner or their outsourced operations team at time of installation as well as conduct a comprehensive training session(s) to convey the methodology, and assembly of the walls to sustain general operational maintenance by the Owner's personnel with clearance over the facilities lifetime.

3.9 FINISH SCHEDULE

A. (ANO-1) Anodized:

1. Type: Manufacturer Standard
2. Color: Clear.

B. (PNT-1) ChromacoatPlus Paint:

1. Type: Manufacturer Standard.
2. Manufacturer: DIRTT.
3. Grade: 1.
4. Color Name: TBD
5. Notes: TBD

C. (THRM-1) Thermofoil:

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1. Type: Manufacturer Standard
2. Grade: 2
3. Color Name: TBD
4. Grain Direction: Vertical/Horizontal
5. Notes: TBD

D. (PWD-1): Powder Coat

1. Type: Manufacturer Standard.
2. Grade: 2.
3. Texture: Smooth/Metallic
4. Color Manufacturer: DIRTT.
5. Color Name: TBD.
6. Notes: TBD.

E. (GLS-1) Glass:

1. Type: Tempered
2. Color/Finish: Manufacturer Standard Clear Manufacturer
3. Thickness: 6mm
4. Notes: Glass for transaction counter fronts

F. (GLS-2) Glass:

1. Type: Tempered

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2. Color/Finish: Manufacturer Standard Etched

3. Thickness: 6mm

4. Color/Finish Name: Etch – 'Haze'

5. Notes: Etched glass for door and privacy glass areas

6. DOOR HARDWARE SCHEDULE

G . (DHW - 1):

1. DIRTT standard hardware for locking Pivot Door as noted in General Hardware noted above

END OF SECTION

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COUNTY OF SAN MATEO
HALL OF JUSTICE

COURTROOM TENANT IMPROVEMENT PROJECT

PROJECT MANUAL

ISSUE FOR PERMIT

FEBRUARY 28, 2025

VOLUME 2 OF 2

Mark Cavagnero Associates, Architects
San Francisco, CA

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SECTION 000010 - SPECIFICATIONS TABLE OF CONTENTS

AUTHOR ABBREVIATIONS
ALL = ALLEGION
ALF = ALFATECH
CSM = COUNTY OF SAN MATEO
MCA = MARK CAVAGNERO ASSOCIATES
PVT = PIVOT INTERIORS
TEE = TEECOM
ZFA = ZFA STRUCTURAL ENGINEERS

GENERAL REQUIREMENTS SUBGROUP
VOLUME 1

			ISSUE FOR PERMIT			
	Division 00 Procurement and Contracting Requirements					
MCA	Document 003100	Available Project Information	•			
CSM	Document 006223	Recycling & Diversion of Debris from Construction & Demolition	•			
CSM	Document 006536	Warranty Form	•			
	Division 01 General Requirements					
MCA	Section 011000	Summary of Work	•			
MCA	Section 012000	Price and Payment Procedures	•			
MCA	Section 012600	Contract Modification Procedures	•			
MCA	Section 013100	Project Management and Coordination	•			
MCA	Section 013119	Project Meetings	•			
MCA	Section 013131	Request for Interpretation	•			
MCA	Section 013200	Construction Progress Documentation	•			
MCA	Section 013300	Submittal Procedures	•			
CSM	Document 013513.19	Special Project Procedures for San Mateo County Facility	•			
MCA	Section 014000	Quality Requirements	•			
MCA	Section 015000	Temporary Facilities and Controls	•			
MCA	Section 016113	Product Substitution Procedures	•			
MCA	Section 016113a	Substitution Request Form	•			
MCA	Section 017000	Execution and Closeout Requirements	•			
CSM	Section 017329	Cutting and Patching	•			
CSM	Section 017823	Operation and Maintenance Data	•			
CSM	Section 017836	Warranties	•			
MCA	Section 018115	CALGreen Requirements	•			
CSM	Section 019100	General Commissioning Requirements	•			
	FACILITY CONSTRUCTION SUBGROUP					
	Division 02 Existing Conditions					
MCA	Section 024119	Selective Demolition	•			

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	Division 03 Concrete					
ZFA	Section 031000	Concrete Forming and Accessories	•			
ZFA	Section 032000	Concrete Reinforcing	•			
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MCA	Section 035416	Hydraulic Cement Underlayment	•			
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SECTION 210500

FIRE PROTECTION SYSTEMS – DESIGN-BUILD

PART 1 - GENERAL

1.1 DESCRIPTION

A. Under this Division, the Contractor shall furnish all labor, equipment, appliances, and materials to perform all operations in connection with the installation of a complete and tested fire protection system as described in the Contract Documents.

1.2 RELATED DOCUMENTS

A. Section 220500: Common Work Results for Plumbing

B. Section 220529: Hangers and Supports for Plumbing Piping and Equipment

1.3 SYSTEM DESCRIPTION

A. Applicable Standards:

1. All Fire Protection design, products, and installation shall comply with the applicable provisions and recommendations of the following jurisdictional codes, authorities, and guidelines:
   a. California Building Code Latest Edition
   b. California Fire Code Latest Edition
   c. National Fire Protection Association Standard 13, Latest Edition
   d. National Fire Protection Association Standard 14, Latest Edition
   e. National Fire Protection Association Standard 72, Latest Edition
   f. Applicable Factory Mutual Insurance Company Data Sheets

      1) FM GLOBAL Data Sheet 2-8 “Earthquake Protection for Water-Based Fire Protection Systems”
      2) FM GLOBAL Data Sheet 2-8N “Installation of Sprinklers (NFPA)”

   g. Local Codes, Code Amendments and Requirements

2. Provide fire protection products including fittings and couplings, supports, anchors, fire stops, sprinklers, etc., that are Underwriters Laboratories listed, and approved by the local Fire Department.

B. Design Parameters

1. Scope of Fire Protection
   a. In General, the existing building sprinkler system has been installed overhead in the protective pattern throughout the buildings. Provide modification, relocation and extension of the main or laterals of the base building automatic sprinkler system for the tenant’s. Provide new main (where required). Prior to bid, the Design-Build contractor shall review the BIM model and include the cost for all the modifications required for the complete Fire Sprinkler System installation. No change order proposal will be acceptable after the bid for the above scope as noted.

2. Provide automatic fire protection sprinkler system complete including all items of piping and equipment necessary for a complete system throughout tenant space. Add new or relocate existing heads, layout piping as required due to architectural layout, including any adjacent areas outside this tenant due to new or relocated walls. All sprinklers new or existing shall be of the quick response type, except for mechanical and electrical rooms.

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a. All equipment and devices shall be Underwriters Laboratories listed, Factory Mutual and local Fire Department approved. Fire Protection Contractor shall sign and seal shop Drawings prior to issuance to Building and Fire Departments for approval. No work shall be installed without approved shop Drawings.
b. It shall be the responsibility of the Contractor to coordinate the location of all sprinkler heads with final reflected ceiling Drawings.
c. Relocated fire sprinkler mains shall not interfere with the HVAC contractor's ability to place HVAC main ducts tight to bottom of fire proofed structural elements.
d. The Contractor shall provide all offsets, drains and drain plugs for trapped piping, and drainage piping. The Contractor shall notify the Architect, in writing, of all discrepancies in sprinkler head locations where local codes are violated; i.e., allowable distance from walls or exterior glass, small room spacing, stairs, etc.
e. System piping shall be hydraulically designed throughout all areas in accordance with the rules and regulations of the applicable standards using the design densities indicated herein:

1) Fire Sprinklers: The fire sprinkler hydraulic calculations shall include hose allowances as defined for the hazard for inside and outside hose streams as required to meet applicable standards.
2) Hydraulically designed sprinkler systems should be designed for a supply pressure of at least 10 percent, but not less than 10 psi, below the supply curve.
3) The velocity of water through the fire protection piping system shall not exceed maximum allowable velocities allowed by applicable standards.

f. The hydraulic calculations shall be based on current flow data obtained from local water authority. Confirm flow data prior to design and layout of fire protection systems.

3. Wet Fire Sprinkler Density Requirements:
a. All sprinkler systems shall be hydraulically calculated. In the event design criteria information from the project fire insurance underwriter is unavailable at the time of initial design, the following minimum criteria shall be used:

1) Light Hazard: Offices, data processing, restaurant seating area, and corridor piping systems shall be sized to deliver a minimum 0. <10 >gpm/sq. ft. over an area of <1500> sq. ft. at the most remote location and 250 gpm for hose stream. The protection area per sprinkler head shall be <225> square feet.

C. No pipes or other apparatus shall be installed so as to interfere in any way with the full swing of doors, building access doors, and access doors in ductwork. The arrangement, positions, and connections of pipes, drains, valves, etc., shown on the Drawings shall be taken as an approximation and while they shall be followed as closely as possible, the right is reserved by the Project Representative to change the locations to accommodate any conditions which may arise during the progress of the work without additional compensation to this Contractor for such changes, provided that the changes are requested prior to the installation of this Contractor's work.

D. Piping typically shall be installed concealed in or above building construction; i.e.; hung ceilings, and shall be so arranged that relocation of lighting fixtures, or plumbing and mechanical systems, will not cause any interference.

1.4 SUBMITTALS

A. Comply with requirements of:
1. Division 1

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2. Insurance Underwriter Company:
   a. Submit three (3) sets of Drawings, three (3) sets of catalog cut sheets for all equipment to be installed, and three (3) sets hydraulic calculations.
   b. Include Sprinkler Identification Number (SIN) nomenclature on fire sprinkler product data.

3. Product Data: Submit manufacturer's product literature including, material specifications and other information required to demonstrate compliance with specified requirements. Submit for engineer's approval an equipment manual which will include all technical data of each essential component of the system such as automatic sprinklers, electrical detectors, control system, etc.

B. Shop Drawings:
   1. Fire Protection Contractor shall sign and seal shop Drawings prior to issuance to City fire authority for approval. No work shall be installed without approved Shop Drawings.
   2. Obtain approval on systems in accordance with construction schedule with fire supply mains, standpipes, etc., submitted first then fire sprinkler head layout, floor by floor as schedule dictates.
   3. Submit fire sprinkler system shop Drawings and hydraulic calculations with submittal of product data.
   4. Submit detailed layout Shop Drawings of complete sprinkler systems. Shop Drawings shall indicate plan locations and elevations of piping and hangers, including bottom elevation of major piping and be coordinated with building conditions, ductwork and other mechanical and electrical services.
   5. Include the following in Shop Drawings in addition to requirements of applicable standards. Drawings submitted without these items will be returned unreviewed:
      a. Finished ceiling components such as ceiling grid, and lights.
      b. Beams and other sprinkler obstructions in unfinished spaces.
      c. Details and sections to clarify design and installation to be in conformance with design criteria and standards described in this section.
      d. Locations and sizes of beam penetrations, approved by the structural engineer.
      e. Locations of all seismic bracing and additional bracing required for flexible type couplings.

C. Written statement that coordination has been accomplished with work of other contractors and installers.

1.5 QUALITY CONTROL

A. Only Subcontractors and workmen experienced and regularly engaged in the installation of automatic sprinkler type fire protection systems for the past five (5) years and licensed as required by the Authority having jurisdiction shall be permitted to install the system.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Following is a list of manufacturers whose products may be submitted for review. All items submitted as being equal to that specified, shall have same quality, finish, material construction, etc., as those specified under base Specification.

B. Acceptable Manufacturers:
   1. Sprinkler Heads: Viking, Grinnell, Central, Reliable to match building standards.

2.2 PIPING AND FITTING MATERIALS

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A. General Characteristics for Threaded Pipe and Fittings: Field Pipe Threading: Comply with ASME B1.20.1 “Pipe Threads, General Purpose (inch)”.

B. General Characteristics for Welded Pipe and Fittings: Welding: Shop Welded and in compliance with AWS B2.1 “Specifications for Qualifications of Welding Procedures and Welders for Piping and Tubing”.

C. Automatic Fire Sprinkler Systems:
   1. Above Grade Piping Systems Pipe Sizes 2 inch and Smaller: Piping: ASTM A135, or A53 B, schedule 40 carbon steel pipe.
   2. Above Grade Piping Systems Pipe Sizes 2½ inches and Larger: Piping: ASTM A135 or A53 B, schedule 10 carbon steel pipe.
   3. Fittings:
      a. Pipe Sizes 2 inch and Smaller:

         1) Class 125 cast iron threaded fittings for working pressures under 175 pounds per square inch, conforming to ANSI B16.4.
         2) Class 150 malleable iron threaded fittings for working pressures under 300 pounds per square inch, conforming to ANSI B16.3.
         3) Class 250 cast iron threaded fittings for working pressures up to 400 pounds per square inch, ANSI B16.4
         4) Class 300 malleable iron threaded fittings for working pressures greater than 175 pounds per square inch up to 800 pounds per square inch, conforming to ANSI B16.3.

      b. Pipe Sizes 2-½ inch and Larger: ASTM B16.9, B16.25 welded fittings, cast iron flanges, and vee-butt welded joints.
      c. Pipe Sizes 1½ inch and Larger:

         1) Various Victaulic “Firelock” fittings/couplings may be acceptable, however mechanical T-fittings 920, 921, Hooker fittings, etc. will not be permitted. Contractor to submit list of fittings he intends to use and in which systems.

   4. Grooveless clamp or saddle fittings are not acceptable.

2.3 VALVES

A. All fire protection valves shall be Underwriters Laboratories label, Factory Mutual approved and to be rated at a minimum of 175 psi working pressure rating or where line pressure exceeds 175 psi, extra heavy. Shut off valves shall be of the indicating type. Where pressure exceeds 175 pounds per square inch, extra heavy rated valves shall be provided.

B. Floor Control, Riser and Isolation valves:
   1. 175 psig Working Pressure:
      a. Gate Valves:

         1) Gate valves up to and including 2-inch, 175 psig cold water, UL listed, FM approved, bronze body, bronze trim, single disc, outside screw and yoke, screwed bonnet valves with seats of bronze, screwed ends.
         2) Gate valves 2½ inch through 12-inch, 175 psig cold water, UL listed, FM approved, and approved iron body, outside screw and yoke bolted bonnet valves with double or single disc, Class 125 ANSI B16.1 flanged ends, bronze trim, bronze seats.

      b. Butterfly Valves:

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1) 2-½ inch through 8 inch UL listed for specification 1091, FM approved under Approval Standard 1112, ductile iron body conforming to ASTM A-536 coated with polyphenylene sulfide blend, ductile iron disc conforming to ASTM A-536 with EPDM coating providing bubble tight shut-off, approved weatherproof manual actuator suitable for indoor or outdoor use with two single pole, double throw supervisory switches either pre-wired (WRD) or unwired (UWD) monitoring the open position as required to meet design requirements, grooved ends for installation with grooved mechanical couplings and rated for service up to 175 psi (1200 kPa) working pressure.
2) UL listed, FM approved, slow-open quarter turn valve with built in tamper switches, 175 psi, threaded ends. Valve shall be provided with tamper switches rated for 0.5 Amps, 28 VDC.

C. Check Valves:
1. 175 psig Working Pressure:
a. Check Valve - 2-1/2 inch and larger: Iron body, swing check, 175 psi working pressure, bronze mounted, flanged pattern, UL listed, FM approved.
b. Check Valve – 4 inch and larger: Iron body, swing check, 175 psi working pressure, bronze mounted, flanged pattern, UL listed, FM approved.

D. Spring Loaded Check Valve – 4 inch to 8 inch Line Sizes: Dual disc, spring loaded, check valves, UL listed and FM approved for a single check and anti-water hammer service and for horizontal or vertical installation, supplied drilled, tapped and plugged at bosses where required, Grade “E” EPDM seal, housing cast of ductile iron conforming to ASTM A-536 or malleable iron to ASTM A-47 with grooved ends for installation with Victaulic grooved end couplings rated for service up to 250 psi working pressure.

E. Pilot Operated Pressure Regulating Valve:
1. Size to operate within 20 percent to 80 percent of its maximum flow rate capacity at sprinkler demand.
2. Horizontal Globe Valve, 300 lb. Class, flanged or screwed, 300 ANSI B16.24 (Bronze) UL, 300 ANSI B16.42 (Ductile Iron) ULC:
a. Inlet Pressure 300 psi maximum.
b. Pressure Differential 10 psi minimum.
c. Pressure Adjustment Range: 30 – 165 psi.
d. Temperature Range: Water to 180 degrees F maximum.

3. Materials:
a. Main valve body & cover: Epoxy Coated Cast Steel ASTM A216-WCB UL, ULC Bronze ASTM B62 UL, ULC.
b. Main valve internal trim: Bronze ASTM B61 Pilot control system.
c. Pilot control valve: Bronze ASTM B62 with Stainless Steel 303 internal trim.
d. Pilot tubing: Copper tubing with brass fittings.

e. Deluge Valves:

1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a) AFAC Inc.
b) Globe Fire Sprinkler Corporation.

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c) Reliable Automatic Sprinkler Co., Inc.
d) Tyco Fire & Building Products LP.
e) Venus Fire Protection Ltd.
f) Victaulic Company.
g) Viking Corporation.

2) Standard: UL 260
3) Design: Electrical/Pneumatic release type.
4) Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.

F. Pressure Relief Valve:
1. UL Listed FM approved Pressure Relief Valve is a direct-acting, spring loaded, diaphragm type relief valve capable of being installed in any position and will open and close within very close pressure limits.
2. Inlet pressure rated for 400 PSI.
3. Pressure adjustment screw to vary the spring load on the diaphragm. Pressure range of 20 to 200 psi. To prevent tampering, the adjustment cap, provide wire seal through lock wire holes provided in the cap and cover,

2.4 FLEXIBLE JOINTS

A. Above Ground Flexible Joint: UL listed, expansion joint capable of movement of 6 inches, including seismic, thermal growth and building settlement in all directions; “Fire loop” by Metraflex or equal (No known equal)

2.5 VALVES SUPERVISORY SWITCH

A. Provide U.L. listed and FM approved, tamper switches with two single pole, double throw micro switches on all valves with alarm signal to register on fire alarm panel on all control valves. PIV switches shall be weather-resistant and shall monitor target position. Acceptable Manufacturers: Potter Electric Signal or approved equal.
1. Valve Tamper Switches: 2 sets of single pole double throw Form C synchronized sets of contacts rated at 15A, 125/250 VAC and 2.5 A, 0-30 VDC, located within tamper resistant NEMA 6P enclosure with electrical. Plug type switches will not be acceptable.

B. Plug and loop type tamper switches shall not be used.
1. All wiring shall be provided under Division 26.

2.6 SPRINKLER HEADS

A. General:
1. Fire sprinklers shall be from one manufacturer throughout the building. No mixing of sprinkler brands shall be permitted, unless otherwise noted for window protection sprinkler heads.
2. Sprinklers shall be of all brass frame construction with a coated metal-to-metal seating mechanism.
3. Sprinklers utilizing non-metal parts in the sealing portion of the sprinkler are strictly prohibited, including O-Rings.
4. Sprinklers shall have a quick response frangible bulb type fusible element with a temperature rating of 155- or 200-degrees F or shall have a fast response metal type fusible element with a temperature rating of 165 to 212 degrees F.
5. Sprinklers to be installed in areas with no ceilings shall be of a brass finish and shall be of adequate temperature for the hazard.

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6. Exposed sprinklers subject to corrosive atmospheres shall have a factory applied corrosion resistant coating.
7. Provide approved sprinkler head wire guards for sprinkler heads located 7 feet 6 inches or lower above finished floor level.
8. Provide sprinkler heads with minimum ½ inch discharge orifice.

B. Finished Ceiling Areas:
   1. Pendant Style: Quick response flush style pendent sprinkler, ½ inch NPT, a standard orifice, nominal K Factor of 5.6, 165 degrees F, UL listed and FM approved; equivalent to Viking Horizon, SIN VK402. Finish: Bright Brass, Polished Chrome, White Polyfinish, and Navajo White Polyester.
   2. Concealed Style: Quick response concealed style pendent sprinkler, ½ inch NPT, a standard orifice, nominal K Factor of 5.6, 165 degrees F, UL listed and FM approved; finish equivalent to Viking Horizon Mirage, SIN VK404. Finish: Bright Brass, Brushed, Brass, Antique Brass, Polished Chrome, Brushed Chrome, and Brushed Copper, Painted White, Painted Custom Color.
   3. Semi Recessed Style: Quick response pendant style semi recessed pendant sprinkler with two piece adjustable chrome plated steel escutcheon for semi recessed installation UL listed and FM approved for use with the sprinkler head in which they are installed.: ½ inch NPT, a standard orifice, nominal K Factor of 5.6, 165 degrees F, UL listed and FM approved, “MQR“SIN VK302 with Model E-1 Recessed Escutcheon. Finish: Bright Brass, Brushed, Brass, Antique Brass, Polished Chrome, Brushed Chrome, and Brushed Copper, Painted White, Painted Custom Color
   4. Sidewall Concealed Style: Quick response concealed sidewall style sprinkler ,push-on type cover plate, pull-off assembly with a 2¾ inch diameter ½ inch NPT, a standard orifice, nominal K Factor of 5.6, 165 degrees F, UL listed and FM approved; finish equivalent to Viking Horizon Mirage, SIN VK408. Finish: Bright Brass, Brushed, Brass, Antique Brass, Polished Chrome, Brushed Chrome, and Brushed Copper, Painted White, Painted Custom Color.
   5. Sidewall: Quick response sidewall style sprinkler with two piece adjustable chrome plated steel escutcheon for semi recessed installation, ½ inch NPT, a standard orifice, nominal K Factor of 5.6, 165 degrees F, UL listed and FM approved; finish equivalent to Viking Horizon Mirage, SIN VK304 with Model E-1 Recessed Escutcheon. Finish: Bright Brass, Brushed, Brass, Antique Brass, Polished Chrome, Brushed Chrome, and Brushed Copper, Painted White, Painted Custom Color.

C. Unfinished Ceiling Spaces:
   1. Upright Style: Quick response upright style sprinkler, ½ inch NPT, a standard orifice, nominal K Factor of 5.6, 165 degrees F, UL listed and FM approved; finish equivalent to Viking Horizon Mirage, SIN VK300. Finish: Bright Brass, Brushed, Brass, Antique Brass, Polished Chrome, Brushed Chrome, and Brushed Copper, Painted White, Painted Custom Color.

D. Dry Pendant Sprinkler: Quick response dry pendent barrel shall be of steel construction with an electro-deposited epoxy base coating. Quick response dry pendent sprinklers shall have a 3 mm frangible bulb type fusible element. Quick response dry pendent sprinklers shall have a 1-inch NPT, a standard orifice, and a nominal K Factor of 5.6. The installation of quick response dry pendent sprinklers should be in conformance with the manufacturer’s installation guidelines. Quick response dry pendent sprinklers shall be UL listed. Quick response dry pendent sprinklers shall be listed for installation in an Ordinary Hazard occupancy if installed in an Ordinary Hazard occupancy. Quick Response Dry Pendent Sprinklers (formerly Model M) shall be Viking SIN VK172 (Plain Barrel), SIN VK176 (Adjustable Standard), or SIN VK180 (Adjustable Recessed).

E. Window Protection Sprinkler Heads: Central Model WS, Chrome plated.

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F. Extended Coverage: Extended coverage quick response pendent sprinklers with two piece adjustable chrome plated steel escutcheon for semi recessed installation,extra-large orifice and an 11.2 nominal K Factor, UL and FM listed for extended coverage application. Quick Response Extended Coverage Light Hazard (ECLH) Extra-Large Orifice Sprinklers (formerly Model M) shall be Viking SIN VK608 with Model E-1 Recessed Escutcheon.

2.7 WATERFLOW DETECTORS

A. Flow Switches: Vane type, UL listed, FM approved water flow detectors in the sprinkler systems where shown on the Drawings or as indicated in these Specifications. Detectors shall be designed for mounting in the horizontal or vertical piping but shall not be mounted in a fitting or within 12 inches of any fitting that changes direction of water flow, and shall have sensitivity setting to signal any flow of water that equals or exceeds the discharge from one sprinkler head. Switches shall be activated by a vane extending into the waterway of the piping. Detectors shall provide a ½ inch conduit entrance.
   1. Required whole sizes shall be 1-5/16 inches for piping 2 inches to 3 inches and 2-1/16 inches for piping 4 through 8-inch size.
   2. Flow Switch: UL/FM listed, rated for 450 psi and surges up to 18 FPS, alarm activation at 10 gpm, sets of single pole double throw Form C synchronized sets of contacts rated at 15 A, 125 VAC and 2A, 24 VDC; corrosion-resistant using factory-installed, non-corrosive insert.
      a. Switch Enclosure: Tamper resistant, meeting NFPA 4 rating, and equipped with instantly recycling adjustable retard with 0-90 second range.

B. Pressure Switches: UL/FM listed, rated for 250 psi and detect 10 psi pressure increase or decrease from normal line pressure, adjustable from 10 to 175 psi, 2 sets of single pole double throw Form C synchronized sets of contacts rated at 15 A, 125 VAC and 2A, 24 VDC; corrosion-resistant using factory-installed, non-corrosive insert, bleed valve assembly.

C. All electrical wiring shall be provided under another Division of the Specifications.
   1. Coordinate all requirements with Division 26.

2.8 DRAINS AND TEST PIPES

A. Fire Sprinkler Zone Valve Assembly:
   1. UL Listed Provide drains at locations indicated or required for complete drainage of systems. Provide other drains, valves or plugs as indicated or required. Pipe drains to approved locations.
   2. Provide test pipes as indicated or required and piped to discharge at approved locations.

B. Assembly shall be UL Listed and FM approved, include all required accessories such as flow switch, sight glasses, restrictive orifices test valve and drain angle valves, flow and valve tamper switch meeting the requirements of the applicable NFPA 13 for inspector test stations and fire sprinkler floor zone isolation and drain down, and relief valve where required by Victualic or approved equivalent.

2.9 PIPE SLEEVES

A. The Contractor shall furnish and install all sleeves required for the lines and mains as needed for sprinkler piping.

2.10 PIPE HANGERS

A. Provide in accordance with referenced standards. Do not mix piping material and hanger material of dissimilar metals. All beam clamps shall be fitted with steel retainer straps. Hanger rods of less than 3/8-inch diameter are not permitted. All horizontal piping shall be supported by means of UL approved clevis type hangers with proper size suspension rods and locknuts, spaced as required by the Underwriters.

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2.11 SPARE SPRINKLER HEADS

A. In addition to the heads actually required, furnish a stock of extra sprinklers of amounts as recommended by the National Fire Protection Associations Standards, including a minimum of six (6) heads of each type and temperature rating used and two (2) suitable wrenches for each type sprinkler head, contained in steel boxes, suitable for use as a service kit on the project.

2.12 IDENTIFICATION SIGNS

A. Metal identification signs, nominally 2 inch x 6 inch or 3 inch x 5 inch, red background with white lettering; equivalent to Potter-Roemer “Series 6300.”
   1. Include appropriate warning and/or identification information such as “Inspectors Test,” “Drain,” “Main Drain.” “Fire Sprinkler Valve - Do Not Close,” “Sprinkler Fire Alarm - Call Fire Department,” hydraulic design information indicating design flow and residual pressure, etc.
   2. Label control valves, fire riser, etc., with appropriate brief descriptions of operating functions.
   3. Provide signage to locate main or section valves in accordance with applicable standards.

B. Provide required signs, securely fastened to control valves, fire department connection, sprinkler control valve, etc., by stainless steel wire or chains indicating the purpose and location of each valve.

2.13 MISCELLANEOUS

A. Water Service Pressure Gauge:
   1. Dial: White aluminum, 4-1/2-inch diameter, rated to 1000 psi with black markings and numerals, ranges provided to be read at mid-range, slotted and adjustable pointer.
   2. Case: Aluminum with phenolic black turret and plastic lens with ¼ inch N.P.T. connections located at bottom, lower back or center back as required.
   3. Operation: ANSI B40.1 Grade A accuracy to 1 percent with brushed bushed rotary movement.

B. Pressure Gauge Accessories
   1. Gauge Cock: 1/4 N.P.T. brass ball valve with lever handle.
   2. Pressure Snubber: Brass housing, psi rating 15000 psi at 70° F, with corrosion resistant porous metal dampening element with porosity selected to meet type of service, and inlet meeting connection size of gauge.
   3. Water and Light Oil (30-225 Saybolt Seconds Universal Viscosity).

C. Ball Drip Valve: ¾ inch cast brass, straight or angle as required.

D. Escutcheon Plates: Escutcheon Plates shall be pressed stainless steel, chrome plated with concealed hinges and springs to hold position on pipe. Install on pipes passing through floors, ceiling, and walls in finished areas. Wall plates exposed to weather shall be stainless steel. Escutcheon wall plates exposed to weather shall be stainless steel.

E. Sprinkler guards: UL listed, Heavy duty welded wire, red baked enamel finish.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. All piping, valves, and other materials shall be installed according to the Local Authority rules and an inspection certificate furnished.

B. Sprinkler piping shall be installed and coordinated with the ductwork and other mechanical and electrical services in the ceiling cavities by the Contractor to provide the clearances for lighting fixtures as indicated on the Drawings. If any departures from the Drawings are necessary to comply with any NFPA requirements, or the authority having jurisdiction, such revisions and/or departures shall be detailed and submitted for approval. All such revisions shall be made and the sprinkler systems installed in accordance therewith, without additional cost to the Owner. Departures shall not be made without prior written approval by the Project Representative. The Drawings are schematic and do not indicate inferred details. This installation shall also meet the approval of the Local Fire Department.

C. The sprinkler heads in public areas, and in typical floor elevator lobbies shall be located as indicated on the Architectural reflected ceiling plans and coordinated with the lighting fixtures. Sprinkler head alignment is required in all areas. Sprinklers shall be provided with a temporary plastic cover when installed in plaster or drywall ceilings.

D. No pipes or other apparatus shall be installed to interfere in any way with the full swing of doors, building access doors, and access doors in ductwork. The arrangement, positions, and connections of pipes, drains, valves, etc., shown on the Drawings shall be taken as approximation and while they shall be followed as closely as possible.

E. The right is reserved by the Project Representative to change the locations to accommodate a change of conditions, which may arise during the progress of the work without additional compensation to this Contractor for such changes, provided that the changes are requested prior to the installation of this Contractor's work.

F. Piping typically shall be installed concealed in or above building construction, i.e., hung ceilings, and shall be so arranged that relocation of lighting fixtures, or plumbing and mechanical systems, will not cause any interference.

G. All components of the fire protection system shall be installed in accordance with the manufacturer's installation recommendations.

H. All sprinkler heads shall be installed in conformance with the UL listing and FM approvals criteria. The spacing of sprinkler heads shall be in conformance with the UL listing and FM approvals criteria for the applicable occupancy type.

I. The fire protection subcontractor shall coordinate the installation of pipes, hangers, valves, and all other items of the fire protection system with the work of all other trades so that all components will be installed to avoid conflicts and provide for proper servicing and maintenance of mechanical and electrical equipment in ceiling plenums.

J. Sprinkler heads shall be installed on a true axis line of ½ inch plus or minus. At the completion of the installation, if any heads are found to exceed this tolerance, heads shall be removed and reinstalled by this Contractor, at no additional cost to the Project Representative.

K. The Project Representative reserves the right to reject any and all work not in accordance with the approved shop drawings.

L. Components improperly installed shall be removed and/or relocated as directed by the Project Representative at no additional cost to the Owner.

M. All sprinkler piping shall be installed concealed in hung ceilings, including drywall ceilings and soffits unless noted otherwise and shall be arranged so that relocation of lighting fixtures shall not cause any interference.

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N. Run all pipe straight and true. Springing or forcing piping into place will not be permitted. Install piping in such a manner as to prevent strain on the equipment.

O. Conceal piping in ceiling cavity where ceiling is provided. Exposed piping shall be installed as nearly as possible parallel to or at right angles to the column lines of the building.

P. All piping shall be carefully graded to eliminate traps and pockets. Where water traps cannot be avoided, provide drains in conformance with NFPA 13.

Q. Make all joints smooth and unobstructed inside. Ream all cut pipe ends to remove burrs. Remove all obstructions prior to fabrication.

R. Install a union or flanges at equipment connections and elsewhere as indicated.

S. Make welded joints on pipe runs with continuous welds, without backing rings, and with pipe ends beveled before fabrication. Gas cuts shall be true and free from burned metal. Before welding, surfaces shall be thoroughly cleaned. The piping shall be carefully aligned, and no metal shall project within the pipe.

T. All screwed pipe throughout the job shall be reamed smooth before being installed. Use full pipe lengths; random lengths joined by couplings will not be accepted.

U. Pipe shall not be split, bent, flattened, or otherwise damaged either before or during the installation.

V. All welded elbows shall be long radius type.

W. The Fire Protection Subcontractor utilizing a grooved piping system shall provide a letter of certification to the Project Representative stating that a project site training session of at least two (2) hours duration was conducted for this Project by the grooved fitting manufacturer for the Subcontractor's supervisory and installing personnel.

X. All piping that penetrates fire rated construction shall be firestopped.

Y. All piping shall be of the sizes required by applicable codes, but not less than the sizes indicated on the Drawings.

Z. Install sprinkler piping and heads at minimum 24-inch distance from variable air volume box or DDC control.

3.2 PIPING ACCESSORIES AND EQUIPMENT INSTALLATION

A. Underground Piping All bolts, nuts, washers and rodding used for the installation of underground piping, valves and fittings from the riser flange back to, and including, all parts of the water main tap shall be stainless steel conforming to ASTM A194 Grade 8M or ASTM A320 Grade B8M. All of the above materials shall be thoroughly coated with bituminous mastic. After coating, all valves and ferrous fittings shall be wrapped in 8 mil polyethylene film and securely taped in place with underground tape.

3.3 SLEEVES AND ESCUTCHEONS

A. Sleeves: Provide sleeves for all pipes passing through slabs, concrete walls, and lath and plaster ceilings (except drop nipples for heads) and partitions. Sleeves shall extend three inches above floors and be flush with walls, ceilings, and partitions. In concrete construction, sleeves shall be set in forms prior to pour.

B. Clearance between sleeves and pipes shall be one-inch for pipes through 3-1/2- inches, two-inch for pipe sizes 4-inches and greater, and three-inch for seismic joints.

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C. Packing: For sleeves set in fire walls and floors, caulk space between pipe and sleeve with flexible fire-resistive packing compound to achieve rating at least equal to that of the wall or floor penetrated. Annular space between sleeves and piping shall be sealed with UL through-penetration systems #49 (concrete) or #147 (gypsum/stud). Sleeves in floors on grade or exterior walls below grade shall be packed with oakum between pipe and sleeve flush with top of sleeve for floors and with outer surface for walls. Sleeves at seismic joints shall not be packed unless associated with a fire rated wall, partition, floor or floor ceiling assembly.

D. Sleeve Material
   1. In concrete slabs and walls: Schedule 40 black steel pipe.
   2. Sleeves through waterproof membranes: Sleeves set in walls and slabs may be either cast iron or steel and shall be provided with a flashing clamp device and corrosion-resistant clamping holes.

E. Escutcheons: Furnish and install escutcheons on all exposed pipes passing through walls, floors, ceilings, (except for sprinkler heads) and partitions.

3.4 DRAINS AND TEST PIPES

A. Provide drains at locations indicated or requiring for complete drainage of systems. Provide other drains, valves or plugs as indicated or required to meet NFPA 13 recommendations. Pipe drains to approved locations, where required.

B. Provide test pipes as indicated or required locations and piped to discharge at approved locations.

C. Provide all required accessories such funnels air gap fitting, pipe alignment brackets and supports.

3.5 HANGERS AND SUPPORTS

A. All pipes throughout the building shall be thoroughly and substantially supported with UL listed FM approved hangers and support devices and installed in accordance with Underwriter's approved methods.

B. Furnish and install any special hangers or supports that may be required due to any peculiarities of construction. The design, selection spacing, and application of horizontal pipe hangers, supports, restraints, anchors, and guides shall be in accordance with the applicable standards.

C. All vertical pipes 8-inch in diameter and smaller shall be supported at least every other floor with Grinnell Figure 261 or approved equal riser clamps.

D. Hanger rods, inserts, etc., shall be sized and installed as recommended by the manufacturer for the service intended. Hanger rods shall be cadmium plated or galvanized.

E. All horizontal piping shall be supported by means of approved wrought iron clevis type hangers with proper size suspension rods and locknuts, spaced as required by the Underwriters.

F. Retainer straps shall be used with all beam clamps.

G. Supports for vertical piping shall be heavy black iron extension clamps with bolts, each end resting on the building structure or hung from the slab in an approved manner.

H. Provide all auxiliary steel required for pipe support.

I. Submit pipe hanger, insert, and support details for concrete floor construction to the Project Representative for review and approval. Piping shall be hung from structural slab by means of malleable iron concrete inserts set in place before concrete is poured. Drilled type concrete inserts may be provided as approved by structural engineer. Power driven studs shall not be accepted unless accepted by the Project Representative.

J. Piping shall not be hung from ductwork, or the work of other trades.

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3.6 TESTING

A. General:

1. All inspections, examinations, and tests required by the authorities and/or agencies specified hereinbefore shall be arranged and paid for by this Fire Protection Subcontractor, as necessary to obtain complete and final acceptance of the system as installed. The certificates of inspection shall be quadruplicate and shall be delivered to the Architect for distribution. Note: All hydrostatic tests shall be performed as required by the reference standards cited hereinbefore and the Authority Having Jurisdiction, except the testing period shall be not less than eight (8) hours.
2. Provide acceptance test consisting of hydrostatic tests of the fire protection piping system in accordance with NFPA Pamphlet No. 13 and No. 14, but at not less than 200 pounds pressure for two (2) hours, or at 50 pounds per square inch in excess of the maximum static pressure when the maximum static pressure is in excess of 150 pounds per square inch.
3. Provide a hydrostatic pre-test, same as acceptance hydrostatic tests indicated in the foregoing paragraph, for both above ground and underground piping, prior to calling for fire marshal acceptance test. Written confirmation of passed 100 percent pre-test shall be given to the inspector of record prior to calling for final acceptance test. All costs associated with delays caused by failure to complete 100 percent operational pre-test shall be borne by the contractor. A Contractor Material and Test Certificate shall be filled out on completion of the pre-test.
4. Maintenance testing shall be performed in accordance with this code and Administrative Rules published by the chief. Where certified inspection, testing, or qualification of fire protection equipment is required by nationally recognized standards, laws, ordinances, or administrative rules, the chief shall require that the person, firm, or corporation performing such work have a certificate from the fire department.

B. Fire sprinkler systems: Test in accordance with applicable current NFPA 13 and 25 Standards.

C. Fire standpipe systems: Test in accordance with applicable current NFPA 14.

D. Thread Test: A test shall be made of the thread on the hose valves and fire department connections using a coupling from the Local Fire Department hose. The test shall be done in the presence of the Owner or the Project Representative.

E. Fire alarm devices and tamper switches: Test all alarm devices for proper operation and connection to central alarm system and BMS.

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3.7 PERIODIC INSPECTION

A. After completion of the automatic sprinkler system and at the beginning of the warranty period the Automatic Sprinkler Subcontractor shall perform, without charge to the Owner, one (1) inspection of the sprinkler system during the warranty period. Inspection shall be as per the applicable B. NFPA No. 25, “Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems”, plus the following maintenance to be performed during the course of the inspection:

1. Operation of all control valves.
2. Lubrication of operating stems of all interior valves.
3. Operation of water gong, electric alarms, supervisory panels, air compressors, alarm trip switches, flow switches, etc.
4. Cleaning of alarm valves.
5. Lubrication of Fire Department hose connection inlet and fire hose valve threads.
6. The Standard Form of the National Fire Sprinkler Association, Inc., “Report of Inspection” (Sheets 1 and 2), shall be filled out in triplicate after each inspection and the copies sent to the Project Representative.

END OF SECTION

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SECTION 220500

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements and applies to all sections in this Division.

B. The following requirements are included in this Section to expand the requirements specified in Division 01:

1. Drawings and Specifications
2. Submittals.
3. Shop drawings.
4. Product data.
5. Coordination.
6. Coordination drawings.
7. Record documents.
8. Operation and Maintenance manuals.
9. Delivery, storage and handling.
10. General Installation.
11. Cutting and patching.
12. Guarantee and Warranties
13. Quality Assurance
14. Codes and Standards
15. UL Label
16. LEED requirements
17. TITLE 24 acceptance testing and documentation

C. This Section also includes the following which applies to all Sections in this Division:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout and Grouting.
8. Equipment installation requirements common to equipment sections.

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9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.
12. Waterproof and Corrosion Proof Construction
13. Trenching, Excavation, and Backfill
14. Access Doors and Panels
15. Noise and Vibration
16. Start-up and Commissioning

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms. In general, any item that is directly accessible without removing panels, walls, ceilings, or other parts of structure.

C. Exposed, Exterior Installations: Exposed to view outdoors, outside of building structure, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations, equipment yard, under eaves, etc.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. Furnish: Supply and deliver complete.

G. Install: Place, secure, and connect as required to make fully operational.

H. Provide: Furnish and install as defined above.

I. Connect: Complete hookup of item with required services.

J. Rough-in: Provide all indicated services in the necessary arrangement suitable for making final connections to fixture or equipment.

1.4 DRAWINGS AND SPECIFICATIONS

A. Consider all drawings and all divisions of this specification as a whole and provide work of this division shown anywhere therein.

B. Absolute accuracy of the contract drawings cannot be guaranteed. It is the responsibility of the Contractor to coordinate exact requirements and locations as governed by actual job conditions. (See Coordination and Coordination Drawings below). Check all information

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and report any discrepancies to the Architect/Engineer before fabrication and in time to avoid any unnecessary work. Any changes or additions subject to additional charges made without written authorization, based upon an agreed price, shall be at the Contractor's own risk and cost.

C. The Contractor ma shift pipe and equipment as required to meet field conditions. The Contractor shall indicate, and clearly note, all changes on his shop and coordination drawings and submit them to the Architect/Engineer for review prior to ordering or fabrication. The Contractor must obtain submittal review indication “No Exception Taken” for any proposed modifications.

D. The Contractor shall provide all necessary offsets, transitions, fittings, and modifications required to complete the work.

E. Follow equipment and material manufacturer's instructions where items are not specifically covered on the drawings or within the specifications. If instructions are in conflict, obtain clarification before starting work.

F. Scaled and figured dimensions are approximate and are for estimating purposes only. Before proceeding with the work, check and verify dimensions and assume responsibility for fitting materials, equipment, and other parts of equipment within the structure.

G. Confirm all slopes and inverts. Route and coordinate all piping locations as required to obtain necessary slopes and proper drainage. This is particularly important for drainage piping.

H. Where apparatus and equipment have been shown on drawings, dimensions have been taken from the manufacturer’s literature for the scheduled manufacturer. Check manufacturer’s certified drawings to see that equipment proposed for installation will fit into the building and into spaces provided.

1.5 SUBMITTALS

A. General:

1. In addition to the procedures indicated below follow the procedures specified in Division 1 where they exceed the requirements of this section.
2. Provide submittals of material or equipment in accordance with each specification section.
3. Each item submitted shall be labeled or identified the same as on the drawings. (WH1, WC1, SP1, etc.)

B. Equipment, materials, and products specifically identified, described, and scheduled on the drawings are the basis of design and per City’s standard. The other manufacturers or suppliers which may be named in the specification only indicate the general acceptability of the manufacturer or supplier and are considered alternates and require approval from City. It is the Contractor's responsibility to research, select, and submit to City, through the submittal process, that the specific model, size, or type of the alternate proposed manufacturer is equal and will perform equal to that which is the basis of the design. Operational characteristics for such items as outlet velocities, power input, sound levels,

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efficiencies, etc., shall be considered in addition to the overall performance, output, and physical constraints.

C. The Contractor assumes full responsibility that alternative items substituted for the scheduled manufacturer will meet the job requirements and is responsible for the cost of redesign and modifications necessary due to this substitution if approved by City. Revisions or additional work required due to the use of substitute materials and equipment shall be fully indicated on detailed drawings submitted with the shop drawings.

D. Mark submittal "Exactly as Specified" or accompanied by a letter from the supplier explaining in detail what differences, if any, exist between the submitted item and the scheduled item. Failure to point out the differences will be considered cause for disapproval. If differences are not indicated and/or not discovered during the submittal review process, the Contractor will still remain responsible for providing equipment and materials that meet the specifications.

E. Acceptable Manufacturers:Subject to compliance with the requirements of the individual specification sections, provide materials and equipment from the indicated manufacturers only. Submittals of material or equipment manufactured by other than those indicated may be returned, not reviewed. If no manufacturers are indicated, then any product or material which complies with the specification and for the intended application may be submitted.

F. The plumbing and electrical components, structural systems, service clearances, and controls for all equipment are selected and sized, based on the manufacturer and equipment scheduled. If substitutions and/or equivalent alternate equipment are furnished, it shall be the responsibility of all parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics (capacity, size, clearance, acoustics, etc.) and requirements of that submitted to that scheduled. If greater capacity or more materials or labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then it shall be the responsibility of the parties involved in providing the substitute and/or equivalent alternate items of equipment to provide all compensation for additional charges made for the proper rough-in, circuitry, support, and connections for the equipment furnished for all trades affected. No additional charges shall be allowed for such revisions.

G. Allow two weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals.

H. The Engineer and/or Architect will review submitted shop drawings and documents for general conformance with the design concept of the project and the information contained in the contract documents. The Engineer's and/or Architect's review is for the convenience of the City in following the work and does not relieve the Contractor of the responsibility of deviations from the requirements stated in this specification and contract documents.

I. The Engineer's and/or Architect's review shall not be construed as a complete or detailed check of the work submitted, nor shall it relieve the Manufacturer or Contractor of responsibility for errors or omissions of any sort in the shop drawings and samples, or from the necessity of furnishing any work required by the contract documents. The review of a separate item shall not indicate review of the complete assembly in which it functions. Nothing in the Engineer's and/or Architect's review of the shop drawings and samples shall be considered as authorizing 1) a departure from contract documents and specifications, or 2) additional cost to the City, or 3) increased time for completion of the work.

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J. Submittals are not reviewed for quantities, service clearance, dimensions, weights, fabrication processes, construction methods, coordination with work of other trades, construction safety practices, motor location, location of control and electrical panels, and other layout constraints. These items shall remain the sole responsibility of the contractor.

K. The Engineer and/or Architect will review submittals with reasonable promptness and will return them to the Vendor/Supplier/Manufacturer stamped to indicate the appropriate action taken as follows:

1. No Exceptions Taken.
2. Exceptions Taken As Noted. No resubmittal required.
3. Exceptions As Noted. Resubmit.
4. Rejected. Resubmit.
5. Not Reviewed. Must Meet Plans, Specifications, and Codes.

L. Markings or comments or the lack thereof shall not be construed as relieving the Vendor/Supplier/Manufacturer from complete compliance with the project drawings and specifications.

M. No part of the work shall be started in the shop or in the field until the Engineer and/or Architect have reviewed the shop drawings and samples for that respective portion of the work. Shop drawings and samples shall be submitted for review sufficiently in advance of the scheduled start of the work in the shop or in the field to allow ample time, in consideration of the number and complexity of the drawings in the submittal, for the Engineer and/or Architect to make an orderly review. No extension of time to complete the work will be granted to the Vendor/Supplier/Manufacturer by reason of failure to perform in this respect.

N. Each shop drawing and sample submitted for review shall be accompanied by a letter of transmittal, and shall be identified by the project title, Vendor's/Supplier's/Manufacturer's name, and a reference to the related part of the contract documents.

O. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

P. Welding certificates.

1.6 SHOP DRAWINGS

A. Refer to “Submittals” above for additional requirements.

B. Submit information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.

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C. Shop Drawings include fabrication and installation drawings and directions, setting diagrams, schedules, patterns, templates and similar drawings, and installation for metal and wood supports and anchorages. Include as a minimum the following information on drawings or diagrams:

1. Dimensions
2. Identification of products and materials included
3. Compliance with specified standards
4. Notation of coordination requirements
5. Allowance for expansion, contraction, and deflection/movement of support structures.

D. Notation of dimensions established by field measurement

E. Clearances for access and service

F. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.

G. Upon contractor's request, engineer can make electronic data files available at contractor's expense in order to enable contractor to expedite the production of working/coordination/shop drawings for the project. Transfer of the electronic data files to Contractor is for informational purposes only and will only be completed after a waiver is signed by contractor and City relieving engineer of all liability resulting from use of electronic files and all engineer costs to produce electronic files in a format suitable for distribution are paid by contractor.

1.7 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system.

B. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as Shop Drawings.

C. Product Data Information: Includes catalog cuts, sketches, or bulletins indicating performance characteristics and certified performance curves with operating point indicated, features of equipment, controls, instrumentation, valving, equipment dimensions, materials of construction, estimated weight of unit (shipping, installed, and operating), heat rejection load when operating, auxiliaries, specialties, or accessories furnished, roughing-in or anchor diagrams and templates, manufacturer's installation instructions, service clearance requirements, standard color charts, and wiring diagrams.

D. Schematic Drawings shall include elevation and plan views, and indicate all connections, attachments, and details to indicate field required general details of assembly, etc. (Piping, wiring, etc.)

E. Wiring diagrams shall detail wiring for power, signal, and control systems, differentiating between manufacturer-installed wiring and field-installed wiring.

F. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to

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indicate the applicable information. Include the following information with above product data:

1. Manufacturer's printed recommendations
2. Compliance with recognized trade association standards
3. Compliance with recognized testing agency standards
4. Application of testing agency labels and seals
5. Notation of dimensions verified by field measurement
6. Notation of coordination requirements

1.8 COORDINATION

A. **Alfa Tech Revit Model will be available for use as reference only, plumbing contractor shall be responsible to prepare a coordinated Revit model and coordinate with other trades prior to installation.** Coordinate with work performed by other sections to accommodate the requirements of this section and to ensure adequate space and proper location for all necessary work on this project whether or not work is under this section. Provide coordination drawings, as indicated. Coordination shall be done prior to order or manufacture of any systems or components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces.

E. Coordinate work with the Electrical Division. Furnish the Electrical Division with shop drawing information for indicating ratings and control circuits required for the actual equipment furnished. Coordinate voltage, phase, and load requirements, prior to ordering equipment, to insure mechanical and electrical matches. All equipment shall be provided and ordered to suit the power available.

F. Layout support pads, curbs, sleepers, anchor bolts, etc., for all mechanical equipment and materials so as to be in the proper location for the equipment actually ordered. These pads shall be of adequate dimension to provide for proper mounting of equipment isolators and equipment mounting so that anchor bolts meet all seismic criteria. Contractor shall allow for proper service clearances.

G. Provide templates, information, and instructions to other divisions as necessary to properly locate holes and openings to be cut or provided for plumbing work.

H. Layout piping, and other plumbing systems and confirm all sizes of systems and components to be sure they fit the space available prior to ordering and manufacturing of components. Be certain to allow for proper pipe slopes.

I. Provide proper clearances for access to and service of all equipment and items requiring adjustment including shutoff valves.

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J. Coordinate all disciplines to insure maximum point loads that can be attached to structural members are not exceeded. See other sections and structural contract documents for requirements. Provide intermediate supports between existing structural members (Unistrut, angle, etc.) as necessary to not exceed maximum point loads.

K. Lay out trench locations, do all excavation, shoring, laying, backfilling, and compacting for work performed under this division and not provided under other divisions. See other divisions for specification requirements.

1.9 COORDINATION DRAWINGS

A. Prepare and submit, for review, large scale (minimum 1/8 inch = 1 ft.-0 inches) coordination drawings showing location and elevations of all equipment, ducts, piping, cable trays, conduits, structural, and other items in the area. These shall be fully coordinated with all other trades and City supplied items. Check routing and elevations of all piping, ductwork, conduit and equipment before fabricating. Report any conflicts that cannot be solved in the field to the Architect. Extra charges shall not be allowed due to lack of coordination prior to, or during, construction. These drawings shall be distributed to, and coordinated with, all other trades that are affected.

1. In addition to plan view, indicate heights to clarify clearances from structure and from other trades. Use partial sections where necessary.
2. Provide proper clearances for access to and service of all equipment and items requiring adjustment including shutoff valves.
3. Coordinate the location of access panels in the hard ceiling areas to insure all equipment and devices have proper access for servicing and adjusting.
4. The coordination drawings shall be reviewed and checked for completeness by the general contractor. Review by the architect and engineer is to assist the contractor and to attempt to point out obvious errors. Responsibility for proper coordination shall remain with the contractor.

B. Differences or disputes concerning coordination, interference, or extent of work between sections shall be decided by the general contractor.

C. Extra charges shall not be allowed due to lack of coordination (or lack of coordination drawings) prior to or during construction.

D. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work. Indicate the proposed locations of ductwork, piping, conduit, equipment, and materials. Include the following:

1. Clearances for installing and maintaining insulation, including clearances for servicing, and maintaining equipment, and space for equipment disassembly required for periodic maintenance.
2. Clearances for electrical and control components and panels.
3. Equipment connections and support details.
4. Exterior wall and foundation penetrations.
5. Interior floor penetrations
6. Fire-rated wall and floor penetrations.
7. Sizes and location of required concrete pads and bases.

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8. Support, bracing and anchor locations for equipment and conduit.

E. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

F. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

G. Prepare reflected ceiling plans to coordinate and integrate installations, access panel and door locations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items where ceilings are to be installed.

1.10 RECORD DOCUMENTS

A. Prepare recorded documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate the following installed conditions:

1. Indicate actual inverts and horizontal locations of underground piping and conduits.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Accepted substitutions, contract modifications, and actual equipment and materials installed. This includes updating all equipment schedules with actual equipment provided.
4. Indicate duct and pipe routing and locations.

B. The contractor shall maintain a complete set of documents on site that are marked-up during the construction process indicating all changes that have been made. These mark-ups shall be maintained on a regular basis, so they are current as the construction is in process and available for inspection by the Architect/Engineer. Markups shall include changes to pipe routing and sizing.

C. Upon completion of the construction, the contractor shall transfer all mark-ups into AutoCAD and update the contract documents into record documents and the shop/coordination drawings into as-built documents.

1. Upon contractor's request, engineer can make electronic data files available at contractor's expense to enable contractor to expedite the production of record drawings for the project. Transfer of the electronic data files to Contractor is for informational purposes only and will only be completed after a waiver is signed by contractor and City relieving engineer of all liability resulting from use of electronic files and all engineer costs to produce electronic files in a format suitable for distribution are paid by contractor.
2. Architect/engineer makes no representations as to the accuracy or completeness of electronic data files. They are provided to the contractor as a start point to upgrade to Record Drawings.
3. The contractor record documents shall be in the same CAD program, version, and operating system as the original Contract Drawings.

D. Record document updates shall include schedules where contractor has supplied alternate manufacturers to those scheduled or where submitted performance varies.

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E. Provide a minimum of one copy of the markup documents, a hard copy set of prints of the record and as built documents, and one electronic copy (disk) of the CAD files.

1.11 OPERATION AND MAINTENANCE MANUALS

A. Prepare operation and maintenance manuals in accordance with Division 01. In addition to the requirements specified in Division 01, include the following information for equipment items:

1. Installation Instructions.
2. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
3. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions, regulation, control, stopping, shutdown, and emergency instructions.
4. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
5. Servicing instructions and lubrication charts and schedules.
6. Recommended spare parts list:

    a. Spare parts list shall be furnished listing all parts for equipment. Indicate part number and generic description of equipment part manufacturer.
    b. Indicate part number and generic description of both equipment supplier and original part manufacturer if other than supplier.
    c. Indicate delivery time required if not a stock item.

B. Provide a soft copy and a minimum of 2 complete sets of manuals. Manuals shall be bound in a hard board binder and indexed.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

C. Deliver products, materials and equipment marked with product names, model numbers, types, grades, compliance labels, and other information needed for identification. Inspect items for shipping damage and refuse, return, or refurbish items to the satisfaction of the City. Maintain delivery records for inventory control and for use in processing payment request vouchers. Crosscheck delivery records with project schedule so as to eliminate work stoppages due to material shortages.

D. Store products, materials, and equipment in a manner to prevent damage and degradation. Store items on skids or pallets, elevated above the floor or grade. Store items subject to moisture damage in a dry location. Retain protective shipping covers, crates, and cartons during storage. Protect items from contamination by job site dirt and debris and other

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foreign matter. Segregate items into groups of like type for job site storage. Provide a secure, fenced and lighted area for outside job site storage.

E. Handle products, materials, and equipment in accordance with manufacturer's recommendations and recognized industry standards. Utilize lifting lugs, and designated lift points when hoisting equipment. In all cases, carefully handle, transport, and position items to prevent damage during construction. After placement or installation, cover items with tarps or sheeting where required to protect from damage during construction.

F. Immediately, upon delivery, inspect shipment including City furnished items to ensure that products are undamaged and in accordance with requirements. Should the product be damaged or not in compliance with requirements, immediately repair as directed or approved or order replacement at no additional cost to the City.

G. Any products, materials, or equipment damaged during storage on site, installation, or during construction shall be replaced by the contractor at no additional cost to the project to the satisfaction of the City or City's Representative.

H. Protect new and existing building structures and adjacent finished surfaces during construction. Patch, repair, and refinish existing work damaged by work under this division to match adjacent undisturbed area. Patching, repair, and refinishing shall be performed by workmen skilled in the section involved.

1.13 CLEAN CONSTRUCTION REQUIREMENTS

A. Storage of Material:

1. Piping shall be generally clean of dirt and debris. When stored at the contractors shop or on site, it needs to be kept clean prior to installation. The method used shall be the contractor's responsibility. It is strongly recommended that all pipes be kept capped (visqueen and tape) while in storage and the open ends be kept capped at the end of the day for installed items. The intent is to avoid obvious dirty materials. Should materials be found to be dirty, by the City or City's representative, it shall be the contractor's responsibility to clean them in place, at no cost to the City.
2. Protect stored plastic pipes from direct sunlight. Support, while in storage, to prevent sagging and bending.

B. Installation:

1. Clean the installation area of dust and debris as much as possible.
2. It is strongly recommended that all pipes be kept capped (visqueen and tape) while in storage and the open ends be kept capped at the end of the day for installed items.
3. Inspect the piece prior to installation.
4. Install pipe according to requirements of appropriate specification.
5. Inspect the installed piece of pipe for cleanliness prior to adding any additional pieces.

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1.14 GENERAL INSTALLATION

A. General: Sequence, coordinate, and integrate the various elements of the systems, materials, and equipment.

B. Coordinate systems, equipment, and materials installation with other building components and other trades.

C. Verify all dimensions by field measurements and relative to the certified prints for the actual equipment to be installed.

D. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for installations.

E. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

F. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the Work.

G. Give particular attention to large equipment requiring positioning prior to closing in the building. The contractor shall be responsible for ensuring adequate space and pathways and shall break down and reassemble equipment as necessary for rigging, access, and setting of equipment.

H. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

I. Coordinate connection of systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, service companies, and controlling agencies. Provide the required connection for each service.

J. Install systems, materials, and equipment to conform with submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form.

K. Install systems, materials, and equipment level and plumb, parallel, and perpendicular to other building systems and components.

L. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

M. Install access panel or doors where units are concealed behind finished surfaces.

N. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

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1.15 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 1. In addition to the requirements specified in Division 1, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Install equipment and materials in existing structures.

C. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

D. Cut, remove and legally dispose of selected equipment, components, and materials as indicated, including but not limited to removal of piping, plumbing fixtures and trim, and other plumbing items made obsolete by the new Work.

E. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

F. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

G. Patch all existing and new finished surfaces and building components using new materials matching existing materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

1.16 GUARANTEE AND WARRANTIES

A. All materials, parts, equipment, and workmanship shall be guaranteed for a period of one year from date of City acceptance.

B. If the manufacturer provided for a longer guarantee period, it shall also be submitted.

1.17 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

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2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed revision is accepted in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified, all at no additional cost to City. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.18 CODES AND STANDARDS

A. The work installed under this section shall conform to all applicable local codes, regulations, and standards.

B. Do not construe anything contained in these specifications or drawings to permit work to be installed that does not conform to code. The codes shall govern where they require higher standards or are violated by the drawings and specifications.

C. Consider interpretations and rulings of the enforcing agencies as part of these specifications.

D. Comply with drawings and specifications showing work exceeding minimum code requirements.

E. The Contractor shall furnish without any extra charge additional materials and labor required for the compliance with any rules and regulations.

1.19 UL LABEL

A. Furnish UL labeled and listed materials and equipment except when equipment is of a type for which labeling or listing services are not available from UL. Labeling must meet the requirements of the local authorities.

B. ETL label is acceptable if approved by the local authorities.

1.20 LEED REQUIREMENTS

A. This project will be submitted for LEED Gold certification. The following is a general list of some of the LEED requirements that may affect this discipline. See Division 01 and www.USGBC.org for complete requirements.

B. Contractor shall generate, coordinate, and implement an erosion and sediment control plan per United States Green Building Council (USGBC) S.S. Prerequisite 1 requirements.

C. All site disturbances shall be limited to parameters defined by USGBC S.S. Credit 5.1.

D. Contractor shall develop and implement a construction waste management plan per USGBC M.R. Credit 2.1 requirements.

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E. Contractor shall coordinate and implement use of wood-based materials per USGBC M.R. Credit 7 requirements.

F. Contractor shall develop and implement an indoor air quality management plan for the construction and pre-occupancy phases of the project per USGBC E.Q. Credit 3.1 requirements.

G. Contractor shall develop and implement an indoor air quality management plan for the pre-occupancy phases of the project per USGBC E.Q. Credit 3.2 requirements.

H. The contractor shall coordinate use of low emitting materials, adhesives, and sealants per USGBC E.Q. Credit 4.1 requirements.

I. Contractor shall coordinate use of low emitting materials, paints, and coatings per USGBC E.Q. Credit 4.2 requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
3. Where the submitted manufacturer is not the scheduled manufacturer it is considered an alternate and shall meet the requirements indicated under Submittals above (where either “Available Manufacturers” or “Manufacturers” are indicated).

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

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1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Available Manufacturers:

    a. Cascade Waterworks Mfg. Co.
    b. Dresser Industries, Inc.; DMD Div.
    c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
    d. JCM Industries.
    e. Smith-Blair, Inc.
    f. Viking Johnson.
    g. Underground Piping NPS 1-1/2and Smaller: Manufactured fitting or coupling.

2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
3. Aboveground Pressure Piping: Pipe fitting.

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B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Available Manufacturers:

a. NIBCO INC.
b. NIBCO, Inc.; Chemtrol Div.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Available Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Fernco, Inc.
c. Mission Rubber Company.
d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

A. General: Isolate ferrous from non-ferrous material in piping systems and equipment connections with dielectric fittings.

B. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psigminimum working pressure at 180˚ F.

1. Available Manufacturers:

a. Epco Sales, Inc.
b. Capitol Manufacturing Co.
c. Central Plastics Company.
d. Eclipse, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.

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E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psigminimum working pressure as required to suit system pressures.

1. Available Manufacturers:

a. Watts Industries, Inc.; Water Products Div.
b. Capitol Manufacturing Co.
c. Central Plastics Company.
d. Epco Sales, Inc.

F. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psigminimum working pressure where required to suit system pressures.

G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psigminimum working pressure at 225˚F.

1. Available Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psigminimum working pressure at 225˚F.

1. Available Manufacturers:

a. Victaulic Co. of America.
b. Perfection Corp.
c. Precision Plumbing Products, Inc.
d. Sioux Chief Manufacturing Co., Inc.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.

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b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint. Available Manufacturers: Pipe Shields, Inc.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw and polished chrome-plated finish.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

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2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are reviewed without exception on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Cut piping accurately to job measurements and install without springing or forcing, true to line and grade, generally square with building and adequately supported to prevent sagging or undue stress on pipe, fittings, and accessories.

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M. Thoroughly clean all pipe and maintain in such condition throughout construction. Temporarily cap off plug ends of unprotected pipe.

N. Install unions or flanges at connections to equipment, on service side of valves and elsewhere as required or shown to facilitate maintenance. Install union and drain line on discharge side of relief valves.

O. Arrange piping and hangers to allow for expansion, contraction, and structural settlement. Do not install piping in contact with the building structure. Anchor pipes properly so expansion/contraction is controlled.

P. Provide piping subject to expansion or contraction with suitable offsets, expansion loops or manufactured expansion joints as necessary to control expansion/contraction. Provide adequate guides to prevent misalignment.

Q. Allow for pipe movement at all piping connections to equipment so that expansion/contraction does not stress the equipment or connections. Provide three changes of direction prior to connection for hard connected equipment.

R. Use flexible connectors where specifically called for.

S. Make changes in size or direction with manufactured reducing fittings. The use of bushings, reducing flanges, or bending of a pipe is not allowed.

T. Install piping full size through shutoff valves, balancing valves, etc. Change pipe size within three pipe size diameters of the final connection to fixtures and equipment.

U. Protect all piping (except soil pipe or nonferrous pipe) installed below grade and to a minimum of 6 inches above grade with a factory applied covering; plastic coating. Protect field joints as follows: Clean fittings, nipples, and other field joints thoroughly and apply prime coat and one layer of heat applied 62 mil tape in accordance with manufacturer's recommendations.

V. "Bull head" tees shall not be allowed.

W. Flush all pipes free from foreign substances before installing valves, stops, or making final connections.

X. Any section of pipe for which size is not shown or any intermediate section erroneously shown obviously undersized shall be the same size as the largest line connecting to it.

Y. Do not cover or enclose the piping work before it has been tested, inspected, and approved.

Z. Pipe the discharge of each relief valve, backflow preventer, and similar device to floor sink, floor drain, exterior, or other acceptable location whether indicated or not on the drawings and per code requirements.

AA. Install piping at the coils so that coils can be removed with a minimum of pipe dislocation.

BB. Provide temperature and pressure test station (Pete's plug) on both sides of each piece of equipment.

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CC. Make reduction in pipe sizes with concentric reducers unless eccentric reducers are indicated. Make branches from mains with straight or reducing tee fittings. Bushings are not allowed.

DD. Support piping to ensure no strain or piping weight is transmitted to equipment.

EE. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
   c. Insulated Piping: One-piece, stamped-steel type with spring clips.
   d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
   e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
   f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
   g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
   h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:

   a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped-steel type with [concealed or exposed-rivet hinge and spring clips.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
   d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
   e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
   f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
   g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

FF. Sleeves are not required for core-drilled holes.

GG. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

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a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   a. Galvanized Steel Sheet Pipe Sleeves: For pipes smaller than NPS 6
   b. Steel Sheet Sleeves: For pipes NPS 6and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
   d. Seal space outside of sleeve fittings with grout.

4. Pipe shall not rest directly on sleeve where passing through walls and partitions to avoid transmitting any noise or vibration into structure.
5. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

HH. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install them in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

II. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install them in an annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

JJ. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to other Divisions Sections or drawings for materials. At a minimum, seal all penetrations with UL listed assembly matching rating of surrounding walls, partitions, ceilings, and floors. Install per manufacturer’s requirements.

KK. Verify final equipment locations for roughing-in.

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LL. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

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J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

E. Follow manufacturers' installation details and directions except as specifically modified on the drawings and provide any valves or special fittings or other specialty items called for by them as required in order to make the equipment perform as intended.

F. Provide all necessary rigging, rigging equipment, and manpower to set equipment and materials in place.

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3.5 PAINTING

A. Provide painting of systems, equipment, and components where specified or indicated on the drawings. Painting may also be specified in Division 09 Sections.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section Miscellaneous Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

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3.9 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.10 WATERPROOF AND CORROSION PROOF CONSTRUCTION

A. Maintain the waterproof integrity of penetrations through materials intended to be waterproof. Provide flashings at exterior wall and roof penetrations. Caulk watertight penetrations of foundation walls and floors. Provide membrane clamps at penetrations of waterproof membranes.

B. Provide galvanized sheet-metal weather protection canopies, hoods or enclosures over all out-of-door equipment, the operation or maintenance of which would be impaired by rainwater. This requirement applies to but is not limited to non-outdoor rated equipment and materials, controls, instruments, and electrical devices.

C. Provide watertight flashing of all piping penetrations.

D. Products which will be installed exposed to the weather, moisture, or other potentially damaging conditions shall be constructed to resist the effects of such exposure.

E. Exterior casings shall have lapped or gasketed joints effectively sealed to prevent intrusion of moisture or other injurious substances.

F. Casing or parts shall be constructed of materials which are fully resistant to harmful substances they may normally contact or (if ferrous) shall be galvanized after fabrication or shall be fully protected from such substances by paint or other coating in appropriate thickness or number of coats.

G. All bolts, nuts, screws, and washers shall be galvanized or stainless steel.

3.11 EXCAVATION AND BACKFILL

A. Excavating and Backfilling:

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1. In accordance with the requirements of Division 31 – Earthwork.
2. Provide barricades, signs, lanterns, shoring, sheeting, and pumping as part of Work in this Division as required to insure safe conditions. Comply with Cal-OSHA requirements.
3. Dig trenches straight, true to line and grade with sides and bottoms smoothed of any rock points. Excavate 6 inches below grade of pipe, fill with sand properly packed. Support pipe for entire length on packed sand. Shape or pack bottom of trenches for pipe, duct fittings, hubs, couplings, etc., using templates to fit outside periphery of lower third of piping and ductwork. Provide piping outside building with 36-inch minimum cover from top of pipe to finished grade. Minimum width 16 inches.
4. Dispose of all surplus excavation material and seepage water as directed.

B. Backfill:

1. After piping has been installed, tested, and approved, backfill all excavation, tamp and compact by compressed air tampers.
2. Backfill to 6 inches above crown of pipe with unwashed sand, with remainder of trench backfilled and mechanically tamped in 6 inch maximum layers of selected excavated materials, free from organic matter, rocks, etc. Provide 90 percent compaction in accordance with ASTM D 1557-58T; 95 percent compaction for trenches below building slabs.
3. In any asphalt or concrete paved areas, backfill only to subgrade level.
4. Advise Architect after piping has been installed, but prior to backfilling. Do not backfill without Architect's review.
5. Replace to original condition all paving, curbs, gutters, walks, etc., which become disturbed by trenching.

3.12 ACCESS DOORS AND PANELS

A. Where Required: Wherever a piece of equipment or valve and dampers operator is inaccessible and requires access for maintenance, repair, or adjustment.

B. Size: Size is dependent upon the relationship of the door to the product being serviced; therefore, the size of the door shall be selected to provide convenient access to its contents.

C. Available Manufacturers: Inryco/Milcor, Bilco, Cesco.

3.13 NOISE AND VIBRATION

A. Quietness is a requirement. Eliminate noise, other than that caused by specific equipment operating at optimum conditions and at design noise criteria.

B. The limiting of transmission of noise and vibration is required. The Contractor is to pay particular attention that piping, equipment, and ductwork is installed so as not to chatter or rub against other materials, equipment, and the building structure. Provide isomode pads, insulation, or other suitable materials to avoid direct contact and noise conditions unacceptable to the City. Consider, in particular, pipe clamps at risers where they contact the structure, proper shields at pipe hangers, and pipe and duct penetrations of walls and floors.

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3.14 START-UP AND COMMISSIONING

A. The Contractor shall provide all labor, materials, and services necessary for the start-up, commissioning and testing of all systems and equipment furnished and installed under this Division.

B. The contractor shall be responsible for proper operation of all systems, assemblies, minor subsystems, equipment, and services provided under this Division. He shall coordinate start-up procedures, calibration, testing, and system commissioning with all subcontractors and trades involved. Any system operational problems shall be diagnosed, and all correctional procedures shall be initiated with the various subcontractors as required to bring the system into compliance with the design intent.

C. Adjust all equipment and system components to meet the performance as scheduled on drawings, or as required, to result in the intended system operation. Thereafter, because of system operation or as directed by the Architect/Engineer, make readjustments as necessary to refine performance.

D. The Contractor shall be responsible for preparing a written start-up procedure including check-off list and report format showing design conditions and blanks for indicating actual operating conditions. The report format shall include each piece of equipment, system and all items that require adjustment, testing, and verification. The written procedure shall be submitted for review 30 days prior to start-up.

E. Personnel performing start-up and commissioning services shall be fully qualified, experienced, and normally engaged in this type of work. If the Contractor does not have such personnel available from his own company, he shall hire, at his own expense, subcontractors who are qualified.

F. The Contractor shall designate one field person who has the overall responsibility for start-up and commissioning procedures which includes testing and balancing. He shall directly supervise the start-up operations and be available for required coordination before, during, and after start-up.

G. Prior to start-up, ensure that the systems are ready, including but not limited to the checking the following: proper wiring, proper equipment rotation, the systems are flushed and are clean, auxiliary connections, lubrication, controls, venting, all filters, and strainers installed, and properly set relief and safety valves.

H. All electrical testing must be complete and test results submitted before equipment start-up to avoid power interruptions during equipment start-up and commissioning.

I. Start and operate all systems. Provide the services of factory certified and trained technicians for start-up of major equipment and systems where the contractor does not have sufficient capability and where required in other sections.

J. The Contractor (and the factory technician where required) shall check all equipment during the initial start-up to ensure correct rotation, proper lubrication, adequate fluids, non-overloading electrical characteristics, proper alignment, and vibration isolation. Systems shall be checked for water flowing throughout without blockages. Other miscellaneous equipment shall be started and operated as described above as applicable.

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K. During initial operation of the system and until substantial completion, qualified personnel shall be provided and designated for maintaining the equipment and systems in good running order. Failure of equipment during this period due to lack of proper supervision is the responsibility of the Contractor and continued failures shall be grounds for the City to provide such services with back charges to the Contractor.

L. A final and complete start-up and commissioning report shall be submitted prior to final acceptance and payment. This report shall be signed by each person doing the start-up task and by the responsible field person. Report shall include, but not be limited to date of test; instrument used, date of last calibration, set points, rpm, voltage, amperage, pressures, stability, and all other data necessary to indicate the equipment and systems have been properly tested, started-up, commissioned, labeled, and are operating within specified and manufacturers parameters.

M. See other sections for other specific system and equipment start-up and commissioning requirements.

3.15 TITLE 24 ACCEPTANCE TESTING AND DOCUMENTATION

A. This section describes the Acceptance Testing and Documentation of the mechanical systems according to the requirements of California Title 24 (Title 24) and outlines the duties and responsibilities of the contracting team for Acceptance Testing.

B. The acceptance requirements shall be applied to all products, equipment and systems provided under this Division and where required by Title 24 requirements.

C. The Contractor shall engage the services of a firm specializing in commissioning of plumbing systems or shall submit contractor qualifications for review by architect where testing and documentation is to be performed by contractor.

D. The Acceptance Testing Team shall be formed and consists of:

1. Plumbing contractor's representative
2. DDC Controls contractor’s representative
3. Inspector of record
4. City's staff representative

E. The duties of the Acceptance Testing Team are as outlined in the Title 24 Requirements and summarized below:

1. The contractor shall plan, organize, and implement the Acceptance Testing process and shall, within one month of the award of the contract, submit the names and addresses of the team member(s).
2. The Acceptance Testing Team shall submit a complete description of the testing procedures and systems to be tested to the architect for review.
3. The Acceptance Testing Team shall co-ordinate all tests of systems and equipment and assemble all documentation related to tests. All documentation relative to tests and proposed procedures shall be submitted to design engineer for review prior to submitting documentation to Authority having jurisdiction. The team shall be responsible for performing data analysis, calculation of performance indices and crosschecking of results with the requirements of Title 24 and the Contract

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documents. The installing contractor or agent responsible for testing and documentation shall record their State of California Contractor's license number or their State of California Professional Registration License number on each Certificate of Acceptance for submittal.

4. Contractor shall be fully responsible for submitting Certificate of Acceptance including paper and electronic copies of all measurements and monitoring results and all supporting documentation to the Authority having jurisdiction. Where Authority having jurisdiction questions results or requires additional testing, contractor shall complete additional testing and provide required documentation at no additional cost to the City.

F. The time period of the commissioning of the systems shall be determined by the general contractor and Acceptance Testing Team. It is important to note that Authority having jurisdiction will not release a final Certificate of Occupancy until a Certificate of Acceptance is submitted that demonstrates that the specified systems and equipment have been shown to be performing in accordance with the Title 24 standards.

G. All Acceptance Testing shall be coordinated with the Start-up and Commissioning requirements as indicated herein.

H. Acceptance Testing – Phase I - Documentation

1. Team shall assemble documentation showing all thermostat and sensor locations, control device locations, control sequences and notes.
2. Per Title 24 requirements, the team shall provide record drawings to building City within 90 days of receiving a final occupancy permit. The record drawings shall meet the Title 24 requirements as well as other requirements specified herein.
3. Per Title 24 requirements, the team shall provide operating and maintenance manuals to the building City. The operating and maintenance manuals shall meet the Title 24 requirements as well as other requirements specified herein.

I. Acceptance Testing – Phase II – Inspection and Testing

1. Team shall review the installation, perform acceptance testing, and document results for the following systems:

   a. System Programming

2. Review of installation shall confirm plumbing equipment and devices are properly located, identified, calibrated, and set points and schedules programmed per contract document requirements.

J. Acceptance Testing - Phase III - Certification

1. Team shall document operating and maintenance information, complete installation certificate, and indicate test results on the Certificate of Acceptance, and submit the Certificate to the Authority having jurisdiction prior to receiving final occupancy permit. Team shall submit forms MECH-1-A through MECH-9-A as required by Title 24 requirements.

K. Acceptance Tests and Documentation

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1. Refer to California Title 24, Non-residential manual for specific testing procedures and documentation requirements. The detailed requirements can be found at http://www.energy.ca.gov/title24/2005standards/index.html. The contractor is responsible for reviewing and complying with these standards.

END OF SECTION

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SECTION 220519

METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Thermometers.
   2. Gauges.
   3. Test plugs.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Case: Die-cast aluminum or brass, 9 inches long.

B. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.

2.2 PRESSURE GAUGES

A. Direct-Mounting, Dial-Type Pressure Gauges: Indicating-dial type complying with ASME B40.100.

2.3 TEST PLUGS

A. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

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PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the outlet of each domestic, hot water storage tank. At suction and discharge of each circulating pump.

3.2 GAUGE APPLICATIONS

A. Install dry-case-type pressure Gauges for discharge of each pressure reducing valve.

END OF SECTION

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SECTION 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Brass ball valves.
3. Bronze ball valves.
4. Iron, single-flange butterfly valves.
5. Bronze lift check valves.
6. Bronze swing check valves.
7. Bronze gate valves.
8. Bronze globe valves.
9. Lubricated plug valves.

B. Related Sections:

1. Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 22 11 16 "Domestic Water Piping" for valves applicable only to this piping.
3. Section 22 13 19 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

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G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

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B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
3. Wrench: For plug valves with square heads. Furnish City with 1 wrench for every 5 plug valves, for each size square plug-valve head.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

H. Manufacturers: Subject to compliance with requirement, provide products by one of the following or similar:

1. Milwaukee Valve Company.
2. NIBCO.
3. Kitz Corporation

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

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D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for all valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or gate valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: Ball or butterfly valves.
4. Pump-Discharge Check Valves:

    a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

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1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. All valves used for domestic water to be Lead Free per 2014 “Reduction of Lead in Drinking Water Act”

B. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125 bronze disc.
3. Ball Valves: Two piece, regular port, brass or bronze with brass trim.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Gate Valves: Class 125, NRS.
6. Bronze Globe Valves: Class 125, bronze disc.

END OF SECTION

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SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and support for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.
4. Pipe positioning systems.

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B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

PART 2 - PRODUCTS

2.1 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Grinnell Corp.
3. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped. Where finishes are exposed, contractor shall coordinate finishes with all trades to ensure uniform appearance.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.2 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

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1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish. Where finishes are exposed, contractor shall coordinate finishes with all trades to ensure uniform appearance.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
6. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
7. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
8. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
9. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
10. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

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1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450˚F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450˚ F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

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1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

C. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

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G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

H. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

J. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

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3.5 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

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SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Red.

C. Equipment Identification:
1. Automatically started motors shall have white lettering on red background warning signs stating : "Caution: This motor may start at any time".

2.3 PIPE LABELS

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A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

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3.5 WARNING-TAG INSTALLATION

A. Write the required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

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SECTION 220700

PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:

    a. Cellular glass.
    b. Flexible elastomeric.

2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied jackets.
9. Tapes.

B. Related Sections include the following:

1. Division 23 Section "HVAC Insulation".

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Qualification Data: For qualified Installer.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

D. Field quality-control reports.

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1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment".

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings establish and maintain clearance requirements for installation of insulation and field applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

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B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Cell-U-Foam Corporation; Ultra-CUF.
    b. Pittsburgh Corning Corporation; Foamglas Super K.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Aeroflex USA Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 degrees F.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Products, Division of ITW; CP-96.
    b. Foster Products Corporation, H. B. Fuller Company; 81- 33.

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A- 24179A, Type II, Class I.

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1. Products: Subject to compliance with requirements, provide one of the following:

    a. Aeroflex USA Inc.; Aeroseal.
    b. Armacell LCC; 520 Adhesive.
    c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    d. RBX Corporation; Rubatex Contact Adhesive.

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-82.
    b. Foster Products Corporation, H. B. Fuller Company; 85- 20.
    c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    d. Marathon Industries, Inc.; 225.
    e. Mon-Eco Industries, Inc.; 22-25.

2.3 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-76.
    b. Foster Products Corporation, H. B. Fuller Company; 30- 5.
    c. Marathon Industries, Inc.; 405.
    d. Mon-Eco Industries, Inc.; 44-05.
    e. Pittsburgh Corning Corporation; Pittseal 444.
    f. Vimasco Corporation; 750.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following or equal.

    a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 degrees F.
5. Color: White.

2.4 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

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a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.5 JACKETS

A. Factory Applied Vapor Barrier Jacket (ASJ).

1. ASTM C 921, White kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Transmission: ASTM E 96; 0.02 perm inches.
3. Secure with self sealing longitudinal laps and butt strips.
4. Secure vapor barrier mastic.
5. Tie Wire: 16 gage stainless steel with twisted ends on maximum 12 inch centers.
6. Vapor Barrier Lap Adhesive: Compatible with insulation.

B. PVC Plastic

1. Jacket: ASTM C921, One piece molded type fitting covers and sheet material, off white color. Provide custom color at locations as indicated on architectural drawings.

a. Minimum Service Temperature: -40 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Transmission: ASTM E96; 0.002 perm inches.
d. Maximum Flame Spread: ASTM E84; 25.
e. Maximum Smoke Developed: ASTM E84; 50.
f. Thickness: 20 mil.
g. Connections: Brush on welding adhesive, Tacks or Pressure sensitive color matching vinyl tape.

2. Covering Adhesive Mastic: Compatible with insulation.

C. Canvas Jacket: UL listed.

1. Fabric: ASTM C921, 6 oz/sq. yd, plain weave cotton treated with dilute fire retardant lagging adhesive.
2. Lagging Adhesive: Compatible with insulation.

D. Aluminum Jacket: ASTM B209.

1. Thickness: 0.016 inch sheet.
2. Finish: Embossed.
3. Joining: Longitudinal slip joints and 2 inch laps.

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4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel.

E. Stainless Steel Jacket

1. Thickness: 0.020 inch sheet
2. Finish: Smooth

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 degrees and 300 degrees F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 degrees and 300 degrees F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that applies to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

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3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

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3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
4. For below ambient services, apply vapor-barrier mastic over staples.
5. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

1. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

P. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

Q. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

R. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" Firestopping and fire-resistive joint sealers.

S. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

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B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gauges, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.5 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

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1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

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C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
2. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by County’s Representative. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

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B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water:

1. Insulation shall be one of the following:

a. Cellular Glass: Thickness per Title-24 requirements.
b. Flexible Elastomeric: Thickness per Title-24 requirements.

B. Condensate, Equipment Drain Water, Horizontal Storm Drain and Horizontal Overflow Drains Install Above Finished Ceiling:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.

3.11 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

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SECTION 221116

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes domestic water piping and water meters inside the building.

1. Water meters will be furnished and installed by utility company.

B. Related Sections include the following:

1. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with 125 psig unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings and water meters.

B. Water Samples: Specified in Part 3 "Cleaning" Article.

C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

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PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 COPPER TUBE AND FITTINGS

A. Hard drawn Copper Tube: ASTM B 88, Types K and L.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.3 VALVES

A. Bronze and cast-iron, general-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Balancing and drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Section 220500 and Division 31 Section "Earth Moving."

3.2 PIPE AND FITTING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

B. Flanges may be used on aboveground piping, unless otherwise indicated.

C. Aboveground Domestic Water Piping:

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1. All Sizes: Hard copper tube, Type L; copper pressure fittings; and soldered joints.

D. Belowground Domestic Water Piping:

1. All Sizes: Hard drawn copper tube, Type K; copper pressure fittings; and soldered joints.
2. Type L hard drawn copper tube may be used for belowground trap primer piping.

E. Belowground Domestic Hot Water Piping: Ric-Wil, Perma-Pipe, Thermacor or equal. Piping shall be pre-insulated type with schedule 40 black steel carrier pipe, insulation and outer jacket.

F. Non-Potable-Water Piping:

1. 3 Inches and Smaller: Steel pipe; gray-iron, threaded fittings.

a. All sizes: Hard copper tube, Type L; copper pressure fittings; and soldered joints.

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Install hose-end drain valves at low points in water mains, risers, and branches.
2. Install stop-and-waste drain valves where indicated.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties".

E. Install calibrated balancing valves in each hot-water circulation return branch. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

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3.4 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."

C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing".

D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section "Common Work Results for Plumbing."

E. Install shutoff valve, hose-end drain valve, strainer, pressure gauge, and test tee with valve, inside the building at each domestic water service entrance. Pressure gauges are specified in Division 22 Section "Meters and Gauges for Plumbing Piping," and drain valves and strainers are specified in Division 22 Section "Domestic Water Piping Specialties."

F. Install water-pressure regulators downstream from shutoff valves. Water-pressure regulators are specified in Division 22 Section “Domestic Water Piping Specialties."

G. Install domestic water piping level without pitch and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

3.5 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.6 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hanger and support devices are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment". Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

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c. Longer Than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.
d. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

F. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

G. Install supports for vertical copper tubing every 10 feet.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve, and extend and connect to the following:

1. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2½ inches and larger.

3.8 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

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2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

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3.10 CLEANING

A. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
3) Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
4) Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION

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SECTION 221119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Hose bibbs.
8. Drain valves.
9. Water hammer arresters.
10. Air vents.
11. Trap-seal primer valves.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

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1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Co.
b. Cash Acme.
c. Conbraco Industries, Inc.
d. FEBCO; SPX Valves & Controls.
e. Watts Industries, Inc.; Water Products Div.
f. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cash Acme.
b. MIFAB, Inc.
c. Watts Industries, Inc.; Water Products Div.
d. Woodford Manufacturing Company.
e. Zurn Plumbing Products Group; Light Commercial Operation.
f. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1011.
3. Body: Bronze, non-removable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Rough bronze.

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C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ames Co.
   b. FEBCO; SPX Valves & Controls.
   c. Watts Industries, Inc.; Water Products Div.
   d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Accessories:

   a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ames Co.
   b. FEBCO; SPX Valves & Controls.
   c. Watts Industries, Inc.; Water Products Div.
   d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:

   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
   b. Air-Gap Fitting: ASME A112.1.2, matching back flow preventer connection.

B. Hose-Connection Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Watts Industries, Inc.; Water Products Div.
   b. Woodford Manufacturing Company.

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2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Cash Acme.
    b. Watts Industries, Inc.; Water Products Div.
    c. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ITT Industries; Bell & Gossett Div.
    b. NIBCO INC.
    c. Taco, Inc.
    d. Watts Industries, Inc.; Water Products Div.
    e. Bell and Gossett.

2. Type: Ball valve with two readout ports and memory setting indicator.
3. Body: bronze.
4. Size: Same as connected piping, but not larger than NPS 2.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers:

    a. Leonard Valve Company.
    b. Powers; a Watts Industries Co.
    c. Symmons Industries, Inc.

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2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Rough bronze.
9. Primary, Thermostatic, Water Mixing Valves:
10. Piping Finish: Copper.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:

    a. Recommended size by equipment or valve manufacturer.

6. Drain: Factory-installed, hose-end drain valve.

2.7 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solderjoint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral**,** nonremovable, drainable, hoseconnection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.8 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

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1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.9 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company.
    b. PPP Inc.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201,
5. Sizes A through F.

2.10 AIR VENTS

A. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.11 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. PPP Inc.

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b. Sioux Chief Manufacturing Company, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves and bypass with valve. Install pressure gauges on inlet and outlet.

D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gauges on inlet and outlet.

E. Install balancing valves in locations where they can easily be adjusted.

F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

G. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve and solenoid valve.

H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.

I. Install water hammer arresters in water piping according to PDIWH 201.

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J. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

K. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.4 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

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SECTION 221316

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.
3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 15-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures" and as required by authority having jurisdiction.

1.4 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

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PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301. All pipe and fittings shall be marked with CISPI's collective trademark or receive prior approval by the engineer of record.

B. Couplings: CISPI 310.

C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
2. Manufacturers:

    a. ANACO.
    b. Clamp-All Corp.
    c. Mission Rubber Co.
    d. Tyler Pipe; Soil Pipe Div.

3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
4. Manufacturers:

    a. MG Piping Products Co.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.

B. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.

1. Steel Pipe Nipples: ASTM A 733 made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
4. Cast-Iron Flanges: ASME B16.1, Class 125.
5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

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2.4 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

2.5 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Description: ASTM A 674 or AWWA C105, high-density, cross laminated PE film of 0.004-inch or LLDPE film of 0.008-inch minimum thickness.

B. Form: Sheet or tube.

C. Color: Black.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 1-1/2 and smaller shall be:

1. Steel pipe, drainage fittings, and threaded joints.
2. Copper DWV tube, copper drainage fittings, and soldered joints.

C. Aboveground, soil and waste piping NPS 2 and larger shall be:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

D. Aboveground, vent piping NPS 1-1/2 and smaller shall be:

1. Steel pipe, drainage fittings, and threaded joints.
2. Copper DWV tube, copper drainage fittings, and soldered joints.

a. Option for Vent Piping,

E. Aboveground, vent piping NPS 2 and larger shall be:

1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

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2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel and hubless-coupling joints.

F. Underground, soil and waste piping shall be:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel and couplings and hubless-coupling joints.

3.3 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

D. Install underground, ductile-iron, special pipe fittings according to AWWA C600.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

F. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

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J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: Slope downward in direction of flow for piping as required by code and authority having jurisdiction.
2. Vent Piping: Install per code or per authority having jurisdiction.

K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42 clamps.
2. Install individual, straight, horizontal piping runs according to the following:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8- inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

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F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

G. Install supports for vertical steel piping every 15 feet.

H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

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C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

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SECTION 221319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Through-penetration firestop assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and grease.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

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1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Body: Cast iron.
5. Cover: Cast iron with bolted or threaded access check valve.
6. End Connections: Hubless.
7. Type Check Valve: Removable, bronze, swing check, factory assembled.
8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

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2. Standard: ASME A112.36.2M for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Brass plug.
6. Closure Plug Size: Same as cleanout size.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Outlet Connection: Inside calk, Hubless or Neo-Loc.
7. Closure: Bronze plug.
8. Adjustable Housing Material: Cast iron.
9. Frame and Cover Material and Finish: Polish Bronze.
10. Frame and Cover Shape: Round.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Closure Plug Size: Same as cleanout size.
5. Wall Access: Round, Stainless Steel.

2.3 FLOOR DRAINS AND FLOOR SINKS

A. Cast-Iron Floor Drains & Floor Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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a. Josam Company; Josam Div.
b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
c. Tyler Pipe; Wade Div.
d. Watts Drainage Products Inc.
e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Area, Floor drain.
4. Body Material: Cast-Iron.
5. Seepage Flange: Required.
6. Outlet: Bottom.
7. Top or Strainer Material: Nickel bronze.
8. Top of Body and Strainer Finish: Polished Nickel bronze.
9. Top Shape: Round.
10. Dimensions of Top or Strainer: See drawings.
11. Trap Material: Cast iron.
12. Trap Pattern: Standard P-trap.
13. Trap Features: Trap-seal primer valve drain connection.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, hubless outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install drains for trench drains at parking garage entrance ramp provided by others.

G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

H. Install through-penetration firestop assemblies at floor penetrations.

I. Install deep-seal traps on floor drains and other waste outlets, if indicated.

J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

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1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

N. Install chrome plated escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

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E. Install flashing for piping passing through roofs with counter flashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

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SECTION 224000

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following plumbing fixtures and related components:
   1. Plumbing fixtures.
   2. Fixture supports.

B. Related Sections include the following:
   1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
   1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 101-336, "Americans with Disabilities Act" and California Access Compliance Reference Manual for plumbing fixtures for people with disabilities.

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D. Regulatory Requirements: Comply with requirements in Public

E. Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

F. NSF Standard: Comply with NSF 61, "Drinking Water System

G. Components--Health Effects," for fixture materials that will be in contact with potable water.

H. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

I. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
   1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
   2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
   3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
   4. Stainless-Steel Residential Sinks: ASME A112.19.3.
   5. Vitreous-China Fixtures: ASME A112.19.2M.
   6. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.

J. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
   1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
   2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
   3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
   4. Faucets: ASME A112.18.1.
   5. Hose-Connection Vacuum Breakers: ASSE 1011.
   6. Hose-Coupling Threads: ASME B1.20.7.
   7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
   8. NSF Potable-Water Materials: NSF 61.
   9. Pipe Threads: ASME B1.20.1.
   10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
   11. Supply Fittings: ASME A112.18.1.
   12. Brass Waste Fittings: ASME A112.18.2.

K. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
   1. Atmospheric Vacuum Breakers: ASSE 1001.
   2. Brass and Copper Supplies: ASME A112.18.1.
   3. Brass Waste Fittings: ASME A112.18.2.
   4. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

L. Comply with the following applicable standards and other requirements specified for miscellaneous components:
   1. ASSE 1008 and UL 430.
   2. Air-Gap Fittings: ASSE 1021.
   3. Flexible Water Connectors: ASME A112.18.6.
   4. Floor Drains: ASME A112.6.3.
   5. Hose-Coupling Threads: ASME B1.20.7.
   6. Hot-Water Dispensers: ASSE 1023 and UL 499.
   7. Off-Floor Fixture Supports: ASME A112.6.1M.
   8. Pipe Threads: ASME B1.20.1.

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9. Plastic Toilet Seats: ANSI Z124.5.
10. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. Fixtures shall have smooth impervious surfaces, free from defects and concealed fouling surfaces and be Grade A with name or trademark of the manufacturer printed on or pressed into closets and lavatories. A label which cannot be removed without destroying it. containing the manufacturers name or trademark and the quality or class of the fixture, per ANSI/ASME A112.19, shall be affixed to all fixtures and not removed until after the work is accepted.

B. WATER CLOSETS:
   1. See plumbing schedule

C. URINALS:
   1. See plumbing schedule

D. LAVATORIES
   1. See plumbing schedule.

E. COMMERCIAL SINKS

   1. See plumbing schedule

2.2 Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a) TRUEBRO, Inc.
   b) McGuire Manufacturing Co., Inc.
   c) Plumberex Specialty Products Inc.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.3 FIXTURE SUPPORTS

A. Manufacturers:
   1. Josam Company.
   2. Smith, Jay R. Mfg. Co.
   3. Tyler Pipe; Wade Div.
   4. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Water-Closet Supports:
   1. Description: Combination carrier designed for accessible or standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

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C. Urinal Supports:
   1. Description: Urinal carrier with hanger and bearing plates for wall-mounting, urinal-type fixture. Include steel uprights with feet.
   2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Lavatory Supports:
   1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
   2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Fixture Supports:
   1. Support fixtures as recommended by manufacturer, as specified, and as reviewed by the Engineer.
   2. Support fixtures securely in a neat workmanlike manner on approved carriers or supports. Fixture supports shall be adjustable.
   3. Generally, support wall hung water closets on combined chair carrier and adjustable wall closet fitting with base support bolted to structure.
   4. Generally, support wall hung urinals on concealed carriers with base supports bolted to structure.
   5. Generally, support wall hung lavatories and drinking fountains on concealed arm chair carrier, single or double as required, with base supports bolted to structure.
   6. Mounting height shall be taken from the architectural drawings, including handicapped fixtures.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
   1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
   2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
   3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install wall-mounting fixtures with tubular waste piping attached to supports.

E. Install counter-mounting fixtures in and attached to casework.

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F. Install fixtures level and plumb according to roughing-in drawings.

G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
   1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

K. Install toilet seats on water closets.

L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

M. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

N. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

O. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

P. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

Q. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

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D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

E. Equipment connection:
   1. Kitchen and food serving equipment.
   2. Provide continuous waste of copper pipe and fittings for each sink.
   3. Connect drains from refrigerators and from food storage compartments of the kitchen counter and other food service equipment to the sewer through indirect connections.
   4. Location and number of connections is approximate. Determine exact number and rough in dimensions from the equipment drawings

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers, hot-water dispensers and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
   1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
   2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

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3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

END OF SECTION

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SECTION 230500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all the Work of Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC).

B. Provide a complete working installation with all equipment called for in proper operating condition. Documents do not undertake to show or list every item to be provided. When an item not shown or listed is clearly necessary for proper operation of equipment which is shown or listed, provide an item which will allow the system to function properly at no increase in Contract Sum.

1.2 DATE ISSUES

A. No parts, components, equipment, devices, systems, hardware, etc. shall fail or malfunction as a result of date issues. This requirement applies as long as the equipment, system or device is in service, even if the specified warranty period has elapsed. Non-conforming equipment, systems, etc. are unacceptable. In the event that there is a failure or malfunction caused by a date issue, the vendor, manufacturer, supplier, installer and contractor shall be responsible for correcting the problem, with all costs.

1.3 RELATED WORK SPECIFIED ELSEWHERE:

A. Concrete. See Section 03 30 00 – Cast-in-Place Concrete.

B. Wall louvers with bird screens: See Section 08 91 00 – Louvers.

C. Undercutting of doors, door louvers: See Sections 08 10 00 – Doors and Frames and Section 08 91 00 – Louvers.

D. Electrical, except as specifically indicated: See Division 26 – Electrical.

E. Painting, except as specifically indicated: See Section 09 90 00 – Painting and Coating.

F. Structural steel, except as specified herein: See Division 05 – Metals.

G. Power conduit and wiring for HVAC, except as specified herein: See Division 26 – Electrical.

H. Fire resistant enclosure at fire dampers at such locations as bottoms of shafts: See Section 09 29 00 – Gypsum Board.

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I. Thermal and sound insulation in partitions and ceilings: See Sections 07 21 00 – Thermal Insulation.

J. Patching and paving: Section 01 73 29 – Cutting and Patching and Section 32 10 00 – Bases, Ballasts, and Paving.

K. Utilities 5 feet beyond building line unless noted otherwise: See Division 33 – Utilities.

L. Description of architectural access doors: See Section 08 31 13 – Access Doors and Frames. Access doors furnished by Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC). Installation by Division 09 – Finishes.

M. Building firestopping and smoke seals: See Section 07 84 00 – Firestopping and Section 07 86 00 – Smoke Seals.

1.4 QUALITY ASSURANCE

A. Requirement of Regulatory Agencies:

1. In accordance with the requirement of Division 1.
2. Nothing in the Drawings or Specifications shall be construed to permit Work not conforming to applicable laws, ordinances, rules or regulations.
3. When Drawings or Specifications exceed requirements of applicable laws, ordinances, rules or regulations, Drawings and Specifications take precedence.
4. It is not the intent of Drawings and Specifications to repeat requirements of codes except where necessary for completeness or clarity.
5. Seismic construction and restraints: In accordance with requirements of Uniform Building Code.
6. If any of the requirements above conflict with one another, or with the requirements of these specifications, the most stringent requirements shall govern.
7. CMC - California Mechanical Code.
8. CPC - California Plumbing Code.
9. CBC - California Building Code.
10. Comply with all applicable requirement of California Code of Regulations, including Titles 8, 17, 19, 20, 21, 22 and 24.
11. JCC – Judicial Council of California Trial Court Facilities Standards
12. CALGreen
13. Locally adopted green building code
14. CEC - California Energy Code

B. Reference Standards:

1. AABC - Associated Air Balance Council.
2. AGA - American Gas Standard.
3. AIA – American Institute of Architects
4. AMCA - Air Moving and Conditioning Association.
5. ANSI - American National Standards Institute.

    a. A13.1 Scheme for Identification of Piping Systems.

6. ARI - Air Conditioning and Refrigeration Institute.
7. ASC - Adhesive and Sealant Council.

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8. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
9. ASME - American Society of Mechanical Engineers.
10. ASSE - American Society of Sanitary Engineering.
11. ASTM - American Society for Testing and Materials.
12. AWWA - American Water Works Association.
13. AWS - American Welding Society.
14. Hydraulic Institute.
15. NBS - National Bureau of Standards.
16. NEBB - National Environmental Balancing Bureau.
17. CEC - California Electric Code.
18. NEMA - National Electrical Manufacturers' Association.
19. NFPA - National Fire Protection Association.
20. PDI - Plumbing and Drainage Institute.
21. SMACNA - Sheet Metal and Air Conditioning Contractors National Association.
22. UL - Underwriters Laboratories.

C. All Base Materials: Comply with standard of ASTM and ANSI.

D. All Gas Fired Devices: Comply with standards and bear label of AGA.

E. All Pressure Vessels, Relief Valves, Safety Relief Valves and Safety Valves: Comply with standards, ASME stamped.

F. All Electrical Devices and Wiring: Conform to standards of NEC. All devices: UL listed and identified.

G. Applicator (Erector) Qualifications:

1. All equipment and accessories shall be the product of a manufacturer regularly engaged in its manufacture.
2. All equipment and accessories new, free from defects.
3. Supply all equipment and accessories in compliance with the applicable standards listed in this Section and with all applicable national, state and local codes.
4. All items of a given type shall be the product of the same manufacturer.
5. Electrical equipment: Listed by UL and bearing their label.

1.5 SUBMITTALS

A. General:

1. Provide submittal schedule at least 2 weeks prior to first submittal. Schedule shall outline the approximate dates Contractor will submit shop drawings and individual specification section’s products.
2. Provide full coordination of field install through Shop Drawings. Shop drawings need to be submitted and approved prior to commencing any installation work. Submit Shop Drawings, penetration location, supplemental data, for all materials, equipment in all Sections of this Division in accordance with the requirement of Section 01 33 00 – Submittal Procedures and as specified.
3. Forward all submittals to Architect in an orderly manner. Individual or incomplete submittals are not acceptable and will be returned without review. Contractor is responsible for any resultant consequence.

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4. Identify each item by manufacturer, brand, trade name, number, size, rating, and other data necessary to properly identify and check materials and equipment. Words "as specified" are not sufficient identification.
5. Identify each submittal item by reference to Specification Section paragraph Drawing and/or Detail number. Mark identification numbers appearing on the equipment schedule.
6. Organize submittals in same sequence as they appear in specification sections, articles or paragraphs.
7. Shop Drawings shall show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, weight.

    a. Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of the Contract Documents.
    b. Draw Drawings to scale and dimension (except piping diagrams not to scale), may be prepared by vendor but submit as instruments of Contractor, thoroughly check and stamp by Contractor before submission to Architect for review.
    c. Catalog cuts and published material may be included to supplement scale drawings.

B. Binders: Prepare submittal material in accordance with Section 01 33 00 – Submittal Procedures and the following:

1. Insert all literature in standard three-ring binders for 8-1/2 inch by 11 inch pages with individual tabs. Do not staple literature on different products together.
2. Number all binders on the outside of the cover and indicate the specification section. Mark binder No. 1 Architect's copy and No. 2 Engineer's copy. Both these binders shall contain original manufacturer's literature.
3. Provide an index with each binder. This index shall follow the same sequence as the Specifications.

C. Submittal literature, drawings and wiring diagrams shall be specifically applicable to this project and shall not contain extraneous material or optional choices. Clearly mark literature to indicate the proposed item. Submittals shall include, but not be limited to those items listed in individual Sections.

D. Substitutions: In accordance with Section 01 61 13 – Product Substitution Procedures.

E. Resubmittals will be reviewed for compliance with comments made on the original submittal only. Clearly identify replies to comments. Mark with resubmittal number and date.

F. Shop Drawings:

1. Shop fabrication, coordination, and installation Drawings that are prepared to scale by the Contractor, are for contractor’s use and shall be the contractor’s responsibility. These Drawings indicate where he intends to install the material and equipment as required by the Contract Documents. Do not submit shop fabrication documents unless requested. Use of Contract Documents or electronic files of Contract Documents for Shop Drawings is not sufficient.
2. Prepare and submit Shop Drawings for work in all areas, clearly indicating solutions to space problems and coordination with Work in other Sections. Identify congested conditions. These Drawings, as a requirement of this Division, shall indicate,

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superimposed, Work of all Sections involved in congested area, including ductwork, piping, electrical work, ceiling work, etc. Include all mechanical rooms. Identification of space problems without solutions is not acceptable.

3. Prepare and submit Shop Drawings for all Work deviating from that indicated on Contract Drawings. Clearly indicate deviations.
4. Review is not intended to verify dimensions or quantities, or to coordinate items shown on these Drawings. Review is for general conformance with design concept of the Project and general compliance with the information given in the Contract Documents. Contractor is responsible for dimensions, which shall be confirmed and correlated at the Jobsite, for fabrication processes and techniques or construction, for coordination of contractor's Work with that of all other trades and the satisfactory performance of his work.

G. Certificates: Submit final inspection certificates signed by governing authorities.

H. Operating and Maintenance Instructions and Manuals: In accordance with requirements of Section 01 78 23 – Operation and Maintenance Data and as follows:

1. Subsequent to completion of balancing, testing operations, this Division is responsible for instructing the Owner's authorized representatives in all aspects of operation, adjustment and maintenance of mechanical plant and other mechanical equipment.
2. Instructions on major items such as pumps, cooling tower, chillers, fans, air handlers, AC units, and temperature control shall be by representative of manufacturer of respective equipment.
3. One month before Owner's personnel assume operation of systems, submit eight sets of operating and maintenance instructions and manuals including the following:
   Names, addresses and phone numbers of contractors and subcontractors.

   a. Complete operating and maintenance instructions and parts lists of all equipment and component parts. Data sheets to show complete internal wiring, mechanical and electrical ratings and characteristics, catalog data on component parts whether furnished by equipment manufacturer or others, names, addresses and telephone numbers of source of supply for parts subject to wear or electrical failure, and description of operating, test, adjustment, and maintenance procedures.

      1) Where data sheets included in manual cover equipment, options, or other features not part of equipment actually furnished, line out these references or otherwise clearly mark so remaining text, diagrams, drawings, schedules, and similar information shall apply specifically to equipment furnished.

   b. A lubrication chart listing each item of equipment, all points of lubrication, proper lubricant, dates lubricated, and lubrication schedule.
   c. Bind data with title index tabs identifying items.
   d. Submit drafts of instruction sheets to Architect for review before preparing final sets.

4. Provide Record one-line diagrams and control diagrams, either in electronic format or as full-size paper copies in metal frames with glass. Diagrams shall show complete equipment, controls, model numbers, etc., marked to correspond to identification on equipment. Obtain diagrams from Architect at Contractor's cost and, if required, have prints framed by a firm normally engaged in this work and locate diagrams as directed.

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I. Letters from manufacturers certifying their supervision of equipment installation and start-up procedures.

J. Machinery vibration test reports.

K. Test certificates.

L. Instruction certificates.

M. Fire Marshal and/or Fire Department approvals of system.

N. Final inspection certificate signed by governing authorities.

O. Piping mechanical grooved joint instruction certification.

P. Others as specified herein and as required.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver equipment in its original package to prevent damage or entrance of foreign matter. Perform all handling and shipping in accordance with manufacturer's recommendations. Provide protective coverings during construction.

B. Identify materials and equipment delivered to Site to permit check against approved materials list, reviewed Shop Drawings.

C. Protect from loss or damage. Replace lost or damaged materials and equipment with new at no increase in Contract Sum.

1.7 JOB CONDITIONS

A. In accordance with Division 01 – General Requirements and the following.

B. Specifications and Drawings:

1. In case of conflict, the most stringent takes precedence.
2. For purposes of clarity, legibility, Drawings are essentially diagrammatic to extent that many offsets, bends, unions, special fittings, exact locations of items are not indicated, unless specifically dimensioned. Especially note a number of required duct and pipe offsets to coordinate with structure and not shown. Coordinate dimensioned conditions, including invert elevations, with other trades prior to installation by any trade.
3. Exact routing of piping, ductwork, etc. shall be governed by structural conditions, obstructions. Make use of data in Contract Documents. In addition, Architect reserves right, at no increase in Contract Sum, to make any reasonable change in location of mechanical items, exposed at ceiling or on walls, to group them into orderly relationships or increase their utility. Contractor to verify Architect's requirements in this regard prior to roughing-in.
4. Take dimensions, location of doors, partitions, similar physical features from Architectural Drawings. Verify at Site under this Division. Consult architectural

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Drawings for exact location of outlets to center with Architectural features, panels, etc., at the approximate location shown on mechanical Drawings.

5. Mounting heights of brackets, outlets, etc., as required.
6. The contractor shall, during demolition, verify all existing mechanical building conditions within scope of work, including comfort conditioning/ventilation components and systems and smoke management (life safety) components and systems. Any variances to as-built drawings shall be reported to the architect and engineering design teams. HVAC equipment intended to remain shall be tested and balanced for performance prior to construction commences. Any defective or deficient HVAC equipment, intending to be reused, needs to be replaced with new equipment if determined to be deficient.
7. Contractor is responsible for providing seismic submittals, with bracing and calculations per code requirements. The contractor shall also provide mechanical equipment, duct, and piping supports, point loads, and all related calculations.

C. Coordination:

1. Work out all conditions for field coordination / field install involving Work under this Division and Work in other Divisions in advance of installation. This includes layout of ductwork, piping, and equipment. If necessary, and before Work proceeds in these areas, prepare supplementary Drawings under this Division for review showing all Work in congested area. Provide supplementary Drawings, additional Work necessary to overcome congested conditions, at no increase in Contract Sum.
2. Difference or disputes concerning coordination, interference or extent of Work between sections shall be decided by Contractor, and contractor's decision, if consistent with Contract Document requirements, shall be final.
3. Coordinate electrical interlocks of mechanical equipment with Division 26 - Electrical.
4. Provide templates, information and instructions to other Divisions to properly locate holes and openings to be cut or provided.
5. Not all offsets in ductwork or piping are shown. Contractor shall decide which item to offset or relocate. Maintain required slope in piping.
6. Mechanical contractor shall coordinate with a controls contractor, authorized and experienced to work with the existing BMS system, to provide all necessary tie-ins.
7. Contractor shall do BIM coordination for shop drawings in their own model. The contractor needs to coordinate with all other trades prior to installation. The design model, if requested, is for reference only and contractor is required to sign a release-statement prior to use.

D. Large Scale Layout Drawings: In accordance with requirements of Section 01 33 00 – Submittal Procedures, prepare large scale detailed layout Drawings showing locations of equipment, piping runs, ductwork, and all other elements of mechanical systems provided under this Division. Include sections of all areas in scope of work to show relative position and spacing of affected elements.

E. Equipment Rough-In:

1. Rough-in locations shown on Mechanical Drawings for equipment furnished by Owner and for equipment furnished under other Divisions are approximate only. Obtain exact rough-in locations from following sources:
   From Shop Drawings for Contractor furnished and installed equipment.

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From Architect for Owner furnished-Contractor installed equipment.
From existing equipment where such equipment is relocated under this Contract.

2. Verify mechanical characteristics of equipment before starting rough-in. Where conflict exists between equipment and rough-in shown on Drawings obtain clarification from Architect and provide as directed at no increase in Contract Sum.
3. Make final connections.

F. Site Examination:

1. Examine site carefully and compare to all existing as-built conditions and drawings. Call any discrepancies to attention of Architect during bidding period and during demolition.

G. Review of Construction:

1. Work may be reviewed at any time by representatives of Architect.
2. Advise Architect that work is ready for review at following times:

a. Prior to backfilling buried work.
b. Prior to concealment of work in walls and above ceilings.
c. When all requirements of Contract have been completed.

3. Neither backfill nor conceal work without Architect's consent.
4. Maintain on job a set of Specifications and Drawings for use by Architect's representatives.
5. Owner’s representative will assist Architect with field review of construction, will inform Architect regarding progress and problems related to construction, and will endeavor to guard Owner against defective materials and faulty workmanship. Engineer's reviews will be periodic, depending upon nature of construction. Engineer is not required to perform extensive or continuous inspection, is not responsible for execution of Contract Documents by Contractor, nor is he responsible for construction methods, sequences, or safety precautions.

H. Schedule of Work:

1. In accordance with Division 01 – General Requirements and as follows:

a. Arrange work to conform to schedule of construction established or required to comply with Contract Documents.
b. In scheduling, anticipate means of installing equipment through available openings in structure.
c. Before making connections or doing any work which will interrupt existing services, notify Owner, in writing, twelve working days in advance and advise duration of interruption; perform such Work as quickly as possible and only at such times designated by Owner, refer to General Conditions.

1.8 WARRANTY

A. In accordance with Section 01 78 36 - Warranties and as follows.

B. Warranty all materials, equipment, apparatus and workmanship to be free of defective materials and faulty workmanship for period of one year from date of filing of Notice of Completion.

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C. Provide new materials, equipment, apparatus and labor to replace that determined by Architect to be defective or faulty.

D. This guarantee shall also apply to services including Instructions, Adjusting, Testing, Noise, Balancing, etc.

E. Furnish Manufacturers' standard Warranties in excess of one year.

1.9 PROJECT RECORD DOCUMENTS

A. In accordance with Section 01 70 00 – Execution and Closeout Requirements and as follows.

B. Keep up-to-date during progress of job, reproducible and editable Mechanical Drawings indicating the Record installation. In addition to changes made during course of Work, show the following by dimension from readily obtained base lines:
Exact location, type, and function of concealed valves, dampers, and controllers.
Exact size, invert elevations and location of underground and underfloor piping and ducts.

C. Progress drawing set shall be available for inspection by Architect or Construction Manager weekly.

D. Submit completed Drawings to Architect.

1.10 SERVICING

A. A manufacturer’s representative and adequate maintenance facilities in all areas of work are required to ensure prompt servicing of all equipment installed. All equipment shall be accessible and it is the contractor’s responsibility to ensure all equipment is accessible.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Identify materials and equipment by manufacturer's name and nameplate data. Remove unidentified materials and equipment from Site.

B. Equipment specified by manufacturer's number shall include all accessories, controls, etc., listed in catalog as standard with equipment. Furnish optional or additional accessories as specified.

C. Where no specific make of material or equipment is mentioned, any first class product of reputable manufacturer may be used, provided it conforms to requirements of system, is submitted for review and is accepted by the Architect.

D. Equipment or material damaged during transportation, installation, or operation is considered as totally damaged. Replace with new. Variance from this permitted only with Owner’s written acceptance.

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E. Provide an authorized representative to constantly supervise Work of this Division, check all materials prior to installation for conformance with Drawings, Specifications, and reviewed Shop Drawings.

F. Equipment shall be as described in the respective Sections of Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC) and as shown.

G. Access Doors/Access Panels: Furnish under this Division where shown, as required by Regulatory Agencies, and for access of all concealed valves, shock absorbers, unions, fire dampers, etc., even though access doors are not shown for Mechanical Work. Doors and access doors in this Division shall be in accordance with requirements of Section 08 31 13 – Access Doors and Frames. Doors and Access doors in Division 26 - Electrical shall all be from same manufacturer for identical appearance and keying. Sizes: 24 inches by 24 inches minimum for ceilings and 12 inches by 12 inches minimum for walls. Furnish fire rated doors where required. Deliver doors for installation under Section 08 31 13 – Access Doors and Frames. Mark each door to accurately establish its location.

H. Conform to conditions shown and specified. Coordinate with other trades for best possible assembly of combined Work. Relocate equipment when necessitated by failures to coordinate Work or to advise Architect of conflicts in writing.

I. Use printed descriptions, specifications, and recommendations of manufacturers as a guide for installation of Work.

J. Design of mechanical systems is generally based on product of one of the manufacturers cited. Where systems for product installed necessitate modification of systems shown on plans, Contractor is responsible for installation of systems appropriate to product installed.

K. Material and Equipment-General Requirements:

1. Approved for use by State Fire Marshal and local building inspection department when applicable.
2. Testing agency labeled or with other identification wherever standards have been established.
3. Architect reserves the right to reject items not in accordance with Specification either before or after installation.
4. Comprised to render complete and operable systems; provide additional items needed to complete installation to realized design.
5. Compatible with space allocated. Modifications necessary to adjust items to space limitations shall be at Contractor's expense.
6. Installed fully operating and without objectionable noise or vibration.

L. Electrical Requirements:

1. Electrical Work in this Division shall conform to requirements of Division 26 - Electrical.
2. Starters: Starters included in motor control centers and all starters for motors are specified in Division 26 – Electrical except starters specifically included as part of specified equipment.
3. Disconnects: Except for disconnects factory mounted on mechanical equipment, or in combination starters, motor disconnects are specified in Division 26 - Electrical.
4. Power wiring: Except for factory wiring on mechanical equipment, power wiring is specified in Division 26 - Electrical. Where Drawings clearly and explicitly differ from the two preceding wiring paragraphs, Drawings have precedence.

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5. HVAC control wiring, Section 23 09 23 – Building Automation System for HVAC: Provide control conduit and wiring for all HVAC controls. Where Drawings clearly and explicitly differ from the two preceding wiring paragraphs, Drawings have precedence.
6. Provide controls, controllers, relays, transformers, switches, etc., required by Work of this Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC).
7. Factory wired assemblies and panels shall be prewired to numbered terminal strips for connection to field wiring.
8. Provide disconnect switch for each control circuit connection to prewired assemblies and control panels.
9. Provide to electrical subcontractor approved wiring diagrams for work to be connected under Division 26 – Electrical.
10. Provide weatherproof devices and installation for out-of-doors work.
11. Product of combustion detectors in ductwork furnished under Division 28 – Electronic Safety and Security, installed by this Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC), and wired by Division 28 – Electronic Safety and Security to fire alarm system.
12. Motors: Provide motors for equipment specified. Coordinate with Division 26 - Electrical.
13. Variable Frequence Drives and Microdrives – coordinate installation with Division 26 – Electrical.

2.2 SPECIAL TOOLS

A. Furnish to Owner the following:

1. One set of any special tools required to operate, adjust, dismantle or repair any equipment of this Division. “Special Tools” means those not normally found in possession of mechanics or maintenance personnel.
2. One pressure grease gun for each type of grease required, complete with adaptors to fit all lubricating fittings on equipment.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that conditions are satisfactory for the installation of materials and equipment. Notify Architect if conditions are not satisfactory and do not commence work until conditions have been corrected.

3.2 INSTALLATION

A. Install materials and equipment in compliance with governing codes.

B. Manufacturers' Directions: Follow in all cases where manufacturers' of articles used furnish directions covering points not specified or shown.

C. Assemble equipment requiring field assembly under the direct supervision of the manufacturers' agent and submit manufacturers’ letters indicating this has been done prior to the final acceptance.

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D. Equipment: Accurately set and level with supports neatly placed and properly fastened. Properly fasten equipment in place with bolts to prevent movement in earthquake. No allowance of any kind will be made for negligence on part of Contractor to foresee means of access for delivery or installation.

E. Piping or Ductwork Systems: As specified in other Sections of this Division.

F. Electrical:

1. All electrical work shall be in accordance with Division 26 – Electrical.
2. Install wiring in conduit at concealed and exposed locations; provide conduit.
3. Install electrical devices with code required clearances and access.

G. Concrete: In accordance with the requirements of Division 03 – Concrete.

H. Sleeves, Chases and Concrete Inserts:

1. This Division shall provide, to cause not delay, all required sleeves, chases, concrete inserts, anchor bolts, etc., be responsible for correct location, installation of same.
2. Sleeves, chases are prohibited in structural members, except where shown or as directed by Architect in writing.
3. Embed no piping in concrete or masonry.
4. Locate and size openings for ductwork through walls, roof, etc., under this Division. Framing of openings provided by respective Divisions in whose Work opening is made.
5. Cutting and Repairing:
6. Do cutting and repairing, including structural reinforcing, necessary for Work under this Division.
7. Do no cutting or patching without Architect's review. Repair damage done by this cutting equal to original condition and seek Architect's review.
8. Assume responsibility for damage to any part of premises or Work of other Divisions, caused by leaks or breaks in piping or equipment furnished or installed under this Division during construction and guarantee/warranty period.

I. HVAC Systems Identification: Refer to Section 23 05 53 – Identification of HVAC Piping and Equipment.

J. Carpentry, Cutting and Patching:

1. In accordance with Section 01 73 29 – Cutting and Patching, Cutting and Patching Article, and as follows.
2. Provide all sleeving, core drilling, carpentry, cutting and patching required for proper installation of material and equipment specified in this Division.
3. Do not cut or drill structural members without consent of Architect.
4. Core drill existing floors and walls as required for this installation. Verify location of all core drills with structural engineer prior to execution.

K. Temporary Service:

1. In accordance with Section 01 50 00 – Temporary Facilities and Controls and as follows.
2. Provide when any existing services are interrupted in connection with Work of this Section beyond the period of time acceptable and approved by the Owner.

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L. Vibration and Seismic Control:

1. Coordinate with Division 1.
2. Design criteria and extent of bracing, anchorage, etc., for all the Work of Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC) are specified in Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

M. Concrete Equipment Bases:

1. Locate and size concrete base for all equipment located on concrete floors. Base to be minimum: 4 inches high and extending 6 inches beyond edge of equipment base unless indicated otherwise. See structural engineer's drawings for pad requirements and Architect's drawings for exact locations.
2. Coordinate concrete bases; concrete is specified in Division 03 – Concrete.

N. Waterproof Construction:

1. Maintain waterproof integrity of penetrations of materials intended to be waterproof. Provide flashings at exterior wall and roof penetrations. Caulk watertight penetrations of foundation walls and floors. Provide membrane clamps at penetrations of waterproof membranes.
2. Provide galvanized sheet metal weather protection canopies, hoods or enclosures over all out-of-doors equipment, the operation or maintenance of which would be impaired by rain water. This requirement applies to damper operators and bearing, damper motors, controls, flexible pipe and duct connectors and instruments. See other paragraphs in this Division for application of this requirement to motors, drive, ducts, and fans.

O. Protection of Materials:

1. Protect from damage, water, dust, etc., material, equipment and apparatus provided under this Division, both in storage and installed, until Notice of Completion has been filed. Provide temporary storage facilities for material and equipment. Material, equipment or apparatus damaged because of improper storage or protection will be rejected. Removed from Site and provide new, duplicate material, equipment or apparatus in replacement of that rejected.
2. Completely cover all motors and other moving machinery to prevent entry of dirt and water during construction.
3. Cap all openings in pipe and ductwork daily to protect against entry by foreign matter.
4. Protect premises and Work of other Divisions from damage arising out of installation of Work of this Division.
5. Perform Work in manner precluding unnecessary fire hazard.

P. Restoration of Damage:

1. Repair or replace, as directed by Architect, materials and parts of premises which become damaged as result of installation of Work of this Division. Remove replaced parts from premises.

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3.3 ADJUSTMENT

A. Preliminary Operation:

1. Operate any portion of installation for Owner's convenience if so requested by Architect. Such operation does not constitute acceptance of Work as complete. If operation is requested by Owner, cost of utilities such as gas and electrical power will be borne by Owner.

B. Startup Service:

1. Prior to startup, ensure that systems are ready, including checking the following: Proper equipment rotation, wiring, auxiliary connections, lubrications, venting fan balance and controls. Properly installed and set relief and safety valves.
2. Start and operate all systems. Provide services of factory trained technicians for startup of major equipment and systems including split system AC units.

C. Adjusting:

1. Adjust all equipment and system components as shown or as otherwise required to result in intended system operation.
2. Thereafter, as a result of system operation or as directed by Architect, make readjustments as necessary to refine performance and to effect complete system "tune-up".
3. After completion of testing and adjustment, operate the different systems and equipment under normal working conditions for 72 hours continuously and show specified performance. If, in the opinion of the Architect, performance of equipment or systems is not in accordance with specifications or submitted data, alter or replace equipment at no increase in Contract Sum. Contractor, at his option, may order tests from an independent approved laboratory to prove compliance. All such tests shall be at no increase in Contract Sum. Repeat process as often as required.
4. At completion of Work, provide written certification that all systems are functioning properly without defects.

D. Noise:

1. Cooperate in reducing any objectionable noise or vibration caused by mechanical systems to the extent of adjustments to specified and installed equipment and appurtenances.
2. Completely correct noise problems caused by failure to make installation in accordance with Contract Documents, including labor and materials required as a result of such failure, at no increase in Contract Sum. Includes refinish walls, floors etc.

3.4 CLEANING AND PAINTING

A. Properly prepare Work under this Division to be finish painted under Section 09 91 00 – Painting and Coating.

B. Refinish Work supplied with final finish under this Division if damaged under this Division to satisfaction of Architect.

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C. Thoroughly clean equipment, fans, pumps, motors, piping and other materials under this Division free from all rust, scale and all other dirt before any covering of painting is done, or the systems put in operation. Leave in condition satisfactory to Architect.

D. Provide moisture resistant paint for exterior painting and heat resisting paint for hot piping, equipment and materials.

E. Colors as directed by Architect unless specified herein.

F. Factory Finishes:

1. Air outlets in acoustical tile ceilings: Baked white enamel, unless otherwise noted.
2. Aluminum air outlets: Bronze anodized, unless otherwise noted.
3. Fans, pumps, compressors, tanks and like items.
4. Air handlers, pumps, water heaters, and like items where exposed.

G. For the following, provide factory prime coat. Also, provide factory finish painting on each if not specified in Painting Division.

1. Other air outlets.
2. Access panels.

H. Paint all equipment supports with two coats of weather resistant enamel.

I. Paint all equipment out of doors with two coats of weather resistant enamel, unless weather-proof factory paint finished is otherwise specified within this Division.

J. Protect all finished surfaces of fixtures with heavy paper pasted thereon, or by other means, throughout the period of construction.

K. Clean ductwork inside and out before grilles are installed and before fans are operated.

L. At all times keep the premises free from accumulation of waste material and debris caused by his employees. At the completion of the Project, and at other times as Architect may direct, remove refuse from within and around the building. All tools, scaffolding and surplus materials shall also be removed, leaving the Site of his Work clean.

M. Lubricate all equipment at completion of Work. Furnish Owner with a written lubrication schedule for all equipment as specified in Section01 78 00 – Closeout Submittals.

END OF SECTION

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SECTION 230513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single Phase Electric Motors

B. Three Phase Electric Motors.

C. Variable Speed Drives.

1.2 RELATED WORK

A. Section 23 81 26 – Split System Air Conditioners.

B. Section 26 29 13 – Soft-Start Motor Controllers

1.3 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.

D. ANSI/NEMA MG 1 - Motors and Generators.

E. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.

B. Submit tests verifying nominal efficiency and power factor for motors larger than 20 horsepower.

PART 2 - PRODUCTS

A. MOTORS

B. General Electric, Westinghouse, Century or Reliance, UL listed and conforming to NEMA standards, MG-1.

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C. 3/4 HP and larger: NEMA rated at 480 volts (unless scheduled otherwise), 3-phase, 60-cycle, low starting torque, squirrel cage induction type; unless indicated otherwise. Coordinate all voltages with Division 26 - Electrical.

D. 1/2 HP and less: NEMA rated at 115-volt, single-phase, 60-cycle, with built-in thermal overload; unless indicated otherwise.

E. Motors 50 HP and over: Reduced voltage start, suitable for star-delta starting.

F. Limit maximum motor speeds to 1750 rpm, unless otherwise specified.

G. Provide totally enclosed, fan cooled (TEFC) motors outside the building or otherwise exposed to the weather, in mechanical rooms, cooling coil airstreams, or suitably protect motor per NEMA Standards. Provide open drip-proof motors generally inside the building, except where splash-proof or explosion-proof construction is required.

H. Provide motors with double shielded, grease lubricated, ball bearings, with grease pockets on each side for re-greasing in service. Provide inlet and outlet grease connections in motor housings for each bearing. Provide factory sealed permanently lubricated ball bearings on roof mounted equipment. Similar bearing may be provided on fractional horsepower motors. Provide sleeve bearings where so specified.

I. For motors used in conjunction with Variable Frequency Drives, provide motors compatible with drive unit. Additionally, any motor controlled by a variable frequency drive shall incorporate a design to prevent arcing through the motor bearings: Insulated bearings, grounded motor shafts or add-on devices such as those manufactured by Shaft Grounding Systems or equal (no known equal).

J. Provide multi-speed motors of separate winding, variable torque type, unless otherwise specified or indicated.

K. Efficiency and Power Factor:
1. Requirements apply to all motors, 1 HP and larger, except for following:
   a. Hermetic and semi-hermetic refrigeration compressors.
   b. Equipment that operates in emergency only.
   c. Ratings in accordance with IEEE, Test Procedure 112A, Method B. Motors labeled with NEMA Efficiency Index code letters.
   d. Minimum guaranteed premium efficiencies and power factors at motor full load rating for 1,750 RPM motors.
   e.

HP	%Efficiency	%Power Factor
1	82.5	84
1 1/2	84	85.7
2	84	85.7
3	86.5	86
5	87.5	86
7 1/2	88.5	82
10	89.5	85.5

   f. Motors with other than 1,750 RPM shall be same type motor as would meet requirements for 1,750 RPM motors.
   g. Verify voltage and frequency of all motors with Division 26 - Electrical.

L. BELT DRIVES

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1. Browning, Gates, Woods or Dayton, V-belt drives, with cast-iron sheaves rated not less than 1 1/2 times motor HP.
2. Adjustable motor sheaves for 7 1/2 HP and smaller; solid sheaves for others.
3. Fan static pressures and RPMs indicated on Drawings are only approximate. Adjust or change drives as required to achieve indicated air quantities.

M. DRIVE GUARDS
1. Comply with requirements of State Division of Industrial Safety.
2. Provide holes in belt guards for tachometer readings.
3. Indoor Belt Drives: 16 gauge expanded metal or wire screen enclosure with 70 percent free area and steel frame.
4. Outdoor Belt Drives: 16 gauge solid galvanized sheet metal with stamped louvers near top and bottom for ventilation.

N. MOTOR STARTERS
1. Manufacturers:
   a. Westinghouse,
   b. Square D,
   c. General Electric,
   d. or equal.
2. Manual Motor Starters:
   a. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, single pole, full voltage controller for fractional horsepower induction motors, with thermal overload unit, red running pilot light, NO auxiliary contact and toggle operator.
   b. Motor Starting Switch: NEMA ICS 2; AC general-purpose Class A manually operated single pole, full voltage controller for fractional horsepower induction motors, without thermal overload unit, red pilot light, NO auxiliary contact and toggle operator.
   c. Enclosure: NEMA ICS 6; Type 1, unless otherwise indicated on the Drawings. NEMA 3R in mechanical rooms and outdoors.
   d. Size starter per applicable NEMA standards.
3. Magnetic Motor Starter:
   a. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Solenoid-operated type. Chatterproof armatures.
   b. Full Voltage Starting: Non-reversing type.
   c. Reduced Voltage Starting: Open-circuit transition wye-delta type.
   d. Two-Speed Starting: Compatible with two-speed motor. Include integral time delay transition between FAST and SLOW speeds. Fully rated for motor, limited duty starters not acceptable.
   e. Coil Operating Voltage: 120 volts, 60 Hertz.
   f. Size: NEMA ICS 2; size per NEMA standards.
   g. Overload Relay: NEMA ICS 2; bimetal type, one for each phase.
   h. Enclosure: NEMA ICS 6; Type 1, unless otherwise indicated on the Drawings. NEMA 3R in penthouse and mechanical room.
4. Combination Motor Starters: Combine motor starters with motor circuit protector disconnect in common enclosure. Motor Circuit Protector: NEMA AB 1; circuit breakers with integral instantaneous magnetic trip in each pole.
   a. Auxiliary Contacts: NEMA ICS 2; two normally open and two normally closed contacts in addition to seal-in contact.
   b. Selector Switches: NEMA ICS 2; HAND/OFF/AUTO in front cover.
   c. Indicator Lights: NEMA ICS 2; RUN: Red in front cover.
   d. Control Power Transformers: 120 volt secondary, 50 VA minimum, in each motor starter.

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e. Provide terminal strips for external control including Fire Department Control Panel, smoke detector, fire alarm, temperature control wiring, and interlock wiring as required and as shown and required.

O. VARIABLE FREQUENCY DRIVES FANS

1. General:
   a. Manufacturers: ABB, Graham, Toshiba or equal.
   b. Provide Variable Frequency Drives, referred to as VFDs or VSDs, in the number and voltages shown on the documents. Continuous fan, blower or pump duty. All drive assemblies to be ETL or UL listed. Drives shall meet or exceed applicable NEMA standards. Contacts to be sized per NEMA standards.
   c. Factory test complete VFD to ANSI/UL Standard 508. Functionally test options, operate dynamometer at full load, cycle load and speed during factory test.
   d. Provide drive with nominal full load amp rating meeting or exceeding motor full load amps. Drive nominal horsepower to equal or exceed motor horsepower.
   e. It is the intent of this specification to describe the performance requirements of the VFD. Specification represents minimal requirements for equipment to accomplish these functions.
   f. Provide VFD compatible with motor it serves. Coordinate with motor manufacturer.
   g. Submit compliance with utility company rebate qualifying requirements.
   h. VFD shall have the ability to interface with the building automation system.
2. Hardware:
   a. Microprocessor based VFD, fully transistorized with 3 phase full wave diode bridge input and Sine-Coded Pulse Width Modulated output.
   b. To minimize electrical and acoustical noise and to eliminate low speed cogging, generate 12 kHz carrier frequency at all frequencies. No sudden frequency shifts and associated acoustical noise shifts through the range of 1.5-60 Hz.
   c. Input power factors fundamental component of 0.95 or better over entire operating speed range. Efficiency 96 percent minimum from 0-100 percent load. Provide manufacturers test results to verify efficiency and power factor of fundamental components.
   d. Standard Solid State Ground Fault Protection. Provide adaptive electronic motor overload protection to protect both the motor and drive at all frequencies. VFD sense load and speed and recalibrate the thermal trip curve to insure low speed motor protection. Initial trip point adjustable from at least 40-100 percent of the VFD amperage rating. Electronic thermal overload circuits which properly protect the motor only at full speed not acceptable.
   e. Provide isolated control inputs. Motor speed directly proportional to 0-10V, 4-20 mA and variable resistance signals. Optional 3-15 PSI input available for pneumatic control.
   f. Microprocessor based control board common for all sizes from 1-350 horsepower.
   g. Switch selectable drive operation options. Include at minimum the following functions:
   h. Automatic minimum speed holding if control signal is lost.
   i. Automatic reduction in voltage with a reduction of load.
   j. Two step over frequency adjustments.
   k. Motor direction reversing.
   l. Provide the following operational features:
   m. Speed search transfer. Able to start from bypass fault trip into spinning load without stopping the motor or creating fault condition. Match motor speed and then drive motor to proper speed.
   n. Adjustable current limit threshold.
   o. Multiple restart upon fault trip.
   p. Minimum 10:1 turndown ratio.
   q. Individually adjustable acceleration and decelerating patterns, adjustable from 1-1800 seconds.

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r. Minimum 0.2 second power loss ride through without drive trip or loss of programming.
s. Suitable for installation and use under the following environmental conditions: -10 to 40 degrees C (20 to 104 degrees F), 0-90 percent RH, non-condensing. Do not locate in direct sunlight or forced air circulation.
t. Total harmonic distortion limit of 10 percent.
    1) Individually programmable maximum motor speeds in auto and manual modes.
u. Provide isolation transformer.
v. LCD digital display, using full English and Spanish words. Alphanumeric codes not acceptable. LED displays not acceptable.
w. All VFDs to have the same display, keypad and connectors, regardless of horsepower.

3. Fault Indication and Operation:
    a. The following fault conditions cause the VFD to shut off (trip). Indicate with complete words on display. VFD to be capable of fault self-diagnosis. The last three faults shall be stored in memory and shall be capable of being displayed.
        1) Phase loss.
        2) OC Instantaneous Overcurrent.
        3) OV Overvoltage.
        4) UV Undervoltage.
        5) OH Over Heat.
        6) EB External Failure.
        7) Ground fault.
        8) Pilot “red running” light, pilot power “green” light.
    b. VFD attempt to restart minimum five times, with ten second pause between attempts, after tripping on fault. Dry contact on VFD close after fifth unsuccessful restart attempt.
    c. Limit power line noise to voltage distortion factor and line notch depth as defined in IEEE Standard 519-1981, Guide for Harmonic Control and Reactive Compensation of Static Power converters. Maximum voltage distortion 5 percent.
    d. Do not emit radiated RFI in excess of limitations in FCC Rules and Regulations, Part 15, for Class A computing devices. Carry FCC compliance label. Provide RFI filters on each PWMS drive.
4. Enclosure, Control Module and Bypass Modes:
    a. VFD and all bypass components housed in single NEMA enclosure.
        1) NEMA Type 1: Inside the building.
        2) NEMA Type 3R: Exposed to weather.
    b. Equip with solid state input fuses of the I2R type.
    c. Equip with fusible door interlocked disconnect switch. Switch load break and horsepower rated and listed.
    d. Equip with digital operator interface with following functions:
        1) Percent frequency indication on LCD display.
        2) Fault indication on the LCD display. Fault reset.
        3) Hand/off/auto operation switch.
        4) Digital speed control.
        5) Forward/reverse operation.
5. NEMA 3R weatherproof enclosures: As above and complete with inlet fans, inlet and outlet filters, and louvers, along with NEMA 4 operator’s devices. Indicator lamps (power on, drive, bypass, safety) shall be bright LEDs, or equivalent conventional lamps, that are easy to tell if they are on or off in bright sunlight conditions to the naked eye without shielding. Enclosures to have hinged windows complete with locks, so that operators can read drive displays and operate drive keypad. The hinged window shall not be positioned to allow access to uninsulated electrical components at line voltage. HOA switch and speed potentiometer shall be accessible either through the hinged window or on the exterior of the door.
6. Equip with three Automatic Transfer Contactors which fully isolates the VFD from line and load side in bypass mode. Contactors shall be mechanically and electrically interlocked and

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respond automatically to VFD failure or to dry contact from external source. Contactors load break and horsepower rated. When in Bypass mode, VFD shall be completely de-energized. Unacceptable for VFD power input or output bus to be energized when VFD is in Bypass mode. Furnish Hand/Off/Auto switch on the face of the VFD enclosure, control transformer, disconnect switch and service switch.

7. Provide auxiliary contacts for external controls input. Contact from fire alarm control system overrides other controls.
8. UL label entire assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

3.2 Electrical work under this Division shall conform to all requirements of Division 26 – Electrical.

A. START-UP SERVICE

1. Provide start-up commissioning of variable frequency drive and optional circuits by factory certified service technician experienced in start-up and repair services. Commissioning personnel shall be same personnel that provide factory service and warranty repairs at site. Sales personnel and other agents who are not factory certified technicians for drive field repair are not acceptable.
2. Include checking for verification of proper operation and installation and interface wiring to building automation system. Include as a minimum:
   a. Verify contractor wire terminations to VFD optional circuitry.
   b. Verify proper operation and reliability of VFD, motor being driven and building automation system.
   c. Provide up to one hour of Owner/operator training on operation and service diagnostics during commissioning.
   d. Measure to verify proper operation on:
      1) Motor voltage and frequency. Verify proper motor operation.
      2) Control input for proper building automation system interface and control calibration.
      3) Calibration check for:
         a) Minimum speed
         b) Maximum speed
         c) Acceleration and deceleration rates
      4) Adjust as necessary.

B. WARRANTY

1. Provide unconditional warranty for 36 months from date of installation in format specified in Division 01 – General Requirements. Include parts, labor, travel costs and living expenses incurred by manufacturer to provide factory authorized on-site service.

END OF SECTION

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SECTION 230529

HANGERS AND SUPPORT FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Pipe, duct, and equipment hangers, supports, and associated anchors.

B. Pipe and duct sleeves, seals and flashing.

C. Pipe shields and fire rated sleeves.

1.2 RELATED WORK:

A. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment

B. Section 23 07 13 – Duct Insulation

C. Section 23 07 19 – HVAC Piping Insulation

D. Section 23 31 00 – HVAC Duct and Casings

1.3 QUALITY ASSURANCE

A. Reference Standards:

1. ANSI/ASME B 31.1 - Power Piping
2. ANSI/ASME B31.9 – Building Services Piping

1.4 DESIGN RESPONSIBILITY

A. Design support and anchorage systems in accordance with procedures indicated herein.

1.5 SUBMITTALS

A. Submit product data under provisions of Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.

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B. Submit all insulated and non-insulated pipe, duct and equipment supports, framing, hangers, guides, anchors and attachment methods.

1. Submit product data or provide calculations to demonstrate compliance with the requirements of regulatory agencies.
2. Submit, in drawing plan form, exact location and weight at each support point for HVAC piping and ductwork.
3. Note compliance with seismic regulations on submittals. Submit additional seismic calculations by California registered Structural Engineer as required by State, Federal or regulatory agencies.
4. Submit record drawings reflecting actual conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hangers and Supports:

1. Superstrut (Thomas & Betts), except as otherwise noted, or Unistrut, Fee & Mason, B-Line. Superstrut numbers are used.
2. Provide electro-chromate finish over galvanized or factory paint over galvanized. Superstrut “GoldGalv” or equivalent. No plain, "black" hangers allowed.
3. Concrete Inserts and Anchors: No. 452, C-475 or C-302 for new construction. Hilti fastening systems or ITW-Ramset Red Head self-drilling anchors for existing concrete. No powder drive anchors permitted. Coordinate with Owner’s Representative.
4. Other Individual Horizontal Piping: Series C-711 hangers 3 inches and smaller. C-710 hangers 4 inches and larger.
5. Other Individual Grouped Piping: Horizontal channel Superstrut A-1200 series with Series 702 straps.
6. Risers: Series C-720 at each floor.
7. Beam Clamps: No. U501, U520 symmetrical beam clamps.
8. Install pipe rollers for pipe subject to expansion and contraction.

    a. No. C728 for trapeze supported pipe.
    b. No. C729 for individually supported piping that is seismically braced.

9. Pipe Risers: Provide with bearing plates and two layers of 1/4- inch thick ribbed or waffled neoprene pad loaded to not more than 50 psi. Separate isolation pads with 1/4-inch steel plate. Weld pipe riser clamps at anchor points to the pipe and to pairs of vertical acoustical pipe anchor mountings which, in turn, rigidly fasten to steel framing.
10. Duct Risers: Provide duct riser supports within shafts with suitable bearing plates and two layers of 1/4-inch thick ribbed or waffled neoprene pad loaded to not more than 50 psi. Separate the isolation pads with 1/4-inch steel plate.
11. Dielectric Isolators: All uninsulated copper tubing systems. Use Superstrut isolators, Cush-A-Strip or Cush-A-Clamp on all pipe clamps. For individual hangers, use felt lined hangers.

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12. Miscellaneous Steel: Provide miscellaneous steel members, beams, brackets, etc., for support of Work of this Division unless specifically included in other Divisions.
13. Vibration Isolation elements of supports for piping, equipment and seismic bracing: As specified in Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
14. Safety Hanger Wires:

    a. Furnish and install safety hanger wires for air diffusers and other mechanical units weighing less than 56 pounds per unit.

        1) As part of Work under this Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC), connect safety wires to mechanical diffusers and equipment.
        2) Where units are mounted on suspended-grid ceiling systems, connect under Division 09.

    b. Provide approved hangers as required by latest CBC chapter 16.
    c. In advance of ceiling hanger-wire work, provide to jobsite layouts or instructions necessary for proper installation of safety wires.

B. Pipe and Equipment Wrapping and Coating:

1. The Manville Company No. 22 primer adhesive.
2. The Manville Company V10-20, 20-mil thick polyvinyl tape.
3. Standard X-Tru-Coat and Thermofit 25-mil extruded polyethylene.
4. Koppers Bitumastic 70-B enamel.
5. Permacell UG pipe tape.

C. Insulated Pipe Supporters:

1. Insulation Shields: 360-degree insert of high density, 100 psi, waterproofed calcium silicate, asbestos-free, K=0.38, encased in a 360-degree galvanized sheet metal shield, ASTM A-527.

    a. Pipe supported on rod hangers: Use Models A1000, A2000, A3000, A4000 and A9000.
    b. Pipe supported on flat surfaces: Use Models A1000, A2000, A5000, A6000 and A7000.
    c. Pipe supported on pipe rolls: Use Models A3000, A4000, A5000, A6000 and A8000.
    d. Model designations are by Pipe Shields, In. or equal.

2. Insulation Saddles: 20-gauge galvanized sheet metal. Superstrut 180 degrees C-790. Saddle length not less than three times the insulation outside diameter; 12 inch minimum length at each hanger.

D. Escutcheons, Flashings and Sleeves:

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1. Escutcheons:

    a. One-piece Grinnell, or Beaton-Corbin; Fig. 2 for copper tubing; Fig. 13 for steel pipe, polished chrome plated brass plates with round head set screws. Spring clips not acceptable. Provide at all exposed piping penetrations of walls, floors and ceilings. "Exposed" means all finished rooms, including storage, janitor and mechanical rooms. Where piping is insulated provide escutcheons to fit insulation outside diameter. Where piping requires special escutcheon sizes, manufacture from stainless steel.
    b. Escutcheons shall be of sufficient outside diameter to cover sleeve opening and fit snugly around pipe. Provide special deep escutcheons where necessary to cover beads of fittings or sleeves extending through floors.

2. Flashings: Flash and counterflash watertight all pipe and duct penetrations of roofs and exterior walls. Pipes through roofs with M.D. Products No. 65; No. 67 with vandal caps for vents; provide counterflashing sleeves. Other flashings shall be 24 gauge galvanized sheet metal. In accordance with Division 07.
3. Make penetrations through any dampproofed/waterproofed surfaces dampproof/waterproof by appropriate means to maintain integrity of system penetrated. Includes penetrations caused by hangers suspended off such surfaces.
4. Sleeves:

    a. Through Interior Concrete Walls and Floors: "Adjust-to-Crete," or A.M.I., telescopic, submerged adjustable sleeves. Pack annular space between pipe and sleeve tight with fiberglass. Seal both sides with mastic for floor sleeves.
    b. Through fire walls or floors, or lightproof or soundproof walls, floors and partitions: Pack space between sleeve and pipe or insulation with non-shrink grout, ceramic fiber, neoprene coated rope or other approved sealant materials. Install rigid calcium silicate insert on insulated pipe. Approved prefabricated assemblies, Pipe Shields or equal.
    c. Provide pipes passing through floors, walls, partitions, roofs or concrete beams with sleeves having internal diameter 1 inch larger than outside diameter of pipe, or of insulation on covered lines, except for sleeves connecting buildings which shall be 1-1/2 inch larger.
    d. Sleeves through outside walls or through slab-on-grade, except soil pipe through slab: Schedule 40 galvanized steel pipe with anchor and waterstop plate and 150 pound galvanized steel slip on welding flange welded at center of sleeve painted with one coat of bitumastic paint inside and outside. Provide a water tight penetration using prefabricated seals, Thunderline Link-Seal or equal. This paragraph does not apply for sleeves connecting buildings.
    e. Terminate sleeves flush with walls and ceilings. Where vertical pipes are exposed, extend sleeves 1 inch above finished floor except where escutcheons are required.
    f. Sleeves passing through roof construction: Extend minimum 8 inches above roof, flash and sealed watertight with safe support of conduit and equipment furnished under each division.
    g. Sleeves through interior walls other than masonry or concrete: 12 gauge galvanized sheet steel, set flush with finished surfaces of partitions.

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h. Sprinklered Areas: Provide water-tight joint between floor and pipe or conduit passing through it by using pipesleeve projecting 3 inches to 6 inches above the floor in accordance with NFPA 13, latest edition , caulked at the top of the sleeves with oakum.
i. Sleeves passing through membrane waterproofing or lead safe: Provide 16 ounce soft sheet copper or four pound lead flashing extending 12-inches beyond sleeves in all directions; secure to waterproofing or lead safe, turn down flashing into space between pipe and sleeve; insert oakum gasket, pour lead, caulk water-tight.
j. Un-insulated copper pipe through ferrous sleeves or in contact with cement or concrete: Wrap pipe with two layers of heavy plastic protective tape. Finish wrapping flush with sleeve ends.
k. Insulated piping or ductwork through sleeves shall have uninterrupted insulation inside sleeves or openings. For underground penetrations stop insulation at seal.
l. Separate piping through walls, other than concrete walls, from contact with wall construction materials with nonhardening caulking and non-shrinking acoustical caulking.

5. Floor penetrations and fire and smoke rated wall penetrations: Division 07 – Thermal and Moisture Protection and as follows:

a. Acceptable manufacturers: Pipe Shields, Inc., ProSet "Firestop Penetrators", or equal.
b. UL or State Fire Marshal (SFM) listed. Furnish listing number and demonstrate SFM approval.
c. Manufactured, pre-engineered, fire-rated pipe sleeve kits shall be provided for all fire wall and deck penetrations.
d. Sleeve and packing shall have the same fire rating as the partition construction in which they are installed.
e. Bare pipe:

1) All steel pipe or copper tubing penetrating fire walls or decks shall be encircled by sheet metal sleeves, minimum 24 gauge, sized for maximum one inch annular spacing between pipe and sleeve. Pack spacing on each end with UL rated ceramic fiber strip insulation.
2) Pipe Shields, Inc. Models F3000, F3200, F3400, F3600, F6000, F6200, F9000 and F9200, or equal.

f. Insulated pipe:

1) Same as for bare pipe, but with the addition of a 360-degree cylinder of waterproofed calcium silicate insulation encasing the pipe and covered with a galvanized sheet metal shielding, all sized to extend to a minimum of one inch beyond wall or deck.
2) All insulated fire-rated wall penetrations shall have the insulation shield grooved if pipe is heat-traced and the groove reinforced as necessary for seismic loading.

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3) Pipe Shields, Inc. Models F1000 through F1600, F2000 through F2600, F4000 through F5200, and F7000 through F8200, or equal.
4) Pipe Shields, Inc. Models F1800 and F2800, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Properly support all material, equipment and apparatus. Minimum safety factor of 5, based on ultimate tensile or compressive strength, as applicable, or material used. Turnbuckles and rod couplings capacity not less than attached rod. Calculate with equipment and piping full of water.

B. Use properly manufactured supports throughout. Do not use makeshift materials such as wire, tape, wood blocks, etc.

C. Comply with applicable requirements of ASME B31.1 and B31.9 for piping.

D. Trapeze hangers may be used for parallel lines if pipes pitch same direction. Size trapeze channel assembly in accordance with manufacturer's published load ratings. Deflections shall not exceed 1/360 of a span (refer to Superstrut load tables).

E. Do not cut or weld to any structural steel without permission of Owner’s Representative.

F. If not specified to be isolated by other means, isolate pipe supported by clamps or hooks from supports and building construction with felt.

G. Clamps shall not anchor piping unless specifically used as part of an anchoring system.

H. Supports from wall shall be steel brackets, hooks or clamps attached to wall structure with anchor bolts.

I. Install riser clamps at each floor and other locations as required by Code.

J. Resiliently isolate any bare copper piping with pipe insulators to prevent steel to copper contact.

K. Fabricate special pipe support systems and racks from steel angle or section and in accordance with Division 05 – Metals.

L. Pipe Hanger Spacing:

1. Support vertical risers at their bases and at each floor minimum. Copper piping less than 1-1/2 inch diameter and steel piping less than 3/4-inch diameter shall have one intermediate support between floors.

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2. Support every pipe branch over three feet long.
3. Support horizontal as follows:

Pipe Size (Inches)	Clamp (Super-strut)	Rod Size (Inches)	Center to SCH 40 Steel Stainless	Copper	Cast Iron (Feet)	PVC SCH 40	PVC SCH 80
1/2-1	C-711	3/8	8	6	-	4	4
1 1/4 - 1 1/2	C-711	3/8	8	8	10	4	6
2	C-711	3/8	10	8	10	4	6
3 - 4	C-711	1/2	12	12	10	4	6
5	C-710	5/8	14	12	10	4	8
6	C-710	3/4	14	12	10	4	8

4. Support any cast-iron piping with no fewer than two supports each section and within 18 inches from both sides of each joint. Maximum 5 foot intervals except for pipe exceeding five foot length; provide supports at intervals equal to pipe length but not exceeding ten feet.
5. Install hanger within 12 inches of each change of direction and for each branch 5 feet and longer.
6. Support refrigerant piping within 6 feet of equipment and within two feet of each bend or angle.

M. Adjust each hanger to carry its proper share of load.

N. Support piping below any ductwork from wall or trapeze with hanger rods outside of ductwork.

O. Support piping including valves, specialties, etc., independently of equipment; no piping weight or stress due to expansion, construction shall be transmitted to equipment. Contractor shall be responsible for proper alignment of piping at equipment in all conditions (maximum hot to minimum cold); install anchors, guides, bracing and spring supports as required. Flexible connections, expansion joints' deflections shall be always within allowable limits. Do not install piping at equipment until inspected for alignment at extreme temperature conditions.

P. Pre-insulated pipe supports shall be installed while the pipe is being erected.

1. Pipe Guides: Flexonics or Metraflex. Sizes suitable to receive insulation.

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Q. Thrust Blocks:

1. All buried pressure piping with friction type joints (bell and spigot, Tyton, etc.) shall have adequate concrete thrust blocks installed at each change of direction (horizontal, vertical), at each tee and dead end. Anchor pipe at entrance to building.

R. Wrapping and Coating Installation:

1. Buried piping: Wrap all uninsulated, buried, steel and copper piping and fittings as follows:

a. Thoroughly clean piping and fittings of loose scale, rust, dirt, oil and grease before wrapping. Wire brush as required; use solvent for removal of oil and grease.
b. Coat with primer adhesive.
c. Wrap with polyvinyl tape. Stretch tape tight during application. Overlap tape to result in double thickness.
d. Check all wrapped pipe with electric type holiday tester. Patch holidays prior to backfill and/or pour.

3.2 PRE-INSULATED PIPE SUPPORT AND SHIELDS

A. Insulated pipe supports shall be supplied and installed by the Mechanical Contractor on all insulated pipe and tubing. Insulated pipe supports shall be manufactured by Pipe Shields, Inc. or equal.

B. All insulated pipe supports shall be load rated. Load ratings shall be established by pipe support manufacturer based upon testing and analysis in conformance with the latest edition of the following codes: ASME B31.1, MSS SP-58, MSS SP-69 and MSS SP-89.

C. All insulated pipe supports shall have Calcium Silicate insulation and galvanized steel jackets. Pipe supports for use on flat surfaces shall have integral load distribution plates coated with zinc primer minimum 3 mils thick.

D. Approved Insulated Pipe Supports

1. Pipe supported on rod hangers - use Models A1000, A2000, A3000, 4000 and A9000.
2. Pipe supported on flat surfaces - use Models A1000, A2000, A5000, A6000, A7000, A7200 and A7400 Series.
3. Pipe supported on pipe rolls - use Models A3000, A4000, A5000, A6000, A8000, A8200 and A8400 Series.
4. Model designations are by Pipe Shields, Inc. Use only models designed for service for which supports are to be used.

E. Anchors and Guides: Provide anchors and guides where indicated on the Drawings and as required. Structural inserts shall be high density calcium silicate compressive strength 600 psi. Guide slide pads shall be teflon. Contractor shall ensure that slide accommodates pipe

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movement over full range of service and out-of-service temperatures. Guides shall be Pipe Shields, Inc. Model #B3000 or equal. Anchors shall be Pipe Shields, Inc. Model #C4000 or equal. All steam and condensate pipework supports shall be provided with guides.

F. Hangers and supports shall fit outside of all pipe insulation and insulation inserts. Provide pre-insulated pipe supports as specified and install per manufacturer's installation instructions. Shield lengths and gauges shall also be per manufacturer's recommendations.

G. Tape all butt joints where pipe insulation butts up against hanger shield.

1. On hot pipe, apply three inch wide vapor barrier tape or band over the butt joint.
2. On chilled water piping, apply a wet coat vapor barrier lap cement on all butt joints and seal the joints with a minimum of three inch wide vapor tape or band.

H. For additional requirements refer to Section 23 05 48.

END OF SECTION

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SECTION 230548

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL

A. Description
1. Vibration isolation for all piping, ductwork, rotating equipment, inertia bases and equipment support frames, including resilient attachments.
2. Selection, engineering and incorporation of all bracing, anchorage and seismic restraints for all vibration isolated and non-vibration isolated equipment, piping, ductwork and in-line devices. Such restraints shall not reduce the vibration isolation capabilities of the system.
3. Supervision and inspection of installed vibration isolation hardware.

B. Quality Assurance
1. Design Criteria:

a. Vibration Isolation: Provide isolation to avoid excessive noise or vibration in the building due to the operation of machinery or equipment, or due to interconnected piping, ductwork or conduit.
b. Anchorage and Bracing: Anchor, support and brace all equipment, piping and ductwork to resist seismic forces in accordance with requirements for anchorage bracing as specified.

2. Testing Laboratory:

a. Testing Laboratory shall test expansion bolts as specified in Division 05 – Metals.

3. Requirements of Regulatory Agencies:

a. CCR – California Code of Regulations, Title-24, Building Standards

4. Reference Standards:

a. SMACNA - Sheet Metal and Air Conditioning Contractors National Association.

1) "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems".

b. Codes and Standards for Noise Control:

1) ADC 1062R-4: Air Diffusion Council: Certification Rating and Test Manual
2) ANSI S1.13: American National Standards Institute: Measurement of Sound Pressure Levels
3) ARI 575: American Refrigeration Institute: Measurement of Sound in Equipment Rooms
4) ARI 443: American Refrigeration Institute: Standard of Sound Rating of Fan Coil Air Conditioners

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5) ASHRAE 36-72: American Society of Heating, Refrigeration and Air Conditioning Engineers: Determination of Ventilating Equipment Sound Power
6) AMCA 300: Air Moving and Control Association: Determination of Fan Sound Power Levels
7) ASTM E477: American Society for Testing and Materials: Test of Duct Lining and Silencer Performance
8) ASTM C423: American Society for Testing and Materials: Method for Measuring Sound Absorption
9) ASTM E90: American Society of Testing and Materials: Method for Measuring Sound Transmission Loss
10) STM E413: American Society of Testing and Materials: Determination of Sound Transmission Class
11) SMACNA: Sheet Metal and Air Conditioning Contractors National Association

5. Acoustical Testing/Quality Assurance:

a. The contractor shall cooperate with regard to sound tests (ARI 575, ANSI S1.13), which may be conducted by the Owner of his representative to verify that noise criteria are met.
b. The contractor shall notify the Construction Administrator of any changes, which will affect the acoustical performance.

C. Design Responsibility
1. Design support and anchorage systems in accordance with procedures indicated herein and in Division 01 – General Requirements.
2. See structural engineer's drawings and specifications for wind and seismic design requirements for project.
3. See acoustical engineer's report for requirements related to product performance.

D. Submittals
1. Submit engineered anchorage and bracing shop drawings and calculations in compliance with the CBC chapter 16 and section 17 08 .5 with stamped and signed by a California-registered Structural Engineer for all equipment/piping/ductworks. Calculations shall clearly show equipment weight, equipment center of gravity, location of attachment to the structure, and the seismic and gravity forces at each attachment location. Include designs for the attachment of the equipment or equipment support base to the structure, and the equipment to the support base.
2. Note compliance with seismic code regulations and the project specification on the submittals.
3. Submit, in drawing plan form, exact location and weight at each support point for floor mounted and suspended HVAC equipment and piping larger than 2 1/2 inch diameter. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
4. Submit record drawings reflecting actual conditions.
5. Submit for each isolator

a. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Calculation should substantiate, size, quantity, location, and connection to structure. Include rated load, rated deflection, and overload capacity.

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b. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic forces required to select vibration isolators and restraints and for designing vibration isolation bases.

1) Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors

c. Complete manufacturer's description.
d. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required
e. Actual loading at each isolator for floor mounted and suspended equipment and all vibration isolated piping.
f. Static deflection, spring outside diameters and free, operating and solid heights of coils

6. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
7. Submit vibration isolation for all equipment in one package, not as part of equipment submittals. All isolators shall be of one manufacturer. Contractor to provide schedule of vibration isolators and their corresponding equipment for review by the Acoustical Consultant. Changes to vibration isolation schedule must be approved by the Acoustical Consultant.
8. Shop Drawings:

a. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
b. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

9. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

E. Coordination
1. Coordinate size, shape and location of concrete pads with 03 30 00 – Cast-in-Place Concrete.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Vibration Isolation Manufacturers
1. Mason Industries
2. Kinetics Noise Control, Inc.
3. M.L. Saussé & Co. (Vibrex)
4. California Dynamics Corporation
5. or approved equal.

B. Supports:

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1. Superstrut
2. Unistrut
3. Fee & Mason
4. Cooper B-Line TOLCO
5. Hilti, Inc.

2.2 VIBRATION ISOLATION

A. General: Provide only products furnished with calculations demonstrating compliance with the requirements of regulatory agencies.
   1. Isolators shall be selected by the supplier, even if sizing is shown. Size vibration isolators on single piece of equipment for equal static deflections based on actual static and dynamic weight distribution per point of support furnished by equipment manufacturer. Dynamic loads include those due to: wind, fluid flow, thrust and rotations inertial. Select each isolator independently for the load distribution on the equipment base, duct or pipe support.
   2. In determining weight of equipment, include concrete inertia bases, grout filled pump bases, etc.
   3. All static deflections are nominal. Actual installed deflections are to be +15 percent of the specified value.
   4. Where static deflections are not specified, provide minimum 2 inch deflection for rotating and reciprocating equipment.
   5. Equipment requires a minimum of four isolators, one at each corner.
   6. Vibration isolators shall have either known height without a load or other markings so that after adjustment, when fully loaded, the deflection can be verified.
   7. Incorporate a resilient neoprene element of 1/4-inch minimum thickness on spring hangers to prevent solid contact between the spring and isolator housing.
   8. Install thrust restraints on fans over 3 inches wg static pressure with the same deflection as isolators supporting the fan.
   9. All spring isolators laterally stable with leveling bolts. Spring isolators minimum additional "travel" to full compression of half the rated deflection. The ratio of lateral to vertical stiffness shall be 0.9 minimum and 1.5 maximum.
   10. Provide all floor-mounted spring isolators with mounting base plates that provide for bolting to the floor and incorporate 3/4-inch thick neoprene bearing pads.
   11. Provide EPDM or equal elastomeric elements in place of neoprene on all vibration isolators installed outdoors.
   12. Provide neoprene material with anti-ozone and antioxidant additives.
   13. Supply all miscellaneous steel to make support compatible with equipment.
   14. Confirm seismic calculations and compatibility with particular equipment to be installed. Submit seismic calculations.
   15. Mount motors on rigid base common with equipment or supported from equipment frame.
   16. Snubbers must not limit vibration isolation capability during normal operation. Where steel limit stops are used, provide 1/4-inch thick neoprene to prevent metalto-metal impact.
   17. Vibration isolation manufacturer representative to supervise and inspect all installed isolation hardware and generate punchlist for Construction Administrator along with corrective measures required. Submit inspection report.
   18. Isolate duct and pipe risers with 3/4-inch waffle pad or neoprene munt, unless specified otherwise.

B. Isolator types: Type of mounting and supporting base and minimum static deflection, as scheduled and required. Mason model numbers used.

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1. Base mounts:

    a. Type NP: Neoprene pad. Waffle, ribbed, or other forms. Typically 3/4-inch thick. Durometers of 40 to 50. Static deflections from 0.125 inch. Provide steel load distribution plates. Size of pad to be specified by isolator supplier based on load per point. Provide grommetted bolt when anchoring. Mason "Super" W and WM.
    b. Type NM: Neoprene mounts. Molded one-piece assemblies with skid resistant base plates and mounting holes. Double deflection type with static deflection range from 0.3 to 0.5 inch. Coat metal surfaces with neoprene to prevent corrosion. Provide friction pad. Mason ND.
    c. Type SM: Spring mounts. Single or multiple bare steel springs, base plates with neoprene pad. Height saving mounting brackets where applicable, height adjustment bolts. Static deflection range from 1.0 to 5.0 inches nominal. Mason SLFH.
    d. Type USM: Unhoused spring mounts. Single or multiple bare steel springs, baseplates with neoprene pad. Height saving mounting brackets where applicable, height adjustment bolts. Static deflection range from 1.0 to 5.0 inches nominal. Mason SLR with C-spring.
    e. Type SML: Spring mounts, drop and rise limiting. Same as Type USM multiple spring with assembly fabricated to prevent rise or drop of greater than 1/4-inch when overloaded or when load removed. Withstand 0.5G acceleration in all directions. Mason, SLR.
    f. Type SSM: Seismic spring mounts. Single spring, leveling device, maximum 1/4-inch travel. Spring diameters no less than 0.8 of compressed height of spring at rated load. Minimum additional travel to solid equal to 50 percent of rated deflection. Spring inspection ports. Static deflection range from 1.0 to 5.0 inches nominal. Withstand 1.0G acceleration in all directions. Mason SSLFH.
    g. Type RSC: Roof spring curb. Roof-mounted spring curbs with continuous perimeter structural steel curb supporting laterally stable coil springs sitting on 1/4-inch neoprene pads. Springs vertically and laterally restrained using neoprene isolated bolts. Provide leveling bolts and cadmium-plated or galvanized hardware. Mason RSC.
2. Hangers:
    a. Type SH: Hangers shall consist of rigid steel frame containing a minimum 1-1/4” (32mm) thick LDS rubber element at the top and a steel spring with general characteristics as in specification B seated in a steel washer reinforced LDS rubber cup on the bottom. The LDS rubber element and the cup shall have molded bushings projecting through the steel box. In order to maintain stability the boxes shall not be articulated as clevis hangers nor the LDS rubber element stacked on top of the spring. Spring and hanger lower hole diameters shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30° capability. Hangers shall be supplied with a combination rubber and steel rebound washer as the seismic up stop for suspended piping, ductwork, equipment and electrical cable trays. Rubber thickness shall be a minimum of 1/4” (6mm). Submittals shall include a drawing of the hanger showing the installation of the rebound washer. Hangers shall be type RW30N as manufactured by Mason Industries, Inc.

3. Seismic Snubbers:

    a. Type SS: All-directional seismic snubber. Mason Z-1225 or equal.
4. Risers:

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a. Type RC: Vertical riser piping support/suspension. Pipe clamps supported on each side from structure through appropriate isolator and static deflection as specified in Section 15 14 0. Single point of support desired. Multiple points of support acceptable, but must be engineered, complete with detailed installation and adjustment instructions by supplier.
b. Type DS: Vertical duct risers in shafts. Support with appropriate isolator as specified in Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
c. Type RG: Vertical riser guides. Double deflection neoprene guides at mid or multiple locations along riser to preclude swing motion. Points to comply with local codes regarding normal attachment points. Mason PRG.

5. Resilient attachments:

a. Type RA-1: 3/4-inch nominal thickness resilient pipe sleeve between pipe and clamp or hanger. 80 degrees F, except in plenums: Armstrong Armaflex, Manville Aerotube or approved equal.

b. Type RA-2: Manufactured insulated hanger for uninsulated pipe: Superstrut P/A-716 Cush-AClamp, Unistrut, B-line or approved equal.
c. Type RA-3: Manufacturer resilient attachment for water pipes 1 inch and less diameter: Technical Specialties Acousto-Plumb System (orange and blue).

6. Other Supports:

a. Type A: Pipe anchors, vertical or horizontal. Resilient anchor points in piping to preclude direct contact of piping with structure yet provide a neutral point for expansion/contraction or piping. Mason ADA.
b. Type T: Trapeze. Supporting sling of steel member with mount or hangers at each end. Used to distribute load or to conserve space.
c. Type S: Stanchion support. A supporting arm or system for equipment or piping between the isolator and load.
d. Type "cable" seismic restraints shall be constructed of 7 x 19 strand galvanized aircraft cable. Cable assembly shall come compete with two "U" bolt clamps per end. Allowed loads shall contain a safety factor of three when worse-case loading applied to one cable. Cable shall be installed with 1/4-inch slack to prevent the transmission of vibration to the structure.

7. Bases:

a. Type SF: Structural steel integral frame of wide flange (W) or junior beam (M) members. Rigid fabrication to preclude deflections or frame distortion under dynamic load. Motor mounts, base plate mounts, stanchion support for piping or as shown on Drawings for equipment, pumps, fans, etc. Brackets to prevent drop of frame more than 3/8-inch. Thickness minimum 8 percent longest dimension. Mason WFSL. Space between bottom of base and floor to be at least 1 inch.
b. Type B: Brackets to equipment. Height saving brackets attached directly to equipment where rigidity of same does not require supplemental frame. Drop protection as for Type SF. Mason.
c. Type IB: Inertia base frame. Welded steel frame with rebar reinforcement and height saving brackets. Provision for air decoupling holes on large units. Unit delivered ready for assembly. Pour of concrete by General Contractor. Preset equipment mount attachment bolts or other hold down methods for equipment involved. Space between bottom of base and floor to be at least 2 inches. Minimum weight equal to one to two times weight of equipment or as noted. Thickness minimum 8 percent largest dimension. Mason KSL.

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C. Pipe and Duct Seismic Supports:
1. Provide products with current calculations demonstrating compliance with regulatory requirements. Only known complying systems are SMACNA "Guidelines for Seismic Restraint System," pre-approval No. R- 0010 and "Superstrut Seismic Restraint System," pre-approval No. R-0003, and "B-Line Seismic Restraint System," preapproved No. R-0071.

D. Expansion Bolts: As specified in Division 05 – Metals.

E. Flexible connections
1. For pipes: Twin-Sphere rubber connection, equal to Mason Safeflex
2. For ductwork: bellows type canvas for ducts
3. Metal braided hose pipe connectors are not considered acoustically flexible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Suspend the vibration isolators supporting piping ductwork and equipment from structural members.
2. Provide 2 inches minimum clearance between the top of the housekeeping pad or floor and the underside of concrete inertial pads and/or steel equipment support frames.
3. Fasten all vibration isolators to the structure, not to floor diaphragms or lightweight components. Use bolts where holes are provided in the mounting flanges; otherwise, adhere using structural adhesive. Where mounting flanges are steel, use neoprene grommets and washers under anchor bolts.
4. Do not use vibration isolation components to straighten or connect misaligned sections of piping or ductwork.
5. Align spring isolation hanger rods to clear the hanger box under all operating conditions.
6. Any bracing or supports for mechanical ductwork, piping, and equipment shall not bridge or reduce the effectiveness of vibration isolators.
7. Level vibration isolated equipment under rated design operating conditions while maintaining the isolation criteria. Isolators shall be plumb and aligned to preclude misalignment or undesired contact during operation.
8. Piping and ductwork to be isolated must pass freely through walls and floors without rigid connections. Maintain ¾-inch to 1¼-inch clearance around outside surfaces of piping or ductwork at penetration points. Pack this clearance space tightly with fiberglass, and provide acoustical sealant, as required) around entire perimeter to provide an airtight seal. Provide supports 6 to 8 inches from walls or partitions on both sides of penetrations.
9. Do not make rigid connections between equipment and building structure that degrades or short circuits the vibration isolation system specified herein.
10. Provide flexible connectors to all other connections to vibration isolated equipment such as condensate drains, and other piping as allowed by codes and/or local authorities. Braided steel flexible connectors shall not be acceptable.
11. Loop electrical circuit connections to isolated equipment to allow free motion. Include at least one slack 90° bend.
12. Install isolators with the isolator hanger box attached to, or hung as close as possible to, the structure. Provide outrigger supports where required for clearance to equipment and to maintain minimum clearance of equipment to structure above.
13. Align hanger rods to clear the hanger box. Replace bent rods.

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14. Suspend horizontal pipe 2 inches and smaller by means of Type E isolator with a minimum 0.25 inch deflection. Support pipe larger than 2 inches by isolator Type C with a minimum 1½-inch static deflection.

B. Equipment:
   1. Equipment vibration isolation selection as indicated in project drawing set.

C. Piping and Ductwork:
   1. Support and brace all piping and ductwork as required in CBC.
   2. Use trapezes for vertical support to horizontal piping only. Brace trapeze with an pre-approved bracing system or provide calculations demonstrating compliance with regulatory requirements.
   3. No electrical conduit, fixture, ceiling suspension wires or other elements of the building construction attached to or abutted against the duct and piping systems.
   4. Where duct and piping penetrate sound-isolation partitions, caulk the penetration airtight with acoustical sealant. For indoors, provide non-toxic sealant approved for indoor use.
   5. Contain rough-in of piping within stud wall cavities no less than 1/4-inch from the plane of the studs and 1 inch from gypsum board or other wall sheathing.
   6. Install flexible connections at all connections to vibration isolated equipment, rotating, reciprocating and other vibrating equipment, all pumps, whether isolated or not and at all air handlers whether internally isolated or not.
   7. All piping over or adjacent to occupied spaces shall be resiliently mounted with bushing clips and with spring vibration isolated.

D. Piping:
   1. Comply with requirements in MSS SP-127.
   2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   3. Brace a change of direction longer than 12 feet.
   4. Do not suspend piping from ducts, conduits or related supports.
   5. Isolate pipes 3 inches in diameter and greater attached to the inlet and discharge of prime movers, rotating and reciprocating equipment and pressure-reducing valves using Type SSM or SH isolators. One inch static deflection within 25 feet acceptable from the inlet and discharge.
   6. Isolate pipes less than 3 inches in diameter attached to prime movers, rotating and reciprocating equipment and pressure reducing valves for a minimum of 100 feet from the inlet and discharge. Use Type NH isolators for vibration isolation hangers and Type NM for floor-supported mounts. Static deflection of 0.35 inches. Use Type NP resilient pads under pipe elbows supported from the floor.
   7. Isolate all individual pipes using Type RA-1 resilient attachments in walls and Type RA-2 attachments for uninsulated pipe beneath slabs and above ceiling.
   8. Isolate all grouped pipes adjacent to or above occupied spaces by using Type NH vibration isolators supporting trapeze hangers. Static deflection of 0.35 inches. Isolate grouped floor-supported pipes using Type NM isolators having a static deflection of 0.35 inches. Where vertical orientation of the isolator attachment base is required, use "SNM" vibration isolator.
   9. Provide flexible connectors in inlet and discharge piping systems for pumps having concrete inertial bases and where indicated on the Drawings.

E. Ductwork:
   1. Sheet metal band supports are not permitted on ducts suspended on vibration isolators. Use threaded rods, or other indicated support.
   2. Do not suspend ducts from piping, plumbing, conduits or related supports.

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3. Incorporate flexible connections in ductwork adjacent to all equipment.

F. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

G. Adjusting:
1. Adjust isolators after equipment or piping and ductwork is at operating weight.
2. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
3. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

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SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL

A. Description

1. All HVAC piping, ductwork and equipment shall have identification markers.
2. Pipe markers shall comply with ANSI A13-1, Scheme of Identification of Piping Systems (OSHA).

B. Submittals

1. Submit product data under provisions of Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.
2. Submit full size nameplate and tag samples. Samples will be returned after approval.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S IDENTIFICATION

A. Manufacturer's nameplate, name or trademark shall be permanently affixed to all equipment and material furnished under this Division. The nameplate of Subcontractor or Distributor is not acceptable.

B. Identify model number, size, capacity, electrical characteristics, serial number, etc.

C. Leave nameplates clean, legible and with unobstructed view.

2.2 EQUIPMENT IDENTIFICATION

A. Equipment nameplates shall be 1 inch high, 1/16-inch thick, three layer black laminated plastic plates with 3/4-inch high white lettering engraved through the black layer. Four edge bevel. Confirm nameplate nomenclature with Owner’s Representative.

B. Equipment identification shall be embossed aluminum or engraved plastic securely attached to each piece of equipment.

C. Secure nameplate to each starter, switch, relay, transformer, etc. that controls the equipment.

D. Nameplate notations shall correspond to those appearing on operating instructions and Drawings.

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2.3 PIPE IDENTIFICATION

A. Identify with symbol identification and color-code all piping. Provide directional arrows on circulating systems separate from and adjacent to each identifier. Identification shall be in conformance with ANSI A-13.1

B. Submit one 8-1/2 inch by 11 inch sample of each color for review prior to installation.

C. Plastic Markers: Brady Perma-Code or Setmark Type "SNA" self adhesive markers. Each marker shall show accepted color-coded background, proper color of legend in relation to background color, accepted legend letter size, accepted marker length. 1. 2 inch letter size for pipe or insulation 3 inches or larger. 1 inch letter size for pipe or insulation 2-1/2 inches or smaller.

D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mils thick, manufactured for direct burial service.

E. Color Coding:

Service	A.S.A. Color Background	Color Of Letter
Electric Conduit	Gray	Black
Heating Hot Water Return	Yellow	Black
Heating Hot Water Supply	Yellow	Black

2.4 DUCTWORK IDENTIFICATION

A. Duct markers shall be stenciled onto insulation of duct with legend and flow arrow. Letters shall be 2 inches high.

2.5 VALVE IDENTIFICATION

A. Attach to hand wheel or stem of each control and line shutoff valve installed under this Division, with heavy brass "S" hook, color-coded plastic laminate or brass identification tag. Engrave laminate tags with 1 inch high designating numbers, in accordance with typed schedule required below.

B. Engrave identification tags with "N.O.” for normally open (green) or "N.C.” for normally closed (red). Engrave Cv value on control valve tags.

C. Brass tags with stamped letters. Tag size minimum 1-1/2 inch diameter or square with smooth corners.

2.6 VALVE AND EQUIPMENT CHARTS

A. Provide typewritten schedule listing numbers, service, locations, sizes, Cvs, and notations of open or closed, of all tagged valves. Enclose schedule in transparent plastic binder. List piping systems with symbol and color coding on pipe identification chart. List valve model numbers

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and symbol for service corresponding to piping symbol on valve identification chart. Provide small "key plan" identifying valves as related to column lines.

B. Submit drafts of valve schedule for review before preparing final sets.

C. Provide typewritten list of equipment, indicating location and service for each piece of equipment.

2.7 CONTROLS

A. Provide engraved plastic laminate identification of function on switches and manually operable controls, including switches furnished under another Division.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials of any materials that will prevent paint to marker adhesion.

3.2 EQUIPMENT IDENTIFICATION

A. Properly identify each piece of equipment and controls pertaining thereto by nameplates mounted on equipment and controls using round head brass machine screws, pop rivets or contact cement. Cardholders in any form not acceptable.

B. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

C. Place warning signs on machines driven by electric motors which are controlled by fully automatic starters, in accordance with Article 3281, General Industry Safety Orders.

D. Identify air handling units, fans and pumps with area served.

E. Small devices, such as inline pumps, may be identified with tags.

F. Identify control panels and major control components outside panels with plastic nameplates.

G. Identify equipment out of view behind access doors, in unfinished rooms on the face of the access door.

3.3 IDENTIFICATION SCHEDULE

A. Refer to Section 09 91 00 – Painting and Coating.

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3.4 DUCTWORK IDENTIFICATION

A. Provide identification of all supply, return and exhaust air ducts by means of stenciled lettering identifying contents and direction of flow.

B. Colors: Black lettering on white background.

C. Locations: Stencil identification in ducts coming out of shaft at each floor and in equipment rooms and every 30 feet of duct.

D. Application: Apply to clean surfaces free of dust, grease, oil or any other material which will prevent paint adhesion.

3.5 PIPING IDENTIFICATION

A. Apply markings only after insulating, cleaning, and painting of piping is complete.

B. Secure each end of marker with 2-1/4 inch wide Brady or equal self sticking clear tape; wrap entire periphery.

C. Location for Pipe Identification:

1. Within one foot of each valve, fitting, thermometer or gauge.
2. At each branch and riser takeoff.
3. At each pipe passage through wall, floor and ceiling construction.
4. On all horizontal runs spaced 25 feet maximum but not less than once in each room at entrance and exit of each concealed space.
5. Where capped piping is provided for future connections, provide legible and durable metal tags indicating symbol identification.
6. At wall and ceiling access panels.
7. Practicable variations or changes in locations and spacing may be made with specific approval of the Owner’s Representative to meet specific conditions.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G. In finished areas, label exposed pipes or ducts only as directed by Owner’s Representative.

3.6 VALVE IDENTIFICATION

A. Tag all valves. Add numbers to the following prefixes:

1. Hot water heating valves – “HHW”

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B. Number tags to conform to directory listing number, location and use.

C. Secure tags to valves with approved corrosion resistant brass "S" hooks.

3.7 CONCEALED IDENTIFICATION

A. Provide color-coded ceiling tacks to locate VAV-boxes, fire/smoke dampers, valves, control devices, etc. or other approved label on each T-bar suspended ceiling push-out tile. Locate in corner of panel closest to equipment.

END OF SECTION

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SECTION 230593

TESTING, ADJUSTING FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide services and coordination required for completely balanced, tested and certified air and water systems. This includes reinstated sections of existing systems.

B. Pre-installation review of Project Documents to determine work to be performed or devices to be added to allow for proper testing, adjusting and balancing.

C. Minimum of three site visits to inspect installation prior to closing in portions of systems to be balanced and to report deficiencies that might impact testing, adjusting and balancing.

D. Test, adjust and balance air and water moving equipment and distribution systems. Complete and test all systems early enough to enable completion of balancing prior to Owner move-in.

E. During the warranty period, calibrate and adjust systems as required to maintain satisfactory space requirements.

1.2 QUALITY ASSURANCE

A. Testing Agency (General and Mechanical Systems):

B. Provide services of an independent agency, certified by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB), whose business is dedicated to the balancing, adjusting and testing of heating, ventilating, and air conditioning systems.

C. The agency shall provide proof of having successfully completed at least five projects of similar size and scope

D. The agency shall comply with all standards as set forth by the "Associated Air Balance Council" (AABC).

E. All Work by this agency shall be done under direct supervision of a qualified heating and ventilating engineer employed by them.

F. All instruments used by this agency shall be accurately calibrated and maintained in good working order.

G. Testing procedures shall be per the AABC standards and as specified hereinafter. Conduct tests in the presence of the Owner's Representative.

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1.3 REFERENCE STANDARDS:

A. General mechanical systems: Comply with applicable procedures and standards of "National Standards for Field Measurements and Instrumentation, Total System Balance" by the AABC.

B. SMACNA - Sheet Metal and Air Conditioning Contractors National Association

C. ASHRAE - Handbook of Fundamentals

1.4 SUBMITTALS

A. Submittals shall be made in accordance with Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.

B. Quality Assurance Submittal

1. Submit the name of selected Test and Balance agency for approval within thirty days after award of contract. If the Contractor fails to submit an acceptable agency within 30 days, Owner may select firm to accomplish the work. Selection is binding upon the Contractor at no increase in contract sum.
2. Submit documentation to confirm compliance with quality assurance provisions:

a. Organization, supervisor and personnel training, and qualifications, including registration of certified Test and Balance engineer.
b. Specimen copy of each of the report forms proposed for use. Forms shall be standard TAB contractor's forms.
c. General plan of testing procedures and sequences.
d. General description of each system with its associated equipment.

C. Pre-Construction Submittal

1. With the initial mechanical Shop Drawings and at least 60 days prior to starting field work, submit the following::

a. A set of report forms filled out with design values of equipment and air terminals.
b. A complete list of instruments proposed to be used, organized in appropriate categories, with data sheets for each. Show:

1) Manufacturer, model and serial number.
2) Description and use when needed to further identify the instrument.
3) Size or capacity range.
4) Latest calibration date and certificates of calibration.

c. A detailed description of the balancing and testing procedures. These procedures shall conform to AABC requirements and recommendations.
d. Written report, based on review of Drawings and Specifications, with suggestions for work to be performed or devices added to allow for proper balancing.

D. Inspection Reports

1. Within two work weeks of each site inspection, submit report to the Owner's Representative listing any deficiencies found that would preclude proper adjusting, balancing and testing.

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2. Final Submittal

a. The testing agency shall perform the tests described, compile the test data, and submit the following:

1) Complete test data typed in final form for forwarding to the Owner's Representative for approval.
2) Indicate supply, return and exhaust air flows and design balance CFM in a room-by-room format.
3) Fan and pump curves with design and actual operation points plotted.
4) Vibration report.
5) Written report as necessary describing any components, i.e. fan drives, dampers, pumps, valves, etc. that have not yet been installed or do not function properly.

E. Job Conditions

1. Prior to start of testing, adjusting and balancing:

a. Systems installation shall be complete and in full operation.
b. Close all windows and doors not used as part of the HVAC system.

2. Notification: Promptly report any deficiencies noted during performance of services. Rectify these deficiencies, and any tests interrupted shall be repeated.

F. Commissioning

1. The project will have selected building systems commissioned. See Division 01, 22, 23, and 26 Specifications for Commissioning requirements.

PART 2 - PRODUCTS

2.1 Products and materials as described in Part 1.3 of this Section and related sections.

PART 3 - EXECUTION

3.1 PREBALANCING REQUIREMENTS

A. See submittal and inspection requirements within this Section.

B. Check all motor starters to confirm heater size is correct. Take length of electrical feeder into consideration.

C. Install dampers, valves and other devices shown or specified for balancing. Provide and install additional devices required for proper balancing at no increase in contract sum. Assure devices are properly installed, indexed, and in good working order.

D. Complete or remedy punch list items impacting system balancing.

E. Lubricate all equipment in accordance with manufacturer's instructions.

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F. Test all systems.

G. Operate the systems for 72 consecutive hours without shutdown with equipment in perfect working order.

H. Place systems in automatic operation

I. Schedule the Work of other trades to assure uninterrupted access to systems and to eliminate system shutdown for any reason once balancing is started.

J. Air systems:

1. Align drives.
2. Set sheaves to provide indicated capacities at specified static pressures.
3. Set manual dampers to 100 percent open position.
4. Check all damper operations to ensure smooth, free activation by the proper controls.
5. Remove adjustable pitch pulleys from motor shaft; clean and lightly oil shaft and pulley threads; and remount, align and properly adjust pulley.
6. Drill 3/8-inch diameter holes in ducts for temperature, pressure and velocity readings. Remove burrs. Provide holes in drive guards that will permit tachometer readings without removing guards. Locate as specified hereinafter and as directed. Install replaceable rubber plug in each hole.
7. Clean interior of plenums, casing, coils and ducts; and install temporary and final filters before starting any systems.
8. Drill test holes in each side of each filter, fan, coil and multiblade damper; 12 inches on center for traverse readings in main ducts and as directed in the field. Turn at least ten extra plugs over to the Owner for use during balancing period.

K. Water systems:

1. Set balancing valves to 100 percent open position.
2. Remove, clean and replace strainer screens, vent air from piping, verify proper operation of automatic air vents.
3. Verify correct pump rotation.
4. Position normally open valves full open.
5. Examine water in system to determine if water has been treated and cleaned.

L. Advise Owner's Representative in writing when systems have been completed and tested and are ready for balancing.

M. Submit report on measured CFM, GPM, RPM, AMPS, inlet and outlet pressures of all equipment after testing and before balancing by Balancing Contractor.

3.2 INSPECTION

A. Review plans and specifications prior to installation of any of the affected systems. Prepare a schedule to inspect systems and equipment. Submit written report with suggestions for work to be performed or devices added to allow for proper balancing. Added devices shall be at no increase in contract sum.

B. The Test and Balance Agency shall visit the jobsite a minimum of three times during fabrication to inspect duct, pipe and equipment installation.

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1. Make all visits in advance of “closing in” portions of systems to be balanced (e.g. prior to shaft, wall and/or ceiling construction, etc). Coordinate visits to coincide with progress of relevant work.
2. After each visit, submit report to the Owner's Representative listing any deficiencies found that would preclude proper testing, adjusting and balancing.

3.3 INSTALLATION

A. Test Balance Service:

1. Perform analysis, test and balance services upon completion of air and water systems, after completion of general operating tests, Pre-balancing Requirements and after the Work specified above.

B. Performances and Capacity Checks:

1. Take readings as shown, specified and as required to demonstrate that all equipment, coils, terminal devices, controls, etc. are operating in accordance with scheduled, specified or manufacturer's published ratings.
2. Recommend adjustments and/or corrections to equipment, air and water systems necessary for proper balancing. Submit report to Owner's Representative.
3. Perform capacity checks of heating systems during the balancing period and again during a design day the following winter. Perform capacity checks for cooling systems during the balancing period and again during a design day the following summer.
4. Operating tests of heating and cooling coils, fans, pumps and other equipment shall be of not less than four hours duration, after stabilized operating conditions have been established. Capacities shall be based on temperatures and air and water quantities measured during such tests.

3.4 AIR BALANCING

A. Adjust all air handling systems to provide the required design air quantity to, or through, each component. Keep doors and windows not used as part of the HVAC system closed and all other ancillary systems in simultaneous operation. Balance under normal traffic conditions.

1. Balancing between runs (sub-mains, branch mains and branches): Use flow regulating devices at, or in, the divided flow fitting to the extent that adjustments do not create objectionable air motion or sound. Minimize restriction imposed by flow regulating devices, in, or at, terminals.
2. Final Measurements of Air Quantity: Make final measurements of air quantity, after the air terminal has been adjusted to provide the optimum air patterns of diffusion.

B. Air Measurements and Balancing:

1. Except as specifically indicated herein, make pitot tube traverses to measure air flow. Pitot tubes, associated instruments, traverses and techniques shall conform to those indicated in the ASHRAE Fundamentals Handbook.
2. Pitot-tube traverse may be omitted if the duct serves only a single room or space and its design volume is less than 500 cfm. In lieu of pitot-tube traverse, determine air flow in the duct by totaling volume of individual terminals served, measured as described herein.
3. Where duct's design velocity and air quantity are less than 800 (fpm/cfm), air quantity may be determined by measurements at terminals served.

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4. Test holes, ventlock type, to be in a straight duct, as far as possible downstream from elbows, bends, take-offs and other turbulence generating devices, to optimize reliability of flow measurements.
5. Use measurement of flow rates by means of velocity meters applied to individual terminals, with or without cones or other adapters, only for balancing. Determine measurement of air quantities at each type of air terminal (inlet and outlet) by the method approved.

C. Adjust air quantities to following tolerance:

1. Each outlet of 200 cfm or less: Minus 0 to plus 10 percent of design.
2. All other outlets: Minus 0 to plus 5 percent.
3. Each room with multiple outlets: Minus 0 to plus 5 percent.
4. Each floor or major zone: -0 to +10 percent of design.
5. Fans: -0 to +10 percent of design.
6. Temperature readings: Within 1/2-degree F.
7. Pressure readings: 0.02-inch W.G.
8. Under no circumstances can room pressure relationships change from that shown on drawings or required by Code, even if within specified tolerances (i.e. equal room cannot become negative or positive, etc.)

D. Adjust control sequence, setting, and operation of automatically controlled dampers for normal operating conditions. Plainly mark final position of manual dampers after balancing is complete. Perform air terminal readings in accordance with the recommendations of the air device manufacturer.

E. First utilize main dampers, then branch dampers. Use dampers behind grilles only as a final adjustment.

F. Make allowance for air filter resistance at time of tests. Air systems shall be tested at design air quantities. Pressure drop across filters within systems with variable speed drives shall be at the scheduled or specified “dirty” condition. Pressure drop across filters for systems with constant speed fans shall be at a condition midway between the design “clean” and “dirty” conditions.

G. As part of balancing procedures, set fresh air and return air dampers to put the entire system into operating balance as shown and required.

H. Take duct and outlet readings with Anemotherms or Alnor velometers. Take readings on large air intakes, coil banks and filter banks with anemometer. Take static pressure readings with Dwyer U-tube manometer No. 400 or equal. Electrical current readings to be made with clamp-on type ammeter.

I. Provide positive identification points of measurements such as a marked print.

J. Tabulated fan capacity may exceed summation of register and diffuser readings. Leakage allowance as specified in Section 23 31 00 – HVAC Ducts and Casings.

K. Provide additional dampers and pressure plates where required to facilitate balancing and to prevent damper, grille and diffuser noise. Provide at no increase in Contract Sum.

L. Check and adjust fan rpm to design requirements and record fan motor amperes.

M. Test, adjust and record system static pressures, suction and discharge ducts.

N. Test and adjust system for design, supply, recirculated, outside and exhaust air, cfm.

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O. Use manufacturer's ratings on all equipment to make required calculations.

P. Adjust diffusers and registers to eliminate drafts in all areas and result in uniform distribution.

Q. Verify leakage tests of all ductwork in accordance with paragraph titled, "Leakage Test" in Section 23 31 00 – HVAC Ducts and Casings.

R. Make adjustments to or change-out of the pulleys, belts, axial fan blade pitch and dampers, or the addition of dampers required for correct balance at no additional cost. RPM shown on drawings are for guidance only.

3.5 WATER BALANCING

A. Adjust all hydronic systems to provide required quantity to, or through, each component.

B. Initial Testing and Balance Procedure for Water Systems:

1. Balance hot/chilled water coils after balancing multiple coil sections for even water distribution through tubes.

C. Final Testing and Balance Procedure for Water Systems:

1. The testing agency shall perform the following test and adjustments upon completion of preparation and initial test:

2. After adjustments to coils and valves are made, recheck settings at the pumps and converters and readjust if required.

a. Read pressure drop through coils at set flow rate on call for full cooling or heating.
b. Adjust water quantities to the following tolerance:

1) Water flow: -5 to +5 percent of design.
2) Temperature: within 1/2-percent F.
3) Pressure: within 1/2-percent psi.

c. Measure water quantities and pressures with calibrated meters, if applicable:

1) Water measurements and balancing: Use venturi tubes, orifices or other metering fittings and pressure gauges. Adjust systems to provide the approved pressure drops through the heat transfer equipment (coils, cooling towers, etc.), prior to the capacity testing.
2) Where flow metering fittings are not installed, determine flow balance by measuring temperature differential across the heat transfer equipment. Perform measurement of temperature differential with the air system, adjusted as described herein, in operation.

d. Position automatic control valves for full flow through heat transfer equipment of the system during tests.
e. Adjust flow through by-pass circuits at three-way valves to balance that through the supply circuit.
f. Adjust distribution by means of balancing devices (cocks, valves and fittings) and automatic flow control valves. Do not use service valves for adjustment. Where automatic flow control valves are utilized in lieu of venturi tubes, record only

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pressure drop across the valves if said pressure drop is within the pressure drop rating.

g. Special procedures: Where available pump capacity is less than total flow requirements of individual heat transfer units of system served, full flow may be simulated by the temporary restriction of flow to portions of the systems.

h. Assure that all modulation control valves provide full throttling from wide open (design) flows to 100 percent shut-off. Verify control sequences, settings and operation to all automatic control valves.

i. Trim pump impellers to extent permitted to deliver the gpm equal to the lowest actual total systems head pressure.

j. Lock set points and plainly mark final position of all balance valves after balancing is complete. Read and record data.

k. Utilize thermometer wells, time-quantity devices and other line flow-measuring devices specified. In closed systems, where no line devices are installed, use a surface pyrometer probe.

l. Where pyrometers are used, tabulate surface temperature differentials between inlet and outlet of heat exchange devices. Pyrometers shall be Alnor Type 4200, scale 0-degrees to 500 degrees F, with a 2 degree F graduations and appropriate pipe probe.

3.6 BUILDING FLUSHOUT

A. After installation of furniture, equipment, etc., operate air handling systems at 100 percent outside air continuously for 48 hours. At end of period, operate all air handling units and reset all thermostats under normal working conditions.

3.7 OPERATION

A. After completion of balancing, operate all systems and equipment under normal working conditions for three consecutive 7-hour days. Submit record of performance.

3.8 VIBRATION TESTING

A. Assure vibration isolation system is operating properly.

B. Operate equipment and make audible and visual inspection to determine obvious rough operation. Correct such conditions before proceeding further.

C. Submit report to Owner’s Representative.

3.9 CONTROL SYSTEM TESTING PROCEDURE

A. Upon completion of the Building Control System completely check out and field test hardware and software to assure that the complete system performs in accordance with the approved sequences of operation. Test all equipment and control functions for proper automatic and manual activation. Test each system and zone for proper operation through its complete heating and cooling cycles.

B. Include the specific tests and control functions listed below:

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1. Full point check.
2. Automatic activation of each smoke control strategy.
3. Manual activation of each fan and smoke damper.
4. System priorities and overrides.
5. Trouble monitoring and annunciation capability.
6. Power resumption response.
7. System failure response.
8. All user notification messages.

3.10 CERTIFIED REPORTS

A. Air System Data: Include for each air-handling system the data listed below:

1. Equipment (fan or factory fabricated station unit):

a. Installation data:

1) Identification number.
2) Manufacturer and model.
3) Size.
4) Service.
5) Arrangement, discharge and class.
6) Motor hp, rated voltage, phase, cycles, and rated full load amps.
7) Full load amperes.
8) Location and local identification data.

b. Design data: Data listed in schedules on Drawings and Specifications or submittals.
c. Fan recorded (test) data:

1) CFM
2) Static pressure: Suction, discharge, total.
3) Fan rpm.
4) Motor rpm.
5) Motor sheave diameter: adjustable or solid.
6) Fan sheave diameter.
7) Outlet velocity.
8) Motor operating amperes.
9) Motor operating BHP.
10) Actual voltage.

B. Duct system:

1. Duct air quantities-Main, submains, branches, outside air, total supply air, return and exhaust:

a. Duct size(s).
b. Number of pitot tube (pressure) measurements.
c. Sum of velocity measurement, excluding pressure measurements.
d. Average velocity.
e. Recorded (test) CFM and FPM.
f. Design CFM and FPM.

2. Individual air terminals:

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a. Terminal identification (supply, return or exhaust, location and number designation).
b. Type, size, manufacturer and catalog identification.
c. Design and recorded quantities-CFM.
d. Deflector vane or diffusion cone settings.
e. Applicable factor for application, velocity, area, etc.
f. Design and recorded velocities-FPM (state "core", "inlet", etc., as applicable).

3. Filter and coil data as specified; scheduled on drawings or as required.
4. Room temperatures.

C. Water System Data:

1. Flow devices including control valves:

a. Service.
b. Locations.
c. Size.
d. Required GPM.
e. Measured pressure difference.
f. Resultant actual GPM from venturi curves.

2. Heating Coils.

a. Design data:

1) Load in BTUH and MBH.
2) GPM.
3) Entering and leaving water temperature.
4) Entering and leaving air conditions (DB and WB).
5) CFM.
6) Water pressure drop.

b. b. Recorded data:

1) Type of equipment and identification (location or number designation).
2) Entering and leaving air conditions (DB and WB).
3) Entering and leaving water temperatures.
4) GPM (if metered).
5) Temperature rise or drop.
6) Water and air pressure drop.

3.11 FINAL TESTS, INSPECTION AND ACCEPTANCE

A. General: Make tests to demonstrate that capacities and general performance of air and water systems comply with Contract requirements. After the Test and Balance contractor has submitted records of final readings and measurements for all systems:

1. Final inspection: At the time of final inspection, spot-check, in the presence of the Owner's Representative, random selections of data, water and air quantities, air motion and sound levels recorded in the Certified Report.
2. Points and areas for spot-check: As selected by the Owner's Representative.
3. Measurement and test procedures: As approved for work forming basis of Certified Report.

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4. Selections for spot-check (specific plus random): In general, selections for check will not exceed 25 percent of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.

3.12 The contractor shall cooperate with regard to sound tests (ARI, ANSI S1.13) which may be conducted by the Acoustical Consultant at the Owner's direction to verify that noise criteria are met. Measurements to include the use of Class 1 sound-level meter to measure NC ratings per IEC 61672-1:2013 to compare to project criteria for room noise level.

Mechanical systems should be designed to meet the following noise criteria:

Space Type	Recommended Maximum HVAC Sound Level
Restrooms	NC 45
Breakroom, Corridors, Copy	NC 40
Offices, Chambers	NC 35
Courtrooms, Conference Rooms	NC 30

3.13 Retests: If random tests elicit a measured flow deviation of 10 percent or more from the Certified Report listings, at 10 percent or more of the spot-checked selections, the report will be automatically rejected. In the event the report is rejected, readjust all systems concerned in the presence of the Owner's Representative. Test, record new data, submit new Certified Reports and make new inspection tests.

3.14 Marking of Settings: Following final acceptance of Certified Reports by the Owner's Representative, permanently mark the settings of all valves, splitters, dampers and other adjustment devices that are exposed to misuse, so that adjustment can be restored if disturbed at any time. Do not mark devices until after final acceptance.

END OF SECTION

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SECTION 230713

DUCT INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide materials and accessories for installation of ductwork insulation as indicated on the Drawings and as specified.

1.2 SECTION INCLUDES

A. Ductwork insulation.

B. Fire Wrap

C. Acoustic Lining

D. Acoustic Lagging

E. Insulation jackets.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Section 23 05 00 “General Work Results for HVAC”, apply to this. Test

1.4 REFERENCES

A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

C. ASTM E84 - Surface Burning Characteristics of Building Materials.

D. ASTM E96 - Water Vapor Transmission of Materials.

E. NFPA 255 - Surface Burning Characteristics of Building Materials.

F. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

G. UL 723 - Surface Burning Characteristics of Building Materials.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.

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B. Product Data: Provide product description, list of insulation, facing and jacket materials and thickness for each service, and locations, adhesive details and fastening devices, performance curves and thermal ratings.

C. For fire rated duct wrap submit certificate of instruction by factory authorized representative and installation instructions

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.

B. Manufacturer's Installation Instructions.

1.7 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84.

1.8 QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of General Conditions and Division 01 – General Requirements as applicable.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, Mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Glass Fiber Insulation and Acoustic Lining
   1. Owens Corning
   2. Certainteed
   3. Knauf
   4. Johns Manville
   5. Or equal.

B. Elastomeric Insulation Products
   1. Armacell

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C. Duct Lining
   1. John Mansville Linacoustic RC

D. Fire Rated Duct System
   1. 3M Fire Barrier Wraps
   2. Thermal Ceramics – Firemaster
   3. No known equal.

E. Acoustic Lagging
   1. Kinetics – KNM with 2” insulation and 1” psf mass loaded vinyl

F. Flexible Duct
   1. Casco Silentflex
   2. FlexMaster Type 6B

2.2 GLASS FIBER, FLEXIBLE DUCT WRAP (TYPE DW)

A. Insulation: ASTM C553 and C612; flexible, noncombustible blanket.
   1. 'K' ('Ksi') value : ASTM C518, 0.24 at 75 degrees F
   2. Maximum service temperature: 350 degrees F .
   3. Maximum moisture absorption: 0.20 percent by volume.
   4. Density: 1.5 lb/cu ft.

B. Vapor Barrier Jacket - factory installed. (FSK)
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film
   2. Moisture vapor transmission: ASTM E96 Procedure E; 0.02 perm.
   3. Secure with pressure sensitive tape.

C. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

D. Tie Wire: Annealed steel, 16 gage.

2.3 GLASS FIBER, RIGID DUCT WRAP(TYPE RDW)

A. Insulation: ASTM C612; rigid, noncombustible blanket.
   1. 'K' ('Ksi') value : ASTM C518, 0.23 at 75 degrees F
   2. Maximum service temperature: 350 degrees F .
   3. Maximum moisture absorption: 0.20 percent by volume.
   4. Density: 6.0 lb/cu ft

B. Vapor Barrier Jacket - factory installed (FSK)
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
   2. Moisture vapor transmission: ASTM E96; 0.02 perm.
   3. Secure with pressure sensitive tape.

C. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

2.4 FIRE RATED (TYPE FR)

A. 3M Fire Barrier Duct Wrap 615+ or equal.

B. Non-asbestos, foil-encapsulated, fire resistant wrap consisting of an inorganic fiber blanket encapsulated with a scrim-reinforced foil. The product is 1-1/2 in. thick, 6pcf density.

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C. 3M Fire Barrier Water Tight Sealant 1000 NS, 3M Fire Barrier Water Tight Sealant 1003 SL or 3M Fire Barrier Water Tight Sealant 2000+ Silicone Sealants is used in combination with 3M Fire barrier Duct Wrap 615+ to firestop the duct when the duct penetrates fire rated floors and walls.

D. Insulation: ASTM C518 and E119, UL 1978.
1. 'R' - value 4.15
2. Maximum service temperature: 2000ºF.
3. CSFM-Listed

E. Banding, clips, pins and other materials for UL system.

F. Duct and Hanger wrap. CSFM 2440-1361:100.

2.5 INTERNAL DUCT LINING (TYPE AL)

A. Insulation: ASTM C423.
1. 'K": ASTM C518, 0.23 at 75ºF.
2. Maximum service temperature: 350ºF
3. Maximum moisture absorption: 0.20% by volume.
4. Density: 1.5lb/cu.ft or 3lb/cu.ft as specified
5. Smooth black neoprene or matte facing overlay on air side. Coating shall conform to NFPA 90A, ASTM C665, ASTM G21 and G22.

B. Small diameter ducts which cannot be insulated internally using duct lining materials shall be pre-fabricated. Insulation material shall be fixed between outer duct metal and a perforated metal liner. Manufacturer United McGill k27 series or equal. Fittings shall be insulated to same standard and shall be by same manufacturer.

2.6 ACOUSTICAL LAGGING

A. 1 psf reinforced-foil faced mass loaded limp vinyl noise barrier bonded to a 1-inch thick quilted fiberglass sound absorber/decoupler. Material shall be non-lead composition for safe handling and easy installation.

B. The composite material shall be fabricated to include a nominal 152-mm (6”) wide barrier overlap tab extending beyond the quilted fiber glass to facilitate a leak-tight seal around field joints. Nominal barrier width 1372-mm (54”), nominal fiber glass batt decoupler width 1219-mm (48”).

C. Minimum sound Transmission Loss Values when tested as a free-hanging barrier (ASTM E-90)

125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	STC
13	16	24	33	43	49	28

D. Installation. The correct installation of the sound control lagging material is critical in order to achieve the desired noise reduction. Sound control lagging material shall be cut to length, wrapped around the outside of the pipe or duct, and fastened with mechanical fasteners or bands. Tape and adhesive can be used in conjunction with mechanical fasteners or bands. All sound control lagging materials must be installed per the manufacturer’s installation guidelines.

E. Provide 2 psf duct acoustical duct lagging typical for FCU over Courtroom 2 and as noted on drawings.

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2.7 JACKETS

A. Aluminum sheet metal jacketing, minimum 0.02” thick. Use a clear hard film acrylic coating paint for additional corrosion resistance. Rolled jacketing for ducts up to 60” wide (or dia.) and 3/16” corrugated 0.02” thick jacketing for larger ducts. Fully water seal all joints in the jacketing with Fosters Sealfas GPM 35-00/45-00, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that ductwork has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Insulate all ducts as scheduled.

C. Install insulation where it cannot become wet. Wetted insulation is not acceptable. Ensure insulation is dry before and during installation.

D. Finish insulation neatly at hangers, supports and other protrusions

E. No supports shall be embedded in insulation.

F. Locate insulation or cover seams in least visible locations.

G. Where ducts cannot be insulated after erection insulate prior to erection.

H. Finish with ducts at operating conditions.

I. Where specified thickness of insulation exceeds available thickness in a single layer provide insulation in 2 or more layers with joints staggered.

J. Duct Wrap -flexible fiberglass insulation (DW)
1. Provide insulation with vapor barrier jackets.
2. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
3. Secure insulation with 4" strips of adhesive at 8" on center, 2" lap strip at one end.
4. Install duct wrap to allow maximum fullness at corners. Avoid excessive compression. Minimum thickness at corners is 1".
5. Lift ductwork off trapeze hangers and install spacers.
6. Seal lap strips with a foil vapor barrier tape or vapor barrier Mastic such as Foster Vapor Safe 30-80.
7. Where ducts are over 24" in width, additionally secure the duct wrap to the bottom of rectangular ducts with mechanical fasteners spaced on 12" centers to prevent sagging of insulation. Seal penetration of facing to provide a vapor-tight system with vapor barrier Mastic such as Foster Vapor Safe 30-80.
8. Continue insulation through walls, sleeves, hangers, and other duct penetrations. Pack around ducts with fireproof self-supporting insulation material and properly seal.

K. Duct Wrap - Rigid Fiberglass insulation (RDW)

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1. Provide insulation with vapor barrier jackets.
2. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
3. Secure insulation with 4" strips of adhesive at 8" on center, 2" lap strip at one end.
4. Score insulation to cover standing seams.
5. Seal all joints and pin penetrations with pressure sensitive aluminum foil tape to provide a vapor-tight system. Provide vapor barrier Mastic, over tape to assure seal, Vapor Safe 30-80.
6. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers. Where ducts are over 24" in width, additionally secure the duct wrap to the bottom of rectangular ducts with mechanical fasteners spaced on 12" centers to prevent sagging of insulation. Seal penetration of facing to provide a vapor-tight system with vapor barrier Mastic such as Foster Vapor Safe 30-80.
7. Continue insulation through walls, sleeves, hangers, and other duct penetrations. Pack around ducts with fireproof self-supporting insulation material and properly seal.
8. Stop and edge seal insulation around access doors and damper operators to allow operation without disturbing wrapping.

L. Fire Wrap
1. Install in strict adherence to manufacturers recommendations and UL/State Fire Marshal approvals, including at penetrations of rated surfaces.

M. Duct Liner (AL)
1. Provide insulation.
2. Insulate all portions of duct scheduled or noted to receive duct liner.
3. Neatly butt transverse joints with no interruptions or gaps.
4. Cut duct liner to assure overlapped end compressed longitudinal corner joints.
5. Apply with 100 percent coverage of Foster's 85-20 (solvent based) or Foster 85-60 (water-based) adhesive or equal. Use Tuffweld nylon pins or gripnail fasteners at 12" on center but not less than one pin on each surface of duct.
6. Ensure that insulation is mounted with correct side of duct liner to air stream. Ensure that surface adjacent to air flow, including at joints, is uniformly flat.
7. Seal butt joints with Foster 40-10 or equal and exposed edges of liner to prevent erosion. Tape all seams and joints with 40-10 and reinforcing where duct is large enough for access to joints.
8. At access openings and doors in ducts and plenums, along edges exposed to air flow and at leading edges in rectangular ducts provide 24 gauge sheet metal Z sections framed over the edge of the insulation.
9. Fasteners

    a. Where pins or anchors are required above secure insulation to ductwork in accordance with following minimum requirements.

        1) Weld pins and adhered anchors at minimum 12 inch centers.
        2) Maximum permissible load:

            a) 5 lb. for 2" by2" baseplate
            b) 10lb for 2¾" by 2¾" baseplate.

        3) Clip off pin penetrations flush with insulation surface or facing.
        4) Seal pins and washers with 2" by 2" square pieces of vapor barrier material to match facing. Adhere with vaporseal adhesive.

10. Butt insulation tightly at joints.

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N. Internal duct lining shall be vacuumed and cleaned of all contaminants prior to and following erection. Obtain inspection certificate from Owner's Representative and/or Inspector of Record that each section is cleaned.

3.3 DUCTWORK INSULATION SCHEDULE

A. Insulation thicknesses shall meet both minimum Title-24 requirements and the dimension listed in the table below.

System	Location	Insulation	Thick	Finish
Supply Air Return Air & Outside Air	Mechanical rooms, penthouses and parking garage.	RDW 6 lbs./cu.ft.	2”	Sheet Metal Jacket
Supply Air & Outside Air	Shafts	DW 1.5 lbs./cu.ft.	1-1/2”	-
Supply Air & Return Air	Out-of-Doors	RDW 6 lbs./cu.ft.	2”	Stainless Steel Jacket***
Supply Air	Concealed within building	DW 1.5 lbs./cu.ft.	1-1/2"	-
Supply Air	Exposed in conditioned spaces being served.	None	__	__
Supply Air	Exposed in conditioned spaces not being served.	DW 1.5 lbs./cu.ft.	1-1/2"	__
Return Air	Concealed in conditioned spaces	None, except when cavity is adjacent to roof level, then DW 1.5 lbs./cu.ft.	1-1/2"	__
Outside Air	Within building	DW 1.5 lbs./cu.ft.	1-1/2"	Vapor barrier

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System	Location	Insulation	Thick	Finish
				FSK/wire
Any/All	Where shown on drawings	Acoustic Lining (AL) 3 lbs./cu.ft.	2”**	__
Any/All	Where shown on drawings	Acoustic Lagging 1 lbs./cu.ft.	1”	__
Fire Rated	__	FR	Per req’d rating	__

* Use rigid insulation up to 8’ above finished floor level. Flexible insulation may be used at high level.

No insulation shall be applied to exhaust air ductwork where the ductwork does not connect to a heat recovery device. Exhaust air ducts upstream of heat recovery device shall be insulated as return air ducts.

** Unless otherwise indicated on Drawings.

*** Provide aluminum jacket alternate for pricing. Confirm direction with Owner.

3.4 NET DIMENSIONS

A. Where acoustical liner is indicated on the Drawings the duct sizes indicated on the Drawings shall be clear inside dimensions.

END OF SECTION

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SECTION 230719

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide materials and accessories for installation of mechanical insulation to piping systems as indicated on the drawings and as specified.

B. Related Work
Section 23 05 29 - Hangers and Supports for HVAC Piping and equipment

1.2 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.3 REFERENCES

A. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM C 177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

C. ASTM C 335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

D. ASTM C 585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe.

E. ASTM C 921 - Properties of Jacketing Materials for Thermal Insulation.

F. ASTM E 84 - Surface Burning Characteristics of Building Materials.

G. ASTM E 96 - Water Vapor Transmission of Materials.

H. NFPA 255 - Surface Burning Characteristics of Building Materials.

I. UL 723 - Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.

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B. Product Data: Provide product description, list of materials, thickness for each service, performance curves and thermal ratings.

C. Submit the following: insulation materials; jackets and facing materials, adhesives, fastening devices and vapor barrier.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.
Owner's Manual: Manufacturer's Installation Instructions.

1.6 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E 84, NFPA 255 and UL 723.
Flame proofing treatment subject to deterioration due to moisture or humidity is not acceptable.

1.7 QUALIFICATIONS

A. Applicator: Company specializing in performing the Work of this section with minimum three years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of General Conditions and Division 1 as applicable.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
Store insulation in original wrapping and protect from weather and construction traffic.
Protect insulation against dirt, water, chemical, and mechanical damage.

C. ENVIRONMENTAL REQUIREMENTS
Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
Maintain temperature during and after installation for minimum period of 24 hours.

1.9 MANUFACTURERS

A. Insulation

1. Owens Corning

2. Certainteed

3. Johns Manville

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4. Knauf
5. Armstrong
6. Or equal.

B. PVC Jackets

1. Schuller
2. Speedline
3. Or equal

PART 2 - PRODUCTS

2.1 GLASS FIBER

A. Insulation: ASTM C 547; rigid molded, noncombustible.

1. 'K' ('ksi') value : ASTM C 335, 0.23 at 75 degrees F
2. Minimum Service Temperature: -20 degrees F
3. Maximum Service Temperature: 450 degrees F
4. Maximum Moisture Absorption: 0.2 percent by volume.
5. Flexural Strength 100 psi

2.2 ELASTOMERIC TUBING

A. Insulation ASTM C 534

1. K value 0.28 at 75 degrees F
2. Maximum service temperature 220 degrees F
3. Density 6.0 pcf
4. Closed cell form. Vapor permeability ASTM E96 0.2 perm
5. Max moisture absorption: 1.0 percent by volume, 10 percent by weight.

B. Seal with Rubatex adhesive or equal

2.3 JACKETS

A. Factory Applied Vapor Barrier Jacket (ASJ).

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1. ASTM C 921, White kraft paper reinforced with glass fiber yarn and bonded to aluminized film.

2. Moisture Vapor Transmission: ASTM E 96; 0.02 perm inches.

3. Secure with self sealing longitudinal laps and butt strips.

4. Secure vapor barrier mastic.

5. Tie Wire: 16 gage stainless steel with twisted ends on maximum 12 inch centers.

6. Vapor Barrier Lap Adhesive: Compatible with insulation.

B. PVC Plastic

1. Jacket: ASTM C921, One piece molded type fitting covers and sheet material, off white color. Provide custom color at locations as indicated on architectural drawings.

2. Minimum Service Temperature: -40 degrees F.

3. Maximum Service Temperature: 150 degrees F.

4. Moisture Vapor Transmission: ASTM E96; 0.002 perm inches.

5. Maximum Flame Spread: ASTM E84; 25.

6. Maximum Smoke Developed: ASTM E84; 50.

7. Thickness: 20 mil

8. Connections: Brush on welding adhesive, Tacks or Pressure sensitive color matching vinyl tape.

9. Covering Adhesive Mastic: Compatible with insulation.

C. Aluminum Jacket: ASTM B209.

1. Thickness: 0.016 inch sheet.

2. Finish: Embossed.

3. Joining: Longitudinal slip joints and 2 inch laps.

4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry and that foreign material has been removed.

C. Ensure insulation is dry before and during installation

3.2 INSTALLATION

A. Insulate all piping, valves, fittings, flanges and accessories of the following systems to prevent heat loss and condensation:

B. Install materials in accordance with manufacturer's instructions.

C. Locate insulation seams and cover seams in least visible locations. For outdoor installations, locate seam at bottom of equipment, etc to promote water-tightness.

D. Install insulation where it cannot become wet. If insulation becomes wet, remove and dispose of properly and replace with new, dry insulation. Wetted insulation is not acceptable. Ensure insulation is dry before and during installation.

E. Insulate fittings, joints and valves. Refer to Section 23 07 13 – Equipment Insulation, for insulation of strainers, expansion joints, fittings and accessories requiring servicing or inspection insulation.

F. Insulate unions and flanges with insulation sleeve of same material as pipe insulation to cover union or flange and overlap insulation on adjacent piping.

G. Continue insulation through walls, sleeves, pipe hangers and other pipe penetrations.

H. Finish insulation at supports, protrusions and interruptions. No hangers or supports shall be embedded in insulation. Do not insulate expansion bellows.

I. Fiber Glass insulation:

1. Provide insulation with factory applied vapor barrier jackets.

2. Butt edges neatly. ASJ with 3 inch minimum butt strips.

3. Longitudinal overlaps: Minimum 2 inch self sealing, double adhesive.

4. Apply additional jacket as specified.

5. For piping conveying fluids below ambient temperature finish with vapor barrier adhesive.

J. Elastomeric Tubing

1. Provide insulation.

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2. Butt edges neatly. Seal longitudinal and transverse joints with adhesive to maintain minimum vapor permeability. Adhesive shall be selected and applied in accordance with insulation manufacturer's recommendations

3. Apply additional jacket as specified.

K. For pipe systems exposed in occupied spaces or mechanical equipment rooms, finish with aluminum jacket.

L. For exterior applications, provide vapor barrier jacket.

3.3 SCHEDULES

A. Pipe Insulation Schedule
Insulation Thickness for Nominal Pipe Sizes:

System	Pipe less than 1" O.D.	Pipe 1¼" inch to 1.5" O.D.	Notes
Horizontal condensate drains in building or plenum.	½"	½"	Elastomeric or fiberglass
Refrigerant. Indoors and outdoors.	1"	1"	Elastomeric or fiberglass
Heating Hot Water Piping	1.5	1.5	Elastomeric or fiberglass

B. Pipe, Valve And Fitting Cover Schedule:

System	Location	Jacket
Condensate drain	Concealed in unconditioned spaces	ASJ
Refrigerant Piping	Outdoors	Aluminum
Heating Hot water.	Outdoors	Aluminum
Heating Hot water	Mechanical rooms and unoccupied spaces	Aluminum
Heating Hot water	Concealed within building	ASJ

ASJ is All Service Jacket. See Section 2.

END OF SECTION

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SECTION 230800

COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. HVAC commissioning description.
2. HVAC commissioning responsibilities.

B. Related Sections:

1. Section 230593 - Testing, Adjusting, and Balancing for HVAC: For requirements and procedures concerning testing, adjusting, and balancing of mechanical systems.
2. Section 230923 – Building Automation System for HVAC: Submittal, training, and programming requirements.
3. Section 233300 - Air Duct Accessories: Product requirements for ductwork test holes.

1.2 REFERENCES

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE Guideline 1 - The HVAC Commissioning Process.

B. Building Commissioning Association:

1. BCA - Commissioning Handbook.

C. National Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Building Systems Commissioning.

D. Testing Adjusting and Balancing Bureau:

1. TABB - Commissioning Manual.

1.3 COMMISSIONING DESCRIPTION

A. HVAC commissioning process includes the following tasks:

1. Testing and startup of HVAC equipment and systems.
2. Equipment and system verification checks.

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3. Assistance in functional performance testing to verify testing and balancing, and equipment and system performance.
4. Provide qualified personnel to assist in commissioning tests, including seasonal testing.
5. Complete and endorse functional performance test checklists provided by Commissioning Authority to assure equipment and systems are fully operational and ready for functional performance testing.
6. Provide equipment, materials, and labor necessary to correct deficiencies found during commissioning process to fulfill contract and warranty requirements.
7. Provide operation and maintenance information and record drawings to Commissioning Authority for review verification and organization, prior to distribution.
8. Provide assistance to Commissioning Authority to develop, edit, and document system operation descriptions.
9. Provide training for systems specified in this Section with coordination by Commissioning Authority.

B. Equipment and Systems to Be Commissioned:

1. New HVAC systems that were installed under this Contract.
2. Existing HVAC systems that were modified, adjusted, upgraded, or affected by the work performed under this Contract.

C. The following is a partial list of equipment that may be included in this HVAC Commissioning:
1. Piping systems.
2. Ductwork.
3. Variable frequency drives.
4. Split-VRF, Air Conditioning Unit + Heat Pump
5. Split system air conditioning units.
6. Air handling units.
7. Fan Coil Units.
8. Constant volume terminal units.
9. Variable volume terminal units.
10. Fans.
11. Fire dampers.
12. Smoke dampers.
13. Indoor air quality.
14. Equipment sound control.
15. Equipment vibration control.
16. Automatic HVAC control system.
17. Testing, Adjusting and Balancing work.

D. Perform seasonal function performance tests for the following equipment and systems:

1. Heating equipment during heating season and Cooling equipment during cooling season.

1.4 COMMISSIONING SUBMITTALS

A. Section 019100 - Commissioning: Requirements for commissioning submittals.

B. Draft Forms: Submit draft of system verification form and functional performance test checklist.

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C. Test Reports: Indicate data on system verification form for each piece of equipment and system as specified.

D. Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks equipment or system to achieve specified performance.

1.5 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.

C. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ASHRAE Guidelines.

B. Perform Work in accordance with California Title-24 and CalGreen standards.

C. Maintain one copy of each document on site.

1.7 COMMISSIONING RESPONSIBILITIES

A. Equipment or System Installer Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Ensure temperature controls installer performs assigned commissioning responsibilities as specified below.
3. Ensure testing, adjusting, and balancing agency performs assigned commissioning responsibilities as specified.
4. Provide instructions and demonstrations for Owner's personnel.
5. Ensure subcontractors perform assigned commissioning responsibilities.
6. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
7. Develop startup and initial checkout plan using manufacturer’s startup procedures and functional performance checklists for equipment and systems to be commissioned.
8. During verification check and startup process, execute HVAC related portions of checklists for equipment and systems to be commissioned.
9. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Authority.
10. Provide manufacturer’s representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
11. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.

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12. Provide personnel to assist Commissioning Authority during equipment or system verification checks and functional performance tests.
13. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
14. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
15. Provide factory supervised startup services for all new and reused equipment and systems. Coordinate work with manufacturer and Commissioning Authority.
16. Perform verification checks and startup on equipment and systems as specified.
17. Assist Commissioning Authority in performing functional performance tests on equipment and systems as specified.
18. Perform operation and maintenance training sessions scheduled by Commissioning Authority.
19. Conduct HVAC system orientation and inspection.

B. Temperature Controls Installer Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Review design for ability of systems to be controlled including the following:

    a. Confirm proper hardware requirements exists to perform functional performance testing.
    b. Confirm proper safeties and interlocks are included in design.
    c. Confirm proper sizing of system control valves and actuators and control valve operation will result capacity control identified in Contract Documents.
    d. Confirm proper sizing of system control dampers and actuators and damper operation will result in proper damper positioning.
    e. Confirm sensors selected are within device ranges.
    f. Review sequences of operation and obtain clarification from Architect/Engineer.
    g. Indicate delineation of control between packaged controls and building automation system, listing BAS monitor points and BAS adjustable control points.
    h. Provide written sequences of operation for packaged controlled equipment. Equipment manufacturers? stock sequences may be included, when accompanied by additional narrative to reflect Project conditions.

3. Inspect, check, and confirm proper operation and performance of control hardware and software provided in other HVAC sections.
4. Submit proposed procedures for performing automatic temperature control system point-to-point checks to Commissioning Authority and Architect/Engineer.
5. Inspect check and confirm correct installation and operation of automatic temperature control system input and output device operation through point-to-point checks.
6. Perform training sessions to instruct Owner's personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan and requirements of Section Div. 23.
7. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.
8. Provide control system technician to assist during Commissioning Authority verification check and functional performance testing.

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9. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.
10. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

C. Testing, Adjusting, and Balancing Agency Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Participate in verification of testing, adjusting, and balancing report for verification or diagnostic purposes. Repeat sample of **20** percent of measurements contained in testing, adjusting, and balancing report **as indicated in commissioning plan.**
3. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.8 COMMISSIONING MEETINGS

A. Attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.9 SCHEDULING

A. Requirements for scheduling.

B. Prepare schedule indicating anticipated start dates for the following:

1. Piping system pressure testing.
2. Piping system flushing and cleaning.
3. Ductwork cleaning.
4. Ductwork pressure testing.
5. Equipment and system startups.
6. Automatic temperature control system checkout.
7. Testing, adjusting, and balancing.
8. HVAC system orientation and inspections.
9. Operation and maintenance manual submittals.
10. Training sessions.

C. Schedule seasonal tests of equipment and systems during peak weather conditions to observe full-load performance.

D. Schedule occupancy sensitive tests of equipment and systems during conditions of both minimum and maximum occupancy or use.

1.10 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination.

B. Notify Commissioning Authority minimum of four weeks in advance of the following:

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1. Scheduled equipment and system startups.
2. Scheduled automatic temperature control system checkout.
3. Scheduled start of testing, adjusting, and balancing work.

C. Coordinate programming of automatic temperature control system with construction and commissioning schedules.

PART 2 - PRODUCTS

2.1 Not Used.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install additional balancing dampers, balancing valves, access doors, test ports, and pressure and temperature taps required **by Commissioning Authority.**

B. Place HVAC systems and equipment into full operation and continue operation during each working day of commissioning.

C. Install replacement sheaves and belts to obtain system performance, as requested by Commissioning Authority.

D. Install test holes in ductwork and plenums as requested by Commissioning Authority for taking air measurements.

E. Prior to start of functional performance test, install replacement filters in equipment.

3.2 FIELD TESTS AND INSPECTIONS

A. Seasonal Sensitive Functional Performance Tests:

1. Test heating equipment at winter design temperatures.
2. Test cooling equipment at summer design temperatures **with fully occupied building**.
3. Participate in testing delayed beyond **Substantial Completion** to test performance at peak seasonal conditions.

B. Be responsible to participate in initial and alternate peak season test of systems required to demonstrate performance.

C. Occupancy Sensitive Functional Performance Tests:

1. Test equipment and systems affected by occupancy variations at minimum and peak loads to observe system performance.

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2. Participate in testing delayed beyond Substantial **Completion** to test performance with actual occupancy conditions.

END OF SECTION 230800

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SECTION 230923

BUILDING AUTOMATION SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General Requirements

B. Description of Work

C. Quality Assurance

D. Submittals Requirements

E. Sequence of Work

F. Training and Warrantee

G. Power Management Description

H. Products
   1. For Alteration
   2. Network Bandwidth
   3. Field Devices

I. General Execution Requirements

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Section 230500 “General Work Results for HVAC”, apply to this. test

B. Section 23 08 00 – Mechanical System Commissioning

C. Section 27 05 33 – Communications Building Pathways – Conduits and Boxes

D. Section 27 09 21 – Communications Backbone ISP Fiber Optic Cabling

E. Section 27 15 13 – Communications Horizontal Twisted Pair Cabling

F. Section 28 31 00 – Fire Alarm System

G. All system hardware and its installation shall be in accordance with all codes, specifications, standards, recommended practices of trade, governmental organizations, and local authorities having jurisdiction.

H. All materials and equipment used shall be new and free from defects, of the same manufacturer for a given type, UL listed and approved where applicable and/or required, and of standard

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manufacture (not custom in design). All components shall have been thoroughly tested and proven in actual use.

I. All the patch cords are being provided and installed by the Owner.

1.3 WORK INCLUDED

A. Contractor shall furnish and install a direct digital control and building automation system (BAS). The new BAS shall utilize electronic sensing, microprocessor-based digital control, and electronic actuation of dampers and valves to perform control sequences and functions specified. Refer also to the control drawings in the different building packages and sequences of operation.

B. This scope is intended as a general description of the work. The Contractor shall verify and coordinate the BAS design with all other mechanical, electrical, plumbing, life-safety, technologies and other technical systems designs being prepared by other trades, including cross coordination within the project specifications. The scope shall tie-in to existing BMS. All controls components shall be compatible with existing systems.

C. Provide all project management, engineering design labor, field installation labor, building management control hardware, building management control software, installation materials, piping, conduit, wiring, control power to all devices and panels, 3rd party software, file servers, workstations, routers, hubs, control valves, valve and damper actuators, flow meters, all other field devices and sensors, transducers, transmitters, power supplies and associated work to complete the designated control system tasks specified herein.

D. All control work shall be installed by the BAS contractor, unless specified otherwise. Certain mechanical systems such as VRF split systems are equipped with manufacturer furnished controls. All labor, materials, equipment, software, and services necessary for the installation of a complete integrated system shall be provided.

E. The work shall generally include BAS controls for the following: buildings and their systems.

1. L01 Renovation
    a. New AC unit (indoor/outdoor equipment)
    b. New VRF equipment
    c. New terminal units
    d. New exhaust fans
    e. New equipment shall be connected to existing building BAS

F. Expansion capabilities shall be included for future designated and non-designated points. BAS network and BAS/BC Panel shall have spare capacity to allow for individual office space control and future fit out options as per mechanical drawings. This BAS/BC Panel spare capacity shall allow for points count and physical size including the future fit out options. The BAS performance shall be the same in shell and core package as well as in future expansion/fit out package. Each BC shall be provided with capability of adding expansion panels. The expansion capability as follows

1. Terminal units

    a. Due to flexibility of space design, BAS points could increase by additional 130%

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G. BAS shall be comprised of microprocessor based, distributed digital controllers, utilizing electronic sensing, electronic and digital computer control as defined herein.

H. BAS shall utilize "open" system architecture(s) using the BACnet communication protocol (ASHRAE standard 135) for BC's, AAC and ASC controllers, and industry standard communications interfaces with 3rd party equipment. No proprietary communications protocol shall be allowed.

I. Provide all project management, engineering design labor, field installation labor, building management control hardware, building management control software, installation materials, piping, conduit, wiring, control power to all devices and panels, 3rd party software, operator servers, trending servers, workstations, routers, hubs, control valves, valve and damper actuators, flow meters, all other field devices and sensors, transducers, transmitters, power supplies and associated work to complete the designated control system tasks specified herein.

J. Integrate equipment specified in other Sections and prepare composite electronic/electric, direct-digital control diagrams showing interlocking of all equipment and controls.

K. Provide interface and control instrumentation including but not limited to control relays, current transducers, pressure and temperature transmitters & sensors, damper & valve position end switches, air static pressure sensors, transducers and transmitters wherever required.

L. Develop, install and test software sequences of operation as specified and required for the efficient operation of all included systems. This shall include work necessary to provide for complete and operating systems whether or not specifically defined herein.
   1. A breakdown of test procedures and activities with associated hours should be submitted.
   2. Based on supplied specifications and drawing outlining the system performance; estimates and description of required functional tests should be provided.

M. Develop and provide graphical dynamic data system displays in accordance with project and specification requirements. Different levels of graphics shall be developed for facilities operators and building occupants. In order to facilitate this Operator-BMS Interface, it is critical that the BAS be able to display and accurate graphic representation of each piece of equipment in the facility. In addition, Equipment Graphics representing the actual interface panel of each piece of integrated equipment shall be provided for all integrated systems. These graphics shall incorporate real time live data from the associated interface points.

   1. Overall Site Graphic
   2. Floor Plan Graphics
   3. Real time dynamic floor plans
   4. Floor plans indicate thermal comfort using dynamic colors to represent zone temperature relative to zone setpoint.
   5. Exhaust System Graphics
   6. Air Distribution Systems Graphics
   7. Zone Terminal Unit Graphics
   8. Mechanical Equipment Electrical Performance Graphics
   9. Any piece of BAS controlled equipment
   10. Develop and provide systems diagnostic software and reports designed to log any and all data monitoring points, process and display processed results such as kW/ton vs. time in graphical form.
   11. Hyperlinks shall be provided for the following:

      a. to upstream and downstream systems,

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b. links to other physical areas,
c. Provide Time-lapse Color graphics of the entire Building zone temperatures for a minimum of 1 year history at any 24 hour increment.
d. System shall include an easily configured energy reporting tool on a building basis.
e. Equipment graphics shall have accurate representation itself. The graphics shall incorporate real time live data from the associated points to form a complete system.

N. Provide all point to point checkout, controller startup, controller LAN configuration and startup, commissioning, acceptance testing and demonstration of the entire BAS on site. Provide complete adjustment, calibration and tuning of all building management control system PID loops on site, set-points, system flags, equipment run times, lead/lag schedules and sequences.

O. Instruct Owner's operating staff on maintenance and operation of the complete BAS.

P. Provide complete system upgrades during the first year warranty period.

Q. Carpet removal works to access BAS devices/components shall be included during warranty period.

R. Third party switches cannot be provided without explicit approval from Owner's IT department. Contractor shall plan on connecting to Owner-approved switches.

1.4 SPECIAL INSTRUCTIONS

A. Integrate into the design and coordinating all aspects of the work required to be performed by each impacted sub-contractor in order to properly integrate their work.

B. Provide dynamic graphic displays depicting all systems and equipment operations and modes connected under this Work.

C. Install supply fan static pressure transmitters in accessible spaces and extend FR tubing in ceiling plenums to pitot sensing tips. Extend the low pressure reference tubing to a controller panel mounted in HVAC riser within the cores away from the return air openings.

1.5 FUNCTIONAL INTENT

A. Throughout this section, detailed requirements are specified, some of which indicate a means, method or configuration acceptable to meet that requirement. Contractor may submit products that utilize alternate means, methods, and configurations that meet the functional intent. However these will only be allowed with prior approval by the architect and client.

1.6 DEFINITIONS

A. Accuracy: Accuracy shall include combined effects of nonlinearity, non-repeatability and hysteresis.

B. Advanced Application Controller (AAC): A device with limited resources relative to the Building Controller (BC). It may support a level of programming and may also be intended for application specific applications.

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C. Application Protocol Data Unit (APDU): A unit of data specified in an application protocol and consisting of application protocol control information and possible application user data (ISO 9545).

D. Application Specific Controller (ASC): A device with limited resources relative to the Advanced Application Controller (AAC). It may support a level of programming and may also be intended for application-specific applications. However it's programming still must be fully programmable and not just "canned programs".

E. Binding: In the general sense, binding refers to the associations or mappings of the sources network variable and their intended or required destinations.

F. Building Automation System (BAS): The entire integrated management and control system

G. Building Controller (BC): BACnet IP based controller. A fully programmable device capable of carrying out a number of tasks including control and monitoring via direct digital control (DDC) of specific systems, acting as a communications router between the LAN backbone and sub-LANs, and data storage for trend information, time schedules, and alarm data.

H. Change of Value (COV): An event that occurs when a measured or calculated analog value changes by a predefined amount.

I. Client: A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device. If software "key" or Licenses are required then the BAS manufacture must price up a minimum of 500 License users.

J. Continuous Monitoring: A sampling and recording of a variable based on time or change of state (e.g. trending an analog value, monitoring a binary change of state).

K. Controller or Control Unit (CU): Intelligent stand-alone control panel. Controller is a generic reference and shall include BCs, AACs, and ASCs as appropriate.

L. Control Systems Server (CSS): This shall be a computer (or computers) that maintains the systems configuration and programming database. This may double as an operator workstation.

M. Direct Digital Control (DDC): Microprocessor-based control including Analog/Digital conversion and program logic.

N. Facility Information Technology (FIT): Reference to Facility Management’s Information Technology department.

O. Field Control Units or Field Panel (FCU): Intelligent stand-alone control panel. Controller is a generic reference and shall include BCs, AACs, and ASCs as appropriate. But must be fully programmable. All BAS Manufacturers product these type of controllers, they just produce low cost non-fully programmable ones as well, those are not acceptable.

P. Functional Profile: A collection of variables required to define a the key parameters for a standard application. As this applies to the HVAC industry, this would include applications like VAV terminal, fan coil units, and the like.

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Q. Gateway (GTWY): A device, which contains two or more dissimilar networks/protocols, permitting information exchange between them.

R. Hand Held Device (HHD): Manufacturer's microprocessor based device for direct connection to a Controller.

S. LAN Interface Device (LANID): Device or function used to facilitate communication and sharing of data throughout the BAS

T. Local Area Network (LAN): General term for a network segment within the architecture. Various types and functions of LANs are defined herein.

U. Local Supervisory LAN: Ethernet-based LAN connecting Primary Controller LANs with each other and OWSs and CSSs. See System Architecture below. This LAN can function as the Primary Controlling LAN.

V. Master-Slave/Token Passing (MS/TP): Data link protocol as defined by the BACnet standard. (ASHRAE/ANSI 135-2004).

W. Open Database Connectivity (ODBC): An open standard application-programming interface (API) for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system (DBMS) is handling the data.

X. Operator Interface (OI): A device used by the operator to manage the BAS including OWSs, POTs, and HHDs.

Y. Operator Workstation (OWS): The user's interface with the BAS system. As the BAS network devices are stand-alone, the OWS is not required for communications to occur.

Z. Point-to-Point (PTP): Serial communication as defined in the BACnet standard.

AA. Portable Operators Terminal (POT): Laptop PC used both for direct connection to a controller and for remote dial up connection.

BB. Primary Controlling LAN: High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System Architecture below.

CC. Router: A device that connects two or more networks at the network layer.

DD. Secondary Controlling LAN: LAN connecting AACs and ASCs, generally lower speed and less reliable than the Primary Controlling LAN. Refer to System Architecture below.

EE. Server: A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device.

FF. SQL: Standardized Query Language, a standardized means for requesting information from a database.

GG. Smart Device (SD): A control I/O device such as a sensor or actuator that can directly communicate with the controller network to which it is connected. This differs from an ASC in that it typically deals only with one variable.

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1.7 QUALITY ASSURANCE

A. Product Line Demonstrated History: The product line being proposed for the project must be the most current model and version and have an installed history of demonstrated satisfactory operation for a length of [5] years since date of final completion in at least [20] installations of comparative size and complexity. Documentation of this requirement with references shall be available upon request.

B. Installer's Qualifications: Firms specializing and experienced in control system installations for not less than [5] years. Firms with experience in DDC installation projects with point counts equal to this project and systems of the same complexity as those of this project. Experience starts with awarded Final Completion of previous projects. Documentation of this requirement with references shall be available upon request.

C. Installer's Experience with Proposed Product Line: Firms shall have specialized in and be experienced with the installation of the proposed product line for not less than [three] years from date of final completion on at least [5] projects of similar size and complexity. Submittals shall document this experience with references.

D. Installer’s Field Coordinator and Sequence Programmer Qualifications: Individual(s) shall specialize in and be experienced with control system installation for not less than [5] years. Proposed field coordinator shall have experience with the installation of the proposed product line for not less than [2] projects of similar [size] [and complexity]. Installer shall submit the names of the proposed individual and at least one alternate for each duty. Submittals shall document this experience with references. {Edit as applicable} The proposed individuals must show proof of the following training:

1. Product Line Training: Individuals overseeing the installation and configuration of the proposed product line must provide evidence of the most advanced training offered by the Manufacturer on that product line for installation and configuration.
2. Programming Training: Individuals involved with programming the site-specific sequences shall provide evidence of the most advanced programming training offered by the vendor of the programming application offered by the Manufacturer.

E. Installer’s Service Qualifications: The installer must be experienced in control system operation, maintenance and service. Installer must document a minimum [5] year history of servicing installations of similar size and complexity. Installer must also document at least a one year history of servicing the proposed product line.

F. Installer’s Response Time and Proximity

1. Installer must maintain a fully capable service facility within a 40 mile radius of the project site. Service facility shall manage the emergency service dispatches and maintain the inventory of spare parts.
2. Emergency response times are listed below in this section. Installer must demonstrate the ability to meet the response times.

G. Installer’s Quality Assurance Plan

1. Installer must provide a description of their quality assurance operations from contract award through final delivery. The description shall include organizational responsibilities for each department represented within the execution of this document from installer’s to engineers, service technicians and management.

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2. Submit the plan for approval.

1.8 SYSTEM PERFORMANCE TESTING AND ADJUSTING PROCEDURES

A. Refer to Section 230800 – Mechanical System Commissioning and Section 23 08 01 – Building Automation Commissioning for a list of required testing and adjusting procedures.

B. Also see other Commissioning Section and Test and balance section.

1.9 FINAL PROCEDURES

A. Remedial Work: Perform any remedial work to correct inadequate performance or unacceptable conditions of, or relating to any of this work.

B. The selected BAS vendors shall maintain an office in the local area, directly involved for the next five years in the business related to the products required in these Specifications. The vendor shall maintain spare parts inventories for both installation and service of the products provided for this project in the local area (within 50 miles).

C. Experienced electricians, technicians and qualified engineering supervision shall be provided for the fabrication and installation of equipment and systems to the highest trade standards of workmanship.

D. Unless specified, directed or indicated otherwise, provide new materials, equipment and devices in strict accordance with the manufacturer's recommendations and approved shop drawings.

E. Wherever standards of quality are not specifically defined herein, products and services shall meet as a minimum the standards of the existing equipment and systems.

1.10 CODES AND STANDARDS

A. Work shall be performed in accordance with applicable requirements of governing codes, rules and regulations including the following minimum standards, whether statutory or not:

B. Be responsible for securing Building Permits, as required, and for the associated fees. Meet applicable codes, regulations and standards in the performance of this work.

C. The following codes and standard intended to apply as applicable as not all will apply to all parts of the installations

D. California Administrative Code (CAC) Title 24, Part 3, Basic Electrical Requirements, State Building Standards Electrical Code.

E. California Administrative Code (CAC) Title 24, California Uniform Building Code, Chapter 53.

F. National Electrical Code, including local interpretation.

G. Uniform Building Code, Chapter 43 relating to combustibles in the air plenums.

H. Equipment and materials specified under this Division shall conform to the standards of UL, ASTM, NEMA, ANSI, and ETL. Base materials shall be ASTM and/or ANSI standards.

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Electrical manufactured apparatus provided under this section shall conform to National Electrical Manufacturer's Association (NEMA) standards and shall bear the Underwriters' Laboratories (UL) or Electrical Testing Laboratory (ETL) label where such a label is applicable.

I. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).

J. ANSI/ASHRAE standard 135-2004, BACnet – A Data Communication Protocol for Building Automation and Control Networks.

K. BACnet Testing Laboratories-Certified.

L. Electronics Industries Alliance

1. EIA-709.1-B-2002: Control Network Protocol Specification
2. EIA-709.3-99: Free-Topology Twisted-Pair Channel Specification
3. EIA-232: Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
4. EIA-458: Standard Optical Fiber Material Classes and Preferred Sizes
5. EIA-485: Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.
6. EIA-472: General and Sectional Specifications for Fiber Optic Cable
7. EIA-475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications
8. EIA-573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications
9. EIA-590: Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications

M. Underwriters Laboratories

1. UL 916: Energy Management Systems.
2. UL 864: UL Supervised Smoke Control

N. NEMA Compliance

1. NEMA 250: Enclosure for Electrical Equipment
2. NEMA ICS 1: General Standards for Industrial Controls.

O. NFPA Compliance

1. NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
2. NFPA 70 National Electrical Code (NEC)

P. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems
2. IEEE 802.3: CSMA/CD (Ethernet – Based) LAN
3. IEEE 802.4: Token Bus Working Group (ARCNET – Based) LAN

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1.11 SUBMITTALS

A. Refer to Division 01 and Commissioning Sections for other submittal requirements.

B. No work shall be initiated or fabrication of any equipment started prior to the return of required submittals.

C. Format: Make each submittal in one complete and contiguous package. Partial or unmarked submittals will not be reviewed.

D. All alarms and trends are to be submitted for approval.

E. Schedule of Submittals

1. In accordance with Division 1 requirements with the following technical additions.

a. First submittal after contract award: Schedule of work and Qualifications. It is to be to be submitted within 30 days of contract award.
b. Second submittal after contract award Manufacturer's Data, Shop drawings, System point listing, control logic documentation, alarm. It is listed to be submitted within 45 days of contract award
c. Third submittal after contract award: Annotated control flow charts, control loop statements and definitions, software interlock listings, color graphic page layouts (to be reviewed by A/E team and Owner), and data format displays. This submittal shall include application software reports as well as test and calibration sheets. Acceptance test procedures and operator training course outline for review by Owner's Representative shall be included with this submittal. It is listed to be submitted within 60 days of contract award
d. Final Submittal - Record Drawings and Operating and Maintenance (O&M) manuals:

2. Final Submittal

a. Record Drawings: Submit revised versions of drawings as submitted in the Shop and Field Drawing Submittal showing actual device locations and relationships as built, including wire tagging and the like.
b. Manuals: Submit two preliminary (2) copies of the O&M Manuals.
c. Within fourteen (14) working days of receipt of reviewed Final Submittal, submit the corrected Final Submittal Record Drawings and the Final Operating & Maintenance Manuals to Owner's Representative. 2 hard copies shall be provided and also electronic copies in PDF and native software (Word/CAD etc)
d. After review of final submittal: Laminated control drawings including system control schematics, sequences of operation and panel termination drawings, shall be provided in panels for major pieces of equipment. Terminal unit drawings shall be located in the Roof Plant equipment panel or mechanical room panel.

F. Schedule of Work

1. Prepare and submit a detailed schedule of work including coordination expected from the General Contractor, and other affected disciplines and trades.
2. Schedule shall identify milestones such as; equipment submittals, control panel diagrams, color graphic panel displays, Interlock wiring diagrams, control program sequence software flow chart diagrams, conduit layout diagrams, device location

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diagrams, equipment and component deliveries, installation sequencing, controller startup, point to point startup, control programming, sequence testing, commissioning/pre-functional/acceptance testing, and training.

G. Qualifications

1. Manufacturer, Installer, and Key personnel qualifications as indicated for the appropriate item above. Include QA/QC plan for all phases (design, install, Cx, warranty) along with documentation of industry standard QA/QC practices followed.

H. Seismic Compliance

1. Submit evidence demonstrating BAS Controllers are seismically certified per ASCE 7-05, 13.2.5. Forward to Authority Having Jurisdiction after review and approval by the Structural Engineer of Record

I. Submit Manufacturers Data as follows:

1. Complete materials list of items proposed to be provided and installed. A complete Bill of Materials, listing materials, components, devices, wire, and equipment are required for this work.
2. The Bill of Materials shall be separate for each Field Control Unit on its own page(s) and shall contain the following information for each item listed:

    a. Manufacturer's Name and Model number with provided options highlighted.
    b. Quantity of each by Field Control Unit location.
    c. Description of product (generic).
    d. Corresponding specified item.
    e. Operating Range or Span
    f. Operating Point or Set-point

3. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements, including but not limited to: Catalog cuts, technical data and descriptive literature on hardware, software, and system components to be provided.
4. The data shall be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data. Submit printed manufacturer's technical product data for each control device provided, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials and including printed installation instructions and start-up instructions.
5. Unless specifically called for otherwise, provide bound copies of catalog cuts for standard products, not requiring specifically prepared Shop Drawings, for the following:

    a. Wire and cable, Class II
    b. Face plates for devices.
    c. Disconnect switches for power control.

6. Where more than one item, size, rating or other variations appear on a catalog cut sheet, clearly identify items to be provided. These items shall be properly indexed and referenced to identification numbers, designations and/or details on the Drawings.
7. Include installation and start-up instructions.
8. Include finishes for approval by the architect.

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9. Where components are custom for integration with the architecture, these shall be developed in conjunction with the architect, tested in mockup and detailed designs submitted for approval.
10. Two samples shall be submitted for all visible sensors and devices.

J. Shop drawings:

1. BMS shop drawings for each controlled system shall be submitted.

    a. These shall be drawn based on arrangements from drawings.

2. The BMS drawings shall depict the following information:

    a. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves and all other control/monitoring devices.
    b. Label each control device with initial setting or adjustable range of control.
    c. Required electrical wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field-installed.
    d. Details of control panel faces, including controls, instruments, and labeling.
    e. Interfaces to equipment provided under other Sections identifying numbers of wires, termination location, voltages and pertinent details. Responsibility for each end of the interfaces shall be noted on these drawings whether or not they are a part of this Section.
    f. Equipment locations, wiring and piping schematics, details, panel configurations, sizes, damper motor mounting details, valve schedules, and a point list keyed to specific hardware. Control wiring shall be depicted as fully annotated ladder diagrams with terminations identified, completely configured as to the exact panel, wiring, relay, switch, and component configuration.
    g. Include Sequences of Operations (SOO).
    h. Tag number lists:

        1) Develop instruments tag number system and submit list for approval.
        2) Coordinate methods and number block with the architect/engineer.

3. Format the Shop and Field Drawings to include:

    a. A Title Sheet containing a drawing list, abbreviations list, symbols list, site and vicinity maps for project location and schedules.

        1) Sheets shall be consecutively numbered.
        2) Each sheet shall have a title indicating the type of information included and the HVAC system controlled.

    b. System Architecture and System Layout:

        1) One-line diagram indicating schematic locations of all control units, workstations, LAN interface devices, gateways, etc. Indicate network number, device ID, drawing reference number, and controller type for each control unit. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the diagram. Indicate device instance and MAC address for each CU. Indicate media, protocol, baud rate, and type of each LAN.

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2) Provide floor plans locating all control units, LAN interface devices, gateways, etc. Include all WAN and LAN communication wiring routing, power wiring, power originating sources, and low voltage power wiring. Wiring routing as-built conditions shall be maintained accurately throughout the construction period and the drawing shall be updated to accurately reflect accurate, actual installed conditions. Indicate network number, device ID, address, device instance, MAC address, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the floor plans.

c. Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. Include verbal description of sequence of operation
d. A Riser Diagram illustrating conduit relationships between devices shown on the Floor Plans. Show device nomenclatures.
e. A Single-Line Diagram for each system showing signal relationships of devices within the system. Show device nomenclatures.
f. A complete drawing shall be provided for each air handling unit and other major pieces of controlled equipment.
g. Provide a Control Valve Schedule listing valve and actuator information including: size, Cv, design flow, design pressure drop, manufacturer, model number, close off rating, control signal, etc. Indicate normal positions of spring return valves.
h. Provide a Control Damper Schedule listing damper and actuator information including: size, material, blade arrangement, manufacturer, model number, control signal, etc. Indicate normal positions of spring return dampers.
i. A Wiring Diagram for each assembly, enclosure or free standing device. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring, which are factory-installed and portions to be field-installed. Show

1) The devices within
2) Wiring connections
3) Wire identification
4) Voltage levels
5) Fuse ratings

4. Physical details of Contractor-fabricated assemblies:

a. Provide an assembly drawing showing the finished product. Show components comprising the assembly by manufacturer and model number.
b. Provide a schematic diagram of the assembly, as described above.

K. Point Summary Table

1. Submit a complete point list for each controlled system with the developed number systemlisting system type, equipment type, full point name, point description, Ethernet backbone network number, network number, device ID, object ID
2. Point structuring and naming

a. General: The intent of this section is to require a consistent means of naming points across all Campus facilities. Contractor shall configure the systems from the perspective of the Enterprise, not solely the local project. The following requirement establishes a standard for naming points and addressing Buildings, Networks,

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Devices, Instances, and the like. The convention shall be implemented as much as practical, and any deviations from this naming convention shall be approved by Owner.

b. Point Summary Table

1) The term 'Point' is a generic description for the class of object represented by analog and binary inputs, outputs, and values.
2) With each schematic, Contractor shall provide a Point Summary Table listing:

a) Building number and abbreviation
b) System type
c) Equipment type
d) Point suffix
e) Full point name (see Point Naming Convention paragraph)
f) Point description
g) Ethernet backbone network number,
h) Network number
i) Device ID
j) Device MAC address
k) Object ID (object type, instance number)
l) Engineering units.

3) Point Summary Table shall be provided in both hard copy and in electronic format (ODBC-compliant).
4) Point Summary Table shall also illustrate Network Variables and Data Link Bindings.
5) The BAS Contractor shall coordinate with Owner and compile and submit a proposed Point Summary Table for review prior to any object programming or project startup.
6) The Point Summary Table shall be kept current throughout the duration of the project by the Contractor as the Master List of all points for the project. Project closeout documents shall include an up-to-date accurate Point Summary Table. The Contractor shall deliver to Owner the final Point Summary Table prior to Substantial Completion of the system. The Point Summary Table shall be used as a reference and guide during the commissioning process.

c. Point Naming Convention

1) All point names shall adhere to the established format. Including all physical I/O points, calculated points used for standard reports, and all application program parameters. For each BAS object, a specific and unique object name shall be required.
2) For each point, four (4) distinct descriptors shall be linked to form each unique object name: Building, System, Equipment, and Point.
3) Owner and the architect/engineer shall designate the Building descriptor. The System descriptor shall further define the object in terms of air handling, cooling, heating, or other system. The Equipment descriptor shall define the equipment category; e.g., Fan Coil Unit, Air Conditioning Unit, Exhaust Fan, DDVAV, VAV or other equipment. The Point descriptor shall define the hardware or software type or function associated with the equipment; e.g., supply temperature, water pressure, alarm, mixed air temperature set-point, etc. and shall contain any numbering conventions for multiples of equipment

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4) A consistent object (point) naming convention shall be utilized to facilitate familiarity and operational ease across the BAS network. Inter-facility consistency shall be maintained to ensure transparent operability to the greatest degree possible. The table below details the object naming convention and general format of the descriptor string.

5) Object Name Requirements

Descriptors		Comment
Building Floor		Follow existing BAS naming conventions
System	VAV DDVAV Exhaust Supply Heating Hot Water	
Point Suffix	See Input/output point summary table for conventions	

a) Examples: Within each object name, the descriptors shall be bound by a period. Within each descriptor, words shall not be separated by dashes, spaces, or other separators

6) Device Addressing Convention:

a) All assignment of network numbers and Device Object IDs shall be coordinated with Owner.
b) Each Network number shall be unique throughout all facilities.
c) Each Device Object Identifier property shall be unique throughout the system.
d) The BAS Contractor shall coordinate with Owner to ensure that no duplicate Device Object IDs occur.
e) Alternative Device ID schemes or cross project Device ID duplication if allowed shall be approved by Owner before project commencement.

L. Control Logic Documentation

1. Submit control logic program listings to document the control software of all control units.
2. Include written description of each control sequence.
3. Include test plan for each unique control program.
4. For graphical programming packages.

a. Include control response, settings, set-points, throttling ranges, gains, reset schedules, adjustable parameters and limits.

5. For text programming packages.

a. Include comments within code generally describing each section as it relates to the sequence of operation with blank lines between sections to improve readability.

M. Alarm and Reporting List:

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1. Provide a list (MS Excel Format) of recommend alarms and associated reporting actions to Owner for review/approval.

N. Operations and Maintenance Manuals:

1. Following approval of Shop Drawings of control equipment and prior to acceptance of control work, prepare Operating and Maintenance manuals describing operating, servicing, and maintenance requirements of control systems and equipment installed under this Section, in accordance the General and Special Conditions of these Specifications including the following section:

   a. Section 019100 - General Commissioning Requirements
   b. Section 229000 - Plumbing System Commissioning
   c. Section 230800 – Mechanical System Commissioning
   d. Section 269000 - Electrical System Commissioning

2. Information contained in the manual for the above equipment shall include the following:

   a. Manufacturer's catalog cuts and printed descriptive bulletins.
   b. Manufacturer's installation, operating, and maintenance instruction booklets. Complete instructions regarding the operation and maintenance of equipment involved.
   c. Instrument calibration certificates.
   d. Parts list and costs.
   e. Complete nomenclature of replaceable parts, list of recommended spare parts for 12 months operation, their part numbers, current cost and name and address of the nearest vendor of replacement parts.
   f. Name, address and telephone number for closest source of spare parts.
   g. Wiring and schematic diagrams.
   h. Include final record copies of shop drawings.
   i. Copy of guarantees and warranties issued for the various items of equipment, showing dates of expiration.
   j. Reduced plans, diagrams, and control schematics.
   k. Copies of test results.

3. Control System Operating Manual including:

   a. Point of summary and point data base
   b. BAS Hardware and Software manuals.
   c. Complete printout of program listings
   d. CD backup of Field Control Cabinet programs
   e. Cabinet layout
   f. Hard copy of graphic screens
   g. Hard copy of specified reports.
   h. A final Bill of Quantities including a separate schedule for portable equipment, if delivered as part of this work.
   i. Performance, Test and Adjustment Data: Comprehensive documentation of performance verification according to parameters specified herein.

O. Project Record Documents

1. Documentation shall be provided electronically as defined in section1.09/B above plus two (2) hard copies delivered to facility management.

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2. Record copies of product data and control shop drawings updated to reflect the final installed condition.
3. Record copies of approved control logic programming and database shall be electronically posted to FIT's BAS server. Links to this documentation shall be provided on each equipment graphic for access to the as-built shop drawings, point lists, sequences of operation and TAB report (provided by others). Accurately record actual set-points and settings of controls, final sequence of operation, including changes to programs made after submission and approval of shop drawings and including changes to programs made during specified testing.
4. Record copies shall include individual floor plans with controller locations with all interconnecting wiring routing including space sensors, LAN wiring, power wiring, low voltage power wiring.
5. Provide record riser diagram showing the location of all controllers

1.12 TRAINING

A. Provide 2 rounds of 8 hours (16 hours total) of training for the owner's Representative's personnel, including complete system orientation after Final System Acceptance.

B. The 2 rounds is based on the level 1 areas in scope of work.

C. Provide the services of instructors who shall give full instruction to designated personnel in the operation, maintenance and programming of the system. Orient the training specifically to the specific systems installed and sub-systems controlled, rather than a general training course. Instructors shall be thoroughly familiar with the subject matter they are to teach.

D. Training will occur in two sessions. Schedule the first training session (8 hours) to occur immediately following the installation of the control system. Schedule the second training session (8 hours) to occur after six months, but within a year after the first training session. Provide a training manual for each student, approximately four (4), which describes in detail the data included in each training session. Provide equipment and material required for classroom training. Training shall include:

1. Operation of equipment, including digital controllers.
2. Programming, including loop tuning facilities.
3. Failure recovery procedures.
4. Alarm formats.
5. Maintenance and calibration, including reset of instrument spans.
6. Troubleshooting, diagnostics, and repair instructions.
7. Standard and custom report generation including historical and dynamic trending, data processing and down load to spread sheet formats.
8. Modification of graphics, including point addition and adding objects.

E. Training shall emphasize system diagnostics and problem solving related to the operation and safety controls of the systems and integrated equipment.

F. The training plan shall be provided for Owner's approval.

1.13 WARRANTY

A. The Contractor shall provide the standard one year warranty of system (parts and labor) from date of Acceptance of the Entire Work by Owner. As a part of the warranty, respond immediately and repair any functional shortcomings resulting from this work and provide

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maintenance required to keep the control systems operational and functional during the warranty period.

1. Extended warranty shall be provided for all terminal actuating devices to two years.

B. Provide a written statement of the terms of the Warranty to the Owner's Representative, to include the exact text below:

1. Statement of Warranty
2. "The work is warranted to be free from defects in materials and quality of work for a period of twelve (12) months from the date of Acceptance of the Entire Work.
3. This warranty shall be valid for 1 year.
4. Report malfunctions to a designated 24-hr/day manned telephone number.
5. Regular service facilities will be maintained and a qualified technician familiar with this work will be provided at the site within twenty-four (24) hours, during normal working hours, of receipt of a verbal or written notice of malfunction. If the call is declared an emergency, this maximum response time shall be four (4) hours including evenings, weekends and holidays. The material, devices, equipment and personnel necessary to implement repairs will be provided. Approved temporary, alternate equipment will be provided if required by the Owner's Representative, complete and operational within twenty-four (24) hours after receipt of verbal or written notification of a malfunction, at no additional cost (if declared an emergency at time of notification, this time shall be eight (8) hours) and Owner will pay for premium time portion of the labor.
6. Warranty repairs and service will be conducted at the jobsite, unless in violation of manufacturer's warranty; in the latter event, substitute systems, equipment and/or devices which are acceptable to Owner, will be provided for the duration of such off-site repairs. Substitute and/or test systems, equipment, devices, materials, parts and personnel will be transported to and from the jobsite at no additional cost."
7. A copy of this Warranty shall be delivered to and signed for by the Owner's Representative.
8. Substitution: No other warranty may be substituted for this warranty unless approved in writing by Owner. Any warranty substituted for this warranty without written authorization shall be null and void and this warranty shall begin upon written notification of discovery of the substitution by Owner.
9. Provide reproductions of equipment manufacturer Warranty papers to Owner with the Final Submittals.
10. A copy of the written Warranty shall be placed in a clear plastic sleeve permanently attached to the inside door or rear panel of the primary equipment rack serving each system and shall be signed on the back and dated indicating service performed by each service technician attending to this work.

1.14 POWER MANAGEMENT

A. Separation of loads into distinct branches of power is essential for both meeting the electrical code requirement and prioritizing loads for demand response purposes. Demand response capability is required in order to ensure that select loads will continue to operate during a utility power outage. Total on-site generation is sized to allow for critical loads to continue operation during typical outages, loss of utility power during times of peak annual demand or low generation may exceed on-site generation capability. In this event, prioritization allows only the least critical campus loads to be shed, while remaining facilities remain operational. (see 260910 for details)

B. EPMS & BAS at building level communication

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1. BAS shall connect to EPMS in the electrical room at building level to receive power management information on pre-set mode/operation/Scene.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way. Used equipment shall not be used in any way for the permanent installation except where drawings or specs specifically allow existing materials to remain in place.

2.2 UNIFORMITY

A. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer

2.3 LISTING AND LABELING

A. The BAS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.

2.4 MANUFACTURERS

A. The BAS and digital control and communications components installed, as work of this contract shall be an integrated distributed processing system of the following manufacturer. No other vendor's products will be considered as substitutions except where work includes interfacing at the controller network level to an existing building control system.

B. Acceptable Manufacturers:
1. BAS shall match existing building system.

2.5 SYSTEM ARCHITECTURE

A. The system provided shall incorporate hardware resources sufficient to meet the functional requirements of these Specifications. The Contractor shall include all items not specifically itemized in these Specifications that are necessary to implement, maintain, and operate the system in compliance with the functional intent of these Specifications.

B. The system shall be configured as a distributed processing network(s) capable of expansion as specified below.

C. The system architecture shall consist of a Ethernet-based, wide area network (WAN), a single Local Area Network (LAN) or multi-leveled LANs that support BCs, AACs, ASCs, Operator Workstations (OWS), Smart Devices (SD), and Remote Communication Devices (RCDs) as applicable. The following indicates a functional description of the BAS structure.

1. Owner WAN: Internet-based network connecting multiple facilities with a central data server, accessible via standard web-browser. This is provided by Owner and contractor is not required to configure any components of this WAN.
2. Local Supervisory LAN: The Local Supervisory LAN shall be an Ethernet-based, 100/1000 Mbps LAN connecting Primary Control LANs and OWSs. The LAN serves as

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the inter-BC gateway and OWS-to-BC gateway and communications path. Contractor shall provide this as a dedicated LAN for the control system. LAN shall be IEEE 802.3 Ethernet over Fiber or Category 5/6e cable with switches and routers that support 100/1000 Mbps throughput. Power-line carrier communication shall not be acceptable for communications.

3. Primary Controller LAN ('Primary LAN'): High-speed, peer-to-peer communicating LAN used to connect Building Controllers (BCs), AACs, ASCs and communicate control information. Acceptable technologies include:
   a. Ethernet (IEEE802.3)
4. Secondary Controller LAN ('Secondary LAN'): Network used to connect AACs, ASCs or SDs. These can be Master Slave/ Token Passing (EIA-485), in addition to those allowed for Primary Controller LANs. Network speed vs. the number of controllers on the LAN shall be dictated by the response time and trending requirements.

D. Dynamic Data Access: Any data throughout any level of the network shall be available to and accessible by all other devices, Controllers and OWS, whether directly connected or connected remotely.

E. Remote Data Access: Coordinate remote access connectivity with Owner. The system shall support the following methods of remote access to the building data:

1. WAN Ethernet: All workstations shall be equipped with all necessary hardware and software to connect to the Owner Network.
2. Browser-based access: A remote user using a standard browser shall be able access all control system facilities and graphics with proper password. OWNER shall provide the required server side internet connection. The following paradigms are acceptable for browser-based access:

   a. Native Internet-based user interfaces (HTML, Java, XML, etc.) that do not require a plug-in. The user interface must be compatible with the most current stable version of the supporting software (Java, etc.) without requiring the user to downgrade to a lesser version.
   b. User interfaces that via a standard browser use a freely distributed and automatically downloaded and installed plug-in or 'thick' client that presents the user interface across the web.

3. The communication speed between the controllers, LAN interface devices, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein. Contractor shall reconfigure LAN as necessary to accomplish these performance requirements:

   a. 5 seconds between a Level 1 (critical) alarm occurrence and enunciation at operator workstation.
   b. 10 seconds between a Level 2 alarm occurrence and enunciation at operator workstation.
   c. 20 seconds between and a Level 3-5 alarm occurrence and enunciation at operator workstation.
   d. 10 seconds between an operator command via the operator interface to change a set-point and the subsequent change in the controller.
   e. 5 seconds between an operator command via the operator interface to start/stop a device and the subsequent command to be received at the controller.

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f. 10 seconds between a change of value or state of an input and it being updated on the operator interface.
g. 10 seconds between an operator selection of a graphic and it completely painting the screen and updating at least 20 points.It shall automatic refresh every 15 seconds
h. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
i. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec.and shall automatically refresh every 15 sec.
j. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
k. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
l. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 45 sec.
m. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
n. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
o. Multiple Alarm Annunciations. Each workstation on the network shall receive alarms within 5 sec of other workstations.

2.6 CENTRAL CONTROL STATION (CCS) HARDWARE

A. CCS is existing and new CCS is not required.

B. BAS Server hardware
1. All new equipment to match existing system.

a. Connection to the BAS network shall be via an dual Ethernet network interface card, 1GB.

2. It shall hold the backup files of the information downloaded into the individual controllers and as such support uploading and downloading that information directly to/from the controllers.
3. It shall act as a control information server to non-control system based programs. It shall allow secure multiple-access to the control information
4. This shall be a computer (or computers) that maintain the systems configuration and programming database.
5. Be protected from any memory loss due to a loss of power by one or a combination of the following:

a. Volatile RAM shall have a battery backup using a lithium battery with a rated service life of seventy two (72) hours, and a rated shelf life of at least five years. Self-diagnostic routine shall report an alarm for a low battery condition.
b. EEPROM, EPROM, or NOVROM non-volatile memory

C. Trending Server Hardware
1. Existing – all connections and new work shall match existing.

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2. Remote Communications.
3. Provide state-of-the-art router/switches and software on file servers.

2.7 SOFTWARE

A. Central Control Software (CSS)
1. All new work shall be compatible with existing CCS.

B. Communications Software

1. Provide remote access software for connection to the central control station via the Campus Intranet infrastructure. The remote terminal shall operate as a fully functioning workstation on the system when connected via the intranet. Operation shall be identical to the primary workstation so remote support and local operation can occur simultaneously and thereby provide ongoing training while providing warranty service. Provide all necessary software and configuration for the development, management, and maintenance of web based graphic pages.
2. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
3. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher. Web services support shall as a minimum be provided at the workstation or web server level and shall enable data to be read from or written to the system.
4. System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or binary value software points) from any system controller or from the trend history database.
5. System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.
6. For read or write requests, the system shall require user name and password authentication and shall support SSL (Secure Socket Layer) or equivalent data encryption
7. System shall support discovery through a Web services connection or shall provide a tool available through the Operator Interface that will reveal the path/identifier needed to allow a third party Web services device to read data from or write data to any object in the system which supports this service
8. Provide all necessary software and configuration for the remote access to FCU based controllers via the web.
9. In addition to the primary operator interface, the system shall include a secondary interface compatible with a locally available commercial wireless network and viewable on a commercially available wireless device such as a Wireless Access Protocol (WAP) enabled cellular telephone. This secondary interface shall provide a summary of the most important data. As a minimum, the following capabilities shall be provided through this interface:
10. An operator authentication system that requires an operator to log in before viewing or editing any data, and which can be configured to limit the privileges of an individual operator.
11. The ability to view and acknowledge any alarm in the system. Alarms or links to alarms shall be provided on a contiguous list so the operator can quickly view all alarms

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12. A summary page or pages for each piece of equipment in the system. This page shall include the current values of all critical I/O points and shall allow the operator to lock binary points on or off and to lock analog points to any value within their range
13. Navigation links that allow the operator to quickly navigate from the home screen to any piece of equipment in the system, and then return to the home screen. These links may be arranged in a hierarchical fashion, such as navigating from the home screen to a particular building, then to a specific floor in the building, and then to a specific room or piece of equipment.

C. Licensing

1. FIT manages and approves all licensing; coordinate all requirements through FIT and include licensing for all software packages at all required workstations as directed.
2. All software used for the operator interface, programming environment, networking, database management and any other software used by the Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided to the Owner.
3. All software should be available on all Operator Workstations or CSSs provided, and on all Portable Operator Terminals. Hardware and software keys to provide all rights shall be installed on all workstations. At least 2 sets of CD/DVD/USB Drives shall be provided with backup software for all software provided, so that the Owner may reinstall any software as necessary. Include all licensing for workstation operating systems, and all required third-party software licenses.
4. Provide licensing and original software copies for each POW or CSS.
5. Provide licensing and original software copies for each remote graphic workstation. Licenses for remote graphic workstations shall allow for access to any site and shall not be restricted to accessing only the LANs included in this project.
6. The Licenses shall entitle that all rights for the system are provided to the client and no rights are withheld as part of the project.
7. Enterprise version with Unlimited seating shall be provided.
8. Upgrade software to the latest version at the end of the Warranty Period.

D. System Software-General

1. Functionality and Completeness: The Contractor shall furnish and install all software and programming necessary to provide a complete and functioning system as specified. The Contractor shall include all software and programming not specifically itemized in these Specifications, which is necessary to implement, maintain, operate, and diagnose the system in compliance with these Specifications.
2. Configuration: The software shall support the system as a distributed processing network configuration.

E. Controller Software

1. BC Software Residency: Each BC as defined below shall be capable of control and monitoring of all points physically connected to it. All software including the following shall reside and execute at the BC:

    a. Real-Time Operating System software
    b. Real-Time Clock/Calendar and network time synchronization
    c. BC diagnostic software
    d. LAN Communication software/firmware
    e. Direct Digital Control software

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f. Alarm Processing and Buffering software
g. Energy Management software
h. Data Trending, Reporting, and Buffering software
i. I/O (physical and virtual) database
j. Remote Communication software

2. AAC/ASC Software Residency: Each AAC/ASC as defined below shall be capable of control and monitoring of all points physically connected to it. As a minimum, software including the following shall reside and execute at the AAC/ASC. Other software to support other required functions of the AAC/ASC may reside at the BC or LAN interface device (specified in BAS Communication Devices) with the restrictions/exceptions per application provided in BAS Field Panels:

   a. Real-Time Operating System software
   b. AAC/ASC diagnostic software
   c. LAN Communication software
   d. Control software applicable to the unit it serves that will support a single mode of operation
   e. I/O (physical and virtual) database to support one mode of operation

3. Stand Alone Capability: BC shall continue to perform all functions independent of a failure in other BC/AAC/ASC or other communication links to other BCs/AACs/ASCs. Trends and runtime totalization shall be retained in memory. Runtime totalization shall be available on all digital input points that monitor electric motor status. Refer also to BAS Field Panels for other aspects of standalone functionality.
4. Operating System: Controllers shall include a real-time operating system resident in ROM. This software shall execute independently from any other devices in the system. It shall support all specified functions. It shall provide a command prioritization scheme to allow functional override of control functions. Refer also to BAS Field Panels for other aspects of the controllers operating system.
5. Network Communications: Each controller shall include software/firmware that supports the networking of CUs on a common communications trunk that forms the respective LAN. Network support shall include the following:
6. Building Controller/Primary LAN shall be a high-speed network designed and optimized for control system communication. If a Primary LAN communications trunk is severed, BCs shall reconfigure into two separate LANs and continue operations without interruption or Operator intervention.
7. Controller communication software shall include error detection, correction, and re-transmission to ensure data integrity.
8. Operator/System communication software shall facilitate communications between other BCs, all subordinate AACs/ASCs, Gateways and LAN Interface Devices or Operator Workstations. Software shall allow point interrogation, adjustment, addition/deletion, and programming while the controller is on line and functioning without disruption to unaffected points. The software architecture shall allow networked controllers to share selected physical and virtual point information throughout the entire system.
9. Diagnostic Software: Controller software shall include diagnostic software that checks memory and communications and reports any malfunctions
10. Alarm/Messaging Software: Controller software shall support alarm/message processing and buffering software as more fully specified below.
11. Application Programs: CUs shall support and execute application programs as more fully specified below:

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12. All Direct Digital Control software, Energy Management Control software, and functional block application programming software templates shall be provided in a 'ready-to-use' state, and shall not require (but shall allow) Owner programming.
13. Security: Controller software shall support multiple level password access restriction as more fully specified below.
14. Direct Digital Control: Controller shall support application of Direct Digital Control Logic. All logic modules shall be provided pre-programmed with written documentation to support their application. Provide the following logic modules as a minimum:

    a. Proportional-Integral-Derivative (PID) control with analog, PWM and floating output
    b. Two Position control (Hi or Low crossing with deadband)
    c. Single-Pole Double-Throw relay
    d. Delay Timer (delay-on-make, delay-on-break, and interval)
    e. Hi/Low Selection
    f. Reset or Scaling Module
    g. Logical Operators (AND, OR, NOT, XOR)

15. Updating/Storing Application Data: Site-specific programming residing in volatile memory shall be uploadable/downloadable from an POW or CSS connected locally, to the Primary LAN, to the Local Supervisory LAN and remotely via the internet. Initiation of an upload or download shall include the following methods; Manually and Automatically upon detection of a loss or change.
16. Restart: System software shall provide for orderly shutdown upon loss of power and automatic restart upon power restoration. Volatile memory shall be retained; outputs shall go to programmed fail (open, closed, or last) position. Equipment restart shall include a user definable time delay on each piece of equipment to stagger the restart. Loss of power shall be alarmed at operator interface indicating date and time.
17. Time Synchronization: Operators shall be able to set the time and date in any device on the network that supports time-of-day functionality. The operator shall be able to select to set the time and date for an individual device, devices on a single network, or all devices simultaneously. Automatic time synchronization shall be provided.
18. Misc. Calculations: System software shall automate calculation of psychometric functions, calendar functions, kWh/kW, and flow determination and totalization from pulsed or analog inputs, curve-fitting, look-up table, input/output scaling, time averaging of inputs and A/D conversion coefficients.

F. Application PROGRAMMING DESCRIPTION

1. The application software shall be user programmable.
2. This specification generally requires a programming convention that is logical, easy to learn, use, and diagnose. General approaches to application programming shall be provided by one, or a combination, of the following conventions:

    a. Point Definition: provide templates customized for point type, to support input of individual point information. Use standard BACnet Objects as applicable.
    b. Graphical Block Programming: Manipulation of graphic icon 'blocks', each of which represents a subroutine, in a functional/logical manner forming a control logic diagram. Blocks shall allow entry of adjustable settings and parameters via pop-up windows. Provide a utility that shall allow the graphic logic diagrams to be directly compiled into application programs. Logic diagrams shall be viewable either off-line, or on-line with real-time block output values.
    c. Line Programming: Textual syntax-based programming in a language similar to BASIC designed specifically for HVAC control. Subroutines or functions for energy

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management applications, setpoints, and adjustable parameters shall be customizable, but shall be provided preprogrammed and documented.

3. Custom Application Programming. Provide the tools to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:

   a. Language. Language shall be graphically based and shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks.
   b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
   c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
   d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
   e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
   f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
   g. Variables. Operator shall be able to use variable values in program conditional statements and mathematical functions.
   h. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section
   i. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.

4. Provide a means for testing and/or debugging the control programs both off-line and on-line.

G. ENERGY MANAGEMENT APPLICATIONS

1. System shall have the ability to perform all of the following energy management routines via preprogrammed function blocks or template programs. As a minimum provide the following whether or not required in the software:

   a. Time-of-Day Scheduling
   b. Calendar-Based Scheduling

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c. Holiday Scheduling
d. Temporary Schedule Overrides
e. Optimal Start/Optimal Stop-based on space temperature offset, outdoor air temperature, and building heating and cooling capacitance factors as a minimum
f. Night Setback and Morning Recovery Control, with ventilation only during occupancy
g. Economizer Control (enthalpy or dry-bulb)
h. Peak Demand Limiting / Load Shedding
i. Lighting/Occupancy Control (Coordinate Lighting Control Interface with Electrical)
j. Dead Band Control

2. Energy Report

a. System shall include an easily configured energy reporting tool that provides the capabilities described in this section.
b. The energy reporting tool shall be accessible through the same user interface (Web browser or operator workstation software) as is used to manage the BAS.
c. The energy reporting tool shall be preconfigured by the Contractor to gather and store energy demand and consumption data from each energy source that provides metered data to the BAS. Meter data shall be stored at 5 minute intervals unless otherwise specified in the Sequence of Operation provided. This data shall be maintained in an industry standard SQL database for a period of not less than five years
d. The energy reporting tool shall allow the operator to select an energy source and a time period of interest (day, week, month, year, or date range) and shall provide options to view the data in a table, line graph, bar graph, or pie chart. The tool shall also allow the operator to select two or more data sources and display a comparison of the energy used over this period in any of the listed graph formats, or to total the energy used by the selected sources and display that data in the supported formats.
e. The energy reporting tool shall allow the operator to select and energy source and two time periods of interest (day, week, month, year, or date range) and display a graph that compares the energy use over the two time periods in any of the graph formats listed in the previous paragraph. The tool shall also allow the operator to select multiple energy sources and display a graph that compares the total energy used by these sources over the two time periods.
f. The energy reporting tool shall allow the operator to easily generate the previously described graphs "on the fly," and shall provide an option to store the report format so the operator can select that format to regenerate the graph at a future date. The tool shall also allow the user to schedule these reports to run on a recurring basis using relative time periods, such as automatically generating a consumption report on the first Monday of each month showing consumption over the previous month. Automatically generated reports shall be archived on the server in a common industry format such as Adobe PDF or Microsoft Excel with copies e-mailed to a user editable list of recipients.
g. The energy reporting tool shall be capable of collecting and displaying data from the following types of meters:

1) Electricity/Utility
2) Heating and cooling degree days. (May be calculated from sensor data rather than metered.)
3) The user shall have the option of using Kw (Kwh) or Btu/hr (Btu) as the units for demand and consumption reports. Multiples of these units (MWH, kBtu,

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etc.) shall be used as appropriate. All selected sources shall be automatically converted to the selected units. The user shall similarly have the option of entering facility area and occupancy hours and creating reports that are normalized on an area basis, an annual use basis, or an occupied hour basis.

4) The user shall have the option of entering benchmark data for an individual facility or a group of facilities.
5) The user shall have the option of displaying any or all of the following data on any chart, line, or bar graph generated by the energy reporting tool:

    a) Low/High/Average value of the metered value being displayed.
    b) Heating and/or Cooling Degree Days for the time period(s) being displayed.
    c) The Environmental Index for the facilities and time periods

h. Environmental Index. System shall monitor all occupied zones and compile an index that provides a numerical indication of the environmental comfort within the zone. As a minimum, this indication shall be based upon the deviation of the zone temperature from the heating or cooling setpoint. If humidity is being measured within the zone then the environmental index shall be adjusted to reflect a lower comfort level for high or low humidity levels. Similarly, if carbon dioxide levels are being measured as an indication of ventilation effectiveness then the environmental index shall be adjusted to indicate degraded comfort at high carbon dioxide levels. Other adjustments may be made to the environmental index based upon additional measurements. The system shall maintain a trend of the environmental index for each zone in the trend log. The system shall also compute an average comfort index for every building included in this contract and maintain trendlogs of these building environmental indices. Similarly, the system shall compute the percentage of occupied time that comfortable conditions were maintained within the zones. Through the UI the user shall be able to add a weighting factor to adjust the contribution of each zone to the average index based upon the floor area of the zone, importance of the zone, or other static criteria.

i. All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow operator customization. Programs shall be applied to building equipment as described in Sequence of Operation.

H. Password Protection

1. Multiple-level password access protection shall be provided to allow the Owner's authorized BAS Administrator to limit workstation control, display and database manipulation capabilities as they deem appropriate for each user, based upon an assigned user name with a unique password.
2. All passwords for the system shall be provided to Owner including administrator, dealer, or factory level passwords for the systems provided under this project.
3. Passwords shall restrict access to all Control Units.
4. Each user name shall be assigned to a discrete access level. A minimum of five levels of access shall be supported. Alternately, a comprehensive list of accessibility/functionality items shall be provided, to be enabled or disabled for each user.
5. A minimum of 50 user names shall be supported and programmed per Owner's direction.
6. Operators shall be able to perform only those commands available for the access level assigned to their user name.

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7. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving interface device software on-line.

I. Alarm and Event Management Reporting

1. Alarm management shall be provided to monitor, buffer, and direct alarms and messages to operator devices and memory files. The CSS shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall a BCs ability to report alarms be affected by either operator activity at an Operator Workstation or local handheld device, or by communications with other panels on the network.

   a. Alarm Descriptor: Each alarm or point change shall include that point's English language description, and the time and date of occurrence. In addition to the alarm's descriptor and the time and date, the user shall be able to print, display and store an alarm message to more fully describe the alarm condition or direct operator response.
   b. Alarm Prioritization: The software shall allow users to define the handling and routing of each alarm by their assignment to discrete priority levels. A minimum of five priority levels shall be provided. For each priority level, users shall have the ability to enable or disable an audible tone whenever an alarm is reported and whenever an alarm returns to normal condition. Users shall have the ability to manually inhibit alarm reporting for each individual alarm and for each priority level. Contractor shall coordinate with the Owner on establishing alarm priority definitions. Alarm Level 1 Life Safety (i.e. smoke detector), Level 2 Critical (i.e. controller failure), Level 3 Abnormal (i.e. out-of-range temperature), Level 4 Energy Waste (i.e. fighting valves), Level 5 Maintenance Message (i.e. runtime monitor, filter status).

      1) Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points. Alarms shall be BACnet alarm objects and shall use BACnet alarm services
      2) Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying on acronyms.
      3) Alarm Reactions. Operator shall be able to configure (by object) what, if any actions are to be taken during an alarm. As a minimum, the workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
      4) Alarm and Event log. Operators shall be able to view all system alarms and changes of state from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and delete alarms, and archive closed alarms to the workstation or web server hard disk

   c. Alarm Report Routing: Each alarm priority level shall be associated with a unique user-defined list of operator devices including any combination of local or remote workstations, printers, email accounts, SMS accounts and workstation disk files. All alarms associated with a given priority level shall be routed to all operator devices

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on the user-defined list associated with that priority level. For each priority level, alarms shall be automatically routed to a default operator device in the event that alarms are unable to be routed to any operator device assigned to the priority level.

1) Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs
2) Standard Reports. Furnish the following standard system reports:

a) Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
b) Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
c) Logs. System shall log the following to a database or text file and shall retain data for an adjustable period: Alarm History. Trend Data. Operator shall be able to select trends to be logged. Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.

3) Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface

d. Alarm Acknowledgment: For alarm priority levels that are directed to a workstation screen, an indication of alarm receipt shall be displayed immediately regardless of the application in use at the workstation, and shall remain on the screen until acknowledged by a user having a password that allows alarm acknowledgment. Upon acknowledgment, the complete alarm message string (including date, time, and user name of acknowledging operator) shall be stored in the CSS database.

2. It shall be possible for any operator to receive a summary of all alarms regardless of acknowledgement status; for which a particular recipient is enrolled for notification; based on current event state; based on the particular event algorithm (e.g., change of value, change of state, out of range, and so on); alarm priority; and notification class.

J. Trending

1. The software shall display historical data in both a tabular and graphical format. The format shall be approved by Owner. The requirements of this trending shall include the following:

a. Provide trends for all physical points, virtual points and calculated variables.
b. The sample rate and data selection shall be selectable by the operator.
c. The trended value range shall be selectable by the operator.
d. Workstations shall be able to display up to four simultaneous trend graphs with up to four data points per graph.
e. The data points must be exportable from any operator interface in CSV or MS Excel format.

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2. Trend Logs. The operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Trends shall be BACnet trend objects.
3. Control Loop Performance Trends: Controllers incorporating PID control loops shall also provide high resolution sampling in less than five second increments for verification of control loop performance.
4. Data Buffering and Archiving: Trend data shall be buffered at the CUs, and uploaded to CSS storage when archival is desired. All archived trends shall be transmitted to the on-site OWS as applicable. Uploads shall occur based upon a user-defined interval, manual command, or automatically when the trend buffers become full.
5. Time Synchronization: Provide a time master that is installed and configured to synchronize the clocks of all BACnet devices supporting time synchronization. Synchronization shall be done using Coordinated Universal Time (UTC). All trend sample times shall be able to be synchronized. The frequency of time synchronization message transmission shall be selectable by the operator.
6. Additional trending requirement:

    a. Refer to Section 230901 – Building Automation System Commissioning

7. All change of value (COV) points shall be trended/archived for 1 year.

K. Totalization

1. The software shall support totalizing analog, digital, and pulsed inputs and be capable of accumulating, storing, and converting these totals to engineering units used in the documents. These values shall generally be accessible to the Operator Interfaces to support management-reporting functions.
2. BAS sensors used for utility monitoring shall be of the highest reliability and accuracy as described in BAS Basic Materials, Interface Devices, and Sensors. Provide certification for all sensors in this application.
3. Totalization of electricity use/demand shall allow application of totals to different rate periods, which shall be user definable.
4. When specified to provide electrical or utility Use/Demand, the Contractor shall obtain from the local utility all information required to obtain meter data, including k factors, conversion constants, and the like.

L. Scheduling

1. Provide a graphic utility for user-friendly operator interface to adjust equipment-operating schedules.
2. Scheduling feature shall include multiple seven-day master schedules, holiday schedules and override schedules, each with start time and stop time. Master schedules shall be individually editable for each day and holiday.
3. Scheduling feature shall allow for each individual equipment unit to be assigned to one of the master schedules.
4. Timed override feature shall allow an operator to temporarily change the state of scheduled equipment. An override command shall be selectable to apply to an individual unit, all units assigned to a given master schedule, or to all units in a building. Timed override shall terminate at the end of an operator selectable time, or at the end of the scheduled occupied/unoccupied period, whichever comes first. A password level that does not allow assignment of master schedules shall allow a timed override feature.

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5. A yearly calendar feature shall allow assignment of holidays, and automatic reset of system real time clocks for transitions between daylight savings time and standard time.
6. An editor for the scheduling application shall be provided at each workstation. Provide a method of selecting the desired schedule and schedule type. Exception schedules and holidays shall be shown clearly on the calendar. The start and stop times for each object shall be adjustable from this interface.

    a. Provide the capability to execute control functions according to a user created or edited schedule. Each schedule shall provide the following schedule options as a minimum:

        1) Weekly Schedule. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
        2) Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule has executed, the system shall discard and replace the exception schedule with the standard schedule for that day of the week.
        3) Holiday Schedules. Provide the capability for the operator to define up to 24 special or holiday schedules. These schedules will be repeated each year. The operator shall be able to define the length of each holiday period.

M. Overrides

1. BAS shall provide an audit log report of all overrides currently active, historical overrides along with the user who initiated the override.
2. Provide a screen graphic for manual override of the "OFF" for all Scheduled Start/Stop Zones. Provide the necessary software to start any desired zone's equipment by touch screen. The program shall permit operator selection of zones and shall enable all related equipment for that particular zone. The program shall index the selected zone to an "ON" mode in a minimum of one-hour increments for a period of up to six hours in the override condition. Once overridden, the zone equipment shall operate in the occupied mode, including exhaust fan interlocks.
3. Timed override feature shall allow an operator to temporarily change the state of scheduled equipment. An override command shall be selectable to apply to an individual unit, all units assigned to a given master schedule, or to all units in a building. Timed override shall terminate at the end of an operator selectable time, or at the end of the scheduled occupied/unoccupied period, whichever comes first. A password level that does not allow assignment of master schedules shall allow a timed override feature.
4. Provide equipment override programs for all air handling units, and heating and ventilating units. Program shall allow operator to override AHU “Off” command to enable individual units for operation without overriding Zone command. Duration of override shall be for 3 hours. Intent is to allow AHUs, or HVUs to run for maintenance servicing without requiring other equipment in the zone to operate as would be required if the Zone were overridden on.
5. Provide a single point Zones override. Intent is to allow the BAS operator to command all Zones to the unoccupied mode, effectively closing all outdoor air dampers and shutting down exhaust fans.
6. Override shall be possible for analog or time clock values for a given period of time, until a given time or permanently. Overrides may be cleared at the keyboard or through programmable user functions.

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N. Operator Interface Graphic Software

1. Graphic software shall facilitate user-friendly interface to all aspects of the System Software specified above. The intent of this specification is to require a graphic package that provides for intuitive operation of the systems without extensive training and experience. It shall facilitate logical and simple system interrogation, modification, configuration, and diagnosis.
2. System Graphics. The operator interface software shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
3. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.

    a. Animation. Graphics shall be able to animate by displaying different image files for changed object status.
    b. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
    c. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Adobe Flash).

4. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in the same formats as are used for system graphics.
5. Graphic software shall support multiple simultaneous screens to be displayed and resizable in a ‘Windows’-like environment. All functions excepting text entry functions shall be executable with a mouse.
6. Graphic software shall provide for multitasking such that third-party programs can be used while the POW software is on line. Software shall provide the ability to alarm graphically even when operator is in another software package.
7. Operating system software shall be MS Window, or latest version of Owner supported by the BAS manufacturer and approved by Owner.
8. The software shall allow for Owner creation of user-defined, color graphic displays of geographic maps, building plans, floor plans, and mechanical and electrical system schematics. These graphics shall be capable of displaying all point information from the database including any attributes associated with each point (i.e., engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse
9. Screen Penetration: The operator interface shall allow users to access the various system graphic screens via a graphical penetration scheme by using the mouse to select from menus or ‘button’ icons. Each graphic screen shall be capable of having a unique list of other graphic screens that are directly linked through the selection of a menu item or button icon.
10. Dynamic Data Displays: Dynamic physical point values shall automatically updated at a minimum frequency of 6 updates per minute without operator intervention. Point value

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fields shall be displayed with a color code depicting normal, abnormal, override and alarm conditions.

11. Time Span Graphic Replay. Operator shall be able to "replay" any dynamic floor plan graphic, equipment graphic, alarm or trend graphic in the system to see how key values changed over an operator selected period of time. Operator shall be able to select the starting date/time for this display and the end date/time of the display period. System shall then display the graphic as it would have looked at the beginning of that period, displaying key data, dynamic colors, etc. based upon values recorded at the start time. When the operator starts the replay the graphics and key values shall dynamically change to produce the effect of "fast forwarding" through the designated period of time.
12. Point Override Feature: Each displayed point shall be individually enabled/disabled to allow mouse-driven override of digital points or changing of analog points. Such overrides or changes shall occur in the control unit, not just in the workstation software. The graphic point override feature shall be subject to password level protection. Points that are overridden shall be reported as an alarm, and shall be displayed in a coded color. The alarm message shall include the operator's user name. A list of points that are currently in an override state shall be available through menu selection.

    a. Dynamic Symbols: Provide a selection of standard symbols that change in appearance based on the value of an associated point.
    b. Analog symbol: Provide a symbol that represents the value of an analog point as the length of a line or linear bar.
    c. Digital symbol: Provide symbols such as switches, pilot lights, rotating fan wheels, etc. to represent the value of digital input and output points.
    d. Point Status Color: Graphic presentations shall indicate different colors for different point statuses. (For instance, green = normal, red = alarm, gray (or '???') for non-response).
    e. Terminal Equipment Color: Floor plan graphics shall be color coded by the equipment served as follows; green = zone temperature within setpoint, blue = zone temperature below setpoint, yellow = zone temperature above setpoint, red = zone temperature in alarm range.

13. Graphics Development Package: Graphic development and generation software shall be provided to allow the user to add, modify, or delete system graphic displays.

    a. The Contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, cooling coils, filters, dampers, etc.), mechanical system components (e.g., pumps, chillers, cooling towers, boilers, etc.), complete mechanical systems (e.g. constant volume-terminal reheat, VAV, etc.) and electrical symbols.
    b. The Graphic Development Package shall allow the user to perform the following:

        1) Define symbols
        2) Position items on graphic screens
        3) Attach physical or virtual points to a graphic
        4) Define background screens
        5) Define connecting lines and curves
        6) Locate, orient and size descriptive text
        7) Define and display colors for all elements
        8) Establish correlation between symbols or text and associated system points or other displays.
        9) Create hot spots or link triggers to other graphic displays or other functions in the software.

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10) Insert frames of html pages linked internally or externally to the CSS.

O. Remote Personal Computer Workstation Graphic Software

1. Remote graphic operator software shall provide all the functionality specified for the local graphic software.
2. System configuration uses an Internet server and presents web pages that can be pulled up using a standard browser.
3. Software shall be capable of initiating communication to system, upon user command, to perform all specified functions. Software shall be capable of initiating communication to the LANs in accordance with user-programmed time schedules to upload trend and report data. Software shall be capable of communicating from the LAN in accordance with user-programmed time schedules to report alarms, upload trend, and report data.

2.8 FIELD CONTROL UNITS (FCU)

A. Field Control Units include:

1. Building Controller (BC)
2. Advanced application Specific Controllers (AAC)
3. Application Specific Controllers (ASC)

a. Terminal Box Controllers

B. Stand-alone Functionality

1. These requirements clarify the requirements for stand-alone functionality relative to packaging I/O devices with a controller. This must be specified with the controller dependent on its Application Category listed later in this section.
2. Provide controllers so that all points associated with and common to one unit or other complete system/equipment shall reside within a single control unit. Generally systems specified by their application category will identify the standalone control functionality boundary.
3. When referencing a controller with respect to stand-alone functionality, reference is specifically made to the processor. That is, a single controller processor shall execute all the related I/O control logic via one operating system that uses common programming and configuration.
4. The following configurations are considered acceptable with reference to a controller's standalone functionality:

a. Points packaged as integral to the controller such that the point configuration is listed as an essential piece of information for ordering the controller (having a unique ordering number).
b. Controllers with processors and modular back planes that allow plug in point modules as an integral part of the controller.
c. I/O point expander boards, plugged directly into the BC controller board to expand the point capacity of the controller.
d. I/O point expansion devices connected to the BC controller board via wiring and as such may be remote from the controller and that communicate via a sub LAN protocol. These arrangements to be considered standalone shall have a sub LAN that is dedicated to that controller and include no other controller devices (AACs or ASCs). All wiring to interconnect the I/O expander board shall be:

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1) Contained in the control panel enclosure;

5. The following configurations are considered unacceptable with reference to a controller's standalone functionality:

a. Multiple controllers enclosed in the same control panel to accomplish the point requirement.

C. Building Controller (BC) – BACnet Based controller

1. This is also referred to as the BAS Panel in the documents.
2. The BC's shall provide fully distributed control independent of the operational status of the OWSs and CSS. The BC shall be manufactured and provided by the selected controls vendor; no third party equipment will be accepted. All necessary calculations required to achieve control shall be executed within the BC independent of any other device. All control strategies performed by the BC(s) shall be both operator definable and modifiable through the Operator Interfaces.
3. BCs shall perform overall system coordination, accept control programs, perform automated HVAC functions, control peripheral devices and perform all necessary mathematical and logical functions. BCs shall share information with the entire network of BCs and AACs/ASCs for full global control. Each controller shall permit multi-user operation from multiple workstations and portable operator terminals connected either locally or over the Primary Controller LAN. Each unit shall have its own internal RAM, non-volatile memory, microprocessor, battery backup, regulated power supply, power conditioning equipment, ports for connection of operating interface devices, and control enclosure. BCs shall be programmable from an operator workstation, portable operators terminal, or hand held operating device. BC shall contain sufficient memory for all specified global control strategies, user defined reports and trending, communication programs, and central alarming.
4. BCs shall be connected to a controller network that qualifies as a Primary Controlling LAN.
5. All BCs shall be protected from any memory loss due to a loss of power by one or a combination of the following:

a. Volatile RAM shall have a battery backup using a lithium battery with a rated service life of seventy two (72) hours, and a rated shelf life of at least five years. Self-diagnostic routine shall report an alarm for a low battery condition.
b. EEPROM, EPROM, or NOVROM non-volatile memory

6. In addition BCs may provide intelligent, standalone control of HVAC functions. Each BC may be capable of standalone direct digital operation utilizing its own processor, non-volatile memory, input/output, wiring terminal strips, A/D converters, real-time clock/calendar and voltage transient and lightning protection devices. Refer to standalone functionality specified above.
7. The BC may provide for point mix flexibility and expandability. This requirement may be met via either a family of expander boards, modular input/output configuration, or a combination thereof. Refer to stand alone functionality specified above.
8. All BC point data, algorithms and application software shall be modifiable from the Operator Workstation.
9. Each BC shall execute application programs, calculations, and commands via a microprocessor resident in the BC. The database and all application programs for each BC shall be stored in non-volatile or battery backed volatile memory within the BC and will be able to upload/download to/from the OWS and/or CSS.

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10. BC shall provide buffer for holding alarms, messages, trends etc.
11. Each BC shall include self-test diagnostics, which allow the BC to automatically alarm any malfunctions, or alarm conditions that exceed desired parameters as determined by programming input.
12. Each BC shall contain software to perform full DDC/PID control loops.
13. For systems requiring end-of-line resistors those resistors shall be located in the BC.
14. Input-Output Processing

    a. Digital Outputs (DO): Outputs shall be rated for a minimum 24 Vac or Vdc, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each DO shall be discrete outputs from the BC's board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.
    b. Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10 Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the BC's board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 12 bits.
    c. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board.
    d. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
    e. Electronic Analog Outputs (AO): Voltage mode: 0-5 Vdc and 0-10 Vdc; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog via a DO [and transducer] is acceptable only with Owner approval (Generally these will not be allowed on loops with a short time constant such as discharge temperature loops, economizer loops, pressure control loops and the like. They are generally acceptable for standard room temperature control loops.). Where these are allowed, transducer/actuator shall be programmable for normally open, normally closed, or hold last position and shall allow adjustable timing. Each DO shall be discrete outputs from the BC's board (multiplexing to a separate manufacturers board is unacceptable). D/A converters shall have a minimum resolution of 10 bits.
    f. Pulsed Inputs: Capable of counting up to 8 pulses per second with buffer to accumulate pulse count. Pulses shall be counted at all times.

15. A communication port for operator interface through a terminal shall be provided in each BC. It shall be possible to perform all program and database back-up, system monitoring, control functions, and BC diagnostics through this port. Standalone BC panels shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers, or workstations.
16. Each BC shall be equipped with loop tuning algorithm for precise proportional, integral, derivative (PID) control. Loop tuning tools provided with the Operator Workstation software is acceptable. In any case, tools to support loop tuning must be provided such that P, I, and D gains are automatically calculated.
17. All analog output points shall have a selectable failure set-point. The BC shall be capable of maintaining this failure set-point in the event of a system malfunction, which causes loss of BC control, or loss of output signal, as long as power is available at the BC. The failure set-point shall be selectable on a per point basis.
18. Slope intercepts and gain adjustments shall be available on a per-point basis.
19. BC Power Loss:

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a. Upon a loss of power to any BC, the other units on the primary controlling network shall not in any way be affected.
b. Upon a loss of power to any BC, the central UPS shall ensure that the energy management control software, the Direct Digital Control software, the database parameters, and all other programs and data stored in the RAM are retained for a minimum of seventy two (72) hours. An alarm diagnostic message shall indicate that the BC is under battery power.
c. Upon restoration of power within the specified battery backup period, the BC shall resume full operation without operator intervention. The BC shall automatically reset its clock such that proper operation of any time dependent function is possible without manual reset of the clock. All monitored functions shall be updated.
d. Should the duration of a loss of power exceed the specified battery back-up period or BC panel memory be lost for any reason, the panel shall automatically report the condition (upon resumption of power) and be capable of receiving a download via the network, and connected computer. In addition, the Owner shall be able to upload the most current versions of all energy management control programs, Direct Digital Control programs, database parameters, and all other data and programs in the memory of each BC to the operator workstation via the local area network, or via the laptop PC.

20. BC Failure:

a. Building Controller LAN Data Transmission Failure: BC shall continue to operate in stand-alone mode. BC shall store loss of communication alarm along with the time of the event. All control functions shall continue with the global values programmable to either last value or a specified value. Peer BCs shall recognize the loss, report alarm and reconfigure the LAN.
b. BC Hardware Failure: BC shall cease operation and terminate communication with other devices. All outputs shall go to their specified fail position.

21. Each BC shall be equipped with firmware resident self-diagnostics for sensors and be capable of assessing an open or shorted sensor circuit and taking an appropriate control action (close valve, damper, etc.).
22. BCs may include LAN communications interface functions for controlling secondary controlling LANs. Refer to Section 15954 {230904} - BAS System Communications Devices for requirements if this function is packaged with the BC.
23. BCs shall be mounted on equipment, in packaged equipment enclosures, or locking wall mounted in a NEMA 1 enclosure, as specified elsewhere.

D. Advanced Application Specific Controller (AAC) and Application Specific Controller (ASC)

1. AACs and ASCs shall provide intelligent, standalone control of HVAC equipment. The AACs and ASCs shall be manufactured and provided by the selected controls vendor; no third party equipment will be accepted. Each unit shall have its own internal RAM, non-volatile memory and will continue to operate all local control functions in the event of a loss of communications on the ASC LAN or sub-LAN. Refer to standalone requirements by application specified in Part 3 of this section. In addition, it shall be able to share information with every other BC and AAC /ASC on the entire network.
2. Both AAC and ASC must be fully programmable.
3. Each AAC and ASC shall include self-test diagnostics that allow the AAC/ASO to automatically relay to the BC, LAN Interface Device or workstation, any malfunctions or

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abnormal conditions within the AAC/ASC or alarm conditions of inputs that exceed desired parameters as determined by programming input.

4. AACs and ASCs shall include sufficient memory to perform the specific control functions required for its application and to communicate with other devices.
5. Each AAC and ASC must be capable of stand-alone direct digital operation utilizing its own processor, non-volatile memory, input/output, minimum 10 bit A to D conversion, voltage transient and lightning protection devices. All volatile memory shall have a battery backup of at least seventy two (72) hours with a battery life of five years.
6. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops and shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. This feature will reduce commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes. The controller shall be able to support various types of zone temperature sensors with all options listed in the specifications.
7. Firmware or application programs, stored in the controller memory shall conform to the Sequences of Operation. Controllers with manufacturer-preprogrammed sequences that cannot be reprogrammed to the specified sequences are unacceptable. Firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.
8. The controllers shall have LED indication for visual status of communication, power and all output.
9. All point data; algorithms and application software within an AAC /ASC shall be modifiable from the Operator Workstation.
10. AAC and ASC Input-Output Processing

    a. Digital Outputs (DO): Outputs shall be rated for a minimum 24 VAC or VDC, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each DO shall be discrete outputs from the AAC/ASC's board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.
    b. Analog Inputs (AI): AI shall be O-5 Vdc, 0-10Vdc, 0-20Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the BC's board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 8-10 bits depending on application.
    c. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board. Software multiplexing of an AI and resistors may only be done in non-critical applications and only with prior approval of Architect/Engineer
    d. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
    e. Electronic Analog Outputs (AO) as required by application: voltage mode, 0-5VDC and 0-10VDC; current mode (4-20 mA). Provide zero and span calibration and circuit protection. D/A converters shall have a minimum resolution of 8 bits.

E. Terminal Box Controllers:

1. The terminal box controller shall be manufactured and provided by the selected controls vendor; no third party equipment will be accepted and be as per an
2. Terminal box controllers (Direct Digital Air Volume System) controlling damper positions to maintain a quantity of supply or exhaust air serving a space shall have an automatically initiated function that resets the volume regulator damper to the fully closed

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position on a scheduled basis. The controllers shall initially be set up to perform this function once every 24 hours. The purpose of this required function is to reset and synchronize the actual damper position with the calculated damper position and to assure the damper will completely close when commanded. The software shall select scheduled boxes randomly and shall not allow more than 5% of the total quantity of controllers in a building to perform this function at the same time. When possible the controllers shall perform this function when the supply or exhaust air system is not operating or is unoccupied.

3. All terminal box controllers must be allow for full programmability of sequences and other custom scenarios throughout the entire BAS.

F. Hardware Application Requirements (Application Categories)

1. General:

a. The functional intent of this specification is to allow cost effective application of manufacturers standard products while maintain the integrity and reliability of the control functions. A Building Controller as specified above is generally fully featured and customizable whereas the AAC/ASC refers to a more cost-effective unit designed for lower-end applications. Specific requirements indicated below are required for the respective application. Manufacturer may apply the most cost-effective unit that meets the requirement of that application.

2. Standalone Capability:

a. Each Control Unit shall be capable of performing the required sequence of operation for the associated equipment. All physical point data and calculated values required to accomplish the sequence of operation shall originate within the associated CU with only the exceptions enumerated below. Refer to Item 2.8-B above for physical limitations of standalone functionality. Listed below are functional point data and calculated values that shall be allowed to be obtained from or stored by other CUs or SDs (smart devices) via LAN.

3. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.

a. Application Category 0

1) Applications in this category include the following:

a) Monitoring of variables that are not used in a control loop, sequence logic, or safety.

2) Points on BCs, AACs, and ASCs may be used in these applications as well as SDs and/or general-purpose I/O modules.

3) Where these points are trended, contractor shall verify and document that the network bandwidth is acceptable for such trends and is still capable of acceptable and timely control function.

b. Application Category 1:

1) Applications in this category include the following:

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a) Unitary equipment (VRF Units,
b) Variable Speed Drive (VSD) controllers not requiring safety shutdowns of the controlled device.

2) ASCs shall be used in these applications.
3) Standalone Capability: Provide capability to execute control functions for the application for a given set-point or mode, which shall generally be occupied mode control. Only the following data (as applicable) may be acquired from other controllers via LANs. In the event of a loss of communications with any other controller, or any fault in any system hardware that interrupts the acquisition of any of these values, the ASC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

G. Physical/Virtual Point	H. Default Value
I. Scheduling Period	J. Normal
K. Morning Warm-Up	L. Off (cold discharge air)
M. Load Shed	N. Off (no shedding)
O. Summer/Winter	P. Winter

1) Mounting:

a) ASCs that control equipment located above accessible ceilings or below accessible floors shall be mounted on the equipment in an accessible enclosure (36” clearance required) and shall be rated for plenum use.
b) ASCs that control equipment mounted in a mechanical room may either be mounted in, on the equipment, or on the wall of the mechanical room at an adjacent, accessible location.
c) ASCs that control equipment mounted outside or in occupied spaces shall either be located in the unit or in a proximate mechanical space.
d) BAS contractor may furnish ASCs to the terminal unit manufacturer for factory mounting.

2) Programmability: Operator shall be able to modify all set-points (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, inter-stage timing parameters, and mode settings. Application-specific block control algorithms may be used to meet the sequence of operations. The ability to customize the control algorithm is not required unless specifically indicated otherwise.
3) Network Restrictions: Limit the number of nodes on the network to the maximum recommended by the manufacturer.

b. Application Category 2

1) Applications in this category include the following:

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a) Unitary Equipment >= 15 tons (Air Conditioning Units, Heat Pumps, Packaged Heating/Cooling Units, and the like)
b) Small, Constant Volume Single Zone Air Handling Units
c) Misc. Equipment (Exhaust Fan) Start/Stop
d) Misc. Monitoring (not directly associated with a control sequence and where trending is not critical)

2) ASC's may be used in these applications provided the ASC meets all requirements specified below. This category requires a general-purpose ASC to which application-specific control algorithms can be attached.
3) Standalone Capability: Only the following data (as applicable) may be acquired from other ASCs via LANs. In the event of a loss of communications with any other ASCs, or any fault in any system hardware that interrupts the acquisition of any of these values, the AAC/ASC shall use the last value obtained before the fault occurred.
4) Mounting:

a) ASCs that control equipment located above accessible (36" clearance required) ceilings or below accessible floors shall be mounted on the equipment and shall be rated for plenum use.
b) ASCs that control equipment located in occupied spaces or outside shall either be mounted within the equipment enclosure (responsibility for physical fit remains with the contractor) or in a nearby mechanical/utility room in which case it shall be enclosed in a NEMA 1, locking enclosure.

5) Programmability: Operator shall be able to modify all set-points (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, inter-stage timing parameters, and mode settings. Operator shall be able to address and configure spare inputs for monitoring. [Operator shall be able to address and configure spare outputs for simple single loop control actions or event initiated actions.] Application-specific block control algorithms may be used to meet the sequence of operations.
6) Network Restrictions: Limit the number of nodes servicing any one of these applications on the AAC/ASC LAN to 32.

c. Application Category 3

1) Applications in this category include the following:

a) Self-Contained VAV Units
b) Fan Coil Units
c) Airflow Control Boxes (VAV and Constant Volume Terminal Units, including Underfloor Terminal Units)

2) Full programmable ASC/AAC's may be used in these applications provided:

a) The ASC/AAC's meets all requirements specified below.
b) All control functions and physical I/O associated with a given unit resides in one AAC.
c) Input A/D is 10-bit. Exception: 8-bit input A/D can be used when matched with high accuracy sensors, the range of which meets the

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resolution requirements specified for the applicable sensor here in this specification.

d) Pulsed inputs required for the application can be monitored and accumulated effectively.

3) Standalone Capability: Only the following data (as applicable) may be acquired from other ASC/AAC's via LANs. In the event of a loss of communications with any other AACs, or any fault in any system hardware that interrupts the acquisition of any of these values, the AAC shall use the last value obtained before the fault occurred.

4) Mounting:

a) ASC/AAC's that control equipment located above accessible (36" clearance required) ceilings or below accessible floors shall be mounted on the equipment and shall be rated for plenum use.

b) ASC/AAC's that control equipment located in occupied spaces or outside shall either be mounted within the equipment enclosure (responsibility for physical fit remains with the contractor) or in a nearby mechanical/utility room in which case it shall be enclosed in a NEMA 1, locking enclosure.

5) Programmability: Operator shall be able to modify all set-points (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, inter-stage timing parameters, and mode settings. Operator shall be able to address and configure spare inputs for monitoring. Operator shall be able to program custom DDC control algorithms and specify trending parameters, which will be retained in memory in the event of a loss of communications. Application-specific block control algorithms may be used provided they meet the sequence of operations. The control algorithms shall be completely customizable.

6) Network Restrictions: Each LAN which participates in the transfer of data between the CU and the local operator workstation shall be subject to the following criteria:

a) Limit the number of nodes servicing any one of these applications on the AAC/ASC LAN to 16.

Q. Network Bandwidth Management

1. This section is designed to address the MS/TP networks within the DDC systems. Information passed within the MS/TP network will greatly affect the overall performance of the building systems. Scan times from the first controller to the last controller within the building network that exceed 2 seconds are not acceptable. If scan times of 2 seconds or less cannot be achieved, notified the architect/engineer for discrepancy and network shall be analyzed.
2. Once the network is properly configured the contractor shall provide a network bandwidth analysis of the controller network. The analysis shall document network bandwidth utilization does not exceed the requirements stated above for a continuous one hour period.

R. Control Unit Requirements

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1. All control units shall be manufactured and provided by the selected controls vendor; no third party equipment will be accepted.

2.9 COMMUNICATION WIRING:

A. All wiring shall be in accordance with National Electrical Codes and Division 27 of this specification.

B. Contractor shall supply all communication wiring between Building Controllers, Routers, Gateways, AAC's, ASC's and local and remote peripherals (e.g., operator workstations, and printers,).

C. Local Supervisory LAN: For any portions of this network required under this section of the specification, contractor shall use Fiber or Category 6a of standard TIA/EIA (100/1000BaseT). Network shall be run with no splices and separate from any wiring over thirty (30) volts.

D. Primary and Secondary Controller LANs: MS/TP Communication wiring shall be individually 100% shielded pairs, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over thirty (30) volts. Shield shall be terminated and wiring shall be grounded as recommended by BC manufacturer.

2.10 SIGNAL WIRING:

A. Contractor shall run all signal wiring in accordance with National Electric Codes and Division 26 of this Specification.

B. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100% shielded pair, minimum 18-gauge wire, with PVC cover or as recommended by the controller manufacturer. Signal wiring shall be run with no splices and separate from any wiring above thirty (30) volts.

C. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

2.11 LOW VOLTAGE ANALOG OUTPUT WIRING:

A. Contractor shall run all low voltage control wiring in accordance with National Electric Codes and Division 26 of this Specification.

B. Low voltage control wiring shall be minimum 22-gauge, twisted pair, 100% shielded, with PVC cover, Class 2 plenum-rated. Low voltage control wiring shall be run with no splices separate from any wiring above thirty (30) volts.

2.12 CONTROL PANELS

A. Provide control panels with suitable brackets for wall mounting for each control system. Locate panel adjacent to systems served.

B. Fabricate panels of 16-gage furniture-grade steel, or 6063-T5 extruded aluminum alloy, totally enclosed on four sides, with hinged door and pushbutton latch (keyed lock, same key for all locks), with manufacturer's standard shop-painted finish and color.

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C. Control panel shall be completely factory wired and piped, and all electrical connections made to a terminal strip. Control panel shall have standard manufacturer's color.

D. All gauges and control components shall be identified by means of nameplates.

E. All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover.

F. Complete wiring and tubing termination drawings shall be mounted in or adjacent to panel.

G. All control panels shall be factory constructed, incorporating the BAS manufacturer's standard design and layouts. All control panels shall be UL listed as an assembly and have a UL508a label. Control panels shall be fully enclosed, with perforated sub-panel, and hinged door.

H. All panels will be rated NEMA 1 for indoor location and NEMA 4X for outdoor locations and roof plant.

I. Each control panel shall consist of DDC controllers, power supplies, and I/O devices, such as relays and transducers.

J. All I/O connections on the DDC controller shall be provided with removable or fixed screw terminals.

K. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed 300-volt service and provide adequate clearance for field wiring.

L. All wiring shall be neatly installed in plastic tray or tie-wrapped.

M. A 120 volt convenience outlet, fused on/off power switch, and required transformers shall be provided in each enclosure.

N. All conduit penetrations for control panel located in central plant or exterior space must occur in the bottom of the panel.

2.13 FIELD DEVICES

A. General

1. Provide field devices for input and output of digital (binary) and analog signals into DDC hardware. Provide signal conditioning for all field devices as recommended by field device manufacturers, and as required for proper operation in the system.
2. Contractor shall assure that all field devices are compatible with controller hardware and software.
3. Unless otherwise mentioned in this section, field devices specified herein are generally 'two-wire' type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, or is not designed to work with 'two-wire' type transmitters, or if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the Contractor shall provide 'four-wire' type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required.
4. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, Contractor shall

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furnish and install proper device, including 120V power as required. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.

5. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:

   a. Control wiring between field-installed controls, indicating devices, and unit control panels.
   b. Interlock wiring between electrically interlocked devices, sensors, and between a hand or auto position of motor starters as indicated for all mechanical and controls.
   c. Wiring associated with indicating and alarm panels (remote alarm panels) and connections to their associated field devices.
   d. All other necessary wiring for fully complete and functional control system as specified.

6. Certain field devices will be installed as work by others:

   a. Control Valves furnished under this section shall be installed under the applicable piping section under the direction of Section 230923 Contractor who will be fully responsible for the proper operation of the valve.
   b. Control Dampers furnished under this section shall be installed under the applicable air distribution or air handling equipment section under the direction of Section 230923 Contractor who will be fully responsible for the proper operation of the damper
   c. Water Pressure Taps, Thermal Wells, Flow Switches, Flow Meters, etc. that will have wet surfaces, shall be installed under the applicable piping Section under the direction of Section 230923 Contractor who will be fully responsible for the proper installation and application.
   d. Controlled Equipment Power Wiring shall be furnished and installed under Division 26. Where control involves 120V control devices controlling 120V equipment, Division 26 Contractor shall extend power wiring to the equipment and control panel. Section 230923 Contractor shall extend it from the equipment to the control device and provide transformers as necessary to step the voltage down

7. Accuracy: As used in this Section, accuracy shall include combined effects of nonlinearity, non-repeatability and hysteresis. Sensor accuracies specified below shall be minimum accuracy requirements
8. Field devices shall have particular coordination with Architectural Elements - In all conditions where services and equipment manifest themselves within architectural elements, the setting out, configuration and materiality of same shall be required to be coordinated fully and meticulously with the architectural design, the obligations and requirements for which shall be as defined within 013100 – Project Management and Coordination and 013300 - Submittal Procedures

2.14 COMMERCIAL GRADE DDC CONTROL VALVES

A. General: Provide factory fabricated control valves of type, body material and pressure class indicated. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system. Provide valve size in accordance with scheduled or specified maximum pressure drop across control valve. Control valves shall be equipped with heavy-duty actuators, and with proper close-off rating for each individual application. Minimum close-off rating shall be as scheduled and adequate for each application, and shall generally be considered at dead head rating of the pump.

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B. Application:

1. Heating Hot Water.

C. Types Of Valves:

1. Segmented or Characterized Ball Type
2. Body: Carbon Steel (ASTM 216), one-piece design with wafer style ends.
3. Seat: Reinforced Teflon (PTFE).
4. Ball: Stainless steel ASTM A351
5. Port: Segmented design with equal-percentage characteristic.
6. Stem: Stainless steel.
7. Cold Service Pressure: 200 psi WOG
8. Cavitation Trim: Provide cavitation trim where indicated and/or required, designed to eliminate cavitation and noise while maintaining an equal percentage characteristic. Trim shall be a series of plates with orifices to break the pressure drop into multi-stages.
9. Warranty: Minimum manufacturer's warranty shall be five (5) years.
10. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:

    a. Belimo
    b. Johnson Controls
    c. Siemens
    d. TAC
    e. Or equal

D. Plug-Type Globe Pattern for Water Service:

1. Valve Sizing: Where not specifically indicated on the control drawings, modulating valves shall be sized for maximum full flow pressure drop between 50% and 100% of the branch circuit it is controlling unless scheduled otherwise. Two-position valves shall be same size as connecting piping.
2. Single Seated (Two-way) Valves: Valves shall have equal-percentage characteristic for typical heat exchanger service and linear characteristic for building loop connections to campus systems unless otherwise scheduled on the drawings. Valves shall have cage-type trim, providing seating and guiding surfaces for plug on 'top-and-bottom' guided plugs.
3. Double Seated (Three-way) Valves: Valves shall have linear characteristic. Valves shall be balanced-plug type, with cage-type trim providing seating and guiding surfaces on 'top-and-bottom' guided plugs.
4. Temperature Rating: 25F minimum, 250F maximum
5. Body: Bronze, screwed, 250 psi maximum working pressure for 1/2" to 2"; Cast Iron, flanged, 125 psi maximum working pressure for 2-1/2" and larger.
6. Valve Trim: Bronze; Stem: Polished stainless steel.
7. Packing: Spring Loaded Teflon or Synthetic Elastomer U-cups, self-adjusting.
8. Plug: Brass, bronze or stainless steel, Seat: Brass
9. Disc: Replaceable Composition or Stainless Steel Filled PTFE.
10. Ambient Operating Temperature Limits: -10 to 150*F (-12.2 to 66 *C)
11. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:

    a. Belimo
    b. Johnson Controls

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c. Siemens
d. TAC
e. Delta

E. Butterfly Type:

1. Body: Extended neck epoxy coated cast or ductile iron with full lug pattern, ANSI Class 125 or 250 bolt pattern to match specified flanges.
2. Seat: EPDM, except in loop bypass applications where seat shall be metal to metal
3. Disc: Bronze or stainless steel, pinned or mechanically locked to shaft
4. Bearings: Bronze or stainless steel
5. Shaft: 416 stainless steel
6. Cold Service Pressure: 175 psi
7. Close Off: Bubble-tight shutoff to 150 psi
8. Operation: Valve and actuator operation shall be smooth both seating and unseating. Should more than 2 psi dead band be required to seat/unseat the valve, valve shall be replaced at no cost to the client.
9. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:

   a. Belimo
   b. Jamesbury WS815
   c. Bray Series 31
   d. Keystone AR2
   e. Dezurik BGS

F. Ball Type

1. Body: Brass or bronze; one-, two-, or three-piece design; threaded ends.
2. Seat: Reinforced Teflon
3. Ball: Stainless steel.
4. Port: Standard or ‘V’ style.

   a. Only V-type shall be allowed for control. Standard may be used for motorized isolation.

5. Stem: Stainless steel, blow-out proof design, extended to match thickness of insulation.
6. Cold Service Pressure: 600 psi WOG
7. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:

   a. Belimo
   b. TAC
   c. Nibco
   d. Jamesbury
   e. Siemens
   f. Delta

2.15 MAGNETIC FLOWMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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1. Rosemount.
2. Foxboro.
3. Yokogawa.
4. ABB.

B. Application: Basis of design for chilled water, tempered chilled water, heating hot water, condenser water, and city water.

C. Description: Flanged Type and measuring conductive liquid flow directly in gallons per minute (liters per second).

D. Construction Carbon Steel body with PTFE lining; with integral transmitter (8' and below), remote transmitter (above 8') and direct-reading scale.

E. Pressure Rating: Class 150 Temperature Rating: to 350 DegF.

F. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons (liters).

G. Integral Transformer: For low-voltage power operation.

H. Communication Option: HART Protocol.

I. Accuracy: Plus or minus 1/4 percent.

J. Come with Calibration Kits

2.16 TURBINE FLOWMETERS

A. Manufacturers: subject to compliance with requirements, provide products by one of the following.

1. Badger Meter, Inc.; Industrial Div.
2. Fischer, George Inc.
3. ONICON Incorporated.
4. Or equal

B. Application: City water flow, Domestic cold water flow.

C. Description: Insertion type for inserting turbine into piping and measuring flow directly in gallons per minute.

D. Construction: Bronze or stainless-steel body; with plastic turbine or impeller and remote reading scale.

E. Pressure Rating: 150 psig Insert other minimum.

F. Temperature Rating: 180 deg F minimum.

G. Display: Visual instantaneous rate of flow with register to indicate total volume in gallons.

H. Accuracy: Plus or minus 2-1/2 percent.

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I. Come with Calibration Kits

2.17 CONTROL DAMPERS

A. General: Provide factory fabricated automatic control dampers of sizes, velocity and pressure classes as required for smooth, stable, and controllable air flow. Provide parallel or opposed blade dampers as recommended by manufacturers sizing techniques. For dampers located near fan outlets, provide dampers rated for fan outlet velocity and close-off pressure, and recommended by damper manufacturer for fan discharge damper service. Control dampers used for smoke dampers shall comply with UL 555S. Control Dampers used for fire dampers shall comply with UL 555.

B. For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm, differential pressure not greater than 6" w.c.

C. Performance: Test in accordance with AMCA 500.

D. Frames: Galvanized steel, 16-gauge minimum thickness, welded or riveted with corner reinforcement.

E. Blades: extruded aluminum hollow airfoil shape, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 1/2 inch (12.7 mm) shafts, 14 gauge minimum extrusion thickness.

F. Blade Seals: Synthetic elastomeric, mechanically attached, field replaceable.

G. Jamb Seals: Stainless steel.

H. Shaft Bearings: Oil impregnated sintered bronze sleeve, graphite impregnated nylon sleeve, molded synthetic sleeve, or stainless steel sleeve, with thrust washers at bearings.

I. Linkage: Concealed in frame.

J. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.

K. Leakage: Less than 0.1 percent based on approach velocity of 4000 ft./min. and 1 inches wg. (249Pa).

L. Maximum Pressure Drop: 0.15 inches wg.

M. Temperature Limits: -40 to 300 °F

N. Where opening size is larger than 48 inches (1219 mm) wide, or 72 inches (1829 mm) high, provide dampers in multiple sections, with appropriately intermediate frames, and jackshafts.

2.18 ELECTRONIC SENSORS GENERAL

A. All sensors shall have standard output signals, compatible with the I/O of the BAS controllers being supplied. Any required signal conditioning or interface devices are to be supplied and installed by the Contractor. All analog sensors, which have external signal conditioning, shall be equipped with individual zero and span adjustments. All devices shall have enclosures suitable to the environment in which they are installed.

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B. Sensors Installed In Piping

1. Sensors aheating hot water system shall be industrial grade for better precision/performance.

C. Pressure Instruments

1. Pressure transmitters shall be of the force balance type with internal sensing by means of capacitance or strain gauge design. Optional integral metering display shall be specified whenever is possible.

   a. Equipment:
   b. Range: Variable.
   c. Type: Electronic, Capacitance Sensing.
   d. Indicator: Local, 4 digit LCD.
   e. Electronics Housing: NEMA 4X/IP66.
   f. Diaphragm: Stainless Steel
   g. Drain & Vent: Side connection.
   h. Process Connection: ½-inch NPT.
   i. Electrical Connection: ½-inch NPT.
   j. Analog Output: 4-20mAdc.
   k. Power Supply: DC.
   l. Accuracy: 0.25 percent of span.
   m. Mounting Bracket: U-bolt for 2 inch pipe; stainless steel.
   n. BacNet Protocol
   o. Acceptable manufacturers are Rosemount, Yokogawa, Foxboro, Siemens, and approved equal.

2. Local and self-contained pressure regulators shall have all parts compatible with the process and where used on air shall contain an integral filter and gauge.

   a. See Control Valves section for equipment specifications.
   b. Acceptable manufacturers:
   c. Natural Gas Service – Fisher and approved equal.

3. Pressure switches shall be provided with adjustments for the set point and differential gap. Contacts shall be rated to be sufficient for 24V DC and 115V AC, 60Hz circuits.

   a. Equipment:
   b. Range: Variable, adjustable between 15 percent and 100 percent of operating range.
   c. Accuracy: 1.0 percent.
   d. Type: Diaphragm, Viton or Buna-N.
   e. Case: NEMA 4X.
   f. Connections: ½-inch NPT female.
   g. Switch Enclosure: Hermetically sealed.
   h. Switch Type: Single pole double throw snap action.
   i. Deadband: Narrow.
   j. Setpoint: Adjustable.
   k. Acceptable manufacturers are Ashcroft, United Electric Controls, and approved equal.

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4. Chemical seals shall be provided where necessary to prevent corrosive, slurry, or viscous materials from entering the pressure measuring devices.

D. Temperature Instruments

1. Sensors for remote indication shall be three (3) wire 100 Ohm platinum resistance detectors (RTD) with suitable thermowells. Instruments used for energy metering should be matched pairs of sensors and transmitters.

   a. Equipment (Temperature Element):
   b. Type: 100 ohm Platinum, 3-wire.
   c. Element: Single or dual element, with epoxy moisture seal, spring-loaded.
   d. Sheath Diameter: 0.25 inches.
   e. Sheath Material: Stainless Steel.
   f. Temperature Range: Variable.
   g. Sensor Length: Variable.
   h. Temperature Coefficient of Resistance: 0.003850 ohm/ohm/degree C, plus or minus 0.1 degree F interchangeability.
   i. Differential Temperature: Matched pair RTDs.
   j. Connection Head: NEMA 4X rating, ½-inch MNPT instrument and ½-inch FNPT conduit.
   k. Acceptable manufacturers are Rosemount, Yokogawa, Foxboro, Siemens, and approved equal.
   l. Equipment (Transmitter):
   m. Range: Variable.
   n. Type: Electronic.
   o. Indicator: Local, 4- 5 digit LCD [Exception: TES Tank temperature sensors local display not required.
   p. Electronics Housing: NEMA 4X/IP66.
   q. Electrical Connection: ½-inch NPT.
   r. Analog Output: 4-20mAdc.
   s. Power Supply: DC.
   t. Accuracy: ±0.27°F for digital and D/A 0.03 percent of span. Total analog accuracy is digital plus D/A accuracy.
   u. BacNet Protocol
   v. Acceptable manufacturers are Rosemount, Yokogawa, Foxboro, Siemens, and approved equal.
   w. Equipment (Thermowell):
   x. Range: Variable.
   y. Type: Tapered Shank.
   z. Bore Diameter: 0.26 inches (for 0.25 in RTD).
   aa. Mounting: ¾-inch NPT
   bb. Material: 316SS Stainless Steel.
   cc. Service Rating: 5200 psi at 700°F and 4400 psi at 900°F.
   dd. Insertion Length: Variable.
   ee. Instrument Connection: ½-inch FNPT.
   ff. Acceptable manufacturers are Rosemount, Yokogawa, Ashcroft, and approved equal.

2. Temperature switches shall be provided with adjustments for the set points and deadband. Contacts shall be rated to be sufficient for 24V DC and 115V AC, 60Hz circuits. Acceptable manufacturers are Rosemount, Yokogawa, Ashcroft, and approved equal.

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E. Vibration Instruments

1. Vibration instrumentation shall be suitable for rigorous service over the entire spectrum of their range. Standard manufacturer transmission signals shall be used and local indication shall be provided when possible. Acceptable manufacturers are Bently Nevada, IRD Mecanalysis, Metrix and approved equal

F. Differential Pressure Indicators

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ITT Barton.
   b. Meriam Instrument Co.
   c. Rosemount Engineering Co.
   d. Ashcroft.

2. Description: Pressure sensor, two pressure sensors, meter and connecting tubing.
3. Die cast aluminum, 6 inch (152 mm) diameter.
4. Pressure Connections: Brass, NPS 1/4 (DN 8), bottom outlet type, unless otherwise indicated.
5. Pressure-Element Assemblies: Stainless steel bellows and torque tube; self-draining.
6. Movement: Jeweled rotary type with zero and range adjustment screws.
7. Manifold: Stainless steel with carbon steel tubing.
8. Scale: Uniform, calibrated in psig.
9. Accuracy: 1/2 of 1 percent of full scale range.
10. Pressure Rating: 500 psig.

G. Sensors Installed

1. Space temperature sensor: Concealed sensors (non-button type) within enclosed offices connected to BMS. Architect/Owner approval required for proposed sensor.
2. Enclosed meeting spaces shall have concealed (non-display type t) integrate temperature and CO2 sensing, occupancy detection, occupant override and setpoint adjustment. Architect/Owner approval required.
3. Space CO2 sensor: Architect/Owner approval required.

H. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

I. Temperature Sensor Requirements

1. Accuracy will depend on the application.

   a. Room Temperature Sensors

      1) ±0.°F at 77°F. Sensor to be factory calibrated and matched with specified controller.
      2) Locate sensor on a wall or column where air is free to circulate but away away from non-representative air conditions like drafts, heat radiation or other. Coordinate locations with mechanical and architectural documents.

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3) Sensors shall have a bus port to allow hand-held devices to access and commission the connected controller or gain access to any other controller residing on the same control bus.
4) Response - <1minute

b. Single Point Duct Temp Sensor

1) ±0.2°F

c. Averaging Duct Temp Sensor

1) ±0.2°F
2) Allow one linear foot per 3 square foot of duct face

d. Liquid immersion

1) ±0.2°F for chilled and tempered chilled
2) ±0.4°F for other systems

e. Pipe Surface

1) ±0.4°F

f. Outside Air Sensors

1) ±0.4°F

J. Thermistor Temperature Sensors and Transmitters:

1. Manufacturers:

a. Minco
b. BAPI
c. BEC Controls Corporation.
d. Ebtron, Inc.
e. Heat-Timer Corporation.
f. I.T.M. Instruments Inc.
g. MAMAC Systems, Inc.
h. RDF Corporation.

2. Provide a 10K or 100K ohm thermistor-type sensing element, factory calibrated and matched with specified controller.
3. Accuracy: As required by usage
4. Wire: Twisted, shielded-pair cable.
5. Single Point Insertion Elements in Ducts: Use in return and exhaust air ducts where not affected by temperature stratification or where ducts are smaller than 10 sq. ft.. Length as required.
6. Rigid Averaging Elements in Ducts: Use where prone to temperature stratification or where ducts are larger than 10 sq. ft.. Length as required.
7. Flexible Averaging Elements in Ducts: Use where prone to temperature stratification or where ducts are larger than 10 sq. ft.. Length as required.

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8. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
9. Room Sensor Cover Construction:

    a. Set-Point Adjustment (offset): Concealed or exposed. Seek Owner's preference.
    b. Set-Point Indication: Concealed or exposed. Seek Owner's preference .
    c. Digital room temperature and set-point display. Seek Owner's preference.
    d. Color: Seek Owner's preference
    e. Local Override Switch for off-hour operation.
    f. Occupied LED indicator.
    g. RJ-11 port for portable BAS operator's terminal

10. Accessories

    a. Insulating Bases: For sensors located on exterior walls.
    b. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base. Coordinate quantities and locations with Owner.
    c. Adjusting Key: As required for calibration and cover screws.

11. Outside-Air Sensors:

    a. NEMA 3R transmitter. Watertight inlet fitting.
    b. Mount sensor and transmitter in a rugged weatherproof enclosure suitable for outdoor conditions.
    c. Shield from direct sunlight, rain and wind.
    d. Locate in shade, preferably on North side of building, and where effect of sun and radiant heat is minimal.

12. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

K. Temperature RTDs and Transmitters:

1. Manufacturers

    a. Minco
    b. BAPI
    c. Aircuity
    d. BEC Controls Corporation.
    e. MAMAC Systems, Inc.
    f. RDF Corporation.

2. Sensing elements 10K or 100K Ohms, platinum with a Temperature Coefficient of Resistance (TCR) of 0.000385 Ohms/ohm/degree C.
3. Transmitters: 4-20mA, 3-wire loop powered type with individual zero and span adjustments and linearization circuit to compensate for non-linearity of the sensor and bridge. Sized and constructed compatible with the monitored medium. True linear output with temperature over the specified range. Transmitter shall be factory matched and calibrated with sensing element using test instrumentation traceable to NIST. Provide screw terminals for wire connections.
4. Calibration Accuracy: As required by usage
5. Error: Combined sensor and transmitter error shall not exceed plus or minus 1°C over the specified range.][Where tight humidity control is required such as in art galleries and

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museums, temperature sensors and transmitters shall be matched and factory calibrated to eliminate sensor tolerance from system accuracy. The system error (sensor and transmitter) shall not exceed ±0.5°C over the specified range.]

6. Wire: Twisted, shielded-pair cable.
7. Single Point Insertion Elements in Ducts: Single point. Use in return and exhaust air ducts where not affected by temperature stratification or in all ducts are smaller than 9 sq. ft.. Length as required.
8. Rigid Averaging Elements in Ducts: Use downstream of air handlers and where ducts are larger than 9 sq. ft.; length as required.
9. Flexible Averaging Elements in Ducts: Use where prone to temperature stratification, sensing mixed air temperature, measuring temperatures downstream of a heating or cooling coil and where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.
10. Insertion Elements for Liquids:

    a. Supply as complete assembly, fill with thermally conductive compound. Brass socket with minimum insertion length of 2-1/2 inches.
    b. For still liquids, use a zero current thermocouple type sensor.

11. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment (offset): Concealed or exposed. Seek Owner’s preference.
    b. Set-Point Indication: Concealed or exposed. Seek Owner’s preference .
    c. Digital room temperature and set-point display. Seek Owner’s preference.
    d. Color: Seek Owner’s preference.
    e. Local Override Switch for off-hour operation.
    f. Occupied LED indicator.
    g. RJ-11 port for portable BAS operator's terminal

12. Accessories

    a. Insulating Bases: For sensors located on exterior walls.
    b. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base. Coordinate quantities and locations with Owner.
    c. Adjusting Key: As required for calibration and cover screws.

13. Outside-Air Sensors:

    a. NEMA 3R transmitter. Watertight inlet fitting.
    b. Mount sensor and transmitter in a rugged weatherproof enclosure suitable for outdoor conditions.
    c. Shield from direct sunlight, rain and wind.
    d. Locate in shade, preferably on North side of building, and where effect of sun and radiant heat is minimal.

14. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

L. Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers

    a. Vaisala models HMD-60U (duct), HMW-60U (wall) and HMD-60UO (outdoor).
    b. BEC Controls Corporation.

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c. General Eastern Instruments.
d. MAMAC Systems, Inc.
e. ROTRONIC Instrument Corp.
f. TCS/Basys Controls.

2. Transmitters: 4-20mA, single-point field calibration with screw terminals for wire connections.
3. Filter for sensor protection.
4. Accuracy: 5 percent full range with linear output. Room Sensor Range: 0 to 100 percent relative humidity.
5. Room Sensor Cover Construction:

a. Manufacturer's standard locking covers.
b. When sensing mediums below ambient dewpoint, provide a suitable case insulator to prevent internal condensation and moisture on the sensor and transmitter.

6. Accessories

a. Insulating Bases: For sensors located on exterior walls.
b. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base. Coordinate quantities and locations with Owner.
c. Adjusting Key: As required for calibration and cover screws.
d. Color: Seek Owner’s preference.

7. Duct Sensor: 0 to 100 percent relative humidity range with element guard and mounting plate.
8. Outside-Air Sensor and Transmitter:

a. 0 to 100 percent relative humidity range with rugged, NEMA 4 mounting enclosure, suitable for outdoor conditions and temperatures of minus 22 to plus 185 deg F.
b. Provide solar radiation/precipitation shield (Vaisalia model 2212HM).
c. Shield from direct sunlight, rain and wind.
d. Locate in shade, preferably on North side of building, and where effect of sun and radiant heat is minimal.

M. Pressure Transmitters/Transducers:

1. Manufacturers:

a. Setra
b. Veltron (Atrium space)
c. Rosemont (Water pipe)
d. Vaisala.
e. BEC Controls Corporation.
f. General Eastern Instruments.
g. MAMAC Systems, Inc.
h. ROTRONIC Instrument Corp.
i. TCS/Basys Controls.

2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.

a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.

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b. Output: 4 to 20 mA.
c. Building Static-Pressure Range: 0- to 0.25-inch wg.
d. Duct Static-Pressure Range: 0- to 5-inch wg.

3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig ; linear output 4 to 20 mA.
5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
   a. Color: Seek Owner’s preference.
8. Room sensor accessories include the following:

   a. Accessories

      1) Insulating Bases: For sensors located on exterior walls.
      2) Guards: Locking; heavy-duty, transparent plastic; mounted on separate base. Coordinate quantities and locations with Owner.
      3) Adjusting Key: As required for calibration and cover screws.

N. Status Sensors

1. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
2. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
3. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
4. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
5. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
6. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
7. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
8. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

   a. Manufacturers

      1) BEC Controls Corporation.
      2) I.T.M. Instruments Inc.

O. Flow Measuring Stations

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1. AC Unit fan inlet Airflow Stations: Mount measuring station probes within each AC unit fan inlet. One transmitter per fan.

    a. Manufacturers:

        1) Veltron 2500 plus from Air Monitor Corporation.
        2) Wetmaster Co., Ltd.
        3) Or equal.

    b. The Airflow Measuring Station shall have symmetrical averaging signal takeoffs.
    c. Come with Calibration Kits
    d. Traverse Probes:

        1) Insertion type with multiple total and static pressure sensors internally connected to respective averaging manifolds.
        2) Shall not significantly impact fan performance or contribute to fan generated noise levels.
        3) Capable of producing steady, non-pulsating signals of standard total and static pressure, without need for flow corrections or factors, with an accuracy of 3% of actual flow over a fan operating range of 6 to 1 capacity turndown.
        4) Probes, mounting brackets and connection fittings shall be of 316 stainless steel.

    e. Sensors:

        1) Multiple total and static pressure sensors placed at concentric area centers along the exterior surface of the cylindrical probes and internally connected to their respective averaging manifolds
        2) Shall not protrude beyond probe surface.

    f. Transmitter:

        1) Accuracy: 0.25 percent of natural span, including non-linearity, hysteresis and repeatability.
        2) Automatic zeroing circuit.
        3) NEMA 4 enclosure for outdoor installations.

    g. Flow Station: Air Monitor Corporation VOLU-probe/FI-SS model or equal.
    h. Transmitter: Air Monitor Corporation Veltron model 2500-plus or equal.

2. AC Unit Outside Air Flow Station: Combination of air straightener and multiport, self-averaging pitot tube station.

    a. Manufacturers:

        1) Ebtron.
        2) Or equal.

    b. Capable of plus or minus 2 percent accuracy without correction factors between a 0 to 5000 fpm velocity range.
    c. Mounting Brackets: Type 304 SS.
    d. Traverse Probes: Type 304 Stainless Steel, insertion type.

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e. Sensors:

1) Thermal dispersion technology.
2) Two “bead in glass” thermistor probes at each measurement point.
3) Factory calibrated to NIST traceable standards.
4) No calibration or adjustment required over equipment life.

f. Transmitter:

1) Microprocessor based, capable of processing 16 independent sensing points per location.
2) Output 0-10 VDC or 4-20 mA selectable.
3) Capable of indicating individual sensor airflow and ignoring malfunctioning sensors.
4) NEMA 4 enclosure for outdoor installations.

g. Flow Station: Ebtron Model GTx116PC.
h. Transmitter: Ebtron Model GTx116.

P. ACTUATORS

1. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

a. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
b. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

2. Electronic Actuators: Direct-coupled type, designed for minimum 60,000 full-stroke cycles at rated torque.

a. Manufacturers

1) Belimo Aircontrols (USA), Inc.
2) Johnson Control
3) Seimens
4) Honeywell
5) or equal.

b. Manufacturer shall be ISO 9001 Certified
c. UL listed for plenum installation under Standard 873.
d. External, built-in switch shall allow reversing of rotation direction.
e. Provide with a visual position indicator, a conduit fitting and a pre-attached 3 foot cable for easy installation to a junction box.
f. Valves:

1) Motor shall be directly coupled to valve stem through a permanently lubricated reduction gearbox.

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2) Provide manual de-clutching override to allow manual valve operation without electric power Housing: NEMA type 2.
3) Torque:

a) Two-way: Size for torque required for valve close off at 150 percent of maximum pump differential pressure.
b) Three-way: Size for 300 percent of pressure differential between ports A and B at design flow or torque required for valve close off at 100 percent of maximum pump differential pressure.

4) Modulating or two-position (as indicated in Documents) with spring return. Floating (tri-state) control is not acceptable.
5) Cooling coil valves shall be “Normally Open” (NO), heating coil valves shall be “Normally Closed” (NC).
6) Provide adjustable end-of-travel switches: one for “Open” and one for “Closed” to stop the motor at set valve stem positions.
7) Provide integral end (auxiliary) switches to indicate the required position of the valve. Switches shall be “Form C” contacts, enclosed in a watertight housing. If integral ends switches are not available, provide as accessories.
8) All modulating valves shall incorporate a positive feedback signal corresponding to the actual valve position, which can be wired back to the control (BAS) system.
9) Tandem actuators not acceptable.
10) Belimo MFT or equal.

g. Coupling: V-bolt and V-shaped, toothed cradle. Spring return actuators shall have a "V" clamp assembly of sufficient size to be directly mounted to an integral jackshaft.
h. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
i. Fail-Safe Operation: Mechanical, spring-return mechanism, capable of both clockwise and counterclockwise return. Provide external, manual gear release on nonspring-return actuators.
j. Maximum Power Requirements (Two-Position Spring Return): 24 VAC, unless 24 VAC not available. Then use 120 VAC. Contractor to coordinate with Division 26 - Electrical.
k. Maximum Power Requirements (Modulating):

1) 10 VA at 24-V AC or 8 W at 24-V DC.
2) 10 VA at 120-V AC.

l. Proportional Signal: 2- to 10-V DC or 4 to 20 mA, and 2- to 10-V DC position feedback signal. Actuator capable of accepting pulse width modulating control signal and providing full proportional operation of the valve/damper is acceptable.
m. Temperature Rating: Minus 22 to plus 122 deg F.
n. Run Time: 60 to 90 seconds.

PART 3 - EXECUTION

3.1 SUB-SYSTEM REQUIREMENTS

A. Provide all software, programming labor, point mapping, configuration, and startup of specified communications gateways to 3rd party equipment suppliers.

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3.2 CONTROLS INTERFACE/MONITORING

A. Contractor is responsible for tie-in of all controls system.

B. Review Building and Site for additional monitoring/interface requirements for HVAC system. Roof Plant monitoring requirements shall include mapping of critical system requirements as necessary at each building as is required for 24-hour alarm monitoring of critical systems.

3.3 ELECTRICAL WIRING AND MATERIALS

A. Install, connect and wire the items included under this Section. This work includes providing required conduit, wire, fittings, and related wiring accessories.

B. Provide, coordinate and install conduit and wiring between all control devices (of all trades affected) and the nearest standby power source.

C. Provide/Install all necessary transformers/power supplies required to power BAS instrumentation.

D. Specify and coordinate cabling at the office building and Site. Wiring in between building and site shall be run in dedicated conduits. Allow tie-in of all data from this system to Campus network system at the main Operator's Work Station (OWS). The system shall operate from OWS regardless of web connectivity). All systems provided for the campus shall be fully web enabled.

E. No penetration allowed at top of any outdoor panels

3.4 BAS TO CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Section "Communications Horizontal Cabling."

B. BAS contractor to provide Fiber to Ethernet converter.

3.5 SYSTEM CONFIGURATION

A. Contractor shall thoroughly and completely configure BAS system software, supplemental software, network communications, CSS, OWS, remote operator workstation, portable operators terminal, printer, kiosks and remote communications.

B. Site-Specific Application Programming

1. Provide all database creation and site-specific application control programming as required by these Specifications, national and local standards and for a fully functioning system. Contractor shall provide all initial site-specific application programming and thoroughly document programming. Generally meet the intent of the written sequences of operation. It is the Contractor's responsibility to request clarification on sequence issues that require such clarification.
2. All site-specific programming shall be fully documented and submitted for review and approval, both prior to downloading into the panel, at the completion of functional performance testing, and at the end of the warranty period.

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3. All programming, graphics and data files must be maintained in a logical system of directories with self-explanatory file names. All files developed for the project will be the property of the Owner and shall remain on the workstation(s)/server(s) at the completion of the project.

C. Password Setup

1. Set up the following password levels to include the specified capabilities:

a. Level 1: (Owner's BAS Administrators)

1) Level 2 capabilities
2) View, add, change and delete user names, passwords, password levels
3) All unrestricted system capabilities including all network management functions.
4) Operator Access. System Administrators shall also be able to vary and deny each operator's privileges based on the geographic location, such as the ability to edit operating parameters in Building A, to view but not edit parameters in Building B, and to not even see equipment in Building C

b. Level 2: (System Engineers)

1) Level 3 capabilities
2) Configure system software
3) Modify control unit programs
4) Modify graphic software
5) Essentially unrestricted except for viewing or modifying user names, passwords, password levels

c. Level 3: (Senior Maintenance Technician)

1) Level 4 capabilities
2) Override output points
3) Change setpoints
4) Change equipment schedules
5) Exit BAS software to use third party programs

d. Level 4: (Maintenance / Service Desk)

1) Level 5 capabilities
2) Acknowledge alarms
3) Temporarily override equipment schedules

e. Level 5: (Read Only)

1) Display all graphic and trend point data

f. Level 6 (Occupants)

1) Access defined parts of the BAS to alter

a) Personal setpoint

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2) Report to occupant current operational mode
3) Allow override of schedule for 2 hours

2. Contractor shall assist Owner's operators with assigning user names, passwords and password levels.

D. Point Parameters

1. Provide the following minimum programming for each analog input:

a. Name
b. Address
c. Scanning frequency or COV threshold
d. Engineering units
e. Offset calibration and scaling factor for engineering units
f. High and low alarm values and alarm differentials for return to normal condition
g. High and low value reporting limits (reasonableness values), which shall prevent control logic from using shorted or open circuit values.
h. Default value to be used when the actual measured value is not reporting. This is required only for points that are transferred across the primary and/or secondary controlling networks and used in control programs residing in control units other than the one in which the point resides. Events causing the default value to be used shall include failure of the control unit in which the point resides, or failure of any network over which the point value is transferred.
i. Selectable averaging function that shall average the measured value over a user selected number of scans for reporting.

2. Provide the following minimum programming for each analog output:

a. Name
b. Address
c. Output updating frequency
d. Engineering units
e. Offset calibration and scaling factor for engineering units
f. Output Range
g. Default value to be used when the normal controlling value is not reporting.

3. Provide the following minimum programming for each digital input:

a. Name
b. Address
c. Engineering units (on/off, open/closed, freeze/normal, etc.)
d. Debounce time delay (Digital Filter)
e. Message and alarm reporting as specified
f. Reporting of each change of state, and memory storage of the time of the last change of state
g. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.

4. Provide the following minimum programming for each digital output:

a. Name
b. Address

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c. Output updating frequency
d. Engineering units (on/off, open/closed, freeze/normal, etc.)
e. Direct or Reverse action selection
f. Minimum on-time
g. Minimum off-time
h. Status association with a DI and failure alarming (as applicable)
i. Reporting of each change of state, and memory storage of the time of the last change of state.
j. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.
k. Default value to be used when the normal controlling value is not reporting.

E. Trends

1. Contractor shall establish and store trend logs. Trend logs shall be prepared for each physical input and output point, and all dynamic virtual points such as setpoints subject to a reset schedule, intermediate setpoint values for cascaded control loops, and the like as directed by Owner.
2. Owner will analyze trend logs of the system operating parameters to evaluate normal system functionality. Contractor shall establish these trends and ensure they are being stored properly.
3. Data shall include a single row of field headings and the data thereafter shall be contiguous. Each record shall include a date and time field or single date stamp. Recorded parameters for a given piece of equipment or component shall be trended at the same intervals and be presented in a maximum of two separate 2-dimensional formats with time being the row heading and field name being the column heading.
4. The Contractor shall demonstrate functional trends as specified for a period of 30 days after successful system demonstration before Substantial Completion of the system.
5. Each trend shall be at average of [20] seconds.

6. Example Trending points table see specification 230923 Part 3.5.M.

F. Alarms

1. General: Contractor will be responsible for setting initial alarm parameters. No reporting actions will be initiated during construction unless directed by Owner.
2. Archive: Contractor will be responsible for configuring final approved alarm set for CSS archiving no less than two years or the minimum length of the controls warranty, whichever is greater.
3. Override Alarms: Any point that is overridden through the override feature of the graphic workstation software shall be reported as a Level 3 alarm.
4. Analog Input Alarms: For each analog input, program an alarm message for reporting whenever the analog value is outside of the programmed alarm limits. Report a ‘Return-to-Normal’ message after the analog value returns to the normal range, using a programmed alarm differential. Contractor shall coordinate with Owner for final values based on the following parameters:

    a. Space temperature, except as otherwise stated in sequence of operation: Level 3

        1) Low alarm: 64°F
        2) Low return-to-normal: 68°F
        3) High alarm: 85°F

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4) High return-to-normal: 80°F

b. Controlled media temperature other than space temperature (e.g. AHU discharge air temperature, steam converter leaving water temperature, condenser water supply, chilled water supply, etc.): Level 3 (If controlled media temperature setpoint is reset, alarm setpoints shall be programmed to follow setpoint)

1) Low alarm: 3°F below setpoint
2) Low return-to-normal: 2°F below setpoint
3) High alarm: 3°F above setpoint
4) High return-to-normal: 2°F above setpoint.

c. AC Unit mixed air temperature: Level 4

1) Low alarm: 45°F
2) Low return-to-normal: 46°F
3) High alarm: 90°F
4) High return-to-normal: 89°F

d. Duct Pressure:

1) Low alarm: 0.5”w.g. below setpoint
2) Low return-to-normal: 0.25”w.g. below setpoint
3) High alarm: 0.5”w.g. above setpoint
4) High return-to-normal: 0.25”w.g. above setpoint

5. BAS System Failure Alarm: Generate alarm that reads “BAS System Failure”. Alarm shall be generated when communication is lost to any controller or when any controller is determined to be in an abnormal state.
6. Every [5] seconds.
7. Example alarm points table see specification 230923 Part 3.5.M.

G. Graphic Screens

1. Floor Plan Screens: The contract document drawings will be made available to the Contractor in AutoCAD format upon request. These drawings may be used only for developing backgrounds for specified graphic screens; however the Owner does not guarantee the suitability of these drawings for the Contractor’s purpose.

a. Provide graphic floor plan screens for each floor, wing, or tower of the building. Indicate the location of all equipment that is not located on the equipment room screens. Indicate all equipment zones with corresponding ON/OFF status. Indicate the location of temperature sensors associated with each temperature-controlled zone (i.e., VAV terminals, fan-coils, single-zone AHUs, etc.) on the floor plan screens. Display the space temperature point adjacent to each temperature sensor symbol. Use a distinct line symbol to demarcate each terminal unit zone boundary. Use distinct colors to demarcate each air handling unit zone. Mechanical floor plan drawings will be made available to the contractor upon request for the purpose of determining zone boundaries. Indicate room numbers as provided by the Owner. Indicate all down duct static pressure sensor locations. Provide a drawing link from each space temperature sensor symbol and equipment symbol shown on the

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graphic floor plan screens to each corresponding equipment schematic graphic screen.

b. Real Time Dynamic Floor Plans. All facility floor plans must indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint. Numerical zone temperature and setpoint information is not acceptable.

c. Provide graphic floor plan screens for each mechanical equipment room and a plan screen of the roof. Indicate the location of each item of mechanical equipment. Provide a drawing link from each equipment symbol shown on the graphic plan view screen to each corresponding mechanical system schematic graphic screen.

d. If multiple floor plans are necessary to show all areas, provide a graphic building key plan. Use elevation views and/or plan views as necessary to graphically indicate the location of all of the larger scale floor plans. Link graphic building key plan to larger scale partial floor plans. Provide links from each larger scale graphic floor plan screen to the building key plan and to each of the other graphic floor plan screens.

e. Provide a graphic site plan with links to and from each building plan.

2. System Schematic Screens: Provide graphic system schematic screen for each HVAC subsystem controlled with each I/O point in the project appearing on at least one graphic screen. System graphics shall be consistent with current path line style; coordinate with path line. System graphics shall include flow diagrams with status, set points, current analog input and output values, operator commands, etc. as applicable. General layout of the system shall be schematically correct. Input/output devices shall be shown in their schematically correct locations. Include appropriate engineering units for each displayed point value. Verbose names (English language descriptors) shall be included for each point on all graphics; this may be accomplished by the use of a pop-up window accessed by selecting the displayed point with the mouse. Indicate all adjustable setpoints on the applicable system schematic graphic screen or, if space does not allow, on a supplemental linked-setpoint screen.

   a. Provide graphic screens for each air handling system. Indicate building outside air temperature, humidity and enthalpy. Indicate mode of operation as applicable (i.e., occupied, unoccupied, warm-up, cool-down). Link screens for air handlers to the heating system and cooling system graphics. Link screens for supply and exhaust systems if they are not combined onto one screen. Include external links to sequence of operations, as-built control drawing, as-built electrical schematic and approved shop drawings.

   b. Provide a graphic screen for each zone. Provide links to graphic system schematic screens of air handling units that serve the corresponding zone.

   c. Equipment Graphics. In order to facilitate this Operator-BMS Interface, it is critical that the BAS be able to display and accurate graphic representation of each piece of equipment in the facility. In addition, Equipment Graphics representing the actual interface panel of each piece of integrated equipment shall be provided for all integrated systems. These graphics shall incorporate real time live data from the associated interface points.

   d. Provide a cooling system graphic screen showing all points associated with the chillers, cooling towers and pumps. Indicate outside air dry-bulb temperature and calculated wet-bulb temperature. Link screens for chilled water and condenser water systems if they cannot fit onto one cooling plant graphic screen. Include external links to sequence of operations, as-built control drawing, as-built electrical schematic and approved shop drawings.

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e. Provide a heating system graphic screen showing all points associated with the boilers, heat exchangers and pumps. Indicate outside air dry-bulb temperature and calculated wet-bulb temperature. Include external links to sequence of operations, as-built control drawing, as-built electrical schematic and approved shop drawings.

f. Link screens for heating and cooling system graphics to utility history reports showing current and monthly electric uses, demands, peak values, and other pertinent values.

g. Provide a link to as-built BAS schematics, TAB report and sequences of operation for each piece of equipment from the equipment graphic screen. Link should open document in a separate window without closing or modifying the current BAS graphic view.

h. Time Span Graphic Replay. Operator shall be able to “replay” any dynamic floor plan graphic, equipment graphic, alarm or trend graphic in the system to see how key values changed over an operator selected period of time. Operator shall be able to select the starting date/time for this display and the end date/time of the display period. System shall then display the graphic as it would have looked at the beginning of that period, displaying key data, dynamic colors, etc. based upon values recorded at the start time. When the operator starts the replay the graphics and key values shall dynamically change to produce the effect of “fast forwarding” through the designated period of time.

i. Full Color Psychrometric Chart Graphics provided at front end BMS displaying real time Supply air, Return Air, Dew point temperature for each of the environment monitoring stations (Psych chart graphics for each relevant NV loops or systems) and ambient Outdoor Air conditions. Psych Chart shall have outlines that designate Allowable and Recommended ranges of operation (modes); coordinate with Engineer for dry bulb, relative humidity, dew point ranges.

H. Alarms: Each programmed alarm shall appear on at least one graphic screen related to the equipment in alarm and a cumulative graphic alarm screen showing all active alarms for the current building. In general, alarms shall be displayed on the graphic system schematic screen for the system that the alarm is associated with (for example, chiller alarm shall be shown on graphic cooling system schematic screen). For all graphic screens, display analog and digital values that are in an ‘alarm’ condition in a red color.

I. Warranty Countdown Clock: Contractor shall initiate a warranty countdown clock (days & hours) in the presence of Owner and displayed on the primary project graphic screen at the start of warranty that will expire at the end of warranty. Countdown clock shall not be impacted by loss of power or restarting of servers or workstations.

J. Alarm and Trend Points Table

1. BAS Vendor shall present formatted alarm and trend table to Owner for final approval.
2. All points on major/critical equipment/space shall be included.

END OF SECTION

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SECTION 233100

HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide ductwork as indicated on the Drawings and as specified.

B. Seal duct, fittings and accessories where manufacturers and codes permit, per Part 3. Note that duct construction pressure class may differ from leakage pressure class depending on building function.

C. Clean and pressure-test ductwork.

1.2 QUALITY ASSURANCE

A. Reference Standards:

1. National Fire Protection Association (NFPA): NFPA No. 90-A. "Air Conditioning and Ventilating Systems".
2. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA), 8224 Old Court House Road, Vienna, Virginia, 22180.

    a. Balancing and Adjustment Manual: In this Specification shall mean the first edition of the "Manual for the Balancing and Adjustment of Air Distribution System".
    b. "HVAC Duct Construction Standards-Metal and Flexible", 2005.
    c. "Round Industrial Duct Construction Standards", 2013.
    d. "Rectangular Industrial Duct Construction Standards", 2004.
    e. "HVAC Air Duct leakage Test Manual", 2012.

3. American Conference of Governmental Industrial Hygienists (ACGIH). "Industrial Ventilation-A Manual of Recommended Practice", 20th edition.
4. Factory Mutual (FM) Standard 7-78.
5. NFPA 91.
6. National Bureau of Standards (NBS) Voluntary Product Standard 15-69.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Section 23 05 00 "General Work Results for HVAC", apply to this. Test

1.4 SUBMITTALS

A. Shop Drawings and Product Data:

1. Submit large-scale Drawings in accordance with the requirements of Section 23 05 00 – Common Work Results for HVAC, and as follows:

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a. Large-scale layout Drawings of mechanical equipment rooms and penthouses showing all related equipment and clearances required by other trades.
b. Large-scale layout Drawings of all areas in which it may be necessary to deviate substantially from layout shown on the Drawings. Minor transitions in ductwork, required to avoid local interference with other trades, need not be submitted, as long as the duct area is maintained. Show major relocation of ductwork and major changes prior to ductwork fabrication.

2. Shop drawings shall include all ductwork including elevations, and shall show all terminal unit and air device connections. Drawings shall be at a minimum scale of ¼ inch per 1 foot – 0 inches and shall be based on coordination programs of all trades. Clearly identify all Work deviating from that indicated on Contract Drawings.
3. Submit written report from the testing, adjusting and balancing agency. based on review of Drawings and Specifications, with suggestions for work to be performed or devices added to allow for proper balancing.
4. Method of attachment of duct hangers to building construction.
5. Certification: If required by the Authority Having Jurisdiction, submit written certification from a nationally recognized testing agency indicating the maximum load upper attachments for securing hangers will support, and that these attachments will not work loose by rapid and repeated oscillation or mechanical vibration.
6. Ductwork.

a. Duct pressurization/leakage test report.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Construct of galvanized sheet metal, except where otherwise shown or required. Duct gauges per SMACNA and CMC.

B. Steel: ASTM A527 lock forming quality. Black or galvanized as hereinafter specified. Galvanizing: ASTM A525 commercial coating class G-90, on both sides. Cold-rolled, soft steel sheets.

C. Stainless steel: ASTM A480, Type 304 or 316, sheet form with No. 4 finish on ducts exposed to view; No. 2B finish on concealed ducts.

D. Aluminum: ASTM B209-2, 1.4, alloy 3003, temper H14, base alloy not more than 0.40 percent copper, mill finish for concealed ducts, one-side bright finish for ducts exposed to view, commercial sheet 16,000 psi. Aluminum sheets shall be one gauge heavier than galvanized steel.

E. Ducts and Fittings:

1. United, Semco, MINA, Pacific Air Products or equal prefabricated duct and fittings.
2. Fittings shall be continuously welded or spot welded and sealed. Where zinc coating has been burned during fabrication, fittings shall be painted by the manufacturer.
3. Tapers: Unless specifically indicated on Drawings, pitch sides of duct in “diverging” or “converging” airflow maximum of 1 to 4 taper.
4. Elbows and transitions:

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a. Elbows:

1) Smooth radius elbows. Radius equals 1.5 times duct diameter or width. Minimum four-piece construction for round.
2) Short radius elbows are acceptable for locations downstream of terminal boxes, for general exhaust ducts serving fewer than three thermostatic zones and where specifically indicated on Drawings. Radius equals duct diameter or width. Minimum four-piece construction for round.
3) Square turns in rectangular ducts only where required to facilitate installation. Provide turning vanes except in kitchen hood exhaust ducts.

F. Exhaust systems serving LAB's fume hoods:

1. Stainless steel: Type 316, continuous weld.

G. Duct Hangers:

1. Band Hangers: Same material as ducts, except that hangers for stainless steel ducts in unfinished spaces may be galvanized steel.
2. Rod-Type Hangers: Mild low carbon steel, unless otherwise specified; fully threaded or threaded each end. Unless galvanized or cadmium plated, provide a shop coat of red lead or zinc chromate primer paint.
3. Conform to requirements specified in Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

H. Miscellaneous Fasteners and Upper Hanger Attachments:

1. Screws:

a. Same material as sheet, except as shown.
b. On aluminum sheets, provide cadmium plated or stainless steel.
c. Zinc or cadmium plated, permitted on galvanized sheets.
d. Minimum screw size: No. 10.

2. Duct sealants:

a. High-pressure, high-velocity duct sealant for indoors.
b. Hardcast 5400 tape with Hardcast RTA 50 adhesive; or high-pressure, high velocity, weatherproof duct sealant for outdoors.
c. Gaskets:

1) Continuous, reinforced, inert self-conforming type.
2) 1/8-inch thick.
3) Width: To match angle connection.
4) 3M Weatherban ribbon sealer or equal.

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3. Spring fasteners: DZUS, Simmons Quick-Lock or equal.

    a. Oval head stud and receptacle.
    b. Screwdriver slot.
    c. Self-ejecting.

4. Machine bolts and nuts: Galvanized or cadmium plated steel.
5. Concrete inserts: Steel or malleable iron.
6. Welding studs: DSM Products, capacitor discharge, low carbon steel, copper flashed.
7. Self-drilled expanding fastener: Hilti or Phillips type.
8. Expansion shields: "Star Slugin", single unit type, unless otherwise specified.
9. Electrically operated tools for installing welded studs and fasteners shall be listed by a nationally recognized test agency.

I. Beaded sleeve round duct seams. Crimp joints acceptable for 18 inch and smaller round.

J. Pittsburgh lock longitudinal joints. No button punch snap lock for ductwork rated above +2 inches WG or below –2 inches WG. No "S" slip or drive slip transverse joints except on branch runouts. Pocket lock transverse joints. SMACNA TDC and/or TDF acceptable. DUCTMATE system is acceptable alternate.

K. Use stainless steel where exhausting moist air from showers and where otherwise indicated.

L. Gasket Material:

1. For use with registers, grilles, and diffusers installed in exposed uninsulated ductwork: 1/4-inch thick felt or sponge rubber material, of width as required by the flange on the particular device.
2. For Use with Flanged Joints in Ducts: 1/8-inch thick reinforced inert plastic on the self-conforming type, of width as required by the particular flange.

M. Flexible Duct:

1. Acoustical Flexible Duct:
    a. Flexmaster U.S.A. Inc., Type 6-B
    b. Acosta Acoustical Flex
    c. Casco SF-181M
    d. Or equal.

2. Materials

    a. Insulated flexible duct acoustically designed to provide high insertion loss characteristics. Published flexible duct acoustical data shall be obtained in accordance with Air Diffusion Council Flexible Air Duct Test FD72R1, Paragraphs 3.2.1, Sound Attenuation; 3.2.2, Sound Generation; 3.2.3, Radiated Noise Reduction. Duct shall be rated for 4000 FPM velocity minimum.

        1) Flexible ducts shall consist of an exterior bi-directional fiberglass reinforced metalized film vapor barrier, nominal 1-1/2 inches thick fiberglass insulation (K = 0.23 at 75 degrees F) with a 0.1 ASTM 96 A perm rating, and a strong, spun bonded nylon internal lining permanently bonded to a coated spring

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steel wire helix providing an impervious, smooth, nonperforated interior liner to shield the airflow from fiberglass erosion.

2) Connect individual lengths of flexible duct to inlet and outlet collars and branch ducts per Air Diffusion Council (ADC) 2003 recommendations. Use heat-stabilized Nylon 6/6 or Tefzel (Dupont) ties meeting UL 2043 for continuous exposure above 200°F. Complete connection with tape meeting ASTM E2342-03 for a test period of at least 60 days and have "CEC Approved" stamp. Cloth back adhesive tapes known to have passed this test are as follows:

   a) Polyken 558CA or Nashua 558CA, by Berry Plastics, Tapes and Coatings Division.
   b) Shurtape PC 858CA, by Shurtape Technologies.

3) Flexible ducts may be used to cross seismic joints. Provide with sufficient slack to accommodate anticipated "design" seismic movement. See Structural Drawings.

b. Construction: In accordance with SMACNA flexible ductwork classification for minus 1 inch to 4 inches WG.

3. Install with a minimum inside bending radius not less than one duct diameter, a maximum turn angle of 90 degrees, no pinches or twists, and with a limit of two bends.
4. Length to air outlets/grilles = five (5) feet minimum, seven (7) feet maximum.
5. Do not use flexible duct for connections through walls or gypsum board ceilings.
6. Do not use flexible duct for connections to terminal units.
7. Adhesives and Sealants: Refer to VOC limits specified in Section 01 81 13 – Sustainable Design Requirements for adhesives and sealants applied on site, within the weatherproofing line
8. Reference minimum insertion loss performance for 5' length, similar to:

Duct ID (in.)	Frequency (Hz)						
	125	250	500	1000	2000	4000	8000
6	11	33	37	39	37	19	14
8	13	35	34	39	29	17	14
≥12	10	26	26	35	24	11	9

Regenerative noise caused by air turbulence in the flexible duct shall not exceed the following levels for a 12-inch diameter duct with an air speed of 1000 fpm.

	Sound Power Levels, dB re. 10^{-12} Watts, at Octave Band Center Frequency, Hz				
	125	250	500	1000	2000
Maximum Regenerative Noise	30	31	30	22	20

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Ductwork:

1. Construct with gauges, joints, bracing, reinforcing, and other details per latest SMACNA and CMC, unless specified otherwise.
2. Properly seam, brace, stiffen, support and seal ducts.
3. Where internal insulation or acoustical lining is applied, duct sizes as shown on the Drawings shall represent net inside clear dimensions. Add lining thickness to determine metal duct dimensions.
4. Adjust ducts to suit local coordination conditions. Alter duct sizes on basis of equal friction where required to facilitate installation with no increase in Contract Sum. As duct shape affects acoustics and pressure drops, contractor shall highlight (cloud) and submit any proposed conversion of round duct to rectangular duct or rectangular to round as shop drawings for Owner's Representative's review.
5. Notify Owner's Representative where duct dimension field changes are required to conform to the building structure or to avoid interfering with other trades.
6. Avoid penetration of ducts. Provide airtight rubber grommets at unavoidable penetrations of hanger rods.
7. At exposed duct penetrations of walls, floors and ceilings, provide sheet metal angle type escutcheons.
8. Duct openings: Provide openings where required to accommodate thermometers, smoke detectors, controllers, etc.
9. Coordinate pitot tube openings where required for testing of systems.
10. Sealant;

    a. Seal with high pressure, high velocity sealant.
    b. Unless otherwise allowed by this specification, adhesive type duct tape is not acceptable.
    c. Some sealants can adversely affect the release function of breakaway connections to fire dampers; consult the damper manufacturer for installation restrictions.

11. Waterproof seams and joints in ductwork exposed to the weather by application of Hardcast 5400 tape and RTA50 sealer or high velocity sealant.
12. Joints between ducts:

    a. Mechanically fastened with sheet metal screws.
    b. Seal per above. Apply coating of duct sealer at joints and screws.

13. Junctions between ducts:

    a. Branch takeoff: 45 degrees, 90 degree with 45 degrees tapered transition or round, conical tap- or spin-ins.
    b. Where possible, avoid connecting branch ducts to bottom of main duct.

14. Aluminum ductwork:

    a. Joints and seams made watertight by:

        1) Continuous soldering
        2) Continuous aluminum welding

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3) Apply epoxy adhesive

a) Scotch-Weld Structural Adhesive No. 2216, Design Polymerics 1020 or equal.
b) Apply epoxy adhesive to seams and joints before fabrication.

b. Grilles on aluminum ductwork: Aluminum.
c. Separate aluminum ducts, casing, plenums, housings and louvers from direct contact with concrete by resilient gasketing or caulking compound.

15. Plenums: Match material of connected ductwork system. Construct with gauges, joints, bracing, reinforcing, and other details per latest SMACNA and CMC unless specified otherwise.

16. Ducts out-of-doors:

a. Construct all ducts subject to rain watertight and to insure water runoff by one or more of following techniques:

1) Use round ducts.
2) Standing seams arranged to not act as dams.
3) Entire top of duct sloped down toward side.
4) Vertical struts within duct to bow top panels of duct into convex shape.

17. Where final branch duct is not smooth continuation of main, extend main horizontal branch duct a minimum of one foot beyond diffuser.
18. Cap ductwork downstream from terminal filters at the end of each working day. Take special care to keep these ducts free of dirt while work is performed.
19. Install flexible duct only where shown on mechanical drawings. Where flexible duct is installed, the following restrictions apply:

a. Maximum turn angle 90 degrees
b. Minimum inside radius one duct diameter
c. Limit of two bends per flexible duct
d. Support at or near mid-length with 2 inch wide 28 gauge steel hanger collar attached to the structure with approved duct hanger.

B. Duct Hangers and Supports:

1. General:

a. Attachment to structure, as specified in Sections 23 05 00 – Common Work Results for HVAC and 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
b. Seismic restraints as specified in Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
c. Ducts and duct support must not contact ceiling framing and wires.

2. Install hangers for ducts as specified in SMACNA
3. Upper hanger attachments:

a. Attachment to existing cast-in-place concrete:

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1) Secure hangers to overhead construction with wedge anchor.
2) Secure hanger attachment required to be supported from wall to floor construction with single unit expansion shields or self-drilling type expansion shields and machine bolts.

4. Access doors: Provide access doors in ducts for reaching fan wheels, modulating dampers and motors, fusible links, controllers, and other movable devices. In addition, provide access doors at all elbows upstream of turning vanes and upstream of duct coils. Not required for splitters. Access is required for terminal air box reheat coils when noted or otherwise required.
5. Do not suspend ducts from piping, plumbing, conduits or related supports.

3.2 DUCT PRESSURE TESTING

A. General:

1. Leak test all ductwork and plenums except for:

   a. Supply duct downstream of terminal units.
   b. Return duct between shaft and air inlets.
   c. Exhaust systems served by fans scheduled at 2.0 in. w.g. total static pressure or lower.
   d. Exhaust and outside air associated with penthouse-located AHU's.
   e. Ducts associated with fan coils or other small, unitary systems.

2. The Owner's Representative shall select one of each of the above excepted duct systems for pressure testing. If each of these test results indicates a "pass", pressure testing for the excepted system types shall be considered complete. If any of these initial tests "fail", the Owner's Representative shall select another one of each excepted system for testing. This shall continue, for each system, until each system passes the pressure test.
3. Testing shall be in presence of Owner's Representative and before ducts are concealed.
4. Use portable high-pressure blower and necessary instruments to indicate amount of leakage.

B. Procedure:

1. Conduct tests as specified in Section 23 05 93 – Testing, Adjusting and Balancing, as recommended in SMACNA HVAC Air Duct Leakage Test Manual, and as follows:
2. The following table summarizes duct seal, pressure and leakage classes. Separate "pressure" columns are included to describe duct construction duct leakage requirements.

Duct Type / Location	Pressure Class	Seal Class	Metal Duct Leakage Class (rect/round)
Supply air, upstream of terminal units.	4 inches	A	6/3
Supply air, between terminal units and air outlets	2 inches	A	24/12
Return air risers.	2 inches	A	24/12
Return air, between air inlets and risers.	2 inches	A	24/12

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Duct Type / Location	Pressure Class	Seal Class	Metal Duct Leakage Class (rect/round)
Supply and return air, between fan coil units and air outlets/inlets.	1 inch	A	24/12
Exhaust air systems where scheduled fan operating pressure > or = 1.5 inches w.g.	3 inches.	A	6/3
Exhaust air systems where scheduled fan operating pressure <1.5 inches w.g.	2 inches.	A	24/12
Exhaust air systems where scheduled fan operating pressure <0.50 inches w.g.	1 inch.	A	24/12
All others	at least as high as associated fan's operating pressure	A	6/3

3. Determine amount of air leakage by makeup airflow measurements. The total leakage shall be determined by summation of leakage for each section of system tested.
4. Noise generated from duct leakage is not acceptable.
5. Visually mark tested sections with certification sticker and initials of field test inspector.
6. Submit certification of test results.

3.3 DUCT CLEANING

A. Adhere to duct cleanliness standards as described in SMACNA "Duct Cleanliness for New Construction" guidelines. The following level guidelines shall be followed, including instructions for duct delivery, site storage, installation, protection and production.

1. "Intermediate" for all supply air duct
2. "Basic" with additional provision for capping open work for all other systems.

END OF SECTION

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SECTION 233300

AIR DUCT ACCESSORIES

PART 1- GENERAL

1.1 DESCRIPTION OF WORK

A. Provide ductwork accessories complete for the air distribution system, as indicated on the Drawings and as specified.

1.2 SUBMITTALS

A. Shop Drawings and Product Data:

1. Submit product data under provisions of Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.
2. Submit the following:

a. Flexible connections.
b. Turning vanes.
c. Volume dampers.
d. Fire and smoke dampers.
e. Backdraft dampers.
f. Duct access doors.
g. Sound attenuators.

PART 2- PRODUCTS

2.1 MATERIALS

A. Flexible Connections: Ventfabrics, Elgen "Silent duct" type SDN-6, Durodyne or equal neoprene coated fiberglass.

1. SMACNA Low Pressure Duct Manual, except as shown.
2. With metal collars.
3. At connections to fans:

a. Neoprene coated glass fabric. Maintain not less than 4-inches metal-to-metal separation and with fabric folds to allow for flexibility.
b. 30 ounces per square yard.
c. Sewed and cemented seams.
d. 25-flame spread, 50 smoke-developed rating.
e. For high velocity, waterproof, out of door, dishwasher and range hood appliances if allowed by code.

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B. Turning Vanes:

1. Aero/Dyne, HEP, SMACNA or equal.
2. Galvanized steel ductwork: galvanized steel or painted black steel, except as noted.
3. Other ductwork: Same material as ductwork.
4. Low pressure systems: SMACNA-HVAC Duct Construction Standards 1985, except as noted.

    a. Single width turning vanes with 3/4-inch trailing edge and 2-inch radius for ducts 36 inches or less in width; hollow airfoil type blades for ducts greater than 36 inches wide. Rigidly connect vane rails.
    b. Vane length not to exceed 36 inches. Provide separate equal size sections for greater lengths.

5. Medium and high pressure systems: SMACNA-HVAC Duct Construction Standards 1985, except as shown.

    a. Small double thickness vanes with 2-inch inside radius.
    b. Long radius vanes where shown or required.

6. Vane length not to exceed 36 inches. Provide separate equal size sections for greater lengths.

C. Dampers - General:

1. For all types of dampers, fabricate damper blades, axles, frames, etc., of the same material as ductwork in which they are to be installed.

D. Volume and Splitter Dampers:

1. Ruskin, Terri or American Warming.
2. Provide where required to provide complete air balance and where shown on drawings. Coordinate with air balance firm. Not all dampers are shown.
3. In ducts greater than 9 inches high, provide opposed-blade-type dampers with frames of minimum 16 gauge formed channel, minimum 3-1/2 inches wide with minimum 7/8-inch deep flanges.
4. In ducts 9 inches high or less, provide single-blade dampers with frames of minimum 4-1/2-inch by 12-gauge material.
5. Blades: 16 gauge minimum. Blades in multiblade dampers: 8 inches wide maximum.
6. Axles 1/2-inch round minimum or hexagonal stock.
7. Bearings: Molded synthetic material or bronze oilite, spacing 48 inches maximum.

E. Damper Regulators:

1. At accessible dampers, provide locking quadrant operators, Ventlok, Ventfabrics, Inc., Young or equal.

    a. Shaft length 12 inches or less: No. 620.
    b. Shaft length 13 inches to 20 inches: No. 635.
    c. Shaft length 20 inches to 36 inches: No. 641.

2. At inaccessible dampers, provide remote operators Greenheck RBD or equal.

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F. Extractor Dampers: Titus Model AG-45 with Number 2 operator.

G. Fire and Smoke Dampers:

1. General:

a. All fire and smoke dampers UL 555S listed and listed in the latest California State Fire Marshal's Bulletins and Listings under Guide No. 3225. Install in accordance with their requirements. Submit listing numbers.
b. Submit substantiation of California State Fire Marshal damper approval and acceptance of installation details and assembly in accordance with the requirements of Section 23 05 00 – Common Work Results for HVAC.
c. Dampers operating with blades closing in any direction shall be assisted in closing by a heat resistant, reel-type stainless steel spring.
d. Every effort has been made to show all dampers on the Mechanical Drawings. The Architectural Drawings indicate by symbol all such rated partitions. The Contractor shall verify all locations and provide dampers which are required but not shown on the Mechanical Drawings at no increase in Contract Sum.
e. All dampers guaranteed by the manufacturer to close against air flow. Provide locking closure, UL listed spring assembly. Bear UL label as dynamic fire damper.
f. Provide dampers for rectangular or round duct connections as required.
g. Provide duct access panel at each fire/smoke damper, suitably sized and located for inspection and resetting. Ceiling or wall access doors as specified in General Mechanical Section.

2. Combination fire/smoke dampers:

a. Ruskin FSD-60/or FSD-60OW (out of wall installation when there is not adequate space is provided) UL 555S to 1,500 fpm, 2.5 inches W.G.; FSD-60 airfoil type damper to 4,000 fpm, 6 inches W.G. Single blade not acceptable over 1,500 fpm.
b. At penetrations of fire-rated shafts and in main ducts provide motorized multi-louver fire damper with Firestat in lieu of fusible link for automatic remote override control.
c. Provide damper with UL listed dual firestat for mechanical and electrical operation, 212 degrees F high temperature limit switch so damper cannot be remotely reset under fire condition.
d. Smoke detectors shall be installed under Division 23, furnished under Division 26 and connected by Division 26. . Provide all required mounting devices and accessories.
e. Leakage not to exceed 4 CFM per square foot at 1 inch wg.
f. Electric motor operated 115 volt, single-phase, non-stall type actuators.
g. Open in 15 seconds or less and close in 15 seconds or less after alarm or smoke detection has occurred.

H. Backdraft dampers:

1. Ruskin, Air Balance or American Warming.
2. Gravity backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturer's standard construction.
3. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of 16 gauge galvanized steel or extruded aluminum, with blades of maximum 6 inch width. Provide

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with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure. Provide Ruskin, American Warming and Ventilation or equal. For dampers installed in stainless steel ducts provide dampers of the same material as the ductwork.

I. Duct Access Doors:

1. Ventlok, Ventfabrics, Inc., or equal latches.
2. Provide insulated access doors a minimum of 12 inches by 12 inches in size (see Section 23 31 00 – HVAC Ducts and Casings for additional requirements), fabricated of the same material, finish and gauge as the ductwork in which installed, unless otherwise shown or required. Insulation shall conform to 'k' values specified in ductwork insulation specification. Access doors shall be painted and labeled with similar color coding specified in Section 23 05 53 – Identification for HVAC Piping and Equipment. Paint fire /smoke damper access doors in red with white stenciled lettering.

    a. Un-insulated ducts:

        1) Provide hollow metal doors of thickness to match insulation, fabricated from a minimum of No. 20 gauge sheet metal.
        2) Design lock edge of doors with a bevel of 1/8-inch in 1 inch and fill interior hollow space with insulation, thermally equivalent to the ductwork insulation. Lap inner face of door over duct opening, a minimum of 1/4-inch on all four edges of the free duct opening.
        3) Frame duct opening for each door with a continuous 1 inch by 1 inch by No. 12 gauge sheet metal angle, of the same material as the duct in which installed, riveted to the exterior surface of the duct opening.
        4) Provide each door with minimum of two butt hinges and a surface type latch with inside striker for contacting inside of door framing, so as to provide a compression fit. Provide doors over 24 inches high with minimum of three hinges and two latches.
        5) Provide all doors with a 3/4-inch wide sponge rubber or felt gasket, around all four sides of duct opening.

3. Provide doors for access to items in ducts and plenums requiring inspection, maintenance, and adjustment.
4. Wherever possible, install doors so that air pressure differential tends to keep door closed.
5. On doors of systems where fan is scheduled for 4 inches S.P. or greater, provide painted signs appropriately worded as follows:
    1) "CAUTION – DOOR CLOSES WITH AIR PRESSURE"
    2) or
    3) "CAUTION – DOOR OPENS WITH AIR PRESSURE"

J. Access Door Hardware:

1. Butt hinges: Provide galvanized steel with brass pins, approximately 2 inches by 1-10/16 inches wide for doors under 25 inches high and 3 inches by 2 inches wide for doors over 24 inches high.
2. Casement fasteners: Steel or cast aluminum with a galvanized or aluminized finish.

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3. Door latches: Ventfabrics, Inc., Ventlok No. 260 or DuraDyne Corp. Code No. SP Series.
4. Door windows: Ventlok, glass window in galvanized steel frame. 12 inch by 12 inch size unless noted otherwise on Drawings.

K. Duct Test Openings:

1. Ventfabrics No. 699, located where air measurements are required for balancing air systems. Coordinate with balancing firm.

L. Flashing:

1. 16 gauge ducts through roof, galvanized steel, flashed and counterflashed, and provided with storm collars to secure watertight construction.

M. Bird Screens:

1. No. 14 gauge, 1/2-inch galvanized wire mesh set in galvanized steel frame.

N. Drip Pans:

1. 18 gauge, galvanized sheet metal 2 inches deep, solder-jointed, with drain piped to nearest air gap waste, unless specifically shown otherwise. Extend coil drip pans under coil valving, under concealed fan coils and exposed fan coils located in moisture sensitive areas. Extend drain full size to over approved receptacle.

O. Equalizing Grid:

1. 3 inch thick aluminum honeycomb grid with 3/8-inch openings securely fastened inside a 16 gauge galvanized steel duct section 6 inches long.
2. Grid and casing in outside air intake duct 304 stainless steel.

P. Sound Attenuators:

1. Industrial Acoustics Company, United McGill, Rink, Commercial Acoustics or equal.
2. Manufacturers to meet performance scheduled on drawings and specified herein.
3. Models, sizes, attenuation and maximum pressure drops as indicated on Drawings.
4. Attenuations indicated on Drawings are minimum dynamic insertion losses, together with self-noise power levels, and shall have been determined by an independent testing laboratory.
5. Galvanized steel in accordance with ASHRAE guide recommendations for high pressure rectangular ductwork. Seams lock formed. Steri-Loc non-porous skin or approved equal to provide clean air flow to meet CMC requirements.
6. Mineral fiber acoustic fill inorganic, inert, moisture and vermin resistant. No erosion or pregnability of acoustic fill. No carryover of inorganic particulate matter from silencer to airstream.
7. Removable panel for access to all internal surfaces for removal of fill and cleaning. Furnish cleaning instructions.
8. Differential air pressure of 8 i.w.g. inside or outside of casing.
9. Test silencer under dynamic airflow conditions in accordance with ASTM Specification E477 and applicable portions of ASME, AMCA, and ADC airflow test codes. The test setup and procedure shall be such that all effects due to end reflection, directivity,

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flanking transmission, standing waves and test chamber sound absorption are eliminated. Dynamic Insertion Loss (DIL) and Self-Noise (SN) Power Levels both for Forward Flow (air and noise traveling in same direction) and Reverse Flow (air and noise traveling in opposite directions). Data presented for tests using silencers no smaller than 24W by 24H.

10. With submittals, supply certified ASTM 477 tunnel test data on Dynamic Insertion Loss, Self-Noise Power Levels, and Aerodynamic Performance for Reverse and Forward Flow test conditions. For standard product, conduct all rating tests in same facility, utilize same silencer and open to inspection upon request from Owner's Representative. Computer generated test data not acceptable.
11. Install attenuators in banks as indicated on Drawings. Seal airtight with non-hardening caulk between each attenuator. Reinforce banks with galvanized steel angle framework as necessary to assure rigid installation and adequate support.

Q. Duct Liner

1. Duct liner product thickness: 1", or 2" (or 4" for plenums) as shown on drawings
2. Performance: Type "A" Mounting, minimum NRC 0.95 (2" or 4" thickness), NRC 0.70 (1" thickness)
3. Acceptable Products

    a. John Manville Linacoustics RC
    b. Knauf Ductliner or Rigid Plenum Liner

4. Acceptable Fiberglass-free products:

    a. Armacell Armaflex
    b. K-flex

PART 3- EXECUTION

3.1 INSTALLATION

A. Install ductwork accessories in accordance with the manufacturer's printed instructions.

B. Provide ductwork connected to air-handling equipment or air inlet and outlet devices, with all necessary transformation pieces, flexible fabric connections, as shown or required.

1. For round duct connection, install fabric connectors a minimum of 3 inches in length for ducts having a maximum diameter of 18 inches and a minimum of 5 inches in length for duct diameters over 18 inches in size.
2. Secure fabric connectors tightly to fans, casings and ducts as follows:

    a. Secure round connectors with No. 12 USS gauge by 1 inch wide galvanized steel draw bands. Secure bands with bolts and nuts.
    b. Secure rectangular connectors with 1 inch by 1/8-inch thick flat galvanized steel bars, with screws or bolts on 8 inch centers maximum, or with sheet metal slip joints. Tightly crimp fabric into sheet metal joint and secure complete joint with sheet metal screws on 6-inch centers maximum.

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3. Allow at least 3 inch slack in connections.
4. Fabric connectors may be factory pre-fabricated pre-assembled units, with minimum No. 24-gauge metal edges, secured to fabric with double lock seams.
5. Do not paint fabric connectors.
6. Install also in ducts at structural expansion joints.

C. Duct Access Doors: In addition to access doors required for inspection, maintenance and adjustment, provide access doors every 50 feet to facilitate duct cleaning. Provide access door upstream of duct coils and 10 feet on center in acoustically lined ducts.

END OF SECTION

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SECTION 233416

HVAC FANS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Centrifugal fans.

B. Inline fans.

C. Motors and drives.

E. Inlet/outlet screens.

F. Access doors.

1.2 RELATED WORK

A. Section 23 05 13 – Common Motor Requirements for HVAC Equipment

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment

C. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment

D. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment

E. Section 23 09 23 – Direct Digital Control System for HVAC

F. Section 23 31 00 – HVAC Ducts and Casings

G. Section 23 33 00 – Air Duct Accessories

1.3 REFERENCES

A. AMCA 99 - Standards Handbook.

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

D. AMCA 301 - Method of Calculating Fan Sound Ratings from Laboratory Test Data.

E. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

F. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

G. SMACNA - Low Pressure Duct Construction Standard.

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1.4 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.

C. Fabrication: Conform to AMCA 99.

1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.

B. Provide product data on centrifugal fans and accessories as required for the work.

C. Provide fan curves with specified operating point clearly plotted. Show complete performance over entire range of possible performance.

D. Submit sound power levels for both fan inlet and outlet at rated capacity.

E. CFM, RPM, SP, HP, BHP, outlet velocity, discharge arrangement, rotation, class, base details.

F. Select fans to allow for a change in volume without operating in an unstable range.

G. Submit factory balance test report for completed assembled fans. Detail exact vibration level recorded on each fan.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01 60 00 – Product Requirements.

B. Store and protect products under provisions of Section 01 60 00 – Product Requirements.

C. Protect motors, shafts, and bearings from weather and construction dust.

PART 2 - PRODUCTS

2.1 INLINE CENTRIFUGAL EXHAUST FANS

A. Manufacturer

1. Greenheck
2. Cook

B. General

1. Fans used shall not decrease motor size, increase noise level, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 20 percent, from specified criteria. Fans shall be capable of accommodating static pressure variations of plus or minus 10 percent.

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2. Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas.

C. Wheel And Inlet

1. Backward Inclined: Aluminum construction with smooth curved inlet flange, heavy backplate, backwardly curved blades welded or riveted to flange and backplate; cast iron or cast steel hub riveted to backplate and keyed to shaft with set screws.
2. Provide spark-proof construction as indicated on the schedule. Spark proof construction shall be aluminum and include the wheel, inlet cone and any fasteners used in the airstream. In addition, the fan shaft needs to have a sheath to cover the steel, or the shaft is to be constructed from monel.

D. Housing

1. Heavy gage steel, spot welded for AMCA 99 designated Class I and II fans, and continuously welded for Class III, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut-off. Provide bolted construction with horizontal flanged split housing.
2. Weatherproof motor and drive covers at utility sets.
3. Provide inspection access panels at the wheels of all blowers.
4. Factory finish before assembly with electrostatic applied and baked powder coat paint finish meeting ASTM B117 for 1000 hours. Externally paint fans exposed to weather to provide corrosion resistance to the environment.
5. Provide spark-proof housing as indicated on the schedule. Spark proof construction shall be aluminum construction.

E. Motors And Drives

1. Motors: As indicated, in compliance with Section 23 05 13 – Common Motor Requirements for HVAC Equipment.
2. Provide direct drive fans with ECM motors per Schedule.
3. Bearings: ANSI/AFBMA 9, L-10 life at 100,000 hours, heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, or ANSI/AFBMA 1, L-50 life at 400,000 hours, pillow block type, self-aligning, grease-lubricated roller bearings.
4. Shafts: Hot rolled steel, ground and polished, with key-way, protectively coated with lubricating oil.

2.4 ACCESSORIES

A. Fixed Inlet Vanes: Steel construction with fixed cantilevered inlet guide vanes welded to inlet bell.

B. Inlet/Outlet Screens: 1/2-inch mesh galvanized steel welded grid.

C. Access Doors: Shaped to conform to scroll with quick openings latches and gaskets.

D. Scroll Drain: 3/4-inch threaded steel pipe coupling welded to low point of fan scroll.

E. Weatherproof motor and drive coves.

F. Windband damper assembly as indicated on schedule.

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G. Provide butterfly type backdraft damper at discharge as indicated on the schedule.

H. Extended bearing lubrication fittings to assure easy access to lubrication points.

I. Provide motor cover and belt OSHA guard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

B. Install fans as indicated, with resilient mountings and flexible electrical leads. Refer to Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

C. Install flexible connections specified in Section 23 33 00 – Air Duct Accessories between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

D. Install fan restraining snubbers. Refer to Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment. Flexible connectors shall not be in tension while running.

E. Provide sheaves required for final air balance.

F. Provide safety screen where inlet or outlet is exposed.

G. Pipe scroll drains to nearest floor drain.

H. Provide backdraft dampers on discharge of exhaust fans.

END OF SECTION

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SECTION 233600

AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit the following under this section:

1. Single duct VAV boxes.

2. Attenuators and other box accessories

a. Dual Duct VAV boxes
b. Attenuators and other box accessories

B. Product Data:

1. Submit product data under provisions of Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.
2. For each type of product indicated, include rated capacities, furnished specialties and accessories. Submit fan information including fan curves and sound data for underfloor terminal units. Submit discharge and radiated noise criteria; inlet, discharge and radiated sound-power ratings

C. Shop Drawings:

1. For each type of product indicated, include the following:

a. Detailed equipment assemblies and indicated dimensions
b. Required clearances
c. Method of field assembly

1.2 RELATED WORK

A. Division 01 Section - General Requirements

B. Section 23 05 00 – Common Work Results for HVAC

C. Section 23 33 00 – Air Duct Accessories

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PART 2 - PRODUCTS

2.1 MATERIALS

A. Variable Volume Boxes:

1. Titus, Price or equal.
2. Single duct unit. Sizes and capacities as scheduled on Drawings.
3. 22 gauge galvanized steel or aluminum casing with 1 inch, 1- 1/2-pound density fiberglass insulation in compliance with UL No. 181.

B. Single Duct Terminal Units:
1. Direct digital damper operator, installed at factory, same manufacturer as controls.
2. Damper blade to have neoprene seals.
3. Pressure independent with constant air volume with plus or minus 5 percent of variable set point, maximum 2 percent leakage at 3 inch static pressure electronic controller.
. Electronic (DDC), factory installed operators:

a. Of manufacturer submitted with Section 23 09 23 Direct Digital Control System for HVAC. Field adjustable maximum and minimum air quantities from maximum catalog CFM to zero with tappings for air quantity readings.
b. Adjust from minimum to maximum CFM within a two degree thermostat throttling range. Controller capable of N.O. or N.C.; reverse or direct acting without additional external controls or relays.

4. Set initial settings at factory. Provide factory lined plenum box with acoustical lining with perforated metal mesh cover where permitted by code, or "Steri-Loc" liner where specified or required. Submit cataloged sound data with “Steri- Loc” liner on box.
5. ARI tested and certified. Include certification in submittal.
6. Provide terminal air boxes serving sensitive areas with sound attenuators in conformance with the sound attenuator specification paragraph 2.01(R).
7. Multipoint flow cross, center averaging sensor with amplified signal. Sensors that are not center averaging are not acceptable.

C. Dual Duct Terminal Units:
1. Terminal shall include a mixer-attenuator section as an integral part of the terminal to minimize downstream stratification. The terminal shall provide less than 2 F, discharge temperature variation with a 20 differential in inlet temperature.
2. Cooling and heating inlets shall have separate damper assemblies for complete pressure independent control of each airstream for variable or constant volume total discharge applications. Terminals with inlet dampers mechanically interconnected are not acceptable. The dampers shall be heavy gauge steel with solid shaft rotating in Delrin self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking and a synthetic seal to limit close-off leakage to the maximum values shown in the Damper Leakage table.
3. Actuators shall be capable of supplying at least 35 inches per pound of torque to the damper shaft and shall be mounted externally for service access. Terminals with internal actuator mounting or linkage connection must include gasketed access panel, removable without disturbing ductwork. Casing with access panel shall be constructed to hold leakage to the maximum values shown in the Casing Leakage table.

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D. Acoustical Requirements:

a. Testing: Terminal units shall be tested to ASHRAE 130 or ANSI/AHRI 880 standards, and comply with all requirements of this Specification. Representative samples shall be subjected to tests in accordance with applicable standards and procedures in order to demonstrate such compliance.
b. All measurements shall be made in accordance ASHRAE 130 or ANSI/AHRI 880 standards.
c. The results of the tests shall be certified by the testing agency, and submitted to the Architect for approval. The submittal shall include a complete description of the test conditions and the measurement procedure. Performance characteristics including pressure drop and sound data for the terminal or terminal/silencer assembly shall have been attained through lab testing in accordance with ASHRAE 130 and AHRI 880.
d. Acoustical Criteria: The maximum Sound Power Level (PWL) in dB re 10-12 watts in octave bands for inlet or discharge should not exceed the following according to the type of space served.

Maximum RADIATED Sound Power Levels (dB re: 10^{-12} Watts)

	Radiated Sound Power Level, dB, at Octave Band Center Frequency, Hz					
Noise Criteria*	125	250	500	1000	2000	4000
NC 40	60	60	60	55	55	55
NC 35	60	55	55	50	50	50
NC 30	55	50	50	45	45	45

*as indicated for space adjacent to unit

	Maximum DISCHARGE Sound Power Levels (dB re: 10^{-12} Watts) for VAV Boxes rated with 3 feet of unlined duct:					
Noise Criteria*	125	250	500	1000	2000	4000
NC 40	67	62	59	54	52	45
NC 35	65	58	57	53	51	44
NC 30	62	56	54	52	50	42
NC 25	60	52	51	49	46	40
NC 20	55	50	46	43	40	34

*as indicated for space being served by unit

e. The above maximum sound power levels assume a minimum of 5-feet of lined rigid ductwork at the box and 5 feet of insulated flexible ductwork will be used at the diffusers/grilles. If the terminals exceed the sound power levels listed above, silencers may be required between the terminal and the diffusers/grilles to reduce the

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noise. Or, if acceptable, additional lined ductwork may be used between the volume control devices and the diffusers/grilles.

f. If a terminal will service more than one diffusers/grilles/hoods, the allowable sound power levels should be increase by 10*log(N) decibels, where N is the number of diffusers/grilles.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units in accordance with the manufacturer’s printed instructions.

B. Provide minimum straight length of ductwork at each box in accordance with manufacturer's recommendations.

C. Provide ductwork connected air terminal units with all necessary transitions as shown or required.

D. Install underfloor terminal units level and plumb. Maintain sufficient clearance for normal services and maintenance.

E. Complete installation and startup checks according to manufacturer’s instructions and perform the following:

1. Verify that inlet duct connections are as recommended by manufacturer to achieve proper performance.
2. Verify that any identification tags are visible.
3. Verify locations of thermostats, humidistats and other exposed control sensors with drawings and room details before installation.

END OF SECTION

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SECTION 233700

AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Supply Air Diffusers

B. Return and Exhaust Air Grilles

C. Transfer Grilles

D. Provide accessories complete for the air systems, as indicated on the Drawings and as specified.

1.2 RELATED DOCUMENTS

A. 23 05 00 – Common Work Results for HVAC

B. 23 09 23 – Building Automation System for HVAC

C. 23 31 00 – HVAC Ducts and Casings

1.3 SUBMITTALS

A. Shop Drawings and Product Data:

1. Submit product data under provisions of Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.
2. Submit product data and shop drawings covering each item together with schedule of air devices indicating type, neck size, frame size, mounting type, finish, material, application, noise level and all components.
3. Submit supporting data that shows outlets were tested in ADC certified lab.
4. Submit manufacturer's installation instructions.
5. Submittal data, other than first named specified air outlets, are to include individual listing of each outlet showing NC, throw and pressure drop along with itemized comparison to specified air outlet.

1.4 COORDINATION

A. Review requirements of air devices as to neck size, frame size, finish, and type of mounting prior to submitting shop drawings and air device schedules.

B. Check location of outlets and make necessary adjustments in position to coordinate with architectural features, symmetry, and lighting arrangement.

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C. Coordinate layout and installation of diffusers with other construction that penetrates flooring, including but not limited to: electrical fixtures, network equipment, HVAC equipment, and partition assemblies.

D. Specific configuration of the supply and return ductwork, electrical work, and piping at each unit has been indicated on the drawings. If the configuration of the units furnished on the project differs from that indicated on the drawings (whether or not the units furnished are the specific units or an acceptable substitute), it shall be the contractor's responsibility to modify ductwork, piping, etc., as required to accommodate the actual configuration of units furnished on the project.

1.5 QUALITY ASSURANCE

A. ACC 1062 - Certification, Rating and Test Manual.

B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

D. ARI 650 - Air Outlets and Inlets.

E. ASHRAE 70 - Method of Testing for Rating and Air Flow Performance of Outlets and Inlets.

F. SMACNA - Low Pressure Duct Construction Standard.

G. Conduct airflow tests and sound level measurements in accordance with ARI 650, ASHRAE 70, ISO Standard 5219, ISO Standard 3741, and ANSI/ASHRAE Standard 70-1991.

H. Manufacturer shall certify cataloged performances and ensure correct application of air device types.

I. Test in accordance with ADC Test Code Standards.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Air Outlets and Inlets shall be manufactured by Titus or approved equal.

B. Provide sizes as indicated on the equipment schedules and drawings.

C. Steel or aluminum outlets as scheduled unless indicated otherwise.

D. Unless otherwise specified, fabricate all grilles and frames of steel with a factory-applied finish as follows:

1. For installation in gypsum board, hard plaster or acoustic plaster ceilings specified to be painted, provide factory-applied prime coat of paint unless otherwise scheduled. Coordinate with Architect

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2. For installation in walls, specified to be painted, provide factory applied prime coat of paint unless otherwise scheduled. Coordinate with Architect.
3. For acoustic tile ceilings, provide factory off-white finish unless otherwise scheduled. Coordinate with Architect.

E. Provide frames compatible with adjacent surface finishes for each grille as follows:

1. In Modular Ceilings: Snap-in T-bar, inverted T-bar or spline type as required.
2. For Perforated Face Devices in Hard Ceilings: Curved, surface-mounted.
3. For all other devices in Hard Ceilings or Walls: Flat face frames with 1-1/4 inch wide margins and counter screws.
4. Diffusers in Rough-textured Ceilings such as acoustical plaster: Provide anti-smudge frames.
5. Devices in plaster surfaces: Provide plaster frames.
6. The following exceptions apply, where grilles are:

a. Installed directly in exposed uninsulated ductwork.
b. Installed in gypsum board walls or ceilings.

F. Provide manufacturer's plenum or factory round duct neck transition per schedule.

G. Locate grilles and diffusers symmetrically, in accordance with Sections 09 51 23 – Acoustical Panel Ceilings, 09 54 27 – Acoustical Wood Plank Ceiling Systems

H. Provide all branch ducts to grilles and diffusers complete with volume control dampers. Where Drawings dictate face-accessible dampers, provide grilles and diffusers with opposed blade key operated dampers located directly behind the grilles or diffuser. Provide two keys for each type of operator.

I. Provide adjustable pattern devices. When not applicable, provide baffles to direct air away from walls, columns, or other obstructions within radius of diffuser operation.

2.2 WALL SUPPLY GRILLES

A. Provide with Titus 272RL standard white finish or equal.

B. Titus aluminum or steel double deflection surface mount wall-type grille with front blades parallel to the long (horizontal) dimension and rear blades parallel to the short (vertical) dimension. Blade spacing is ¾ inch, all blades individually adjustable. Provide with opposed blade volume damper (OBD) where indicated.

C. The grille shall be finished per schedule and subject to approval by Architect/Owner.

2.3 LINEAR SLOT DIFFUSERS / LINEAR SLOT RETURN / LINEAR SLOT EXHAUST

A. Provide inactive segments and blank offs as required for linear diffuser installations.

B. Titus FL-20 extruded aluminum linear slot ceiling diffuser, incorporating fully adjustable air pattern and flow control vanes capable of deflecting air from full horizontal to full vertical down or to any intermediate setting. Slot opening shall be per schedule. See schedule for slot quantity.

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1. Pattern controllers: Ice tong pattern controllers shall be used, and be able to vary airflow rate without affecting air pattern. Pattern controllers shall be capable of controlling air patterns and flow rates without the use of an additional damper or the need for any special tools. Pattern controllers will be supplied in maximum 3ft sections to allow for multiple airflow patterns along a continuous diffuser length.
2. Assembly: Install each length of diffuser without any visible means of fastening. Assemble multiple lengths with concealed aligning devices. Provide appropriate end caps.
3. Diffuser Fastening Methods: Compatible with ceiling type used.
4. Plenum Boots: where indicated. Boots shall be the non-insulated type, suitable for field applied external insulation, provided without inlet damper.
5. Finish: Air pattern controllers and all interior parts shall be finished with B17 black powder coat, while the frame shall be finished with B12 white powder coat. Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting of blistering as per ASTM D610 and ASTM D714. In addition, finish shall meet a 500 hour UV Resistance test to ASTM G-154. Finish shall be able to withstand a 140 lb-in indirect impact as proven by passing ASTM D-2794.
6. Manufacturer to supply paint finish spec sheet upon request. All paint and finishes subject to Architect approval.

C. The diffuser shall be finished per schedule and subject to approval by Architect/Owner.

2.4 WALL TRANSFER, RETURN AND EXHAUST GRILLES

A. Titus 350ZRL

1. Provide the cores, sizes and mounting types indicated on the plans and schedule. See also architectural plans and elevations for blank-off requirements.
2. Grilles shall have fixed 0, 15, 30 degree blades, spaced 1/4 in., 1/2 in., 7/16 in. on center, suitable for the installed location and application.
3. The outlet core shall have 3/4 in. deep extruded aluminum blades mechanically locked to a 5/16 in. O.D. aluminum Mandrel tube with .035 in. thick walls. Blades shall run parallel to the long dimension of the grille.
4. The grille border shall be heavy duty extruded aluminum construction with precise factory mitered corners and reinforcing support bars for extra support for the Mandrel tubes. The support bars and Mandrel tubes shall not exceed 12 in. on center.
5. The core shall be held into the border with removable core clips allowing the removal of the core without special tools.
6. The grille shall be finished per schedule and subject to approval by Architect/Owner.

2.5 LINEAR SLOT DIFFUSERS

A. Titus FL-15

B. Description: Furnish and install linear slot diffuser and linear slot plenum of the sizes, configurations and capacities indicated on the plans and air outlet schedule.

C. Performance: The linear slot diffusers shall have a single slot and shall be capable of being used for supply air, return air, exhaust air or any combination thereof. Correction factors for performance must be available for linear slot diffusers that will be used in a return/exhaust application. Performance of the selected linear slot diffuser shall be based on catalogued data obtained from the tests conducted in accordance with ASHRAE Standard 70-2006.

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D. Pattern Controllers / Spacer Bars: The steel pattern controllers must be adjustable, allowing for side to side movement to create airstreams that can be directed flat against the ceiling in either direction or downward as well as allowing throw reduction every two feet along the entire length of the linear slot diffusers. Air pattern controllers shall be set in the normal operating position with a compatible supply air plenum. Air pattern controllers and spacer bars shall be removable for on-site modification and trimming. Air pattern controllers shall be sectioned every 24-in. for total adjustment flexibility.

E. Slots: Slots shall be provided as indicated on the Schedules.

F. Support: Provide hanger wire support clips that are integral with the linear slot diffusers allowing the linear slot diffusers to be supported from the building structure with ceiling wire and the ceiling tiles to rest on the diffuser frame. Install diffusers to fit properly in the ceiling system with suspension wire (48 in. o/c max) and /or attachment plates – as required.

G. Volume Adjustment: Pattern controllers shall be dual layer to allow for volume adjustment as well as pattern adjustment and be attached by sliding into the frame extrusion. Single layer pattern controllers that can only adjust the pattern from horizontal to vertical and cannot provide volume control are not acceptable. The airstreams shall be maintained at the ceiling plane and shall retain the tight ceiling pattern even at low turn down VAV applications.

H. Plenum: All slot diffusers shall be manufactured by the same manufacturer of the plenums and hoods. No exceptions will be allowed. Plenum lengths and entry collar sizes shall be as indicated on the plan schedules. Engineered plenums shall be manufactured of heavy gauge wipe coat steel. The air inlet collar is provided with a 1.25 in. flange for flexible duct connection. Where shown on the drawings or otherwise indicated, provide a butterfly style volume damper located in the entry collar of the supply air plenum, accessible through the slot diffuser. Where engineered plenum end caps are not positioned directly over the linear spacer bar, install MB blank-offs from plenum end cap to next spacer bar. Provided fiber free or coated fiber glass insulation. Concealed mounting brackets must be provided with linear slot diffusers on gypsum board applications for plenum integration. The diffuser and plenum are installed directly in the suspension structure prior to installation of any ceiling material. Diffuser discharge section shall be coordinated with the Architect and General Contractor to ensure fit and performance.

I. Finish: Air pattern controllers and all interior parts shall be finished with B17 black powder coat, Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting of blistering as per ASTM D610 and ASTM D714. In addition, finish shall meet a 500 hour UV Resistance test to ASTM G-154. Finish shall be able to withstand a 140 lb-in indirect impact as proven by passing ASTM D-2794.

J. Manufacturer to supply paint finish spec sheet upon request.

2.6 PERFORATED FACE DIFFUSERS

A. Titus PSS

1. Provide steel construction, Provide white, powder coat finish.
2. Provide border Type 3 (lay-in) for acoustical tile ceilings and border type 1 (surface-mount) for hard surfaces.
3. Diffuser shall consist of a flush perforated air distribution face of no less than 51% free area, and a heavy gauge steel backpan.

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4. Air deflector modules shall allow full field adjustment of air flow pattern from 1 way to 4 way discharge without affecting the inlet free area or the pressure/nosie performance of the diffuser.
5. The perforated face shall be removable from the diffuser face and shall be fitted with hinges to facilitate the removal of face screen for cleaning or air pattern adjustment.
6. Provide with integral butterfly style volume control damper where indicated.

B. Titus PAR

1. Provide steel construction, white, powder coat finish as standard, to be confirmed with architect.
2. Diffuser to be designed for use in lay-in applications with drop face or for surface mount or flush face lay-in applications.
3. Diffuser shall consist of a flush or extended perforated air distribution face of no less than 51% free area, and a heavy gauge steel backpan.
4. The perforated face shall be removable from the diffuser face and shall be fitted with hinges to facilitate the removal of face screen for cleaning or air pattern adjustment.
5. Provide with integral opposed blade volume control damper where indicated.

2.7 DOOR RETURN GRILLES

A. Titus 350RL door transfer grille.

1. Provide steel construction white, powder coat finish.
2. ‘V’ shaped, Chevron blades shall be used to minimize light penetration through the grille and create a sight proof appearance.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install items in accordance with manufacturer's printed instructions.

B. Grilles and Diffusers Installed in Exposed Ductwork:

1. Cut and form openings in ducts, so that there shall be a double thickness of metal, to attach the registers or grilles to the ductwork, with sheet metal screws. Bend back edges of the openings into the duct, on all four sides, a minimum of 1 inch to provide the thickness of metal stated above.

C. Install inclined blade return and exhaust grilles and registers so that blades obstruct vision by inclining blades as follows:

1. Ceiling outlets: Incline toward nearest wall.
2. Wall outlets near ceiling: Incline toward ceiling.
3. Wall outlets near floor: Incline toward floor.

D. Adjust throw-patterns of all supply air outlets to result in uniform, draft free room air distribution at minimum and maximum air flows.

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E. Provide slack wires, cables, and other support devices as required to comply with State of California codes.

F. Install diffusers level and plumb. Maintain sufficient clearance for normal services, maintenance, or in accordance with construction drawings.

G. Complete installation and startup checks according to manufacturer's instructions and perform the following.

H. Verify that inlet duct connections are as recommended by manufacture to achieve proper performance.

I. Verify that any identification tags are visible.

J. Verify locations of thermostats, humidistats, and other exposed control sensors with drawings and room details before installation.

END OF SECTION

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SECTION 234000

HVAC AIR CLEANING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Disposable, extended area panel construction filters.

B. Pre-filters

C. Final filters

D. Filter frames and housing systems.

E. Filter gauges.

1.2 RELATED WORK

A. Section 23 08 00 – Commissioning of HVAC

B. Section 23 31 00 – HVAC Ducts and Casings

C. Section 23 33 00 – Air Duct Accessories

D. Section 23 81 26 – Split System Air Conditioners

E. Section 23 37 00 – Air Outlets and Inlets

1.3 REFERENCES

A. ANSI/UL 900 - Test Performance of Air Filter Units.

B. ASHRAE 52.1 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

1.4 QUALITY ASSURANCE

A. Filter media shall be ANSI/UL 900 listed, Class 2, as approved by local authorities.

B. Provide all filters as product of one manufacturer.

C. Assemble filter components to form filter banks from products of one manufacturer.

1.5 SUBMITTALS

A. Submit product data under provisions of Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.

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B. Submit filter media, filter performance data, filter assembly and filter frames. Include dimensions and electrical connections.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store and protect products under provisions of Division 01.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Camfil Farr

B. Environmental Filter Corporation (EFC)

C. Eco-Air

D. American Air Filter

2.2 GENERAL

A. Comply with NFPA Pamphlet No. 90, 90A or 96. Provide means of access for inspection and renewal. Quantities and nominal face area dimensions as shown.

B. Install all filters prior to operating fans.

C. Each filter bank or housing to be complete with retainer frames, clips and other hardware necessary for a complete, serviceable installation.

D. All metal components to have a corrosion-resistant finish.

E. Minimum efficiencies to be in accordance with ASHRAE Standard 52.1 Test Methods.

F. Supply UL listed, Class 2 filters.

2.3 FILTER MEDIA

A. Disposable Construction Filters

1. Filters: 2 inches thick completely disposable type with fiberglass media, EFC EP-40S or approved equal, UL Class 2 listed.
2. See Filter Schedule

2.4 PRE-FILTERS

A. MERV 8 filters shall be Camfil Farr 30/30 or equal

B. MERV 9 and MERV 11 filters shall be Camfil Farr S-Flo or equal

C. Media continuously laminated to expanded metal grid on the air leaving side.

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D. Pleated media type pre-filters shall be 2 inches thick completely disposable type with pleated mat-type media. Effective filter area minimum three square feet for each square foot of filter face area. Expanded diamond metal or welded wire grid media support formed to affect a radial pleat design with media bonded thereto.

E. Bag type filters shall be replaceable factory-assembled cartridges incorporating a fine-fibered all-glass medium or spun polypropylene, encased in a non-woven backer mat material. Flexible internal supports maintain individual pleats in a tapered form under rated air flow conditions. At any point, sizes of upstream and downstream air passages are in exact proportion to the volume of unfiltered and filtered air being handled at that point.

F. Completely and permanently seal fasteners used to maintain desired pleat configuration at each point of penetration of media pleat so there will be no bypass leakage. Prevent movement of fasteners thus eliminating any possibility of abrasion and possible damage to the media.

2.5 FINAL FILTERS

A. MERV 13 filters shall be Camfil Farr Durafil ES Shall be replaceable factory-assembled cartridges constructed of microfine glass fibers formed into uniform pleats

B. Shall include a sealing gasket on one vertical header to eliminate air bypass between headers in multiple filter systems

C. Open area on cartridge face available for air passage should not be less than 90 percent of the total face area.

D. Completely and permanently seal fasteners used to maintain desired pleat configuration at each point of penetration of media pleat so there will be no bypass leakage. Prevent movement of fasteners thus eliminating any possibility of abrasion and possible damage to the media.

2.6 FILTER FRAMES

A. Air Handling Unit Filter Frames
Shall comply with Section 23 74 23 - Custom Indoor Central-Station Air Handling Units

B. Fan Coil Unit Filter Frames
Shall comply with Section 23 82 19 - Fan Coil Units

C. Transfer Grille Filter Frames
Shall comply with Section 23 37 00 Air Outlets and Inlets

2.7 SPARE CARTRIDGES

A. Furnish one new complete set of cartridges for each filter bank on completion and acceptance of the Work. Install only if and when directed.

2.8 FILTER GAUGES

A. Furnish and install Dwyer or equal combination magnehelic gauge and Transmitter Series 605, range as recommended by filter manufacturer, across each filter bank.

B. Provide gauge with standard air filter installation kit and adjustable signal flag.

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C. Provide red line at designated static pressure changes.

D. Provide transmitter contacts for interface to Building Automation system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Do not operate fan systems until filters (temporary or permanent) are in place. Replace temporary filters used during construction.

D. Prefilters for Construction:

1. Protect all 40 percent or higher efficiency filters upstream of air handling units during construction with blankets of 2-inch fiberglass filter media or 2 inch disposable construction filters, UL Class 2 listed.

    a. Remove after air balancing and prior to acceptance.

2. Provide a spare set of construction prefilters.
3. Construction prefilters shall be maintained to avoid collapse due to overloading from dust or moisture during construction.
4. Install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.

E. Changeout all filters used during construction with new just prior to turning project over to owner.

END OF SECTION

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SECTION 238126

SPLIT-SYSTEM AIR CONDITIONERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged variable capacity air conditioning system (VRV/VRF). The system shall consist of multiple evaporators, refrigeration distribution system using PID control and condenser unit. The condenser shall be a direct expansion (DX), air-cooled heat pump, multi-zone air-conditioning system with variable speed compressors using R-410A refrigerant (R-32 if required by EPA and ASHRAE 15 per the construction schedule). All zones connected to the system are each capable of operating separately with individual temperature control.
   1. Outdoor Condensing Units
   2. Indoor Units
   3. Branch connector boxes
   4. Zone controls

B. Controls.

1.2 RELATED SECTIONS

A. Section 23 0513 – Common Motor Requirements for HVAC Equipment

B. Section 23 0529 – Hangers and Supports for HVAC Piping and Equipment

C. Section 23 0548 – Vibration and Seismic Controls for HVAC Piping and Equipment

D. Section 23 0923 – Direct Digital Control System for HVAC

E. Section 23 2300 – Refrigerant Piping

F. Section 23 3100 – HVAC Ducts and Casings

G. Section 23 3300 – Air Duct Accessories

H. Section 23 3416 – Centrifugal HVAC Fans

I. Section 23 4000 – HVAC Air Cleaning Devices

1.3 REFERENCES

A. ARI 210 – Unitary Air-Conditioning Equipment.

B. ARI 270 – Sound Rating of Outdoor Unitary Equipment.

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1.4 SUBMITTALS

A. Submit product data under provisions of Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.

B. Submit product data for manufactured products and assemblies required for this project.

C. Submit manufacturer's catalog sheets, performance charts, standard schematic drawings, wiring diagrams and specifications. Submittal data for all fans shall include fan curves. These curves shall show the relationship of CFM to static pressure and shall contain a family of curves at differing speeds allowing for variation from 30 percent to 120 percent of scheduled flow and shall include scheduled operating point, BHP curves, and efficiency curves. Curves shall be correct for air density of operation. Submittal shall include:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories
   4. Material gauges and finishes, including color charts
   5. Dampers, including housings, linkages and operators
   6. Submit drawings indicating components, dimensions, weights and loadings, required clearances and location and size of field connections

D. Certified laboratory measured octave band sound power levels at the design operation point for inlet and outlet of unit and maximum casing radiated power levels. Calculated data is not acceptable.

E. Operating load at each support and weight of heaviest removable item.

F. Indicate water, drain, and electrical rough-in connections on product data.

G. Submit manufacturer's installation instructions under provisions of Section 01 33 00 – Submittal Procedures and Section 23 05 00 – Common Work Results for HVAC.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01 78 23 – Operation and Maintenance Data.

B. Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver product to site under provisions of Section 01 60 00 – Product Requirements.

B. Store and protect products under provisions of Section 01 60 00 – Product Requirements.

C. Protect finished cabinets from physical damage by leaving factory packing cases in place before installation and providing temporary covers after installation.

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1.7 WARRANTY

A. Provide one year limited parts warranty on the complete unit, and a five-year warranty on the compressor.

1.8 QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995/CAN/CSA-C22.2 No. 236-05 (R2009) – Heating and Cooling Equipment and bear the Listed Mark.

B. All wiring shall be in accordance with the National Electric Code (NEC)/Canadian Electrical Code (CEC).

C. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

D. The outdoor unit will be factory charged with R-410A.

E. Manufacturer shall ensure distribution piping design ensures correct refrigerant flow and balancing. Refrigerant pipe sizing shown on drawings is schematic in nature for coordination and must be verified/confirmed with manufacturer's design.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Daikin

B. Mitsubishi

C. or equal.

2.2 OUTDOOR CONDENSING UNIT

A. General:
   1. Unit shall be in current production, with published literature available.
   2. UL tested and listed for its intended application.
   3. Certified in compliance with ARI Standards 210 and 270.
   4. See schedule for sound power requirements.
   5. Condensing units shall be supported with a fan motor ESP up to 0.5 WG as standard to allow connection of discharge ductwork and to prevent discharge air short-circuiting.
   6. See schedules for required performance. Cooling performance conditions to be established based on the following for standard rating conditions:
      a. Indoor temp = 80F DB/67F WB
      b. Outdoor temp = 95F DB
   7. Performance shall also be provided for project conditions to ensure required cooling and heating capacity is met.

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B. The outdoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of a scroll compressor, motors, fans, condenser coil, electronic expansion valve, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut-off valves, oil separators, service ports, refrigerant regulator, liquid receivers and accumulators. Liquid and suction lines must be individually insulated between the condensing and indoor units.

C. Each condensing unit must be able to support the quantities and loads of the indoor units as shown and scheduled on the drawings.

D. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for re-programming.

E. The following safety devices shall be included on the condensing unit; high pressure switch, control circuit fuses, crankcase heaters, fusible plug, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers. To ensure the liquid refrigerant does not flash when supplying to the various fan coil units, the circuit shall be provided with a sub-cooling feature. Oil recovery cycle shall be automatic occurring 1 hour after start of operation and then every 6 hours of operation.

F. Unit shall incorporate an auto-charging feature.

G. Provide unit with sub-cooling feature to prevent refrigerant flash at indoor units.

H. Unit charged with R-410A refrigerant.
   1. Current unit selections are based on R-410A. Equipment shall be capable of being switched to refrigerant in accordance with ASHRAE 15 requirements without any change order to bid.

I. Unit Enclosure:
   1. For outdoor installation.
   2. With 18 gauge galvanized steel and an electrically deposited, baked enamel finish.
   3. With drainage holes for moisture removal.
   4. With removable panels for easy access to all internal components for maintenance, service and adjustment.
   5. With condenser guard grill.

J. Components:
   1. Fan:
      a. The condensing unit shall consist of one propeller type, direct-drive fan motor with multiple speed operation via a DC inverter.
      b. The fan shall be a vertical discharge configuration.
      c. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
      d. The fan motor shall be provided with a fan guard to prevent contact with moving parts.
      e. Equipped with internal overload protection.
   2. Condenser Coil:
      a. The condenser coil shall be manufactured from 3/8” copper tubes expanded into aluminum fins to form a mechanical bond.

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b. The coil shall be of a waffle louver fin and high heat exchanger, rifled bore tube design to ensure highly efficient performance.
c. The coils shall be complete with corrosion treatment.

3. Compressor:

a. The scroll compressor shall be variable speed controlled which is capable of changing the speed to follow the variations in total cooling load as determined by the suction gas pressure as measured in the condensing unit.
b. The inverter driven compressor in each condensing unti shall be of highly efficient reluctance DC, hermetically sealed scroll type.
c. The capacity control range shall be 14% to 100%, with 29 individual capacity steps. Each non-inverter compressor shall also be of the hermetically sealed scroll type.
d. Each compressor shall be equipped with a crankcase heater, high-pressure safety switch, and internal thermal overload protector.
e. Oil separators shall be standard with the equipment together with an oil balancing circuit.
f. The compressor shall be mounted to avoid the transmission of vibration.

4. Brazed copper refrigerant tubing with liquid line filter drier.
5. Weather protected electrical control compartment.
6. Vertical discharge for condensing air.
7. Low operating sound level.
8. Low ambient operation to 20 degrees
9. Factory leak testing and dehydration.
10. Quick connect or sweat type refrigerant fittings.
11. A full factory charge of refrigerant
12. Five-minute off-cycle timer.
13. Stub adapters.

2.3 INDOOR FAN COIL UNITS

A. General:
1. Provide built-in ceiling concealed fan coil units.
2. See schedule for sound power requirements.
3. Each indoor unit shall use a dedicated electronic expansion valve for independent control.
4. Indoor units shall use PID to control superheat.
5. Systems shall be capable of achieving the horizontal and vertical piping runs as shown on the plans. Contractor to coordinate final refrigerant line runs with Manufacturer.
6. Coordinate with requirements as outlined in Section 238219 – Fan Coil Units
7. Indoor units shall be factory assembled and tested. Units to be provided with factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an adjustable external static pressure switch.
8. Both refrigerant lines shall be insulated from the outdoor unit.
9. The indoor units shall be equipped with a return air thermistor.

B. Unit Cabinet:
1. The cabinet shall be located into the ceiling and ducted to the supply and return openings.
2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

C. Fan:

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1. The fan shall be direct-drive type fan with ECM Motors, statically and dynamically balanced impeller with high and low fan speeds available.
2. The airflow rate shall be available in high and low settings.
3. The fan motor shall be thermally protected.
4. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.

D. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 3 row cross fin copper evaporator coil with 13 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1-5/16 inch outside diameter PVC.
5. Provide thermistors on liquid and gas lines.
6. Unit shall come equipped with factory-installed condensate pump

E. Filters:
1. Unit shall have filter track with factory-supplied cleanable filters. See filter schedule for filtration requirements.

F. Electrical:
1. See schedule for electrical requirements.
2. Control wiring to be provided within the maximum allowable distances as established by the manufacturer.

G. CONTROLS
1. Provide self-contained controls and remote wall-mounted thermostat for each zone.
2. Provide BACnet interface to integrate VRF controls into building BAS.

2.4 INDOOR AIR HANDLING UNIT

A. Manufacturers
1. Daikin Applied
2. or equal

B. Fan Coil Type and Arrangement
1. The unit shall be furnished as a draw-through style air handler.
2. VRV cooling coil shall be factory-installed.
3. A secondary electric resistive heater shall be factory-furnished upstream of the primary coil. Automatic and manual thermal cut out switches shall be furnished and installed by the manufacturer. The switches will disconnect the electric heater at air temperature unsafe

C. General Construction
1. The air handling unit shall include a blower, fan housing, coil, and drain-pan enclosed within and mounted to a rigid cabinet. Steel parts exposed to moisture shall be galvanized and insulated to prevent condensation. The complete fan assembly shall be wired via quick connect electrical contacts and easily removable for service and maintenance.

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a. The unit shall be supplied with 1-inch, double-wall panels. The cabinet is to be thermally isolated through injected foam insulation inside each cabinet. Single wall cabinets with fiberglass insulation exposed in the airstream are not acceptable. Frame channels which allow heat conductance between the inside and outside of the cabinet are not acceptable. Base rails used for unit mounting/hanging are acceptable. Panel shall a minimum thermal insulation of R-6.5. Foam injected insulation conforms to:

1) ASTM C1071

2) UL 181 for erosion

3) 25/50 rating for flame spread/smoke developed per ASTM E-84, UL 723 and NFPA 90A.

2. Supply Fans
   a. Supply fan shall be a welded aluminum airflow plenum type fan. Fan assemblies shall be balance tested dynamically by the manufacturer. Manufacturer must ensure maximum fan RPM is below critical speed RPM.
   b. The complete fan assembly, including motor and main drain pan shall be easily removable.
   c. Fan motor assembly shall be direct drive style.
   d. Manufacturer's supply fan motor must have means to adjust motor speed for field balancing.
   e. Units shall be certified in accordance with the Central Station Air Handler certification program that is based on AHRI Standard 430.
   f. Units shall be certified in accordance with the Central Station Air Handler certification program that is based on AHRI Standard 430.
3. Filters
   a. Filter section shall be MERV-13 deep pleated panel filters.
   b. Filter media shall be UL 900 listed.
   c. Filters shall be easily accessible via a door or panel located in the bottom or side of unit.
4. Electrical
   a. Supply fans shall be driven by NEMA Premium Efficiency motors that are run-tested in the assembled unit and permanently lubricated. All motors shall have integral thermal overload protection with a maximum ambient operating temperature of 40°C. Motors shall be capable of operating 90 percent of rated voltage on all speed settings. Motors can operate up to 10 percent over rated voltage.
5. DX Coil
   a. Provide DX coil with performance shown on mechanical schedules.
   b. Unit shall include a stainless steel primary drain pan and secondary drain pan. The primary drain pan shall be positively sloped in every plane. Primary and secondary drain pans to be insulated with anti-microbial closed-cell insulation. The drain pan shall be designed to ensure to pooling of condensate water per ASHRAE 62.2.
6. Economizer/mixing box
   a. A factory installed mixing box for mixing two separate airstreams is to be furnished attached to the main unit. The component must be constructed of a similar cabinet that the main unit is constructed of.
   b. An economizer section shall be provided, controlling return, exhaust, and outside air.

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c. Dampers intended for modulating each airstream are to be furnished to cover the openings of the supplied mixing box. Return and outdoor air dampers shall be controlled independently.
d. Damper blades shall be of airfoil construction. Dampers shall be AMCA Class 1-A leakage rated.
e. Damper actuators to be furnished by controls contractor.

7. Controls
   a. Unit shall be supplied with factory installed and configured integrated controls. There should be control panel connected to all fan-coils and condensing units.

      1) The controller shall control discharge air temperature base on space temperature.

         a) The controller shall allow separate setpoints based on cooling and heating and setpoints for occupied, unoccupied, and standby modes.

         b) Sensors shall be provided for temperature, discharge air temperature, discharge coil temperature, duct static pressure, outside air temperature, condensate overflow, freeze protection, airflow providing switch, return air temperature, dirty filter switch.

         c) The controller shall be configurable to operate with a CO2 sensor for demand control ventilation.

         d) Outdoor air damper shall have a minimum programmable minimum opening position.

         e) The economizer shall be equipped with Title-24 compliance fault detection diagnostics. Economizer shall be controlled via OSA temperature.

         f) The controller shall be factory configured to control SCR electric heat.

         g) The controller shall feature a startup test operation mode in which setpoints may be set outside of standard operation to confirm component operation.

         h) The controller shall provide run-time totalization for filter, supply fan, compressor start-up totalization and runtime, and compressor runtime control.

         i) Controller shall provide dirty filter notification based on differential filter pressure switch.

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j) Network communication shall enable read/write functionality of control points, including space temperature, CO2 value, fan speed, outdoor air temp, network enabling/disabling of economizer/cooling/heating.

k) Unit shall be furnished with a disconnect switch which shall be operable from the outside of the cabinet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Coordinate installation of units with architectural and electrical work.

C. Supply units fully charged with refrigerant and filled with oil.

D. Scheduled performance is based on ARI 210 conditions.

E. Bolt condensing unit to concrete roof pad with neoprene waffle pad supports unless otherwise scheduled.

F. Provide interconnecting wiring between indoor and outdoor units.

END OF SECTION

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SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general administrative and procedural requirements and applies to all sections in this Division.

B. Refer also to Section to Section 01 81 13 Sustainable Design Requirements for additional work and requirement.

1. LEED Submittals: Complete the LEED Material Buyout Form and provide all of the noted required supporting documents for the credits the project is pursuing including in particular EQc4.1 “Adhesives and Sealants”

C. The following requirements are included in this Section to expand the requirements specified in Division 1:

1. Drawings and Specifications
2. Submittals.
3. Shop drawings.
4. Product data.
5. Coordination
6. Coordination drawings.
7. Record documents.
8. Operation and Maintenance manuals.
9. Delivery, storage and handling.
10. General Installation.
11. Cutting and patching.
12. Guarantee and Warranties
13. Quality Assurance
14. Codes and Standards
15. UL Label
16. LEED requirements

D. This Section also includes the following which applies to all Sections in this Division:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout and Grouting.
5. Common electrical installation requirements.
6. Equipment installation requirements common to equipment sections.
7. Painting and finishing.
8. Concrete bases.
9. Supports and anchorages.
10. Waterproof and Corrosion Proof Construction

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11. Trenching, Excavation, and Backfill
12. Access Doors and Panels
13. Noise and Vibration
14. Start-up and Commissioning
15. Title 24 Acceptance Testing & Documentation

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and electrical/mechanical equipment rooms. In general, any item that is directly accessible without removing panels, walls, ceilings, or other parts of structure.

C. Exposed, Exterior Installations: Exposed to view outdoors, outside of building structure, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations, equipment yard, under eaves, etc.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. Furnish: Supply and deliver complete.

G. Install: Place, secure, and connect as required to make fully operational.

H. Provide: Furnish and install as defined above.

I. Connect: Complete hookup of item with required services.

J. Rough-in: Provide all indicated services in the necessary arrangement suitable for making final connections to fixture or equipment.

1.3 DRAWINGS AND SPECIFICATIONS

A. Consider all drawings and all divisions of this specification as a whole and provide work of this division shown anywhere therein.

B. Absolute accuracy of the contract drawings cannot be guaranteed. It is the responsibility of the Contractor to coordinate exact requirements and locations as governed by actual job conditions. (See Coordination and Coordination Drawings below). Check all information and report any discrepancies to the Architect/Engineer before fabrication and in time to avoid any unnecessary work. Any changes or additions subject to additional charges made without written authorization, based upon an agreed price, shall be at the Contractor's own risk and cost.

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C. The Contractor shall shift equipment as required to meet field conditions. The Contractor shall indicate, and clearly note, all changes on his shop and coordination drawings and submit them to the Architect/Engineer for review prior to ordering or fabrication. The Contractor must obtain submittal review indication “No Exception Taken” for any proposed modifications.

D. The Contractor shall provide all necessary offsets, transitions, fittings, and modifications required to complete the work.

E. Follow equipment and material manufacturer's instructions where items are not specifically covered on the drawings or within the specifications. If instructions are in conflict, obtain clarification before starting work.

F. Scaled and figured dimensions are approximate and are for estimating purposes only. Before proceeding with the work, check and verify dimensions and assume responsibility for fitting materials, equipment, and other parts of equipment within the structure.

G. Where apparatus and equipment have been shown on drawings, dimensions have been taken from the manufacturer’s literature for the scheduled manufacturer. Check manufacturer’s certified drawings to see that equipment proposed for installation will fit into the building and into spaces provided.

1.4 SUBMITTALS

A. General:

1. In addition to the procedures indicated below follow the procedures specified in Division 1 where they exceed the requirements of this section.
2. Provide submittals of material or equipment in accordance with each specification section.
3. Each item submitted shall be labeled or identified the same as on the drawings.

B. Equipment, materials, and products specifically identified, described, and scheduled on the drawings are the basis of design. The other manufacturers or suppliers which may be named in the specification only indicate the general acceptability of the manufacturer or supplier and are considered alternates. It is the Contractor's responsibility to research, select, and prove, through the submittal process, that the specific model, size, or type of the alternate proposed manufacturer is equal and will perform equal to that which is the basis of the design. Operational characteristics for such items as outlet velocities, power input, sound levels, efficiencies, etc., shall be considered in addition to the overall performance, output, and physical constraints.

C. The Contractor assumes full responsibility that alternative items substituted for the scheduled manufacturer will meet the job requirements and is responsible for the cost of redesign and modifications necessary due to this substitution. Revisions or additional work required due to the use of substitute materials and equipment shall be fully indicated on detailed drawings submitted with the shop drawings.

D. Mark submittal "Exactly as Specified" or accompanied by a letter from the supplier explaining in detail what differences, if any, exist between the submitted item and the scheduled item. Failure to point out the differences will be considered cause for disapproval. If differences are not indicated and/or not discovered during the submittal review process, the Contractor will still remain responsible for providing equipment and materials that meet the specifications.

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E. Acceptable Manufacturers: Subject to compliance with the requirements of the individual specification sections, provide materials and equipment from the indicated manufacturers only. Submittals of material or equipment manufactured by other than those indicated may be returned, not reviewed. If no manufacturers are indicated, then any product or material which complies with the specification and for the intended application may be submitted.

F. The electrical and mechanical components, structural systems, service clearances, and controls for all equipment are selected and sized, based on the manufacturer and equipment scheduled. If substitutions and/or equivalent alternate equipment are furnished, it shall be the responsibility of all parties concerned, involved in, and furnishing the substitute and/or equivalent alternate equipment to verify and compare the characteristics (capacity, size, clearance, acoustics, etc.) and requirements of that submitted to that scheduled. If greater capacity or more materials or labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then it shall be the responsibility of the parties involved in providing the substitute and/or equivalent items of equipment to provide all compensation for additional charges made for the proper rough-in, circuitry, support, and connections for the equipment furnished for all trades affected. No additional charges shall be allowed for such revisions.

G. Allow15 days for initial review. Allow additional time if processing must be delayed permitting coordination with subsequent submittals.

H. The Engineer and/or Architect will review submitted shop drawings and documents for general conformance with the design concept of the project and the information contained in the contract documents. The Engineer's and/or Architect's review is for the convenience of the City in following the work and does not relieve the Contractor of the responsibility of deviations from the requirements stated in this specification and contract documents.

I. The Engineer's and/or Architect's review shall not be construed as a complete or detailed check of the work submitted, nor shall it relieve the Manufacturer or Contractor of responsibility for errors or omissions of any sort in the shop drawings and samples, or from the necessity of furnishing any work required by the contract documents. The review of a separate item shall not indicate review of the complete assembly in which it functions. Nothing in the Engineer's and/or Architect's review of the shop drawings and samples shall be considered as authorizing 1) a departure from contract documents and specifications, or 2) additional cost to the City, or 3) increased time for completion of the work.

J. Submittals are not reviewed for quantities, dimensions, weights, fabrication processes, construction methods, coordination with work of other trades, construction safety practices, service clearance, coil and motor location, location of control and electrical panels, and other layout constraints. These items shall remain the sole responsibility of the contractor.

K. The Engineer and/or Architect will review submittals with reasonable promptness and will return them to the Vendor/Supplier/Manufacturer stamped to indicate the appropriate action taken as follows:

1. No Exceptions Taken.
2. Exceptions Taken as Noted. No resubmittal required.
3. Exceptions as Noted. Resubmit.
4. Rejected. Resubmit.
5. Not Reviewed. Must Meet Plans, Specifications, and Codes.

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L. Markings or comments or the lack thereof shall not be construed as relieving the Vendor/Supplier/Manufacturer/Contractor from complete compliance with the project drawings and specifications.

M. No part of the work shall be started in the shop or in the field until the Engineer and/or Architect have reviewed the shop drawings and samples for that respective portion of the work. Shop drawings and samples shall be submitted for review sufficiently in advance of the scheduled start of the work in the shop or in the field to allow ample time, in consideration of the number and complexity of the drawings in the submittal, for the Engineer and/or Architect to make an orderly review. No extension of time to complete the work will be granted to the Vendor/Supplier/Manufacturer by reason of failure to perform in this respect.

N. Each shop drawing and sample submitted for review shall be accompanied by a letter of transmittal, and shall be identified by the project title, Vendor's/Supplier's/Manufacturer's name, and a reference to the related part of the contract documents.

1.5 SHOP DRAWINGS

A. Refer to “Submittals” above for additional requirements.

B. Submit information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.

C. Shop Drawings include fabrication and installation drawings and directions, setting diagrams, schedules, patterns, templates and similar drawings, and installation for metal and wood supports and anchorages. Include as a minimum the following information on drawings or diagrams:

1. Dimensions
2. Identification of products and materials included
3. Compliance with specified standards
4. Notation of coordination requirements
5. Allowance for expansion, contraction, and deflection/movement of support structures.

D. Notation of dimensions established by field measurement

E. Clearances for access and service

F. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.

G. Upon contractor’s request, engineer can make electronic data files available at contractor’s expense in order to enable contractor to expedite the production of working/coordination/shop drawings for the project. Transfer of the electronic data files to Contractor is for informational purposes only and will only be completed after a waiver is signed by contractor and City relieving engineer of all liability resulting from use of electronic files and all engineer costs to produce electronic files in a format suitable for distribution are paid by contractor.

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1.6 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system.

B. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as Shop Drawings.

C. Product Data Information: Includes catalog cuts, sketches, or bulletins indicating performance characteristics, features of equipment, controls, instrumentation, equipment dimensions, materials of construction, estimated weight of unit (shipping, installed, and operating), auxiliaries, specialties, or accessories furnished, roughing-in or anchor diagrams and templates, manufacturer's installation instructions, service clearance requirements, standard color charts, and wiring diagrams.

D. Schematic Drawings shall include elevation and plan views, and indicate all connections, attachments, and details to indicate field required general details of assembly, etc.

E. Wiring diagrams shall detail wiring for power, signal, and control systems, differentiating between manufacturer-installed wiring and field-installed wiring.

F. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information with above product data:

1. Manufacturer's printed recommendations
2. Compliance with recognized trade association standards
3. Compliance with recognized testing agency standards
4. Application of testing agency labels and seals
5. Notation of dimensions verified by field measurement
6. Notation of coordination requirements

1.7 COORDINATION

A. Coordinate with work performed by other sections/divisions in order to accommodate the requirements of this section and to ensure adequate space and proper location for all necessary work on this project whether or not work is under this section. Provide coordination drawings, as indicated. Coordination shall be done prior to order or manufacture of any systems or components.

B. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. To connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

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D. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

E. Coordinate sleeve selection and application with selection and application of firestopping.

F. Coordinate voltage, phase, and load requirements, prior to ordering equipment, to insure electrical matches with other trades. All equipment shall be provided and ordered to suit the power available.

G. Layout support pads, curbs, sleepers, anchor bolts, etc., for all equipment and materials so as to be in the proper location for the equipment actually ordered. These pads shall be of adequate dimension to provide for proper mounting of equipment isolators and equipment mounting so that anchor bolts meet all seismic criteria. Contractor shall allow for proper service clearances.

H. Provide templates, information, and instructions to other divisions as necessary to properly locate holes and openings to be cut or provided for mechanical work.

I. Layout conduit and other electrical systems and confirm all sizes of systems and components to be sure they fit the space available prior to ordering and manufacturing of components. Be certain to allow for proper slopes.

J. Provide proper clearances for access to and service of all equipment and items requiring adjustment.

K. Arrange for conduit spaces, chases, slots, and openings in building structure during progress of construction, to allow for electrical installations.

L. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

M. Coordinate all disciplines to ensure maximum point loads that can be attached to structural members are not exceeded. See other sections and structural contract documents for requirements. Provide intermediate supports between existing structural members (Unistrut, angle, etc.) as necessary to not exceed maximum point loads.

N. Lay out trench locations, do all excavation, shoring, laying, backfilling, and compacting for work performed under this division and not provided under other divisions. See other divisions for specification requirements.

1.8 COORDINATION DRAWINGS

A. Prepare and submit, for review, large scale (minimum match the Contract Documents) coordination drawings showing location and elevations of all equipment, ducts, piping, conduits, structural, and other items in the area. These shall be fully coordinated with all other trades and City supplied items. Check routing and elevations of all cable trays, conduit, piping, ductwork, and equipment before fabricating. Report any conflicts that cannot be solved in the field to the Architect. Extra charges shall not be allowed due to lack of coordination prior to, or during, construction. These drawings shall be distributed to, and coordinated with, all other trades that are affected.

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1. In addition to plan view, indicate heights to clarify clearances from structure and from other trades. Use partial sections where necessary.
2. Provide proper clearances for access to and service of all equipment and items requiring adjustment including shutoff valves.
3. Coordinate the location of access panels in the hard ceiling areas to ensure all equipment and devices have proper access for servicing and adjusting.
4. The coordination drawings shall be reviewed and checked for completeness by the general contractor. Review by the architect and engineer is to assist the contractor and to attempt to point out obvious errors. Responsibility for proper coordination shall remain with the contractor.

B. Differences or disputes concerning coordination, interference, or extent of work between sections shall be decided by general contractor.

C. Extra charges shall not be allowed due to lack of coordination (or lack of coordination drawings) prior to or during construction.

D. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work. Indicate the proposed locations of conduit, equipment, and materials. Include the following:
1. Clearances for servicing and maintaining equipment, and space for equipment disassembly required for periodic maintenance.
2. Clearances for electrical and control components and panels.
3. Equipment connections and support details.
4. Exterior wall and foundation penetrations.
5. Interior floor penetrations
6. Fire-rated wall and floor penetrations.
7. Sizes and location of required concrete pads and bases.
8. Support, bracing and anchor locations for equipment and conduit.

E. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

F. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

G. Prepare reflected ceiling plans to coordinate and integrate installations, access panel and door locations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items where ceilings are to be installed.

1.9 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1. In addition to the requirements specified in Division 1, indicate the following installed conditions:
1. Indicate actual inverts and horizontal locations of underground conduits.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Accepted substitutions, contract modifications, and actual equipment and materials installed. This includes updating all equipment schedules with actual equipment provided.

B. Contractor shall maintain a complete set of documents on site that are marked-up during the construction process indicating all changes that have been made. These mark-ups shall be

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maintained on a regular basis so they are current as the construction is in process and available for inspection by the Architect/Engineer. Markups shall include changes to conduit, bus duct and cable tray routing and sizing.

C. Upon completion of the construction, the contractor shall transfer all mark-ups into AutoCAD and update the contract documents into record documents and the shop/coordination drawings in to as-built documents.

1. Upon contractor's request, engineer can make electronic data files available at contractor's expense in order to enable contractor to expedite the production of record drawings for the project. Transfer of the electronic data files to Contractor is for informational purposes only and will only be completed after a waiver is signed by contractor and City relieving engineer of all liability resulting from use of electronic files and all engineer costs to produce electronic files in a format suitable for distribution are paid by contractor.
2. Architect/engineer makes no representations as to the accuracy or completeness of electronic data files. They are provided to the contractor as a start point to upgrade to Record Drawings.
3. The contractor record documents shall be in the same CAD program, version, and operating system as the original Contract Drawings.

D. Record document updates shall include schedules where contractor has supplied alternate manufacturers to those scheduled or where submitted performance varies.

E. Provide a minimum of one copy of the markup documents, a hard copy set of prints of the record and as built documents, and one electronic copy (disk) of the CAD files.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Prepare operation and maintenance manuals in accordance with Division 1 In addition to the requirements specified in Division 1, include the following information for equipment items:

1. Installation Instructions.
2. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
3. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions.
4. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
5. Servicing instructions and lubrication charts and schedules.
6. Recommended spare parts list:

    a. Spare parts list shall be furnished listing all parts for equipment. Indicate part number and generic description of equipment part manufacturer.
    b. Indicate part number and generic description of both equipment supplier and original part manufacturer if other than supplier.
    c. Indicate delivery time required if not a stock item.

B. A minimum of 2 complete sets of manuals shall be provided. Manuals shall be bound in a hard board binder and indexed.

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1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver products, materials and equipment marked with product names, model numbers, types, grades, compliance labels, and other information needed for identification. Inspect items for shipping damage and refuse, return, or refurbish items to the satisfaction of the City. Maintain delivery records for inventory control and for use in processing payment request vouchers. Crosscheck delivery records with project schedule so as to eliminate work stoppages due to material shortages.

B. Store products, materials, and equipment in a manner to prevent damage and degradation. Store items on skids or pallets, elevated above the floor or grade. Store items subject to moisture damage in a dry location. Retain protective shipping covers, crates, and cartons during storage. Protect items from contamination by job site dirt and debris and other foreign matter. Segregate items into groups of like type for job site storage. Provide a secure, fenced and lighted area for outside job site storage. Coordinate all on-site storage requirements with general contractor.

C. Handle products, materials, and equipment in accordance with manufacturer's recommendations and recognized industry standards. Utilize lifting lugs, and designated lift points when hoisting equipment. In all cases, carefully handle, transport, and position items to prevent damage during construction. After placement or installation, cover items with tarps or sheeting where required to protect from damage during construction.

D. Immediately, upon delivery, inspect shipment, including City furnished items, to ensure that products are undamaged and in accordance with requirements. Should the product be damaged or not in compliance with requirements, immediately repair as directed or approved or order replacement at no additional cost to the City.

1.12 CLEAN CONSTRUCTION REQUIREMENTS

A. Storage of Material:

1. Electrical equipment and materials that will be installed in a clean environment needs to be generally clean of dirt and debris. When stored at the contractors shop or on site, it needs to be kept clean prior to installation. The method used shall be the contractor’s responsibility. It is strongly recommended that all materials be kept wrapped (visqueen and tape) while in storage. The intent is to avoid obviously dirty materials. Should materials be found to be dirty, by the City or City’s representative, it shall be the contractor’s responsibility to clean them in place, at no cost to the City.

B. Installation:

1. Clean the installation area of dust and debris as much as possible.
2. Inspect the piece prior to installation.
3. Install items according to requirements of appropriate specification.

1.13 GENERAL INSTALLATION

A. Sequence, coordinate, and integrate the various elements of the systems, materials, and equipment.

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B. Coordinate systems, equipment, and materials installation with other building components and other trades.

C. Verify all dimensions by field measurements and relative to the certified prints for the actual equipment to be installed.

D. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for installations.

E. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

F. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the Work.

G. Give particular attention to large equipment requiring positioning prior to closing in the building. Contractor shall be responsible for ensuring adequate space and pathways and shall break down and reassemble equipment as necessary for rigging, access, and setting of equipment.

H. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

I. Coordinate connection of systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, service companies, and controlling agencies. Provide required connection for each service.

J. Install systems, materials, and equipment to conform with submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form.

K. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.

L. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

M. Install access panel or doors where equipment and materials are concealed behind finished surfaces.

N. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

1.14 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 1 Section "CUTTING AND PATCHING." In addition to the requirements specified in Division 1, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

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B. Perform cutting, fitting, and patching of equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Install equipment and materials in existing structures.

C. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

D. Cut, remove and legally dispose of selected equipment, components, and materials as indicated, including but not limited to removal of conduit, cable tray, fixtures and trim, and other items made obsolete by the new Work.

E. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

F. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

G. Patch all existing and new finished surfaces and building components using new materials matching existing materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

1.15 GUARANTEE AND WARRANTIES

A. All materials, parts, equipment, and workmanship shall be guaranteed for a period of one year from date of City acceptance.

B. If the manufacturer provided for a longer guarantee period, it shall also be submitted.

1.16 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

1.17 CODES AND STANDARDS

A. The work installed under this section shall conform to all applicable local codes, regulations, and standards.

B. Do not construe anything contained in these specifications or drawings to permit work to be installed that does not conform to code. The codes shall govern where they require higher standards or are violated by the drawings and specifications.

C. Consider interpretations and rulings of the enforcing agencies as part of these specifications.

D. Comply with drawings and specifications showing work exceeding minimum code requirements.

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E. The Contractor shall furnish, without any extra charge, additional materials and labor required for the compliance with any rules and regulations.

1.18 UL LABEL

A. Furnish UL labeled and listed materials and equipment except when equipment is of a type for which labeling or listing services are not available from UL. Labeling must meet the requirements of the local authorities.

B. ETL label is acceptable if approved by the local authorities.

1.19 LEED REQUIREMENTS

A. This project will be submitted for LEED certification. See Division 1, other articles within this division and www.USGBC.org for complete requirements.

B. Contractor shall document LEED compliance for use of low emitting materials, adhesives and sealants.

C. Contractor shall document LEED compliance for use of low emitting materials, paints and coatings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified as the basis of design specification. Basis of design shall comply with City Standards.
3. Where the submitted manufacturer is not the scheduled manufacturer it is considered an alternate and shall meet the requirements indicated under Submittals above where either “Available Manufacturers” or “Manufacturers” are indicated and shall meet the requirements of the Basis of design manufacture.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

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B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

F. Installation shall comply with CITY STANDARDS & GUIDELINES. Nothing in the Contract Documents is meant to be at odds with the CITY STANDARDS. If any discrepancies or conflicts, the Contractor shall advise the CITY/ENGINEER of any discrepancies and request clarifications prior to proceeding with the work.

3.2 FIRESTOPPING

A. Maintain indicated fire rating of walls, partitions, ceilings, and floors at penetrations for electrical work. Seal penetrations with firestop materials. At a minimum, seal all penetrations with UL listed assembly matching rating of surrounding walls, partitions, ceilings, and floors. Install per manufacturer’s requirements

B. Firestopping materials and installation requirements are specified in Division 07 Section 07 84 13 PENETRATION FIRESTOPPING.

3.3 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.

D. Install equipment to allow right of way for piping installed at required slope.

E. Follow manufacturers' installation details and directions except as specifically modified on the drawings and provide any special fittings or other specialty items called for by them as required in order to make the equipment perform as intended.

F. Provide all necessary rigging, rigging equipment, and manpower to set equipment and materials in place

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3.4 PAINTING

A. Provide painting of systems, equipment, and components where specified or indicated on the drawings. Painting may also be specified in Division 09 Sections."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.5 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete." Or Section 03 30 53 "Miscellaneous Cast-in-Place Concrete." t.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 for metal fabrications.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.8 WATERPROOF AND CORROSION PROOF CONSTRUCTION

A. Maintain the waterproof integrity of penetrations through materials intended to be waterproof. Provide flashings at exterior wall and roof penetrations. Caulk watertight penetrations of foundation walls and floors. Provide membrane clamps at penetrations of waterproof membranes.

B. Provide galvanized sheet-metal weather protection canopies, hoods or enclosures over all out-of-door equipment, the operation or maintenance of which would be impaired by rainwater. This

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requirement applies to but is not limited to: non-outdoor rated equipment and materials, controls, instruments, and electrical devices.

C. Products which will be installed exposed to the weather, moisture, or other potentially damaging conditions shall be constructed to resist the effects of such exposure.

D. Exterior casings shall have lapped or gasketed joints effectively sealed to prevent intrusion of moisture or other injurious substances.

E. Casing or parts shall be constructed of materials which are fully resistant to harmful substances they may normally contact or (if ferrous) shall be galvanized after fabrication or shall be fully protected from such substances by paint or other coating in appropriate thickness or number of coats.

F. All bolts, nuts, screws, and washers shall be galvanized or stainless steel.

3.9 TRENCHING, EXCAVATION, AND BACKFILL

A. Provide all necessary excavation and backfill for the installation of the work of this Division unless specifically included under another Division. Walls of all trenches shall be a minimum of six (6) inches from the side of the nearest pipe.

B. Backfill shall not be placed until all lines have been tested and approved.

C. Utility Trench Excavation:

1. Keep excavated portions of the work free of water at all times and until backfilling is completed. Install adequate facilities for removing excess water.
2. Shore and brace excavations where necessary to prevent cave-ins and/or in accordance with all safety laws.

D. Meet the requirements of Division 31 for trenching, evacuation, backfill, and compaction.

3.10 ACCESS DOORS AND PANELS

A. Where Required: Wherever a piece of equipment or material is inaccessible and requires access for maintenance, repair, or adjustment.

B. Size: Size is dependent upon the relationship of the door to the product being serviced; therefore, the size of the door shall be selected to provide convenient access to its contents.

C. Section 08 31 13 Access Doors and Frames requirements apply to this section.

3.11 NOISE AND VIBRATION

A. Quietness is a requirement. Eliminate noise, other than that caused by specific equipment operating at optimum conditions and at design noise criteria.

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B. The limiting of transmission of noise and vibration is required. The Contractor is to pay particular attention that conduit and raceways is installed so as not to chatter or rub against other materials, equipment, and the building structure. Provide elastomeric isolation pads, insulation, or other suitable materials to avoid direct contact and noise conditions unacceptable to the City.

C. Electrical conduit should include flexible connectors similar to Crouse-Hinds XD Expansion Coupling where connected to vibration-isolated equipment.

D. For large conduit sections that cannot be isolated from vibration-isolated equipment, conduits should be supported with hangers with a minimum 0.25-inch static deflection.

3.12 START-UP AND COMMISSIONING

A. The Contractor shall provide all labor, materials and services necessary for the start-up, commissioning and testing of all systems and equipment furnished and installed under this Division.

B. Contractor shall be responsible for proper operation of all systems, assemblies, minor subsystems, equipment, and services provided under this Division. He shall coordinate start-up procedures, calibration, testing, and system commissioning with all subcontractors and trades involved. Any system operational problems shall be diagnosed and all correctional procedures shall be initiated with the various subcontractors as required to bring the system into compliance with the design intent.

C. Adjust all equipment and system components to meet the performance as scheduled on drawings, or as required, to result in the intended system operation. Thereafter, as a result of system operation or as directed by the Architect/Engineer, make readjustments as necessary to refine performance.

D. The Contractor shall be responsible for preparing a written start-up and commissioning procedure including check-off list and report format showing design conditions and blanks for indicating actual operating conditions. The report format shall include each piece of equipment, system and all items that require adjustment, testing, and verification. The written procedure shall be submitted for review 30 days prior to start-up.

E. Personnel performing start-up and commissioning services shall be fully qualified, experienced, and normally engaged in this type of work. If the Contractor does not have such personnel available from his own company, he shall hire, at his own expense, subcontractors who are qualified.

F. The Contractor shall designate one field person who has the overall responsibility for start-up and commissioning procedures which includes testing and balancing. He shall directly supervise the start-up operations and be available for required coordination before, during, and after start-up.

G. Prior to start-up, ensure that the systems are ready, including but not limited to the checking the following: proper wiring, proper equipment rotation, the systems are clean, auxiliary connections, lubrication, controls, and control interfaces.

H. All electrical testing must be complete and test results submitted before mechanical equipment start-up to avoid power interruptions during mechanical equipment start-up and commissioning.

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I. Start and operate all systems. Provide the services of factory certified and trained technicians for start-up of major equipment and systems where the contractor does not have sufficient capability and where required in other sections.

J. The Contractor (and the factory technician where required) shall check all equipment during the initial start-up to ensure correct rotation, proper lubrication, adequate fluids or air flows, non-overloading electrical characteristics, proper alignment, and vibration isolation. Other miscellaneous equipment shall be started and operated as described above as applicable.

K. During initial operation of the system and until substantial completion, qualified personnel shall be provided and designated for maintaining the equipment and systems in good running order. Failure of equipment during this period due to lack of proper supervision is the responsibility of the Contractor and continued failures shall be grounds for the City to provide such services with back charges to the Contractor.

L. A final and complete start-up and commissioning report shall be submitted prior to final acceptance and payment. This report shall be signed by each person doing the start-up task and by the responsible field person. Report shall include, but not be limited to: date of test; instrument used, date of last calibration, set points, voltage, amperage, , stability, and all other data necessary to indicate the equipment and systems have been properly tested, started-up, commissioned, labeled, and are operating within specified and manufacturers parameters.

M. See other sections for other specific system and equipment start-up and commissioning requirements.

3.13 TITLE 24 ACCEPTANCE TESTING AND DOCUMENTATION

A. This section describes the Acceptance Testing and Documentation of the mechanical systems according to the requirements of California Title 24 (Title 24) and outlines the duties and responsibilities of the contracting team for Acceptance Testing.

B. The acceptance requirements shall be applied to all products, equipment and systems provided under this Division and where required by Title 24 requirements.

C. The Contractor shall engage the services of a firm specializing in commissioning of electrical systems or shall submit contractor qualifications for review by architect where testing and documentation is to be performed by contractor.

D. The Acceptance Testing Team shall be formed and consists of:

1. Electrical contractor's representative
2. Mechanical contractor’s representative
3. Controls contractor’s representative
4. Inspector of record
5. City's staff representative

E. The duties of the Acceptance Testing Team are as outlined in the Title 24 Requirements and summarized below:

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1. The contractor shall plan, organize and implement the Acceptance Testing process and shall, within one monthof the award of the contract, submit the names and addresses of the team member(s).
2. The Acceptance Testing Team shall submit a complete description of the testing procedures and systems to be tested to the architect for review.
3. The Acceptance Testing Team shall co-ordinate all tests of systems and equipment and assemble all documentation related to tests. All documentation relative to tests and proposed procedures shall be submitted to design engineer for review prior to submitting documentation to Authority having jurisdiction. Team shall be responsible for performing data analysis, calculation of performance indices and crosschecking of results with the requirements of Title 24 and the Contract documents. The installing contractor or agent responsible for testing and documentation shall record their State of California Contractor's license number or their State of California Professional Registration License number on each Certificate of Acceptance for submittal.
4. Contractor shall be fully responsible for submitting Certificate of Acceptance including paper and electronic copies of all measurements and monitoring results and all supporting documentation to the Authority having jurisdiction. Where Authority having jurisdiction questions results or requires additional testing, contractor shall complete additional testing and provide required documentation at no additional cost to the City.

F. The time period of the commissioning of the systems shall be determined by the general contractor and Acceptance Testing Team. It is important to note that Authority having jurisdiction will not release a final Certificate of Occupancy until a Certificate of Acceptance is submitted that demonstrates that the specified systems and equipment have been shown to be performing in accordance with the Title 24 standards.

G. All Acceptance Testing shall be coordinated with the Start-up and Commissioning requirements as indicated herein.

H. Acceptance Testing – Phase I - Documentation

1. Team shall assemble documentation showing all thermostat and sensor locations, control device locations, control sequences and notes.
2. Per Title 24 requirements, team shall provide record drawings to building City within 90 days of receiving a final occupancy permit. The record drawings shall meet the Title 24 requirements as well as other requirements specified herein.
3. Per Title 24 requirements, team shall provide operating and maintenance manuals to the building City. The operating and maintenance manuals shall meet the Title 24 requirements as well as other requirements specified herein.

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I. Acceptance Testing – Phase II – Inspection and Testing

1. Team shall review the installation, perform acceptance testing and document results for the following systems:

   a. Indoor Lighting Controls
   b. Automatic Daylighting Controls
   c. Demand Response Lighting Controls
   d. Outdoor Lighting

2. Review of installation shall confirm equipment and devices are properly located, identified, calibrated, and set points and schedules programmed per contract document requirements.

J. Acceptance Testing - Phase III - Certification

1. Team shall document operating and maintenance information, complete installation certificate, and indicate test results on the Certificate of Acceptance, and submit the Certificate to the Authority having jurisdiction prior to receiving final occupancy permit. Team shall submit all required documentation including forms NRCA-LTI-02-A through NRCA-LTI-04-A and NRCA-LTO-02-A as required by Title 24 requirements.

K. Acceptance Tests and Documentation

1. Refer to California Title 24, Non-residential manual for specific testing procedures and documentation requirements. The detailed requirements can be found at http://www.energy.ca.gov/title24/2013standards. The contractor is responsible for reviewing and complying with these standards.

END OF SECTION

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SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Copper building wire rated 600 V or less.
   2. Connectors, splices, and terminations rated 600 V and less.
   3. Metal-clad cable, Type MC, rated 600 V or less.

1.2 DEFINITIONS

A. PV: Photovoltaic.

B. RoHS: Restriction of Hazardous Substances.

C. VFC: Variable-frequency controller.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Alpha Wire Company.
   2. American Bare Conductor.
   3. Cerro Wire LLC.
   4. General Cable Technologies Corporation.

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5. Service Wire Co.
6. Southwire Company.
7. WESTCO

C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation:
1. Type NM: Comply with UL 83 and UL 719.
2. Type THHN and Type THWN-2: Comply with UL 83.
3. Type XHHW-2: Comply with UL 44.

F. Shield:
1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. 3M Electrical Products.
2. AFC Cable Systems; a part of Atkore International.
3. Hubbell Power Systems, Inc.
4. ILSCO.
5. O-Z/Gedney; a brand of Emerson Industrial Automation.
6. Service Wire Co.
7. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Alpha Wire Company.
2. American Bare Conductor.
3. General Cable Technologies Corporation.

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4. Service Wire Co.

C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:
1. Single circuit and multicircuit with color-coded conductors.

E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

F. Ground Conductor: Bare Insulated.

G. Conductor Insulation:
1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.
3.

H. Armor: Steel, interlocked.

I. Jacket: PVC applied over armor.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No 10 AWG and larger.

C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

E. MC Cable: limited to use as follows:
1. Office areas only for branch circuit power.
2. Lighting branch circuits.
3. All home runs shall be copper cable in conduit back to the panelboard.

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3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

I. VFC Output Circuits: Type TC-ER cable with braided shield.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 26 05 36 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

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3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material[and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors].

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 13 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: City will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.
   1. After installing conductors and cables and before electrical circuitry has been energized, test selected conductors feeding the following critical equipment and services for compliance with requirements:
      a. UPS equipment
      b. Emergency Egress Inverter
      c. The main service feeder

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2. Perform each of the following visual and electrical tests:
   a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
   b. Test bolted connections for high resistance using one of the following:
      1) A low-resistance ohmmeter.
      2) Calibrated torque wrench.
      3) Thermographic survey.
   c. Inspect compression-applied connectors for correct cable match and indentation.
   d. Inspect for correct identification.
   e. Inspect cable jacket and condition.
   f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
   g. Continuity test on each conductor and cable.
   h. Uniform resistance of parallel conductors.
3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
   a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

E. Cables will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports to record the following:
   1. Procedures used.
   2. Results that comply with requirements.
   3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

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SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

C. Some components of the grounding system are existing. See drawings and shell and core drawings.

2.2 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
   1. Solid Conductors: ASTM B 3.
   2. Stranded Conductors: ASTM B 8.
   3. Tinned Conductors: ASTM B 33.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

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2.3 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Conduit Hubs: Mechanical type, terminal with threaded hub.

G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

H. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

I. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

J. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.

K. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one-piece clamp.

L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

M. Water Pipe Clamps:
   1. Mechanical type, two pieces with stainless-steel bolts.
      a. Material: Die-cast zinc alloy.
      b. Listed for direct burial.
   2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
   1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
   2. Backfill Material: Electrode manufacturer's recommended material.

C. Ground Plates: 1/4 inch thick, hot-dip galvanized.

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PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
   1. Bury at least 24 inches below grade.

C. Grounding Bus: Install in electrical & IDF equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.

D. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Metallic Fences: Comply with requirements of IEEE C2.
   1. Grounding Conductor: Bare, tinned copper, not less than No. 8 AWG.
   2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
   3. Barbed Wire: Strands shall be bonded to the grounding conductor.

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3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

F. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: City will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

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D. Perform tests and inspections.

E. Tests and Inspections:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
   3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
      a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.

F. Grounding system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Report measured ground resistances that exceed the following values:

I. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

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SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Steel slotted support systems.
2. Aluminum slotted support systems.
3. Nonmetallic slotted support systems.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
8. Fabricated metal equipment support assemblies.

B. Related Requirements:
1. Section 26 05 48.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
a. Slotted support systems, hardware, and accessories.
b. Clamps.
c. Hangers.
d. Sockets.
e. Eye nuts.
f. Fasteners.
g. Anchors.
h. Saddles.
i. Brackets.
2. Include rated capacities and furnished specialties and accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Ductwork, piping, fittings, and supports.
3. Structural members to which hangers and supports will be attached.

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4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
   a. Luminaires.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Projectors.

B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design hanger and support system.

B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified."
2. Component Importance Factor: 1.5.

C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

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2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
   1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
      a. Allied Tube & Conduit; a part of Atkore International.
      b. B-line, an Eaton business.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation; A Member of the ABB Group.
   2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   3. Material for Channel, Fittings, and Accessories: Galvanized steel.
   4. Channel Width: Selected for applicable load criteria.
   5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
         1) Hilti, Inc.
         2) MKT Fastening LLC
   2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1) B-line, an Eaton business.
   2) Empire Tool and Manufacturing Co., Inc.
   3) Hilti, Inc.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: Stainless-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 05 50 00 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
   1. NECA 1.
   2. NECA 101
   3. NECA 102.
   4. NECA 105.
   5. NECA 111.

B. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with single-bolt conduit clamps.

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F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 05 50 00 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

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3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:
   1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 09 91 13 "Exterior Painting" Section 09 91 23 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

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SECTION 260533

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 27 05 28 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
2. Section 28 05 28 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following: A

1. AFC Cable Systems; a part of Atkore International.
2. Allied Tube & Conduit; a part of Atkore International.
3. O-Z/Gedney; a brand of Emerson Industrial Automation.
4. Perma-Cote.
5. Southwire Company.

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6. Thomas & Betts Corporation; A Member of the ABB Group.
7. Topaz Electric; a division of Topaz Lighting Corp.
8. Western Tube and Conduit Corporation.
9. Wheatland Tube Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. EMT: Comply with ANSI C80.3 and UL 797.

E. FMC: Comply with UL 1; zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Fittings for EMT:
   a. Material: Steel or die cast.
   b. Type: Setscrew or compression.
2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

H. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems; a part of Atkore International.
2. CANTEX INC.
3. Condux International, Inc.
4. RACO; Hubbell.
5. Thomas & Betts Corporation; A Member of the ABB Group.
6. Topaz Electric; a division of Topaz Lighting Corp.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

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G. Fittings for LFNC: Comply with UL 514B.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business.
2. Hoffman; a brand of Pentair Equipment Protection.
3. MonoSystems, Inc.
4. Square D.
5. Approved equal.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type (interior) or Flanged-and-gasketed type (exterior) unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Moulded Products, Inc.
2. Hoffman; a brand of Pentair Equipment Protection.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

2.5 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hubbell Incorporated; Wiring Device-Kellems.
      b. MonoSystems, Inc.
      c. Panduit Corp.
      d. Wiremold / Legrand.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Crouse-Hinds, an Eaton business.
   2. Erickson Electrical Equipment Company.
   3. Hoffman; a brand of Pentair Equipment Protection.
   4. Hubbell Incorporated.
   5. Hubbell Incorporated; Wiring Device-Kellems.
   6. MonoSystems, Inc.
   7. Oldcastle Enclosure Solutions.
   8. O-Z/Gedney; a brand of Emerson Industrial Automation.
   9. RACO; Hubbell.
   10. Spring City Electrical Manufacturing Company.
   11. Thomas & Betts Corporation; A Member of the ABB Group.
   12. Topaz Electric; a division of Topaz Lighting Corp.
   13. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Metal Floor Boxes:
   1. Material: Cast metal or sheet metal.
   2. Type: Semi-adjustable.
   3. Shape: Rectangular.
   4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

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I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep).

K. Gangable boxes are allowed.

L. Cabinets:
1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:
1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Oldcastle Enclosure Solutions.
b. Oldcastle Precast, Inc.
c. Quazite: Hubbell Power Systems, Inc.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC." “COMMUNICATIONS”.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

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3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC.
   2. Concealed Conduit, Aboveground: GRC, EMT.
   3. Underground Conduit: RNC, Type EPC-40-PVC concrete encased.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
      a. Loading dock.
      b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
      c. Mechanical rooms.
      d. Gymnasiums.
   4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   6. Damp or Wet Locations: GRC.
   7. Boxes and Enclosures: NEMA 250, Type 1.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
   2. EMT: Use setscrew or compression, cast-metal fittings. Comply with NEMA FB 2.10.
   3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install surface raceways only where indicated on Drawings.

F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

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B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches ((300 mm))of enclosures to which attached.

I. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m)intervals.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
   4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
   5. Change from ENT to GRC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:
   1. Use EMT or RMC for raceways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

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O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

R. Surface Raceways:
1. Install surface raceway with a minimum 2-inch (50-mm)radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

V. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F

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(0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Locate boxes so that cover or plate will not span different building finishes.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

FF. Avoid back-to-back electrical outlet boxes wherever possible. Boxes that are located in opposite sides of a wall should be placed 16” offset or in separate stud bays.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 20 00 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 31 20 00 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to

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provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 20 00 "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
   b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

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3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

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SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings. Include or add room or area names where applicable.

D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

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E. Comply with NFPA 70E and Section 26 05 74 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
3. Colors for 240-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
4. Colors for 480/277-V Circuits:
   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
5. Color for Neutral: White or gray.
6. Color for Equipment Grounds: Green.
7. Colors for Isolated Grounds: Green with white stripe.

C. Raceways and Cables Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.
2.

E. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
3.

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2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:
   a. 1-1/2 by 6 inchesfor raceway and conductors.
   b. 3-1/2 by 5 inchesfor equipment.
   c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.

D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

E. Underground-Line Warning Tape:

1. Tape:

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a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:
a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

3. Tag: Type I:
a. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
b. Width: 3 inches.
c. Thickness: 4 mils.
d. Weight: 18.5 lb/1000 sq. ft..
e. Tensile according to ASTM D 882: 30 lbf and 2500 psi.

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

C. Write-on Tags:

1. Polyester Tags: 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment.
2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
3. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:

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1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:
   a. For signs up to 20 sq. in., minimum 1/16 inch.
   b. For signs larger than 20 sq. in., 1/8 inch thick.
   c. Engraved legend with black letters on white face.
   d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
   e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

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PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."

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3. "UPS."

M. Vinyl Wraparound Labels:
1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Labels:
1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

W. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

X. Metal Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

Y. Nonmetallic Preprinted Tags:

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1. Place in a location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

Z. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

AA. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

BB. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

CC. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

DD. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch-high, black letters on 20-inch centers.

1. Locate identification at changes in direction, at penetrations of walls and floors, and at 30 foot maximum intervals.

D. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Vinyl wraparound labels.

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1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

E. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

F. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

G. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

H. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.

I. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

J. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes or self-adhesive labels with the conductor designation.

K. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

L. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

M. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

N. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.

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3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

O. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

P. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

Q. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
   a. Power-transfer switches.
   b. Controls with external control power connections.

R. Arc Flash Warning Labeling: Self-adhesive labels.

S. Operating Instruction Signs: Baked-enamel warning signs.

T. Emergency Operating Instruction Signs: Baked-enamel warning signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

U. Equipment Identification Labels:

1. Indoor Equipment: Engraved Phenolic labels.
2. Outdoor Equipment: Laminated acrylic or melamine sign.
3. Labels shall include:
   a. Device name, voltage, reference to point of origin (fed from). Match single line.
4. Equipment to Be Labeled:
   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, or engraved, laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Switchgear.
   e. Switchboards.
   f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   g. Substations.
   h. Emergency system boxes and enclosures.
   i. Motor-control centers.
   j. Enclosed switches.
   k. Enclosed circuit breakers.
   l. Enclosed controllers.
   m. Variable-speed controllers.
   n. Push-button stations.
   o. Power-transfer equipment.
   p. Contactors.

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q. Remote-controlled switches, dimmer modules, and control devices.
r. Battery-inverter units.
s. Battery racks.
t. Power-generating units.
u. Monitoring and control equipment.
v. UPS equipment.

END OF SECTION

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SECTION 260574

OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

B. Arc flash study shall include devices upstream of the Amenities building switchboard. Coordinate device settings including ground fault with upstream devices located in the garage and serving the Amenties building.

1.2 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.3 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.
   1. Arc-flash study input data, including completed computer program input data sheets.
   2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
      a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

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1. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
2. Operation and Maintenance Procedures: In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," provide maintenance procedures for use by City's personnel that comply with requirements in NFPA 70E.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. EDSA Micro Corporation.
2. ESA Inc.
3. SKM

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

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C. One-line diagram, showing the following:
   1. Protective device designations and ampere ratings.
   2. Cable size and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Arc-Flash Study Output:
   1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      a. Voltage.
      b. Calculated symmetrical fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. No AC Decrement (NACD) ratio.
      e. Equivalent impedance.
      f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
      g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Incident Energy and Flash Protection Boundary Calculations:
   1. Arcing fault magnitude.
   2. Protective device clearing time.
   3. Duration of arc.
   4. Arc-flash boundary.
   5. Working distance.
   6. Incident energy.
   7. Hazard risk category.
   8. Recommendations for arc-flash energy reduction.

G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
   1. Location designation.
   2. Nominal voltage.
   3. Flash protection boundary.
   4. Hazard risk category.
   5. Incident energy.
   6. Working distance.
   7. Engineering report number, revision number, and issue date.

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C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

a. Phase and Ground Relays:

1) Device tag.
2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
3) Recommendations on improved relaying systems, if applicable.

b. Circuit Breakers:

1) Adjustable pickups and time delays (long time, short time, ground).
2) Adjustable time-current characteristic.
3) Adjustable instantaneous pickup.
4) Recommendations on improved trip systems, if applicable.

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c. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:

   a. Power utility's overcurrent protective device.
   b. Medium-voltage equipment overcurrent relays.
   c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
   d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
   e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
   f. Cables and conductors damage curves.
   g. Ground-fault protective devices.
   h. Motor-starting characteristics and motor damage points.
   i. Generator short-circuit decrement curve and generator damage point.
   j. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.
6. Provide adequate time margins between device characteristics such that selective operation is achieved.
7. Comments and recommendations for system improvements.

3.3 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:
   1. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in "Overcurrent Protective Device Coordination Study." above

C. Calculate maximum and minimum contributions of fault-current size.
   1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.

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2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
1. Fault contribution from induction motors should not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.4 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
1. Verify completeness of data supplied on the one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams,

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overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.5 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:
1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Control panel.

3.6 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.7 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train City's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION

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SECTION 260924
NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 WIRING REQUIREMENTS

A. Use only wired option in the Lutron family of sensors. Wireless transmission and/or reception of data of any kind is explicitly prohibited.

1.2 SECTION INCLUDES

A. Digital-network lighting control system and associated components:

1. Fluorescent electronic dimming ballasts.
2. LED drivers.
3. Power interfaces.
4. Lighting control modules (Lutron Energi Savr Node).
5. DIN rail power modules.
6. Digital dimming ballast and switching modules (Lutron EcoSystem).
7. Lighting management hubs.
8. Lighting management system software.
9. Control stations.
10. Low-voltage control interfaces.
11. Wired sensors.

1.3 RELATED REQUIREMENTS

A. Section 26 2726 - Wiring Devices - Lutron:

1. Finish requirements for wall controls specified in this section.
2. Accessory receptacles and wallplates, to match lighting controls specified in this section.

B. Section 26 5133 - Luminaires, Ballasts, and Drivers - Lutron.

C. Section 26 5134 - Luminaires, Lamps, and Accessories – Ketra: Tunable LED luminaires/lamps for interface with lighting control system.

1.4 REFERENCE STANDARDS

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A. 47 CFR 15 - Radio Frequency Devices; current edition.

B. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements; 2017.

C. ANSI/ESD S20.20 - Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices); 2014.

D. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments; 2019.

E. CAL TITLE 24 P6 – California Code of Regulations, Title 24, Part 6 (California Energy Code); 2016.

F. CSA C22.2 No. 223 – Power Supplies with Extra-low-voltage Class 2 Outputs; 2015 (Updated 2017).

G. IEC 60669-2-1 - Switches for Household and Similar Fixed Electrical Installations - Part 2-1: Particular Requirements - Electronic Switches; 2015.

H. IEC 60929 - AC and/or DC-Supplied Electronic Control Gear for Tubular Fluorescent Lamps - Performance Requirements; 2015.

I. IEC 61000-4-2 - Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test; 2008.

J. IEC 61000-4-5 - Electromagnetic Compatibility (EMC) - Part 4-5: Testing and Measurement Techniques - Surge Immunity Test; 2014, with Amendments, 2017.

K. IEC 61347-2-3 - Lamp Control Gear - Part 2-3: Particular Requirements for A.C. and/or D.C. Supplied Electronic Control Gear for Fluorescent Lamps; 2016.

L. IEEE 1789 - Recommended Practice for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers; 2015.

M. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Cor 1, 2012).

N. ISO 9001 - Quality Management Systems-Requirements; 2015.

O. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

P. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association; 2010.

Q. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; National Electrical Manufacturers Association; 2016.

R. NEMA SSL 7A – Phase Cut Dimming for Solid State Lighting: Basic Compatibility; National Electrical Manufacturers Association; 2015.

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S. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2015).

T. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

U. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

V. UL 508 - Industrial Control Equipment; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

W. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

X. UL 935 - Fluorescent-Lamp Ballasts; Current Edition, Including All Revisions.

Y. UL 1310 – Class 2 Power Units; Current Edition, Including All Revisions.

Z. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

AA. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.

BB. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

CC. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate placement of sensors and wall controls with millwork, furniture, equipment, etc. installed under other sections or by others.

2. Coordinate placement of wall controls with actual installed door swings.

3. Coordinate placement of daylight sensors with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.

4. Where motorized window treatments are to be controlled by lighting control system provided under this section, coordinate work to provide compatible products.

5. Coordinate work to provide luminaires and lamps compatible with lighting controls to be installed.

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6. Notify Architect of conflicts or deviations from contract documents to obtain direction prior to proceeding with work.

B. Preinstallation Meeting: Conduct on-site meeting with lighting control system manufacturer prior to commencing work as part of manufacturer's standard startup services. Manufacturer to review with installer:

1. Low voltage wiring requirements.

2. Separation of power and low voltage/data wiring.

3. Wire labeling.

4. Lighting management hub locations and installation.

5. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", sensor locations to be reviewed in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require deviation from locations indicated.

6. Control locations.

7. Computer jack locations.

8. Load circuit wiring.

9. Network wiring requirements.

10. Connections to other equipment.

11. Installer responsibilities.

C. Remote Prewire Visit; Lutron LSC-PREWIRE-RMTE: Include as alternate to base bid additional costs for Lighting Control Manufacturer to provide one 4-hour session(s) of additional remote prewire support.

D. Sequencing:

1. Do not install sensors and wall controls until final surface finishes and painting are complete.

1.6 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Design Documents: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", Lighting Control Manufacturer to provide plans indicating occupancy/vacancy and/or daylight sensor locations.

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C. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.

1. Occupancy/Vacancy Sensors: Include detailed basic motion detection coverage range diagrams.

D. Shop Drawings:

1. Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.

2. Provide detailed sequence of operations describing system functions.

E. Samples:

1. Wall Controls: One for each product upon request; show available color and finish selections.

2. Sensors: One sample for each product upon request.

F. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. System Performance-Verification Documentation; Lutron LSC-SPV-DOC: Include as alternate to base bid additional costs for manufacturer's enhanced documentation detailing start-up performance-verification procedures and functional tests performed along with test results.

H. Title 24 Acceptance Testing Documentation: Submit Certification of Acceptance and associated documentation for lighting control acceptance testing performed in accordance with CAL TITLE 24 P6, as specified in Part 3 under “COMMISSIONING”.

I. Project Record Documents: Record actual installed locations and settings for lighting control system components.

J. Operation and Maintenance Data: Include detailed information on lighting control system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

K. Warranty: Provide sample of manufacturer's warranty as specified in Part 1 under "WARRANTY". Submit documentation of final execution completed in City's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at project site one copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications:

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1. Company with not less than ten years of experience manufacturing lighting control systems of similar complexity to specified system.

2. Registered to ISO 9001, including in-house engineering for product design activities.

3. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.

D. Title 24 Acceptance Testing Technician Qualifications: Certified by California approved Acceptance Test Technician Certification Provider as Acceptance Test Technician (ATT) in accordance with CAL TITLE 24 P6.

E. Maintenance Contractor Qualifications: Manufacturer's authorized service representative.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store products in clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.9 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1. Lutron System Requirements, Unless Otherwise Indicated:

a. Ambient Temperature:

1) Lighting Control System Components, Except Those Listed Below: Between 32 and 104 degrees F (0 and 40 degrees C).

2) Fluorescent Electronic Dimming Ballasts: Between 50 and 140 degrees F (10 and 60 degrees C).

b. Relative Humidity: Less than 90 percent, non-condensing.

1.10 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

A. Manufacturer’s Standard Warranty, Without Manufacturer Start-Up:

1. Manufacturer Lighting Control System Components, Except Wired Sensors, Ballasts/Drivers, and Ballast Modules: One year 100 percent parts coverage, no manufacturer labor coverage.

2. Wired Sensors: Five years 100 percent parts coverage, no manufacturer labor coverage.

3. Ballasts/Drivers and Ballast Modules: Three years 100 percent parts coverage, no manufacturer labor coverage.

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B. Manufacturer's Standard Warranty, With Manufacturer Start-Up; Lutron Standard 2-Year Warranty; Lutron LSC-B2:

1. Manufacturer Lighting Control System Components, Except Wired Sensors, Ballasts/Drivers and Ballast Modules:

a. First Two Years:

1) 100 percent replacement parts coverage, 100 percent manufacturer labor coverage to troubleshoot and diagnose lighting issue.

2) First-available on-site or remote response time.

3) Remote diagnostics for applicable systems.

b. Telephone Technical Support: Available 24 hours per day, 7 days per week, excluding manufacturer holidays.

2. Wired Sensors: Five years 100 percent parts coverage, no manufacturer labor coverage.

3. Ballasts/Drivers and Ballast Modules: Five years 100 percent parts coverage, no manufacturer labor coverage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Lutron Electronics Company, Inc; Athena; www.lutron.com.

B. Other Acceptable Manufacturers:

1. Lutron Athena, or approved equal.

C. Substitutions:

1. Proposed substitutions (clearly delineated as such) must be submitted in writing for approval by Architect a minimum of 10 working days prior to bid date and must be made available to all bidders. Proposed substitutes must be accompanied by review of specification noting compliance on line-by-line basis.

2. Proposed substitutions to be reviewed by Architect at Contractor's expense.

3. By using pre-approved substitutions, Contractor accepts responsibility and associated costs for required modifications to related equipment and wiring. Provide complete engineered shop drawings (including power wiring) with deviations from original design highlighted in alternate color for review and approval by Architect prior to rough-in.

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D. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

2.2 DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS

A. Sensor Layout and Tuning: No Lighting Control Manufacturer Sensor Layout and Tuning service to be provided; Lutron LSC-NO-SENS-LT.

1. Contractor to utilize Lighting Control Manufacturer Installation Instructions to place/install sensors.

2. At Pre-wire and Startup, Lighting Control Manufacturer to provide rough sensor calibration only. Sensor fine-tuning to be responsibility of Contractor.

B. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. as suitable for purpose indicated.

C. Unless specifically indicated to be excluded, provide required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for complete operating system that provides control intent indicated.

D. Shade Control Requirements:

1. Capable of operating shades and recalling shade presets via keypad, contact closure input, lighting management system software, or other lighting control system interface.

2. Capable of operating any individual, group, or subgroup of shade electronic drive units within system without requiring separate group controllers.

3. Capable of assigning and reassigning individual, groups, and subgroups of shades to any control within system without requiring additional wiring or hardware changes.

4. Capable of controlling shade speed for tracking within plus or minus 0.125 inch (3.17 mm) throughout entire travel.

5. Provide 10-year power failure memory for preset stops, open and close limits, shade grouping and sub grouping and system configuration.

6. Capable of synchronizing multiple shade electronic drive units to start, stop, and move in unison.

7. Capable of stopping shades within accuracy of 0.125 inch (3.17 mm) at any point between open and close limits.

8. Capable of storing up to 250 programmable stop points, including open, close, and any other position.

9. Capable of controlling lights and shades from single wall control button.

10. Capable of adjusting shade limits from user interface.

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E. Design lighting control equipment for 10-year operational life while operating continually at any temperature in ambient temperature range of 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C) and 90 percent non-condensing relative humidity.

F. Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.

G. Dimming and Switching/Relay Equipment:

1. Designed so that electrolytic capacitors operate at least 36 degrees F (20 degrees C) below capacitor's maximum temperature rating when device is under fully loaded conditions at maximum rated temperature.

2. Inrush Tolerance:

a. Utilize load-handling thyristors (SCRs and triacs), field effect transistors (FETs) and isolated gate bipolar transistors (IGBTs) with maximum current rating at least two times rated operating current of dimmer/relay.

b. Capable of withstanding repetitive inrush current of 50 times operating current without impacting lifetime of dimmer/relay.

3. Surge Tolerance: Designed and tested to withstand surges of 6,000 V, 200 amps according to IEEE C62.41.2 without impairment to performance.

4. Power Failure Recovery: When power is interrupted and subsequently restored, within 3 seconds lights to automatically return to same levels, e.g. dimmed setting, full on, or full off, as prior to power interruption.

5. Dimming Requirements:

a. Line Noise Tolerance: Provide real-time cycle-by-cycle compensation for incoming line voltage variations including changes in RMS voltage (plus or minus 2 percent change in RMS voltage per cycle), frequency shifts (plus or minus 2 Hz change in frequency per second), dynamic harmonics, and line noise.

1) Systems not providing integral cycle-by-cycle compensation to include external power conditioning equipment as part of dimming system.

b. Incorporate electronic "soft-start" default at initial turn-on that smoothly ramps lights up to appropriate levels within 0.5 seconds.

c. Utilize air gap off to disconnect load from line supply.

d. Control light sources in smooth and continuous manner. Dimmers with visible steps are not acceptable.

e. Load Types:

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1) Assign load type to each dimmer that will provide proper dimming curve for specific light source to be controlled.

2) Provide capability of being field-configured to have load types assigned per circuit.

f. Minimum and Maximum Light Levels: User adjustable on circuit-by-circuit basis.

g. Line Voltage Dimmers:

1) Dimmers for Magnetic Low Voltage (MLV) Transformers:

a) Provide circuitry designed to control and provide symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472.

b) Dimmers using unipolar load current devices, e.g. FETs or SCRs, to include DC current protection in event of single device failure.

2) Dimmers for Electronic Low Voltage (ELV) Transformers: Operate transformers via reverse phase control. Alternately, forward phase control dimming may be used if dimming equipment manufacturer has recommended specific ELV transformers being provided.

3) Dimmers for Neon and Cold Cathode Transformers:

a) Magnetic Transformers: Listed for use with normal (low) power factor magnetic transformers.

b) Electronic Transformers: Must be supported by ballast equipment manufacturer for control of specific ballasts being provided.

6. Switching Requirements:

a. Rated Life of Relays: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.

b. Switch load in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.

c. Provide output fully rated for continuous duty for inductive, capacitive, and resistive loads.

H. Device Finishes:

1. Wall Controls: To be selected by Architect.

2. Standard Colors: Comply with NEMA WD1 where applicable.

3. Color Variation in Same Product Family: Maximum delta E of 1, CIE L*a*b color units.

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4. Visible Parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

2.3 FLUORESCENT ELECTRONIC DIMMING BALLASTS

A. General Requirements:

1. Designed for 10-year operational life while operating at maximum case temperature and 90 percent noncondensing relative humidity.

2. Designed and tested to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.

3. Lamp Starting Method: Programmed rapid start.

4. Maximum Inrush Current: 7 amperes for 120V ballasts and 3 amperes for 277V ballasts.

1. Current Crest Factor (CCF): Less than 1.7.

2. Comply with ANSI C82.11 and list and label as complying with UL 935.

3. Designed to not interfere with infrared devices operating at frequencies between 38 kHz and 42 kHz.

4. Manufactured in facility that employs ESD reduction practices in compliance with ANSI/ESD S20.20.

5. Inaudible in 27 dBA ambient.

6. No visible change in light output with variation of plus or minus 10 percent line voltage input.

7. Actively prevent overheating in T5-HO linear fluorescent lamp applications.

8. Ballasts to track evenly across multiple lamp lengths and all light levels.

9. Comply with IEC 61347-2-3 as applicable.

B. 3-Wire Control:

1. Provide integral fault protection to prevent ballast failure in event of miswire.

C. Digital Control:

1. Monitor and report lamp and ballast status.

2. Lights automatically return to setting prior to power interruption.

3. Averages two independent daylight harvesting inputs internally.

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4. Responds to digital load shed command, i.e. if light output is at 30 percent and load shed command of 10 percent is received, ballast automatically sets maximum light output at 90 percent and lowers current light output by three percent to 27 percent.

D. Products:

1. 3-Wire Control, One Percent Dimming; Lutron Hi-lume:

   a. Dimming Range: 100 percent to one percent relative light output for T4 compact and T5-HO lamps.

   b. Surge Tolerance: Designed and tested to withstand Category A surges of 6,000 V according to IEEE C62.41.2 without impairment of performance.

   c. Total Harmonic Distortion (THD): Less than 10 percent.

2. 3-Wire and Digital Control, One Percent Dimming; Lutron Hi-lume 3D:

   a. Dimming Range: 100 percent to less than one percent relative light output for T8, T5 and T5HO, and five percent relative light output for T5 twin-tube lamps.

   b. Surge Tolerance: Designed and tested to withstand Category A surges of 6,000 V according to IEEE C62.41.2 without impairment of performance.

   c. Total Harmonic Distortion (THD): Less than 10 percent typical (15 percent for select models).

3. 3-Wire and Digital Control, Ten Percent Dimming; Lutron EcoSystem:

   a. Dimming Range: 100 to ten percent relative light output for T8, T5, T5HO, and T5 twin-tube, and five percent relative light output for T4 compact lamps.

   b. Surge Tolerance: Designed and tested to withstand Category A surges of 4,000 V according to IEEE C62.41.2 without impairment of performance.

   c. Total Harmonic Distortion (THD): Less than 10 percent typical (15 percent for select models).

4. Digital Control, One Percent Dimming; Lutron EcoSystem H-Series:

   a. Dimming Range: 100 to less than one percent relative light output for T8, and one percent relative light output for T5 and T5HO lamps.

   b. Surge Tolerance: Designed and tested to withstand Category A surges of 4,000 V according to IEEE C62.41.2 without impairment of performance.

   c. Total Harmonic Distortion (THD): Less than 10 percent typical (15 percent for select models).

2.4 LED DRIVERS

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A. General Requirements:

1. Operate for at least 50,000 hours at maximum case temperature and 90 percent noncondensing relative humidity.

2. Provide thermal protection by automatically reducing power output to protect LED driver and LED light engine/fixture from damage due to over-temperature conditions that exceed the LED driver's maximum operating temperature at calibration point (tc).

3. Provide integral recording of operating hours and maximum operating temperature to aid in troubleshooting and warranty claims.

4. Designed and tested to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.

5. Manufactured in facility that employs ESD reduction practices in compliance with ANSI/ESD S20.20.

6. UL 8750 recognized or listed as applicable.

7. UL Type TL rated or UL Class P listed where possible to allow for easier fixture evaluation and listing of different driver series.

8. Suitable for field replacement as applicable; listed in accordance with UL 1598C or UL 8750, Class P as indicated.

9. Designed and tested to withstand Category A surges of 4,000 V according to IEEE C62.41.2 without impairment of performance.

10. Class A sound rating; Inaudible in 27 dBA ambient.

11. Demonstrate no visible change in light output with variation of plus or minus 10 percent change in line-voltage input.

12. LED drivers of same family/series to track evenly across multiple fixtures at all light levels.

13. Offer programmable output currents in 10 mA or smaller increments within designed driver operating ranges for custom fixture length and lumen output configurations, while meeting low-end dimming range of 100 to 0.1 percent, 100 to 1 percent or 100 to 5 percent as applicable.

14. Meet NEMA 410 inrush requirements for mitigating inrush currents with solid state lighting sources.

15. Employ integral fault protection up to 277 V to prevent LED driver damage or failure in event of incorrect application of line-voltage to communication link inputs.

16. LED driver may be remote located up to 100 feet (30 m) from LED light engine depending on power outputs required and wire gauge utilized by installer.

B. 3-Wire Control:

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1. Provide integral fault protection to prevent driver failure in event of miswire.

2. Operate from input voltage of 120 V through 277 V at 50/60 Hz.

C. Digital Control (when used with compatible Lutron lighting control systems):

1. Employ power failure memory; LED driver to automatically return to previous state/light level upon restoration of utility power.

2. Operate from input voltage of 120 V through 277 V at 50/60 Hz.

3. Automatically go to 100 percent light output upon loss of control link voltage and lock out system commands until digital control link voltage is restored. Manufacturer to offer UL 924 compliance achievable through use of external Lutron Model LUT-ELI-3PSH interface upon request.

4. Responds to digital load shed command, i.e. if light output is at 30 percent and load shed command of 10 percent is received, ballast automatically sets maximum light output at 90 percent and lowers current light output by three percent to 27 percent.

5. Digital low-voltage control wiring capable of being wired as either Class 1 or Class 2.

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D. Products:

1. Digital Control, 0.1 Percent Dimming with Soft-On and Fade-to-Black Low End Performance; Lutron Hi-lume Premier 0.1% Constant Voltage (L3D0-Series):

a. Dimming Range: 100 to 0.1 percent measured output current.

b. Features smooth fade-to-on and fade-to-black (Lutron Soft-On, Fade-to-Black™) low end dimming performance for incandescent-like dimming experience.

c. Typically dissipates 0.25 W standby power at 120 V and 0.40 W standby power at 277 V.

d. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120-277 V and residential applications at 120 V.

e. Total Harmonic Distortion (THD): Less than 20 percent at maximum power; complies with ANSI C82.11.

f. Class 2 output designed to withstand hot swap of LED loads; meets UL 1310 and CSA C22.2 No. 223.

g. Driver outputs to be short-circuit protected, open-circuit protected, and overload protected.

h. Constant Voltage Drivers:

1) Support for cove and under-cabinet fixtures at 24 V.

(a) Support LED arrays from 2 W to 96 W.

(b) Pulse Width Modulation (PWM) dimming frequency meets IEEE 1789.

(c) Meets solid state requirements for power factor, transient protection, standby power consumption, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

(d) UL listed.

2. 3-Wire Control, 0.1 Percent Dimming; Lutron Hi-lume Premier 0.1% Constant Voltage (L3D0-Series):

a. Dimming Range: 100 to 0.1 percent measured output current.

b. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120-277 V and residential applications at 120 V.

c. Total Harmonic Distortion (THD): Less than 20 percent at maximum power; complies with ANSI C82.11.

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d. UL Class 2 output designed to withstand hot swap of LED loads.

e. Driver outputs to be short-circuit protected, open-circuit protected, and overload protected.

f. Constant Voltage Drivers:

1) Support for cove and under-cabinet fixtures at 24 V.

(a) Support LED arrays from 2 W to 96 W.

(b) Pulse Width Modulation (PWM) dimming frequency meets IEEE 1789.

(c) Meets solid state requirements for power factor, transient protection, standby power consumption, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

(d) UL listed.

3. Digital Control, 0.1 Percent Dimming with Soft-On and Fade-to-Black Low End Performance; Lutron Hi-lume Premier 0.1% Constant Current (PEQ0-Series):

a. Dimming Range: 100 to 0.1 percent measured output current.

b. Features smooth fade-to-on and fade-to-black (Lutron Soft-On, Fade-to-Black™) low end dimming performance for incandescent-like dimming experience.

c. Typically dissipates less than 0.5 W standby power at 120/277 V.

d. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120/277 V.

e. Class 2 output designed to withstand hot swap of LED loads; meets UL 1310 and CSA C22.2 No. 223.

f. Driver outputs to be short-circuit protected and open-circuit protected.

g. Constant Current Drivers:

1) Support for downlights and pendant fixtures from 150 mA to 1.05 A to ensure compatible driver exists.

(a) Support LED arrays up to 20 W.

(b) Constant Current Reduction (CCR) dimming method.

(c) UL listed Class P.

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(d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

2) Support for troffers, linear pendants, and linear recessed fixtures from 150 mA to 1.05 A to ensure compatible driver exists.

(a) Support LED arrays up to 20 W.

(b) Constant Current Reduction (CCR) dimming method.

(c) UL listed Class P.

(d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

4. Digital Control, 1 Percent Dimming with Soft-On and Fade-to-Black Low End Performance; Lutron Hi-lume Premier 1% Constant Current (PEQ1-Series):

a. Dimming Range: 100 to 1 percent measured output current.

b. Features smooth fade-to-on and fade-to-black (Lutron Soft-On, Fade-to-Black™) low end dimming performance for incandescent-like dimming experience.

c. Typically dissipates less than 0.5 W standby power at 120/277 V.

d. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120/277 V.

e. Class 2 output designed to withstand hot swap of LED loads; meets UL 1310 and CSA C22.2 No. 223.

f. Driver outputs to be short-circuit protected and open-circuit protected.

g. Constant Current Drivers:

1) Support for downlights and pendant fixtures from 150 mA to 1.05 A to ensure compatible driver exists.

(a) Support LED arrays up to 20 W.

(b) Constant Current Reduction (CCR) dimming method.

(c) UL listed Class P.

(d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

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2) Support for troffers, linear pendants, and linear recessed fixtures from 150 mA to 1.05 A to ensure compatible driver exists.

(a) Support LED arrays up to 20 W.

(b) Constant Current Reduction (CCR) dimming method.

(c) UL listed Class P.

(d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

5. Forward Phase (Neutral Wire Required), One Percent Dimming; Lutron Hi-lume 1% (LTE-Series):

a. Dimming Range: 100 to one percent relative light output.

b. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial and residential applications at 120 V.

c. Total Harmonic Distortion (THD): Less than 20 percent at full output for 40 W loads; complies with ANSI C82.11.

d. Constant Current Drivers:

1) Support for downlights and pendant fixtures from 200 mA to 2.1 A to ensure compatible driver exists.

(a) Support LED arrays up to 40 W.

(b) Pulse Width Modulation (PWM) or Constant Current Reduction (CCR) dimming methods available.

(c) UL listed Class P.

(d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

2) Support for troffers, linear pendants, and linear recessed fixtures from 200 mA to 2.1 A to ensure compatible driver exists.

(a) Support LED arrays up to 40 W.

(b) Pulse Width Modulation (PWM) or Constant Current Reduction (CCR) dimming methods available.

(c) UL listed Class P.

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(d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

3) Support for cove and under-cabinet fixtures from 200 mA to 2.1 A to ensure compatible driver exists.

(a) Support LED arrays up to 40 W.

(b) Pulse Width Modulation (PWM) or Constant Current Reduction (CCR) dimming methods available.

(c) UL listed.

(d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

e. Constant Voltage Drivers:

1) Support for downlights and pendant fixtures from 10 V to 60 V (in 0.5 V steps) to ensure compatible driver exists.

(a) Support LED arrays up to 40 W.

(b) Pulse Width Modulation (PWM) dimming method.

(c) UL listed Class P.

(d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

2) Support for troffers, linear pendants, and linear recessed fixtures from 10 V to 60 V (in 0.5 V steps) to ensure compatible driver exists.

(a) Support LED arrays up to 40 W.

(b) Pulse Width Modulation (PWM) dimming method.

(c) UL listed Class P.

(d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

3) Support for cove and under-cabinet fixtures from 10 V to 60 V (in 0.5 V steps) to ensure compatible driver exists.

(a) Support LED arrays up to 40 W.

(b) Pulse Width Modulation (PWM) dimming method.

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(c) UL listed.

(d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

6. Digital Control, Five Percent Dimming; Lutron 5-Series (LDE5-Series):

a. Dimming Range: 100 to five percent measured output current.

b. Typically dissipates 0.2 W standby power at 120 V and 0.3 W standby power at 277 V.

c. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120-277 V.

d. Constant Current Reduction (CCR) dimming method.

e. Total Harmonic Distortion (THD): Less than 21 percent at full load; complies with ANSI C82.11.

f. Constant Current Drivers:

1) Lutron K-Case Form Factor: Support for downlights and pendant fixtures in currents from 220 mA to 1.4 A to ensure compatible driver exists.

(a) Support LED arrays up to 40 W.

(b) UL listed Class P.

2) Lutron M-Case Form Factor: Support for troffers, linear pendants, and linear recessed fixtures from 150 mA to 2.1 A to ensure compatible driver exists.

(a) Support LED arrays up to 75 W.

(b) Meets solid state requirements for power factor, transient protection, standby power consumption, start time, and operating frequency in ENERGY STAR for Luminaires Version 2.0.

(c) Models available to meet DesignLights Consortium (DLC) power line quality requirements.

(d) UL listed Class P.

7. Digital Control, One Percent Dimming with Soft-On and Fade-to-Black Low End Performance; Lutron Hi-lume 1% Soft-on Fade-to-Black (LDE1-Series):

a. Dimming Range: 100 to one percent measured output current.

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b. Features smooth fade-to-on and fade-to-black (Lutron Soft-On, Fade-to-Black™) low end dimming performance for incandescent-like dimming experience.

c. Typically dissipates 0.2 W standby power at 120 V and 0.3 W standby power at 277 V.

d. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120-277 V.

e. Employs true Constant Current Reduction (CCR) dimming method from 100 to five percent light level and Pulse Width Modulation (PWM) dimming method from five percent to off.

f. Pulse Width Modulation (PWM) frequency of 240 Hz.

g. Total Harmonic Distortion (THD): Less than 20 percent at full output for drivers greater than 25 W; complies with ANSI C82.11.

h. UL Class 2 output.

i. Driver outputs to be short-circuit protected, open-circuit protected, and overload protected.

j. Constant Current Drivers:

1) Lutron K-Case Form Factor: Support for fixtures from 220 mA to 1.4 A over multiple operating ranges.

(a) Support LED arrays up to 40 W.

(b) Meets solid state requirements for power factor, transient protection, standby power consumption, start time, and operating frequency in ENERGY STAR for Luminaires Version 2.0.

(c) UL listed Class P.

2) Lutron M-Case Form Factor: Support for fixtures from 150 mA to 2.1 A over multiple operating ranges.

(a) Support LED arrays up to 75 W.

(b) Meets solid state requirements for power factor, transient protection, standby power consumption, start time, and operating frequency in ENERGY STAR for Luminaires Version 2.0.

(c) Models available to meet DesignLights Consortium (DLC) power line quality requirements.

(d) UL listed Class P.

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8. Digital Control, Tunable White, One Percent Dimming; Lutron T-Series (PSQ0-Series):

   a. Dimming Range: 100 to one percent measured output current.

   b. Support for tunable white fixtures with LED light sources having color temperatures between 1500 Kelvin and 6500 Kelvin.

   c. Color temperature programmable in 50 Kelvin increments.

   d. Output current programmable in 5 mA increments.

   e. Dissipates less than 0.5 W standby power at 120 V and 277 V.

   f. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120 and 277 V.

   g. Employs true Constant Current Reduction (CCR) dimming method from 1.5A to 0.2A and Pulse Width Modulation (PWM) dimming method below 0.2A to off.

   h. Pulse Width Modulation (PWM) frequency of 3.6 kHz.

   i. Total Harmonic Distortion (THD): Less than 20 percent at full output; complies with ANSI C82.11.

   j. UL Class 2 output.

   k. UL listed Class P.

   l. Driver outputs to be short-circuit protected, open-circuit protected, and overload protected.

   m. Constant Current Drivers:

      1) Support for fixtures from 200 mA to 1.5 A.

         (a) Support LED arrays up to 50 W.

         (b) Models available to meet solid state requirements for power factor, transient protection, standby power consumption, start time, and operating frequency in ENERGY STAR for Luminaires Version 2.1.

         (c) Models available to meet DesignLights Consortium (DLC) V4.3 power line quality requirements.

2.5 POWER INTERFACES

A. Provide power interfaces as indicated or as required to control loads as indicated.

B. General Requirements:

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1. Phase independent of control input.

2. Rated for use in air-handling spaces as defined in UL 2043.

3. Utilize air gap off to disconnect load from line supply.

4. Diagnostics and Service: Replacing power interface does not require reprogramming of system or processor.

C. Products:

1. Phase-Adaptive Power Module; Lutron PHPM-PA: Provides interface for phase control input to provide full 16 A circuit output of forward/reverse phase control for compatible loads.

2. 3-Wire Fluorescent Power Module; Lutron PHPM-3F: Provides interface for phase control input to provide full 16 A circuit output for compatible line-voltage control fluorescent electronic dimming ballasts or LED drivers.

3. Switching Power Module; Lutron PHPM-SW: Provides interface for phase control or switched input to provide full 16 A circuit output of switching for compatible nondim loads.

4. Phase-Adaptive Power Module with 3-Wire Fluorescent/LED Input; Lutron PHPM-WBX: Provides interface for fluorescent ballast/LED driver control input to provide full 16 A circuit output for compatible loads.

5. Ten Volt Interface; Lutron GRX-TVI: Provides interface for phase control input to provide full 16 A circuit output of switching and 0-10 V low voltage control for compatible fluorescent electronic dimming ballasts or LED drivers.

2.6 LIGHTING CONTROL MODULES (LUTRON ENERGI SAVR NODE)

A. Provide lighting control modules as indicated or as required to control loads as indicated.

B. General Requirements:

1. Listed to UL 508 as industrial control equipment.

2. Delivered and installed as listed factory-assembled panel.

3. Passively cooled via free-convection, unaided by fans or other means.

4. Mounting: Surface.

5. Connection without interface to wired:

a. Occupancy sensors.

b. Daylight sensors.

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6. Connects to lighting management hub via RS485.

7. LED status indicators confirm communication with occupancy sensors and daylight sensors.

8. Contact Closure Input (select models):

    a. Directly accept contact closure input from dry contact closure or solid-state output without interface to:

        1) Activate scenes.

            (a) Scene activation from momentary or maintained closure.

        2) Enable or disable after hours.

            (a) Automatic sweep to user-specified level after user-specified time has elapsed.

            (b) System provides occupants visual warning prior to sweeping lights to user-specified level.

            (c) Occupant can reset timeout by interacting with lighting system.

        3) Activate or deactivate demand response (load shed).

            (a) Load shed event reduces lighting load by user-specified amount.

9. Emergency Contact Closure Input:

    a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 listed emergency lighting interface, security system or fire alarm system.

    b. Allow configurable zone response during emergency state.

    c. Disable control operation until emergency signal is cleared.

10. Supplies power for control link for keypads and control interfaces (select models).

11. Distributes sensor data among multiple lighting control modules.

C. Switching Lighting Control Modules:

1. Products:

    a. Lutron SoftSwitch Energi Savr Node; Model QSN-4S16-S: 16 A continuous-use per channel.

    b. Lutron SoftSwitch Energi Savr Node; Model QSN-4S20-S: 20 A (16 A ballast) continuous-use per channel; capable of switching 20A receptacles.

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2. Switching:

a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.

b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.

c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.

d. Module to integrate up to four individually controlled zones.

e. Utilize air gap off, activated when user selects "off" at any control to disconnect load from line supply.

D. Phase Adaptive Lighting Control Modules:

1. Products:

a. Lutron PRO LED+ Phase Adaptive Energi Savr Node; Model QSN-4A5-S; 4-zone.

1) Zone 1: Rated for incandescent/halogen (800 W, 120/277 V), electronic low voltage (800 W, 120/277 V), magnetic low voltage (800 VA/525 W, 120/277 V), or neon/cold cathode (800 VA/525 W, 120/277 V), Lutron Hi-lume 1% 2-wire LED Driver (120 V, maximum of 20 drivers), NEMA SSL 7A forward phase LED (400 W, 120 V), reverse phase LED (6.6 A at 120 V and 2.9 A at 277 V).

2) Zones 2 through 4: Each zone rated for incandescent/halogen (500 W, 120/277 V), electronic low voltage (500 W, 120/277 V), magnetic low voltage (500 VA/375 W, 120/277 V), or neon/cold cathode (500 VA/375 W, 120/277 V), Lutron Hi-lume 1% 2-wire LED Driver (120 V, maximum of 13 drivers), NEMA SSL 7A forward phase LED (200 W, 120 V), reverse phase LED (4.2 A at 120 V and 1.8 A at 277 V).

2. Provides leading-edge or trailing-edge dimming; automatic or manual configuration.

3. Output Zones: One load type per zone.

4. Manual Mode Operation: Provide buttons to turn loads on/off or dim loads up/down for each zone.

5. Manual Override Contact Closure Input: Provides activation of manual override mode; turns all loads on and disables control from other devices.

6. Provide cycle-by-cycle compensation for incoming line voltage variations, including changes in voltage, frequency shifts, harmonics, and line noise; accommodate up to plus/minus two percent change in frequency per second.

7. Comply with NEMA SSL 7A.

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8. Capable of withstanding high-inrush LEDs, bulb blowouts, and direct shorts utilizing RTISS-ICM technology.

E. 0-10V Lighting Control Modules:

1. Products:

a. Lutron 0-10V Energi Savr Node; Model QSN-4T16-S: 16 A continuous-use per channel.

b. Lutron 0-10V Energi Savr Node; Model QSN2-4T16-S-347V: 16 A continuous-use per channel.

c. Lutron 0-10V Energi Savr Node; Model QSN-4T20-S: 20 A (16 A ballast) continuous-use per channel; capable of switching 20A receptacles.

d. Lutron 0-10V Energi Savr Node; Model QSN2-4T20-S: 20 A (16 A ballast) continuous-use per channel; capable of switching 20A receptacles.

2. Coordination Between Low Voltage Dimming Module and Line Voltage Relay: Capable of being electronically linked to single zone.

3. Single low voltage dimming module; capable of controlling the following light sources:

a. 0-10V analog voltage signal.

1) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.

2) Sink current per IEC 60929.

b. 10V-0V analog voltage signal.

1) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.

2) Sink current per IEC 60929.

4. Switching:

a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.

b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.

c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.

d. Module to integrate up to four individually controlled zones.

e. Utilize air gap off, activated when user selects "off" at any control to disconnect load from line supply.

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F. Digital Fixture Lighting Control Modules:

1. Products:

a. One EcoSystem digital link; Lutron EcoSystem Energi Savr Node; Model QSN-1ECO-S.

b. Two EcoSystem digital links; Lutron EcoSystem Energi Savr Node; Model QSN-2ECO-S.

c. Two EcoSystem digital links; Lutron EcoSystem Energi Savr Node; Model QSN2-2ECO-S.

d. Two T-Series digital links; independent correlated color temperature and light intensity control; Lutron T-Series Energi Savr Node; Model QSN-TW.

2. Provides two-way feedback with digital fixtures for energy monitoring, light level status, lamp failure reporting, and ballast/driver failure reporting.

3. Provide testing capability using manual test buttons.

4. Each low-voltage digital communication link to support up to 64 addresses capable of NFPA 70 Class 1 or Class 2 installation.

G. DALI Lighting Control Modules:

1. Product: Lutron DALI Power Module; Model QSN-2DALUNV-S; provides bus power and control for two DALI buses.

2. Provide testing capability using manual test buttons.

3. Each DALI bus supports:

a. Control of up to 64 DALI compliant addressable loads, grouped into up to 64 zones.

b. Up to 250 mA bus power.

2.7 DIN RAIL POWER MODULES

A. Power Module General Requirements:

1. Surge Tolerance: Designed and tested to withstand surges of 6,000 V, 3,000 amps according to IEEE C62.41.2 and IEC 61000-4-5 without impairment to performance.

2. Power: 120 VAC, 50/60 Hz; provide connection as indicated or as required.

3. Communications: Utilize RS485 wiring for low-voltage communications link.

4. Passively cooled via free-convection, unaided by fans or other means.

5. Provide LED indicators for displaying diagnostic information.

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B. Switching Power Modules:

1. Product(s): Lutron Switching Power Module; Model QSN-4S8-120-D; 4-zone.

2. Output Zones: Each zone rated at 8 A for resistive, inductive, or capacitive lighting loads as defined by IEC 60669-2-1 and NEMA 410, or 1/3 HP motor load; maximum of 16 A per module.

3. Manual Mode Operation: Provide buttons to turn loads on/off for each zone.

4. Emergency Contact Closure Input:

a. Provides activation of emergency mode; turns all loads on and disables control from other devices.

b. UL 924 listed.

5. Contact Closure Output:

a. Single contact closure output including both normally open and normally closed dry contacts.

b. Maintained or momentary output.

c. Inductive Loads: Provide flyback diode wired per manufacturer's instructions to control unclamped inductive loads such as relays, solenoids, and motors.

C. Phase Adaptive Power Modules:

1. Products:

a. Lutron Adaptive Power Module; Model QSN-4A5-D; 4-zone.

1) Zone 1: Rated for incandescent/halogen (800 W, 120/277 V), electronic low voltage (800 W, 120/277 V), magnetic low voltage (800 VA/525 W, 120/277 V), or neon/cold cathode (800 VA/525 W, 120/277 V), Lutron Hi-lume 1% 2-wire LTE LED Driver (maximum of 20 drivers), NEMA SSL 7A forward phase LED (400 W, 120 V), reverse phase LED (6.6 A, 120 V; 2.9 A, 277 V).

2) Zones 2 through 4: Each zone rated for incandescent/halogen (500 W, 120/277 V), electronic low voltage (500 W, 120/277 V), magnetic low voltage (500 VA/375 W, 120/277 V), or neon/cold cathode (500 VA/375 W, 120/277 V), Lutron Hi-lume 1% 2-wire LED Driver (maximum of 13 drivers), NEMA SSL 7A forward phase LED (200 W, 120 V), reverse phase LED (4.2 A, 120 V; 1.8 A, 277 V).

2. Provides forward phase or reverse phase dimming; automatic or manual configuration.

3. Output Zones: One load type per zone.

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4. Manual Mode Operation: Provide buttons to turn loads on/off or dim loads up/down for each zone.

5. Emergency Contact Closure Input:

   a. Provides activation of emergency mode; turns all loads on and disables control from other devices.

   b. UL 924 listed.

6. Provide cycle-by-cycle compensation for incoming line variations, including changes in voltage, frequency, harmonics, and line noise; accommodate up to plus/minus two percent change in frequency per second.

7. Systems not providing cycle-by-cycle compensation to include external power conditioning equipment as part of dimming system.

8. Comply with NEMA SSL 7A.

D. 0-10 V Power Modules:

1. Product: Lutron 0-10 V Power Module; Model QSN-4T5-120-D; 4-zone.

2. Output Zones:

   a. Each zone provides 50 mA of 0-10 V dimming control conforming to IEC 60929 Annex E.2; source or sink automatically configures.

   b. Relay: Each zone rated for 5 A for switching of incandescent, electronic low voltage, magnetic low voltage, and LED lighting loads.

3. Manual Mode Operation: Provide buttons to turn loads on/off or dim loads up/down for each zone.

4. Emergency Contact Closure Input:

   a. Provides activation of emergency mode; turns all loads on and disables control from other devices.

   b. UL 924 listed.

E. Digital Fixture Control Modules:

1. Product: Lutron Power Module with EcoSystem; Model QSN-2ECO-120-D; two EcoSystem Digital Links.

2. Provide testing capability using manual test buttons.

3. Each low-voltage digital communication link to support up to 64 ballasts or LED drivers capable of NFPA 70 Class 1 or Class 2 installation.

F. DALI Fixture Control Modules:

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1. Product: Lutron DALI Power Module; Model QSN-2DALUNV-D; provides bus power and control for two DALI buses.

2. Provide testing capability using manual test buttons.

3. Each DALI bus supports:

   a. Control of up to 64 DALI compliant addressable loads, grouped into up to 64 zones.

   b. Up to 250 mA bus power.

4. Contact Closure Input: Directly accept contact closure input from dry contact closure or solid-state output without interface.

5. Emergency Contact Closure Input:

   a. Provides activation of emergency mode; turns all loads on and disables control from other devices.

   b. UL 924 listed.

G. DIN Rail Feed-Through Panels: Provide as indicated or as required to house system components.

1. Rated for feed-through, 120/277 VAC applications.

2. Surface or flush mounting.

3. Products:

   a. Lutron Model PD2-S-ASM Factory Assembled Satellite Panel; 16 inches (40.7 cm) high, nominal; for housing up to two DIN rail power modules and one wire landing board.

   b. Lutron Model PD4-C-ASM Factory Assembled Control Panel; 42 inches (107 cm) high, nominal; for housing up to four DIN rail power modules, four wire landing boards, two power supplies, and two low-voltage interfaces or processors.

   c. Lutron Model PD6-S-ASM Factory Assembled Satellite Panel; 42 inches (107 cm) high, nominal; for housing up to six DIN rail power modules and one wire landing board.

   d. Lutron Model PD8-C-ASM Factory Assembled Control Panel; 65 inches (165 cm) high, nominal; for housing up to eight DIN rail power modules, four wire landing boards, two power supplies, and two low-voltage interfaces or processors.

   e. Lutron Model PD10-S-ASM-Factory Assembled Satellite Panel; 65 inches (165 cm) high, nominal; for housing up to ten DIN rail power modules and one wire landing board.

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H. DIN Rail Breaker Panels: Provide as indicated or as required to house system components.

1. Rated for 120 VAC applications.

2. Surface or flush mounting.

3. 15 A and 20 A branch circuit breakers available.

4. Single-phase, 3-wire and three-phase, 4-wire feed types available.

5. Products:

a. Lutron Model PD8-B-ASM Factory Assembled Breaker Panel; 65 inches (165 cm), nominal; for housing up to eight DIN rail power modules, eight branch circuit breakers, and one wire landing board.

2.8 DIGITAL DIMMING BALLAST AND SWITCHING MODULES (LUTRON ECOSYSTEM)

A. Provide digital dimming ballast and switching modules as indicated or as required to control loads as indicated.

B. General Requirements:

1. Provide continuous 3-wire signal dimming to compatible 3-wire electronic dimming ballasts.

2. Utilize air gap off to disconnect load from line supply.

3. Generate digital communication commands to distribute ballast and sensor data on digital bus.

4. If power is interrupted and subsequently restored, lights automatically return to setting prior to power interruption.

5. Unique internal reference number visible displayed on module cover.

6. Averages two independent daylight harvesting inputs internally.

7. Responds to digital load shed command.

a. Sets high end trim.

b. Automatically scales light output proportional to load shed command, i.e. if light output is at 30 percent and load shed command of 10 percent is received, ballast to automatically set maximum light output at 90 percent and lower current light output by 3 percent to 27 percent.

8. Provide integral fault protection to prevent ballast module failure in event of miswire.

C. Products:

1. 3-Wire Ballast Module, 2 Amp; Lutron EcoSystem Model C5-BMF-2A:

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a. Integrates up to 2 amps of 3-wire electronic dimming ballasts into EcoSystem digital control system as single zone.

2. 3-Wire Ballast Module, 16 Amp; Lutron EcoSystem Model C5-BMJ-16A:

a. Integrates up to 16 amps of 3-wire electronic dimming ballasts into EcoSystem digital control system as single zone.

3. Switching Power Module, 16 Amp; Lutron EcoSystem Model C5-XPJ-16A:

a. Integrates up to 16 amps of high in-rush lighting load (magnetic fluorescent ballast, electronic fluorescent ballast, HID, incandescent, magnetic low-voltage, electronic low-voltage, neon/cold cathode and motor loads) into EcoSystem digital control system as single zone.

2.9 LIGHTING MANAGEMENT HUBS

A. Products:

1. Lutron Athena Light Management Hub (QP5).

a. 1-link hub; Lutron Model QP5-1L-POE; one Athena Edge processor and one QS link.

b. 2-link hub; Lutron Model QP5-2L-POE; one Athena Edge processor and two QS links.

c. 4-link hub; Lutron Model QP5-4L-POE; two Athena Edge processors and four QS links.

2. Lutron Athena Small Area Hub (QP6).

a. 1-link hub; Lutron Model QP6-1L; one Athena Edge processor and one QS link.

3. Accessories:

a. LTE modem; Lutron Model LUT-LTE-1; required where internet connection will not be available at time of system startup; supports connection of up to 16 Athena Edge processors via system Ethernet link.

b. Wire Landing Boards; Lutron Model QS-WLB: Provide as indicated or as required for terminating wiring.

B. Supports internet connection for automated firmware updates and remote access, diagnostics, and service.

C. Provided in pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.

D. Connects to controls via RS485.

E. Integrates control station devices, shades, and external inputs into single customizable lighting control system with:

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1. Multiple Failsafe Mechanisms:

    a. Power failure detection via emergency lighting interface.

    b. Protection: Lights go to full on if ballast wires are shorted.

    c. Distributed architecture provides fault containment. Single hub failure or loss of power does not compromise lights and shades connected to other lighting management hubs.

2. Manual overrides.

3. Automatic control.

F. Furnished with astronomical time clock.

G. Maintains backup of programming in non-volatile memory capable of lasting more than ten years without power.

2.10 LIGHTING MANAGEMENT SYSTEM SOFTWARE

A. Provide system software and hardware that is designed, tested, manufactured, and warranted by single manufacturer.

B. Configuration Setup Software:

1. Product: Lutron Athena Designer.

2. Suitable to make system programming and configuration changes.

3. Windows-based, capable of running on either central server or remote client over TCP/IP connection.

4. Back-Up Project Database: Allows user to back up project database that holds configuration information for system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and time clock.

5. Publish Project Database: Allows user to send new project database to processors and devices. Project database holds configuration information for system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and time clock.

6. Allows end-user (with training to:

    a. Capture system design:

        1) Geographical layout.

        2) Load schedule zoning.

        3) Shade grouping.

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4) Equipment schedule.

5) Equipment assignment to lighting management hubs.

6) Daylighting design.

b. Define configuration for the following in each area:

1) Lighting scenes.

2) Shade group presets.

3) Control station devices.

4) Interface and integration equipment.

5) Occupancy/after hours.

6) Partitioning.

7) Daylighting.

8) Emergency lighting.

9) Night lights.

c. Startup:

1) Addressing.

2) Daylighting.

3) Provide customized conditional programming.

C. API Integration:

1. Support communication, without requiring interface, between lighting control system and third-party systems via RESTful API.

2. API Integration Capabilities:

a. Discovery:

1) Areas: Area and scene names.

2) Zones: Zone names, minimum and maximum light levels.

3) Shade Groups: Shade group and preset names

b. Monitoring:

1) Area Information:

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(a) Occupancy status.

(b) Occupancy enabled.

(c) Lighting zone status.

(d) Active scene.

(e) Instantaneous and maximum lighting power.

2) Zone Information:

(a) Light intensity.

(b) Switch level.

(c) Contact closure output status.

(d) Correlated color temperature, where controllable.

c. Control:

1) Lighting Control:

(a) Activate scene.

(b) Set lighting zone level and correlated color temperature, where controllable.

2) Shade Group Control:

(a) Set shade group level.

(b) Activate shade group preset.

D. Mobile Application:

1. Product: Lutron App.

2. Supports on-site and remote programming and control of multiple systems from iOS mobile device.

3. Supports 10,000 user accounts and 20 concurrent users.

4. Control:

a. Lighting Control:

1) Modify lighting zone levels and activate scenes, reflected in space in real time.

2) Make and save adjustments to scenes.

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3) Ketra Intelligent Light Sources:

(a) Control intensity, correlated color temperature, saturated color, and vibrancy, reflected in space in real time.

(b) Save adjustments to intensity, correlated color temperature, saturated color, and vibrancy to scenes.

b. Shade Group Control:

1) Modify shade group levels and activate shade group presets, reflected in space in real time.

2) Make and save adjustments to shade presets.

c. Make and save adjustments to timeclock events.

2.11 CONTROL STATIONS

A. Provide control stations with configuration as indicated or as required to control loads as indicated.

B. Touchscreen Control Stations:

1. Product: Lutron Athena Touchscreen; Model Q-TOUCH5.

2. Touchscreen Interface: 5-inch (127 mm) capacitive touch display; 800 x 400 resolution; touch gesture navigation support; dark and light user interface mode options.

3. Connects to lighting management hubs via system Ethernet link; powered by Athena QP5 hub or Q-POE-PNL Ethernet range extender; up to 5 touchscreens per processor; maximum of 328 ft (100 m) between touchscreen and lighting management hub with PoE switch or Ethernet range extender.

4. Control:

a. Lighting Control: Area, scene, and zone-level control, including intensity, color temperature, and full color with fine-tune adjustment.

b. Shade Control: Area-level control.

c. Supports access control via admin and user PINs.

5. Programming: On-screen setup through user-guided interface; requires no additional software.

6. Global Language Support: English, Spanish, French, German, Italian, Portuguese, Simplified Chinese.

7. Finish: To be selected by Architect.

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C. Wired Control Stations:

1. General Requirements:

a. Power: Class 2 (low voltage).

b. UL listed.

c. Provide faceplates with concealed mounting hardware.

d. Borders, logos, and graduations to use laser engraving or silk-screened graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.

e. Finish: White, unless otherwise indicated.

2. Multi-Scene Wired Control:

a. General Requirements:

1) Allows control of any devices part of lighting control system.

2) Allows for easy reprogramming without replacing unit.

3) Communications: Utilize RS485 wiring for low-voltage communication.

4) Engrave keypads with button, zone, and scene descriptions to be selected by Architect or City.

5) Software Configuration:

(a) Customizable control station device button functionality:

(1) Buttons can be programmed to perform single defined action.

(2) Buttons can be programmed to perform defined action on press and defined action on release.

(3) Buttons can be programmed using conditional logic off of state variable such as time of day or partition status.

(4) Buttons can be programmed to perform automatic sequence of defined actions.

(5) Capable of deactivating select keypads to prevent accidental changes to light levels.

(6) Buttons can be programmed for raise/lower of defined loads.

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(7) Buttons can be programmed to toggle defined set of loads on/off.

6) Status LEDs:

(a) Upon button press, LEDs to immediately illuminate.

(b) LEDs to reflect true system status. LEDs to remain illuminated if button press was properly processed or LEDs to turn off if button press was not processed.

(c) Support logic that defines when LED is illuminated:

(1) Scene logic (logic is true when all zones are at defined levels).

(2) Room logic (logic is true when at least one zone is on).

(3) Pathway logic (logic is true when at least one zone is on).

(4) Last scene (logic is true when spaces are in defined scenes).

b. Wired Keypads; Lutron seeTouch QS Keypads:

1) Style: Architectural Insert Style.

2) Communications: Utilize RS485 wiring for low-voltage communications link.

3) Mounting: Wallbox or low-voltage mounting bracket; provide wall plates with concealed mounting hardware.

4) Button/Engraving Backlighting:

(a) Utilize backlighting for buttons and associated engraving to provide readability under all light conditions.

(b) Backlight intensity adjustable via programming software.

5) Design keypads to allow field-customization of button color, configuration, and engraving using field-changeable replacement kits.

6) Contact Closure Interface: Provide two contact closure inputs on back of unit which provide independent functions from front buttons; accepts both momentary and maintained contact closures.

7) Terminal block inputs to be over-voltage and miswire-protected against wire reversals and shorts.

c. Wired Keypads; Lutron Architrave QS Keypads:

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1) Mounting: Wallbox; Lutron Architrave Wallbox; provide wall plates with concealed mounting hardware.

2) Design keypads to allow field-customization of button color, configuration, and engraving using field-changeable replacement kits.

3) Contact Closure Interface: Provide two contact closure inputs on back of unit which provide independent functions from front buttons; accepts both momentary and maintained contact closures.

4) Terminal block inputs to be over-voltage and miswire-protected against wire reversals and shorts.

d. Wired Keypads; Lutron Signature Series QS Keypads:

1) Mounting: Wallbox; Lutron Signature Series Wallbox; provide wall plates with concealed mounting hardware.

2) Button/Engraving Backlighting:

(a) Utilize backlighting for buttons and associated engraving to provide readability under all light conditions.

(b) Backlight intensity adjustable via programming software.

3) Design keypads to allow field-customization of button color, configuration, and engraving using field-changeable replacement kits.

4) Contact Closure Interface: Provide two contact closure inputs on back of unit which provide independent functions from front buttons; accepts both momentary and maintained contact closures.

5) Terminal block inputs to be over-voltage and miswire-protected against wire reversals and shorts.

e. Wired Keypads; Lutron QS Wired Palladiom Wallstations:

1) Style: Architectural Style.

2) Mounting: Wallbox; provide wall plates with concealed mounting hardware.

3) Buttons and Faceplate:

(a) Buttons to be greater than 0.65 inch (16.5 mm) in height to provide large target area for ease of use and actuation.

(b) Front of buttons to be flush with faceplate.

(c) Buttons and faceplate to be of same material, e.g. plastic/plastic, glass/glass, metal/metal.

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(d) Buttons to depress and provide tactile feedback of successful button push. Controls utilizing capacitive or resistive touch technology are not acceptable.

(e) Gaps to be less than 0.007 inch (0.18 mm) between buttons and less than 0.15 inch (3.8 mm) between buttons and faceplate.

4) Button/Engraving Backlighting:

(a) Backlighting to be visible through engraved text to provide clear readability in variety of lighting conditions.

(b) Indicate active scene through intensity of backlighting (brighter backlit text indicates active state).

(c) Backlight intensity adjustable via programming software; capable of dynamic adjustment during usage based on conditional logic (time of day, button press, etc.).

(d) Backlight intensity automatically adjusts based on room ambient light level.

5) Design keypads to allow field-customization of button color and engraving using field-changeable replacement kits.

6) Terminal block inputs to be over-voltage and miswire-protected against wire reversals and shorts.

3. Single-Scene or Zoned Wired Control:

a. Product: Lutron Pico Wired Control.

b. Turn individual fixture or group of fixtures on and off.

c. Raise and lower light levels.

d. Recall favorite light levels.

4. Wired Keyswitch:

a. Product: Lutron QS Keyswitch.

b. Configuration:

1) Three position, momentary, center position key removal; Lutron Model QSWS2-KSI-3MOC.

2) Three position, maintained, center position key removal; Lutron Model QSWS2-KSI-3MAC.

3) Two position, maintained, center position key removal; Lutron Model QSWS2-KSI-2MAC.

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4) Two position, maintained, any position key removal; Lutron Model QSWS2-KSI-2MAA.

c. Allows control of any devices part of lighting control system.

d. Communications: Utilize RS485 wiring for low-voltage communications link.

e. Functionality:

1) Allows for easy reprogramming without replacing unit.

2) Requires key insertion to activate actions.

f. Engrave keypads with button, zone, and scene descriptions to be selected by Architect or City.

g. Software Configuration:

1) Customizable control station device button functionality:

(a) Key positions can be programmed to perform single defined action.

(b) Key positions can be programmed using conditional logic off of state variable such as time of day or partition status.

5. Single Touch Slider Control:

a. Product: Lutron GrafikT QS Slider.

b. Allows control of any single lighting zone in system.

c. Communications: Utilize RS485 wiring for low-voltage communications link.

d. Switch Control: Single-touch LED bar for on/off operation.

e. Dimmer Control: Single touch LED bar with one portion of bar for on/off operation and one portion for dimmer adjustment.

1) Single touch of light level adjustment control portion of LED bar raises/lowers lights, with new level becoming current preset level.

2) When off, single touch of on/off control portion of LED bar raises lights to preset level.

3) When on, single touch of on/off control portion of LED bar initiates long fade to off.

4) Provides audible feedback for touch control confirmation.

5) LED bar indicates on/off status and current light level, and functions as locator light when dimmer is off.

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6) Provides for customized adjustment of dimmer functions via programming software:

(a) High/low end trims.

(b) LED brightness.

(c) Sound on/off.

(d) Off fade time.

(e) On fade time.

(f) Preset lock capability.

6. Analog Slider Control:

a. Product: Lutron QS Slider Control.

b. Allows control of any lighting zone in system via intuitive analog slider control.

c. Communications: Utilize RS485 wiring for low-voltage communications link.

d. Available in 1 to 16 zone configurations.

e. Available with or without take command switch to activate slider scene.

f. Optional keypad ganging.

g. Slider zones can be chained in partitioned spaces.

h. Engrave keypads with button, zone, and scene descriptions to be selected by Architect or City.

i. Functionality:

1) Full range dimming of individual zones or groups of zones.

2) Zone levels indicated by slider position.

3) Integrates with multi-scene wired control.

2.12 LOW-VOLTAGE CONTROL INTERFACES

A. Provide low-voltage control interfaces as indicated or as required to control loads as indicated.

B. UL listed.

C. Contact Closure Interface:

1. Product: Lutron Model QSE-IO.

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2. Connects to lighting management hub via RS485.

3. The contact closure input device to accept both momentary and maintained contact closures.

4. The contact closure output device can be configured for maintained or pulsed outputs.

5. Contact closure can be programmed using conditional logic off of state variable such as time of day or partition status.

D. Wallbox Input Closure Interface:

1. Product: Lutron Model QSE-CI-WCI.

2. Connects to lighting management hub via RS485.

3. Mounts in wallbox behind contact closure keypad to provide interface for up to eight contact closure inputs.

4. The contact closure input device to accept both momentary and maintained contact closures.

E. RS232 and Ethernet Interface:

1. Product: Lutron Model QSE-CI-NWK-E.

2. Connects to lighting management hub via RS485.

3. Provide ability to communicate via Ethernet or RS232 to audiovisual equipment, touchscreens, etc.

4. Provide control of:

a. Light scene selections.

b. Fine-tuning of light scene levels with raise/lower.

c. Shade group presets.

d. Fine-tuning of shade preset levels with raise/lower.

e. Simulate system wall station button presses and releases.

5. Provide status monitoring of:

a. Light scene status.

b. Shade group status.

c. Wall station button presses and releases.

d. Wall station LEDs.

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6. Provide ability to send custom output strings.

F. DMX Interface:

1. Product: Lutron Model QSE-CI-DMX.

2. Connects to lighting management hub via RS485.

3. Provide ability to:

a. Map single zone intensity to single DMX512 lighting channel.

b. Map single zone intensity to three DMX512 channels for RGB/CMY color control.

c. Map a single zone intensity to a single DMX512 integration channel.

d. Smoothly transition from one color to another in crossfade.

e. Automatically sequence through variety of colors.

G. Sensor Modules:

1. Products:

a. Sensor module with wired inputs only; Lutron Model QSMX-4W-C.

2. Connects to lighting management hub via RS485.

3. Wired Modules:

a. Provide wired inputs for:

1) Occupancy sensors.

2) Daylight sensors.

3) Wired wall stations.

4. Communicate sensor information to wired low-voltage digital link for use by compatible devices.

H. Automatic Demand Response Interface:

1. Product: Lutron Automated Demand Response Kit; Model LUT-Q-OPNADR-CPN8064.

2. Connects to lighting management hub via RS485; requires internet connection to connect to utility demand response server.

3. Supports automatic demand response for load shedding via OpenADR® 2.0b compliant utility command.

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2.13 WIRED SENSORS

A. Wired Occupancy Sensors:

1. General Requirements:

a. Connects directly to compatible ballasts and modules without need of power pack or other interface.

b. Turns off or reduces lighting automatically after reasonable time delay when room or area is vacated by last person to occupy space.

c. Accommodates conditions of space utilization and irregular work hours and habits.

d. Comply with UL 94.

e. Self-Adaptive Sensors: Continually adjusts sensitivity and timing to ensure optimal lighting control for any use of the space; furnished with field-adjustable controls for time delay and sensitivity to override adaptive features.

f. Provide capability to:

1) Add additional timeout system-wide without need to make local adjustment on sensor.

2) Group multiple sensors.

g. Power Failure Memory: Settings and learned parameters to be saved in nonvolatile memory and not lost should power be interrupted and subsequently restored.

h. Furnished with necessary mounting hardware and instructions.

i. Class 2 devices.

j. Ceiling-Mounted Sensors: Indicate viewing directions on mounting bracket.

k. Wall-Mounted Sensors: Provide swivel-mount base.

l. Color: White.

2. Wired Passive Infrared Sensors:

a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.

b. Ceiling-Mounted Sensors: Provide customizable mask to block off unwanted viewing areas.

c. Products:

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1) Ceiling-Mounted Passive Infrared Sensor, 450 square feet (42 sq m); Lutron Model ULOS-CIR-450-WH (BAA-Buy American Act Compliant): Coverage of 450 square feet (42 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view; self-adaptive.

2) Ceiling-Mounted Passive Infrared Sensor, 1500 square feet (140 sq m); Lutron Model ULOS-CIR-1500-WH (BAA-Buy American Act Compliant): Coverage of 1500 square feet (140 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view; self-adaptive.

3) Wall-Mounted Passive Infrared Sensor; Lutron Model ULOS-WIR-WH (BAA-Buy American Act Compliant): Coverage of 1600 square feet (149 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 110 degree field of view; self-adaptive.

4) High Bay Passive Infrared Sensor, Surface-Mounted, 180 Degree; Lutron Model LUT-WSPSM24V-180-CPN6111: Coverage radius of 42 feet (13 m) at mounting height of 30 feet (9 m) and 50 feet (15 m) at mounting height of 45 feet (14 m); 180 degree field of view; field-adjustable timeout.

5) High Bay Passive Infrared Sensor, Surface-Mounted, 360 Degree; Lutron Model LUT-WSPSM24V-360-CPN6111: Coverage radius of 42 feet (13 m) at mounting height of 30 feet (9 m) and 50 feet (15 m) at mounting height of 45 feet (14 m); 360 degree field of view; field-adjustable timeout.

6) High Bay Passive Infrared Sensor, End-Mounted, 180 Degree; Lutron Model LUT-WSPSM24V-180-CPN6112: Coverage radius of 42 feet (13 m) at mounting height of 30 feet (9 m) and 50 feet (15 m) at mounting height of 45 feet (14 m); 180 degree field of view; field-adjustable timeout.

7) High Bay Passive Infrared Sensor, End-Mounted, 360 Degree; Lutron Model LUT-WSPSM24V-360-CPN6112: Coverage radius of 42 feet (13 m) at mounting height of 30 feet (9 m) and 50 feet (15 m) at mounting height of 45 feet (14 m); 360 degree field of view; field-adjustable timeout.

3. Wired Ultrasonic Sensors:

a. Utilize an operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.

b. Products:

1) Ceiling-Mounted Ultrasonic Sensor, 500 square feet (46 sq m); Lutron Model ULOS-CUS-500-WH (BAA-Buy American Act Compliant): Coverage of 500 square feet (46 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 180 degree field of view; self-adaptive.

2) Ceiling-Mounted Ultrasonic Sensor, 1000 square feet (93 sq m); Lutron Model ULOS-CUS-1000-WH (BAA-Buy American Act Compliant):

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Coverage of 1,000 square feet (93 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 180 degree field of view; self-adaptive.

3) Ceiling-Mounted Ultrasonic Sensor, 2000 square feet (186 sq m); Lutron Model ULOS-CUS-2000-WH (BAA-Buy American Act Compliant): Coverage of 2000 square feet (186 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view; self-adaptive.

4. Wired Dual Technology Sensors:

a. Passive Infrared: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.

b. Ultrasonic: Utilize operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.

c. Ceiling-Mounted Sensors: Provide customizable mask to block off unwanted viewing areas.

d. Isolated Relay: Provide internal additional isolated relay with Normally Open, Normally Closed, and Common outputs for use with HVAC control, Data Logging and other control options.

e. Integral Photocell: Provide integral photocell with adjustable sensitivity to prevent lights from turning on when there is sufficient natural light.

f. Products, Without Isolated Relay and Integral Photocell:

1) Ceiling-Mounted Dual Technology Sensor, 500 square feet (46 sq m); utron Model ULOS-CDT-500-WH (BAA-Buy American Act Compliant): Coverage of 500 square feet (46 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 180 degree field of view; self-adaptive.

2) Ceiling-Mounted Dual Technology Sensor, 1000 square feet (93 sq m); Lutron Model ULOS-CDT-1000-WH (BAAA-Buy American Act Compliant): Coverage of 1000 square feet (93 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 180 degree field of view; self-adaptive.

3) Ceiling-Mounted Dual Technology Sensor, 2000 square feet (186 sq m); Lutron Model ULOS-CDT-2000-WH (BAA-Buy American Act Compliant): Coverage of 2000 square feet (186 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view; self-adaptive.

4) Wall-Mounted Dual Technology Sensor; Lutron Model ULOS-WDT-WH (BAA-Buy American Act Compliant: Coverage of 1600 square feet (149 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 110 degree field of view; self-adaptive.

g. Products, With Isolated Relay and Integral Photocell:

1) Ceiling-Mounted Dual Technology Sensor, 500 square feet (46 sq m); Lutron Model ULOS-CDT-500R-WH (BAA-Buy American Act Compliant):

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Coverage of 500 square feet (46 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 180 degree field of view; with isolated relay and integral photocell; self-adaptive.

2) Ceiling-Mounted Dual Technology Sensor, 1000 square feet (93 sq m); Lutron Model ULOS-CDT-1000R-WH (BAAA-Buy American Act Compliant): Coverage of 1000 square feet (93 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 180 degree field of view; with isolated relay and integral photocell; self-adaptive.

3) Ceiling-Mounted Dual Technology Sensor, 2000 square feet (186 sq m); Lutron Model ULOS-CDT-2000R-WH (BAA-Buy American Act Compliant): Coverage of 2000 square feet (186 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view; with isolated relay and integral photocell; self-adaptive.

4) Wall-Mounted Dual Technology Sensor; Lutron Model ULOS-WDT-R-WH (BAA-Buy American Act Compliant: Coverage of 1600 square feet (149 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 110 degree field of view; with isolated relay and integral photocell; self-adaptive.

B. Power Packs for Wired Sensors:

1. Products:

a. 120-277 VAC power input/24 VDC, 150 mA power output; 16 A lighting (120-177 V), 1 HP motor (120-277 V) relay contact rating; Lutron Model UPP-DV Power Pack (BAA-Buy American Act Compliant).

b. 120-277 VAC power input (manual-on)/24 VDC, 150 mA power output; 16 A lighting (120-177 V), 1 HP motor (120-277 V) relay contact rating Lutron Model UPP-DV-M Power Pack (BAA-Buy American Act Compliant).

c. Control relay only (no power input/output); requires another power pack for power and counts as one of three sensors connected to power pack; 16 A lighting (120-277 V), 1 HP motor (120-277 V), 15 A ballast (347 V) relay contact rating; Lutron Model UPP-SH Power Pack (BAA-Buy American Act Compliant).

2. Provide sensor power packs where required for power connection to sensors.

3. For ease of mounting, installation and future service, power pack(s) to be able to mount through 1/2 inch (16 mm) trade size knockout in standard electrical enclosure and be integrated, self-contained unit consisting internally of isolated load switching control relay and transformer to provide low-voltage power. Transformer to provide power to minimum of three sensors.

4. Plenum-rated.

5. Control Wiring Between Sensors and Control Units: Class 2, 18-24 AWG, stranded UL Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.

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C. Wired Daylight Sensors:

1. Digital Interior Daylight Sensor:

a. Product: Lutron Model EC-DIR-WH.

b. Use Class 2 wiring for low-voltage communication.

c. Can be replaced without reprogramming.

d. Open-loop basis for daylight sensor control scheme.

e. Stable output over temperature from 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C).

f. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.

g. Provide linear response from 0 to 500 footcandles.

h. Integral IR receiver for personal control.

i. Mountable on lighting fixtures or recessed acoustical ceiling tiles.

j. Constructed via sonic welding.

k. Color: White.

2. Daylight Control Package:

a. Product: Lutron CES Series (Lutron CES Analog Sensor, LC8 Controller, and Power Pack).

b. Controller:

1) Product: Lutron Model LC8.

2) Automatically switches dry contact according to changes in ambient light levels.

3) Fully adjustable separate high and low setpoints, with adjustable dead band between set points to prevent unwanted cycling.

4) Input time delay to prevent unwanted cycling due to intermittent light level fluctuations.

5) Signal/setpoint and relay status indication.

6) Sensor calibration input.

c. Sensors:

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1) Class 2, three-wire analog devices.

2) Provision for zero or offset based signal.

3) Indoor Photo Sensors; Lutron Model CES/I: With fresnel lens and 60 degree cone of response; sensor range of 0 to 750 footcandles.

4) Outdoor Photo Sensors; Lutron Model CES/O: Weatherproof, with hood over aperture to shield sensor from direct sunlight; sensor range of 0 to 750 footcandles.

5) Atrium Photo Sensors; Lutron Model CES/A: With translucent dome and 180 degree field of view; sensor range of 2 to 2,500 footcandles.

6) Skylight Photo Sensors; Lutron Model CES/S: With translucent dome and 180 degree field of view; sensor range of 10 to 7,500 footcandles.

D. Infrared Partition Sensors:

1. Product: Lutron Model GRX-IRPS-WH.

2. Provide contact closure based on status of partition wall (open/close) enabling automatic linking of controls.

2.14 ACCESSORIES

A. Emergency Lighting Interface:

1. Product: Lutron Model LUT-ELI.

2. Provides total system listing to UL 924 when used with lighting control system.

3. Senses all three phases of building power.

4. Provides output to power panels or digital ballast interfaces if power on any phase fails and sends all lights controlled by these devices to 100 percent intensity. Lights to return to their previous intensities when normal power is restored.

5. Accepts contact closure input from fire alarm control panel.

B. Emergency Shunt Device:

1. Product: LVS Model LUT-SHUNT-A-TD.

2. UL 924 listed for use with select Lutron and Ketra lamps, luminaires, and controls in emergency lighting systems.

3. Emergency power is passed through to downstream Clear Connect Type X Ketra intelligent light sources.

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4. Upon sensing loss of normal utility power, sends downstream Clear Connect Type X Ketra intelligent light sources to 100 percent intensity and emergency light CCT or saturated color level setting generating 2.5 second power interruption.

C. Provide power supplies as indicated or as required to power system devices and accessories.

1. Products:

a. Junction box-mounted power supply for shades, keypads, and accessories, and for providing additional low voltage power to communication link; Lutron Model QSPS-J-1-35V; with miswire and thermal protection.

b. Plug-in power supply for shades, drapery drive units, keypads, and accessories, and for providing additional low voltage power to communication link; Lutron Model QSPS-P1-1-35V; with miswire protection; powered from standard receptacle using cord 6 feet (1.8 m) in length; complies with DOE Level VI regulation.

c. Ten output power supply panel for shades, drapery drive units, keypads and accessories, and for providing additional low voltage power to communication link; Lutron Model QSPS-10PNL; no replaceable fuses required for overload/miswire protection; contains DOE Level VI Compliant power supplies.

d. Power supply for keypads and accessories (not for shades/window treatments), and for providing additional low voltage power to communication link; Lutron Model QSPS-DH-1-75.

e. Power supply for keypads and accessories (not for shades/window treatments), and for providing additional low voltage power to communication link; Lutron Model WQSPS-DH-1-75; TAA – Trade Agreement Act compliant.

D. Provide locking covers for controls.

1. Reversible to allow lock to be located on either side of control.

2. Products:

a. 1-gang device for compatible Lutron QS keypads; Lutron Model GRX-1GLC.

b. 4-gang device for Lutron Grafik Eye QS main units; Lutron Model QSG-4GLC.

2.15 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Factory Testing; Lutron Standard Factory Testing:

1. Perform full-function factory testing on completed assemblies. Statistical sampling is not acceptable.

2. Perform full-function factory testing on 100 percent of ballasts and LED drivers.

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3. Perform factory audit burn-in of dimming assemblies and panels at 104 degrees F (40 degrees C) at full load for two hours.

4. Perform factory burn-in of 100 percent of ballasts at 104 degrees F (40 degrees C).

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that ratings and configurations of system components are consistent with indicated requirements.

C. Verify that mounting surfaces are ready to receive system components.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Install products in accordance with manufacturer's instructions.

C. Define each dimmer/relay load type, assign each load to zone, and set control functions.

D. Sensor Locations:

1. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", locate sensors in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require deviation from locations indicated. Where Lighting Control Manufacturer Sensor Layout and Tuning service is not specified, locate sensors in accordance with drawings.

2. Sensor locations indicated are diagrammatic. Within design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage, in accordance with manufacturer's recommendations.

E. Mount exterior daylight sensors to point due north with constant view of daylight.

F. Ensure that daylight sensor placement minimizes sensor view of electric light sources. Locate ceiling-mounted and luminaire-mounted daylight sensors to avoid direct view of luminaires.

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G. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

H. Lamp Lead Lengths: Do not exceed 3 feet (0.9 m) for T4 4-pin compact and T5 BIAX lamps and 7 feet (2.1 m) for T5, T5-HO, T8 U-bend, and T8 linear fluorescent lamps.

I. LED Light Engine/Array Lead Length: Do not exceed 100 feet (31 m).

J. System and Network Integration Consultation; Lutron LSC-INT-VISIT: Include as part of base bid additional costs for Lighting Control Manufacturer to conduct meeting with facility representative and other related equipment manufacturers to discuss equipment and integration procedures.

1. Coordinate scheduling of visit with Lighting Control Manufacturer. Manufacturer recommends that this visit be scheduled early in construction phase, after system purchase but prior to system installation.

K. Identify system components.

3.3 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Manufacturer’s Startup services will not be required.

C. Manufacturer's Startup Services; Lutron Standard Startup Services:

1. Manufacturer's authorized Service Representative to conduct minimum of two site visits to ensure proper system installation and operation.

2. Conduct Pre-Installation visit to review requirements with installer as specified in Part 1 under "Administrative Requirements".

3. Post Wire Termination Visit; Lutron LSC-POSTWIRE-VST: Include as alternate to base bid additional costs to conduct site visit to verify system is properly wired and ready for startup.

4. Conduct second site visit upon completion of lighting control system to perform system startup and verify proper operation:

a. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under “DIGITAL-NETWORK LIGHTING CONTROL SYSTEM – GENERAL REQUIREMENTS”, authorized Service Representative to verify sensor locations, in accordance with layout provided by Lighting Control Manufacturer; Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require deviation from locations indicated.

b. Verify connection of power wiring and load circuits.

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c. Verify connection and location of controls.

d. Energize lighting management hubs and download system data program.

e. Address devices.

f. Verify proper connection of panel links (low-voltage/data) and address panel.

g. Verify system operation control by control.

h. Verify proper operation of manufacturer's interfacing equipment.

i. Configure initial groupings of ballasts/drivers for wall controls, daylight sensors and occupancy sensors.

j. Provide initial rough calibration of sensors; fine-tuning of sensors is responsibility of Contractor unless provided by Lighting Control Manufacturer as part of Sensor Layout and Tuning service where specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS".

k. Train City's representative on system capabilities, operation, and maintenance, as specified in Part 3 under "Closeout Activities".

l. Obtain sign-off on system functions.

m. After Hours Startup; Lutron LSC-AH-SU: Include as alternate to base bid additional costs to perform manufacturer's startup procedures outside normal working hours (Monday through Friday, 7am to 5pm).

D. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.4 ADJUSTING

A. On-Site Scene and Level Tuning; Lutron LSC-AF-VISIT: Include as alternate to base bid additional costs for Lighting Control Manufacturer to visit site to conduct meeting with Lighting Designer and City’s Representative to make required lighting adjustments to the system for conformance with original design intent.

B. Remote Programming Assistance; Lutron LSC-PRG-AST-RMTE: Include as alternate to base bid additional costs for Lighting Control Manufacturer to provide 4-hour session(s) of remote programming assistance to make required lighting adjustments to system for conformance with original design intent.

C. Dynamic White Programming Package; Lutron LSC-DWP-PKGE: Include as part of base bid additional costs for Lighting Control Manufacturer to provide minimum of three site visits and one remote session to support fine tuning of tunable LED and/or DALI lighting.

1. Conduct post-wire-termination site visit to verify system is properly wired.

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2. Conduct site visit during normal business hours to perform fine tuning of lighting and programming adjustments in day setting.

3. Conduct site visit after hours to perform fine tuning of lighting and programming adjustments in night setting.

4. Provide one 2-hour remote session for additional adjustments.

D. Sensor Fine-Tuning: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under “DIGITAL-NETWORK LIGHTING CONTROL SYSTEM – GENERAL REQUIREMENTS”, Lighting Control Manufacturer to provide up to two additional post-startup on-site service visits for fine-tuning of sensor calibration. Where Lighting Control Manufacturer Sensor Layout and Tuning service is not specified, Contractor to provide fine-tuning of sensor calibration.

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3.5 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.6 COMMISSIONING

A. See Section 01 9113 for commissioning requirements.

B. Title 24 Acceptance Testing Service; Lutron LSC-SPV-DOC-T24: Include as alternate to base bid additional costs for Lighting Control Manufacturer to perform lighting control acceptance testing in accordance with CAL TITLE 24 P6. Submit required documentation.

3.7 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals for closeout submittals.

B. See Section 01 7900 - Demonstration and Training for additional requirements.

C. Demonstration:

1. On-Site Performance-Verification Walkthrough; Lutron LSC-WALK: Include as alternate to base bid additional costs for Lighting Control Manufacturer to provide on-site demonstration of system functionality to commissioning agent and facility representative.

D. Training:

1. Include services of manufacturer's authorized Service Representative to perform on-site training of City's personnel on operation, adjustment, and maintenance of lighting control system as part of standard system start-up services.

    a. Include training on software to be provided:

        1) Configuration software used to make system programming and configuration changes.

        2) Control and monitor.

2. Customer-Site Solution Training Visit; Lutron LSC-TRAINING: Include as alternate to base bid additional costs for Lighting Control Manufacturer to provide one day of additional on-site system training.

3. Remote Training; Lutron LSC-TRAIN-RMTE: Include as part of base bid additional costs for Lighting Control Manufacturer to provide one 4-hour session(s) of additional remote system training.

3.8 PROTECTION

A. Protect installed products from subsequent construction operations.

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B. Customer System Orientation Visit; Lutron LSC-CSO-VST: Include as alternate to base bid additional costs for Lighting Control System Manufacturer to conduct one site visit 30 after occupancy to train City's personnel and provide system optimization recommendations.

3.9 MAINTENANCE

A. See Section 01 7000 - Execution Requirements for additional requirements relating to maintenance service.

B. System Optimization Visit; Lutron LSC-SYSOPT: Include as an alternate to the base bid additional costs for Lighting Control Manufacturer to visit site six months after system start-up to evaluate system usage and discuss opportunities to make efficiency improvements that will fit with current use of facility.

END OF SECTION

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SECTION 262314

SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes both field-mounted SPDs and integrated SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.2 DEFINITIONS

A. $I_{(n)}$: Nominal discharge current rating.

B. MCOV: Maximum continuous operating voltage.

C. Protection Modes: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.3 SUBMITTALS

A. Product Data:

1. For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Provide verification the SPD is listed or recognized through Underwriters Laboratories to the latest Safety Standard, ANSI/UL 1449 3rd Edition.
3. Operations and Maintenance Data: SPDs to include operation, and maintenance manuals.
4. Warranties: Sample of special warranties.

1.4 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or repair SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Ten years.

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PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by Underwriters Laboratories, and marked for intended location and application.

B. Comply with Underwriters Laboratories ANSI/UL 1449 3rd Edition – Surge Protective Devices.

C. Comply with Underwriters Laboratories ANSI/UL 1283 5th Edition – Electromagnetic Interference Filters. (Applies to Type 2 SPDs)

D. Designed in accordance with ANSI/IEEE C62.41.1-2002, C62.41.2-2002 and C62.45-2002

E. SPDs manufacturer shall be ISO-9001 certified.

F. Modular design with field-replaceable modules.

G. MCOV of the SPD shall not be less than 115% for 480Y/277V and 125% for 208Y/120V nominal RMS system voltages.

H. SPDs installed internal to the distribution equipment shall be of the same manufacturer as the equipment. The equipment shall be fully tested and certified to the following UL standards:

UL 67 = Panelboards
UL 845 = Motor Control Centers
UL 857 = Busway
UL 891 = Switchboards
UL 1558 = Low Voltage Switchgear

2.2 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide SquareD Surgelogic branded Surge Protection, or comparable product by one of the following:

1. Square D by Schneider Electric
2. APC by Schneider Electric
3. Eaton
4. General Electric

2.3 SERVICE ENTRANCE SUPPRESSOR

A. SPDs: Comply with UL 1449 3rd Edition.

1. SPD Type – All SPDs installed on the line side of the service entrance OCPD shall be Type 1 SPDs. SPDs installed on the load side of the service entrance OCPD shall be either Type 1 or Type 2 SPDs.
2. Type 2 SPDs shall also comply with ANSI/UL 1283.

B. SPDs with the following features and accessories:

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1. Optional Integral disconnect switch.
2. Internal fusing design capable of disconnecting the SPD before any damaging external effects to the suppressor or surroundings occur.
3. Indicator light(s) display for power and protection status.
4. Audible Alarm with silencing switch.
5. Form-C contacts- One normally open and one normally closed for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
6. Surge counter with reset switch.

C. Surge Current Rating: The surge current rating of the SPD shall be dependent of its Category/Location,

Category/Location	Application	Per Phase	Per Mode
C	Service Entrance	240 kA	120 kA
B	Distribution	160 kA	80 kA

Protection modes: UL 1449 VPR for grounded WYE configured circuits shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	800 V	1200 V	1500 V
L-L	1200 V	2000 V	2500 V

Protection modes: UL 1449 VPR for Delta configured circuits shall not exceed the following:

D. SCCR: Per NEC 285.6, the short circuit current rating of the SPD shall be equal to or greater than the available short circuit current at the point on the system where installed.

E. Nominal Discharge Current Rating: 20 kA $I_{(n)}$

Modes	240D	480D	600D
L-G; N-G	1200 V	2000 V	2500 V

Note: Surge Protective Devices must carry a minimum Nominal Discharge Current Rating of 20kA to meet the requirements for UL96A – Installation Requirements for Lightning Protection Systems.

2.4 PANELBOARD SUPPRESSORS

A. SPDs: Comply with UL 1449 3rd Edition.

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1. Type 1 or Type 2 SPD
2. Type 2 SPDs shall also comply with UL 1283.

B. SPDs with the following features and accessories:

1. Indicator light(s) for power and protection status.
2. Internal fusing design capable of disconnecting the SPD before any damaging external effects to the suppressor or surroundings occur.
3. Audible Alarm with silencing switch.
4. Form-C contacts - One normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
5. Surge counter with reset switch.

C. Surge Current Rating: The surge current rating of the SPD shall be dependent of its Category/Location.

Protection modes: UL 1449 VPR for grounded WYE configured circuits shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	800 V	1200 V	1500 V
L-L	1200 V	2000 V	2500 V
Category/Location	Application	Per Phase	Per Mode
B	Distribution	160 kA	80 kA
B	Branch	120 kA	60 kA

Protection modes: UL 1449 VPR for Delta configured circuits shall not exceed the following:

D. SCCR: Per NEC 285.6, the short circuit current rating of the SPD shall be equal to or greater than the available short circuit current at the point on the system where installed.

E. Nominal Discharge Current Rating: Minimum of 10 kA $I_{(n)}$

Modes	240D	480D	600D
L-G; N-G	1200 V	2000 V	2500 V

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2.5 ENCLOSURES

A. Enclosure shall meet or exceed the ratings for the environment to be installed as indicated on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install SPD devices at the service entrance in accordance to NFPA 70. All SPDs installed on the line side of the service entrance OCPD shall be Type 1 SPDs. All SPDs installed on the load side of the OCPD shall be either Type 1 or Type 2 SPDs.

B. Follow manufacturers recommended installation practices.

1. Provide a dedicated disconnecting means for the SPD unless otherwise indicated.
2. Install SPDs with properly rated conductors between suppressor and points of attachment as short and straight as possible; adjust circuit-breaker positions to achieve shortest and straightest leads.
3. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
4. Twist input conductors together to reduce the input inductance.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass inspections.

C. Prepare inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect all wires, including neutral of the SPD before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION

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SECTION 262416

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.
4. Electronic-grade panelboards.

1.2 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.

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7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.6 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   a. Altitude: Not exceeding 6600 feet (2000 m).

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

    a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    b. Outdoor Locations: NEMA 250,.
    c. Kitchen Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
    d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Height: 84 inches (2.13 m) maximum.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor. Coordinate with food service drawings for panelboards incorporated into food service equipment.
5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections. Coordinate with food service drawings for panelboards incorporated into food service equipment.
6. Panelboards 51C5, 51C6,51C7 and 51C8: coordinate mounting requirements (surface or recessed) with foodservice plans. Provide stainless steel skirts.
7. Finishes:

    a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Galvanized steel, Same finish as panels and trim.
    c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

G. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

    a. Plating shall run entire length of bus.
    b. Bus shall be fully rated the entire length.

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2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
5. Split Bus: Vertical buses divided into individual vertical sections.

I. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent. Provide breakers for all future spaces – 20 Amp 1Pole unless otherwise indicated on schedules.

K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

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B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD. Refer to 262314 surge protective device specification

2.3 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. General Electric Company; GE Energy Management - Electrical Distribution.
2. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, distribution type.

C. Mains: Circuit breaker.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

F. Contactors in Main Bus: NEMA ICS 2, Class A, electrically or mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
1. External Control-Power Source: 24-V control circuit.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: Circuit breaker.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
1. External Control-Power Source: 120-V branch circuit 24-V control circuit.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

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1. Thermal-Magnetic Circuit Breakers:

    a. Inverse time-current element for low-level overloads.
    b. Instantaneous magnetic trip element for short circuits.
    c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:

    a. RMS sensing.
    b. Field-replaceable rating plug or electronic trip.
    c. Digital display of settings, trip targets, and indicated metering displays.
    d. Multi-button keypad to access programmable functions and monitored data.
    e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    f. Integral test jack for connection to portable test set or laptop computer.
    g. Field-Adjustable Settings:

        1) Instantaneous trip.
        2) Long- and short-time pickup levels.
        3) Long and short time adjustments.
        4) Ground-fault pickup level, time delay, and I squared T response.

4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
6. Subfeed Circuit Breakers: Vertically mounted.
7. MCCB Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.
    c. UL listed for reverse connection without restrictive line or load ratings.
    d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    g. Communication Capability: [Circuit-breaker-mounted] [Universal-mounted] [Integral] [Din-rail-mounted] communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
    h. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
    i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
    j. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

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1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
2. Fused Switch Features and Accessories:

    a. Standard ampere ratings and number of poles.
    b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.

2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

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C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:

1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." Or Section 033053 "Miscellaneous Cast-in-Place Concrete."
2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
3. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

G. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

H. Mount panelboard cabinet plumb and rigid without distortion of box.

I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

J. Mount surface-mounted panelboards to steel slotted supports 1 1/4 inch (32 mm) in depth. Orient steel slotted supports vertically.

K. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

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L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

M. Install filler plates in unused spaces.

N. Stub four 1-inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (25 mm) empty conduits into raised floor space or below slab not on grade.

O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

P. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

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1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:

        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

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3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

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SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Straight-blade convenience, hospital-grade, isolated-ground, and tamper-resistant receptacles.
2. GFCI receptacles.
3. Twist-locking receptacles.
4. Pendant cord-connector devices.
5. Cord and plug sets.
6. Toggle switches.
7. Decorator-style convenience.
8. Wall plates.
9. Floor service outlets.
10. Prefabricated multioutlet assemblies.

1.2 DEFINITIONS

A. Abbreviations of Manufacturers' Names:

1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.
2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
3. Leviton: Leviton Mfg. Company, Inc.
4. Pass & Seymour: Pass& Seymour/Legrand.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

H. UTP: Unshielded twisted pair.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

D. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

1. Hubbel
2. Pass & Seymour
3. Leviton
4. Or Approved Equal

2.2 STRAIGHT-BLADE RECEPTACLES

A. Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

2.3 GFCI RECEPTACLES

A. General Description:

1. 125 V, 20 A, straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

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2.4 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

2.5 PENDANT CORD-CONNECTOR DEVICES

A. Description:

1. Matching, locking-type plug and receptacle body connector.
2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Single Pole or Two Pole or Three Way or Four Way:
2. Manufacturers:
   a. Hubbel
   b. Pass & Seymour
   c. Leviton
   d. Or Approved Equal

C. Pilot-Light Switches: 120/277 V, 20 A.

1. Description: Single pole, with LED-lighted handle, illuminated when switch is off.

D. Key-Operated Switches: 120/277 V, 20 A.

1. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

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F. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

2.8 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic 0.035-inch-thick, or satin-finished, Type 302 stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.9 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Data Communication Outlet: Blank cover with bushed cable opening. Or Two modular, keyed, color-coded, RJ-45 jacks for twisted pair cable complying with requirements in Section 27 15 13 "Communications Copper Horizontal Cabling."

2.10 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. SPD Devices: Blue.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

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B. Device Installation Schedule:

1. Install devices with stainless steel covers in the kitchen.
2. Install devices with weatherproof covers in the dishwashing room.
3. Utilze thermoplasctic covers in the office or dining area only.
4. Install GFCI outlets in compliance with code requirements

C. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

D. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

E. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

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G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Coordinate locations, mounting heights and other installation requirements with food service plans and cabinetry requirements.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 26 05 53 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

E. Wiring device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

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END OF SECTION

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SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

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1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
   a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.2 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

A. Type HD, Heavy Duty:

1. Single or Double throw.
2. Three pole.
3. 600-V ac.
4. 200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified or requierd fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Coodinate Contact rating - 24-V ac 120-V ac 208-V ac 240-V ac 6-V dc 12-V dc 24-V dc.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.

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2.4 NONFUSIBLE SWITCHES

A. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Coordinate Contact rating - 24-V ac 120-V ac 208-V ac 240-V ac 6-V dc 12-V dc 24-V dc.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be100 percent rated or series rated as indicated on the Drawings. Circuit breaker/circuit breaker combinations for series connected interrupting ratings shall be listed by

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UL as recognized component combinations. Any series rated combination used shall be marked on the end-use equipment along with the statement "Caution - Series Rated System. _____ Amps Available. Identical Replacement Component Required."

D. MCCBs shall be equipped with a device for locking in the isolated position.

E. Lugs shall be suitable for 194 deg F rated wire, sized according to the 167 deg F temperature rating in NFPA 70.

F. Standards: Comply with UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents.

G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I-squared t response.

J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

K. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

L. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

M. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

N. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

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5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Section 26 09 13 "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
9. Alarm Switch: One NO NC contact that operates only when circuit breaker has tripped.
10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Electrical Operator: Provide remote control for on, off, and reset operations.
12. Accessory Control Power Voltage: Integrally mounted, self-powered; 24-V ac 120-V ac 208-V ac 240-V ac 12-V dc 24-V dc 120-V dc.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be [finished with] [gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1)] [gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12)] [a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel)] [copper-free cast aluminum alloy (NEMA 250 Types 7, 9)].

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be [externally operable with the operating mechanism being an integral part of the box, not the cover] [directly operable through the front cover of the enclosure (NEMA 250 Type 1)] [directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R)] [externally operable with the operating mechanism being an integral part of the cover (NEMA 250 Types 7, 9)]. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Construction Manager's] written permission.
4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.4 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

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F. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:
   a. Inspect physical and mechanical condition.
   b. Inspect anchorage, alignment, grounding, and clearances.
   c. Verify that the unit is clean.
   d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
   e. Verify that fuse sizes and types match the Specifications and Drawings.
   f. Verify that each fuse has adequate mechanical support and contact integrity.
   g. Inspect bolted electrical connections for high resistance using one of the two following methods:
      1) Use a low-resistance ohmmeter.
         a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
         a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
   h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
   i. Verify correct phase barrier installation.
   j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
   a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

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b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

F. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:
   a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
   b. Inspect physical and mechanical condition.
   c. Inspect anchorage, alignment, grounding, and clearances.
   d. Verify that the unit is clean.
   e. Operate the circuit breaker to ensure smooth operation.
   f. Inspect bolted electrical connections for high resistance using one of the two following methods:
      1) Use a low-resistance ohmmeter.
         a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
         a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
   g. Inspect operating mechanism, contacts, and chutes in unsealed units.
   h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:
   a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
   c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not

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available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.

e. Determine the following by primary current injection:
   1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
   2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
   3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
   4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.

g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.

h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.

i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

4. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
   c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

G. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports.

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1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study." to values indicated on the Drawings.

END OF SECTION

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SECTION 262913.06

SOFT-START MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes soft-start motor controllers that are designed for reduced-voltage start and full-voltage run duty.

1. Enclosed soft-start controllers.
2. Combination soft-start controllers.
3. Bypass motor controller.
4. Enclosures.
5. Accessories.
6. Identification.

1.2 DEFINITIONS

A. CPT: Control power transformer.

B. FLA: Full-load current.

C. MCCB: Molded-case circuit breaker.

D. MCP: Motor circuit protector.

E. NC: Normally closed.

F. NO: Normally open.

G. OCPD: Overcurrent protective device.

H. SCCR: Short-circuit current rating.

I. SCPD: Short-circuit protective device.

J. SCR: Silicon-controlled rectifier.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each type of controller.

1. Include plans, elevations, sections, and mounting details.
2. Indicate dimensions, weights, required clearances, and location and size of each field connection.

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3. Wire Termination Diagrams and Schedules: Include diagrams for signal and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
4. Include features, characteristics, ratings, and factory settings of individual OCPD and auxiliary components.

C. Product Schedule: For each enclosed controller.

1. Each installed soft-start controller type.
2. NRTL listing.
3. Factory-installed accessories.
4. Nameplate legends.
5. SCCR of integrated unit.
   a. For each combination soft-start controller, include features, characteristics, ratings, and factory setting of the SCPD and OCPD.
      1) Listing document proving Type 2 coordination.
   b. For each series-rated combination, state the listed integrated SCCR (withstand) of SCPDs and OCPDs by an NRTL acceptable to authorities having jurisdiction.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Seismic Qualification Data: Certificates, for soft-start controllers, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source quality-control reports.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For soft-start controllers to include in operation and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
   a. Routine maintenance requirements for soft-start controllers and installed components.
   b. Manufacturer's written instructions for testing and adjusting circuit-breaker and MCP trip settings.
   c. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage soft-start controllers.
   d. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate FLAs.

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e. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store soft-start controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect soft-start controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover soft-start controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 50 W per controller.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than 32 deg F and not exceeding 104 deg F, humidity noncondensing.
2. Altitude: Not exceeding 3300 feet.
3. The effect of solar radiation is insignificant.

PART 2 - PRODUCTS

2.1 MOTOR CONTROLLER PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. UL Compliance: Fabricate and label enclosed controllers to comply with UL 508.

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C. NEMA Compliance: Fabricate motor controllers to comply with NEMA ICS 2.

D. Seismic Performance: Soft-start controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified [and the unit will be fully operational after the seismic event]."
2. Component Importance Factor: 1.5.

2.2 ENCLOSED SOFT-START MOTOR CONTROLLERS

A. Description: Controllers designed for reduced-voltage start, full-voltage run, and optional soft stop. The controller shall be an integrated unit with power SCRs, heat sink, microprocessor logic board, door-mounted digital display and user interface module, run-bypass contactor, and overload relay(s); suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.

1. Run-Bypass Contactor: Magnetic contactor in parallel with the SCR of the soft-start controller, bypassing the SCR when full voltage is achieved.

B. Standard: Comply with NEMA ICS 2, general purpose, Class A.

C. Configuration: Standard duty.

1. At least two SCRs per phase to control the starting and stopping of the motor.
2. Microprocessor control shall continuously monitor current and proper operation of the SCRs.
3. Bypass Contactor: Operates automatically when full voltage is applied to motor, and bypasses the SCRs. Soft-start controller protective features and deceleration controls shall remain active when this contactor is in the bypass mode.
4. Power Electronics Disconnect Contactor. Where indicated, installed ahead of the power electronics equipment, and shall open automatically when the motor is stopped, or a controller fault is detected, or when an SCR shorts.
5. Logic Board: Identical for all ampere ratings and voltage classes, with environmental protective coating.
6. Surge Protection: Comply with NEMA ICS 2 requirements for surge suppression.

D. Control Power:

1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
2. Spare CPT Capacity: As indicated on Drawings, available in increments of 100 VA, from 100 to 500 VA.

E. Controller Diagnostics and Protection:

1. Microprocessor-based thermal-protection system for monitoring SCR and motor thermal characteristics, and providing controller overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
2. Protection from line-side reverse phasing; line-side and motor-side phase loss; motor jam, stall, and under-load conditions; and line frequency over or under normal.
3. Input isolation contactor that opens when the controller diagnostics detect a faulted soft-start component or when the motor is stopped.

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F. Cover mounted-controller status panel with LED lights or alphanumeric display to show the following:

1. Starter Status: "Ready," "starting," "stopping," or "run."
2. Motor current in amperes.
3. Faults:
   a. Motor overcurrent trip.
   b. Motor thermal overload.
   c. Starter thermal fault.
   d. Low line voltage.
   e. Loss of a phase.
   f. Phases reversed.
   g. Maximum stating time exceeded.
   h. Serial communications error.

G. Interface Panel: Mounted on controller door.

1. Guarded adjustable set points, not readily accessible.
   a. Motor FLA, adjustable from 40 to 110 percent of the controller's rating.
   b. Current limitation on starting, adjustable from 200 to 500 percent of FLA, typically set at 300 percent.
   c. NEMA ICS 2 overload class. Selections shall include the following tripping classes: Class 5, Class 10, Class 15, Class 20, and Class 30.
2. Adjustable set points, readily accessible.
   a. Linear acceleration, adjustable from 1 to 60 s.
   b. Maximum start time, adjustable from 1 to 250 s.
   c. Selector switch; select coast to stop or soft stop.
   d. Linear deceleration, adjustable from 1 to 60 s.

H. Remote Output Features. All outputs shall be prewired to terminal blocks.

1. Analog output for field-selectable assignment of motor operating characteristics; 0- to 10-V dc.
2. Form C status contacts that change state when controller is running.
3. Form C alarm contacts that change state when a fault condition occurs.

I. Digital Communication Module: RS-485 Modbus, RTU protocol, 4-wire connection to host devices with a compatible port to transmit the following to the LAN:

1. Instantaneous root mean square (rms) current each phase, and three-phase average.
2. Voltage: L-L for each phase, L-L three-phase average, L-N each phase, and L-N three-phase average - rms.
3. Active Energy (kilowatt-hour): Three-phase total.
4. Power Factor: Each phase and three-phase total.

2.3 COMBINATION SOFT-START MOTOR CONTROLLERS

A. Description: Factory-assembled, combination, reduced-voltage soft-start controller with a disconnecting means, SCPD and OCPD, in a single enclosure. The reduced-voltage soft-start controller shall consist of an integrated unit with power SCRs, heat sink, microprocessor logic board, door-mounted digital display and user interface module, run-bypass contactor, and overload relay(s); suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.

1. Run-Bypass Contactor: Magnetic contactor in parallel with the SCR of the soft-start controller, bypassing the SCR when full voltage is achieved.

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B. Standard: Comply with NEMA ICS 2, general purpose, Class A.

C. Configuration: Standard duty.

1. At least two SCRs per phase to control the starting and stopping of the motor.
2. Microprocessor control shall continuously monitor current and proper operation of the SCRs.
3. Bypass Contactor: Operates automatically when full voltage is applied to motor, and bypasses the SCRs. Soft-start controller protective features and deceleration controls shall remain active when this contactor is in the bypass mode.
4. Power Electronics Disconnect Contactor. Where indicated, installed ahead of the power electronics equipment, and shall open automatically when the motor is stopped, or a controller fault is detected, or when an SCR shorts.
5. Logic Board: Identical for all ampere ratings and voltage classes, with environmental protective coating.
6. Surge Protection: Comply with NEMA ICS 2 requirements for surge suppression.

D. Control Power:

1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
2. Spare CPT Capacity: As indicated on Drawings, available in increments of 100 VA, from 100 to 500 VA.

E. Controller Diagnostics and Protection:

1. Microprocessor-based thermal-protection system for monitoring SCR and motor thermal characteristics, and providing controller overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
2. Protection from line-side reverse phasing; line-side and motor-side phase loss; motor jam, stall, and under-load conditions; and line frequency over or under normal.
3. Input isolation contactor that opens when the controller diagnostics detect a faulted soft-start component or when the motor is stopped.
4. <Insert items>.

F. Cover mounted-controller status panel with LED lights or alphanumeric display to show the following:

1. Starter Status: "Ready," "starting," "stopping," or "run."
2. Motor current in amperes.
3. Faults:
    a. Motor overcurrent trip.
    b. Motor thermal overload.
    c. Starter thermal fault.
    d. Low line voltage.
    e. Loss of a phase.
    f. Phases reversed.
    g. Maximum stating time exceeded.
    h. Serial communications error.

G. Interface Panel: Mounted on controller door.

1. Guarded adjustable set points, not readily accessible.
    a. Motor FLA, adjustable from 40 to 110 percent of the controller's rating.

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b. Current limitation on starting, adjustable from 200 to 500 percent of FLA, typically set at 300 percent.
c. NEMA ICS 2 overload class. Selections shall include the following tripping classes: Class 5, Class 10, Class 15, Class 20, and Class 30.

2. Adjustable set points, readily accessible.
a. Linear acceleration, adjustable from 1 to 60 s.
b. Maximum start time, adjustable from 1 to 250 s.
c. Selector switch; select coast to stop or soft stop.
d. Linear deceleration, adjustable from 1 to 60 s.

H. Remote Output Features: All outputs shall be prewired to terminal blocks.

1. Analog output for field-selectable assignment of motor operating characteristics; 0- to 10-V dc.
2. Form C status contacts that change state when controller is running.
3. Form C alarm contacts that change state when a fault condition occurs.

I. Digital Communication Module: RS-485 Modbus, RTU protocol, 4-wire connection to host devices with a compatible port to transmit the following to the LAN:

1. Instantaneous rms current each phase, and three-phase average.
2. Voltage: L-L for each phase, L-L three-phase average, L-N each phase, and L-N three-phase average - rms.
3. Active Energy (kilowatt-hour): Three-phase total.
4. Power Factor: Each phase and three-phase total.

J. Fusible Disconnecting Means:

1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J fuses.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
3. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.

K. MCP Disconnecting Means:

1. UL 489 and NEMA AB with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
3. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
4. [NC] [NO] alarm contact that operates only when MCP has tripped.
a. Current-limiting module to increase controller SCCR (withstand) to 100 kA.

L. MCCB Disconnecting Means:

1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
2. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
3. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
4. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
5. [NC] [NO] alarm contact that operates only when MCCB has tripped.

M. Molded-Case Switch Disconnecting Means:

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1. UL 489 and NEMA AB 3, with in-line fuse block for Class J or Class L power fuses (depending on ampere rating), providing an interrupting capacity to comply with available fault currents; MCCB with fixed, high-set instantaneous trip only.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
3. Auxiliary contacts "a" and "b" arranged to activate with molded-case switch handle.
4. [NC] [NO] alarm contact that operates only when molded-case switch has tripped.

2.4 BYPASS MOTOR CONTROLLER

A. Description: Factory-assembled, combination, full-voltage electromagnetic motor controller with a disconnecting means, SCPD and OCPD, in a single enclosure. Connected as a bypass controller, operating manually, with NORMAL/BYPASS selector switch.

B. Standard:

1. Comply with NEMA ICS 2, general purpose, Class A.
2. Fabricate and label the bypass motor controllers to comply with UL 60947-4-1.

C. Configuration: Across-the-line start, electrically held.

D. Contactor Coils: Pressure-encapsulated type with coil transient suppressors when indicated.

1. Operating Voltage: Manufacturer's standard unless otherwise indicated.

E. Control Power: 24-V ac; obtained from integral CPT, with primary and secondary fuses, and with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

1. Spare CPT Capacity: As indicated on Drawings, 50 VA.

F. Overload Relays:

1. Thermal-Overload Relays:
   a. Inverse-time-current characteristic.
   b. Class 20 tripping characteristic.
   c. Heaters in each phase shall be matched to nameplate FLA of actual protected motor and with appropriate adjustment for duty cycle.
   d. Ambient compensated.
   e. Automatic resetting.
2. Solid-State Overload Relays:
   a. Switch or dial selectable for motor running overload protection.
   b. Sensors in each phase.
   c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

G. Class II Ground-Fault Protection: Comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.

H. Digital Communication Module: RS-485 Modbus, RTU protocol, 4-wire connection to host devices with a compatible port to transmit the following to the LAN:

1. Instantaneous rms current each phase, and three-phase average.
2. Voltage: L-L for each phase, L-L three-phase average, L-N each phase, and L-N three-phase average - rms.

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3. Active Energy (kilowatt-hour): Three-phase total.
4. Power Factor: Each phase and three-phase total.

I. Fusible Disconnecting Means:

1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

J. Nonfusible Disconnecting Means:

1. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

K. MCP Disconnecting Means:

1. UL 489 and NEMA AB 3 (with interrupting capacity to comply with available fault currents) instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

L. MCCB Disconnecting Means:

1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
2. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
3. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.5 ENCLOSURES

A. Comply with NEMA 250, Type designations as indicated on Drawings, to comply with environmental conditions at installed location.

B. Construction of the enclosures shall comply with NEMA ICS 6.

C. Controllers in hazardous (classified) locations shall comply with UL 1203.

2.6 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Standard duty, except as needed to match enclosure type. Heavy-duty or oiltight where indicated in the controller schedule.
   a. Push Buttons: As indicated in the controller schedule.
   b. Pilot Lights: As indicated in the controller schedule.
2. Elapsed Time Meters: Heavy duty with digital readout in hours; resettable.
3. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus 2 percent accuracy. Where indicated, provide selector switches with an off position.

B. Breather assemblies, to maintain interior pressure and release condensation in Type 4 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

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C. Space heaters, with NC auxiliary contacts, to mitigate condensation in Type 3R enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

D. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

2.7 IDENTIFICATION

A. Controller Nameplates: Baked-enamel signs, as described in Section 26 05 53 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.

B. Arc-Flash Warning Labels:

1. Comply with requirements in Section 26 05 74 "Overcurrent Protective Device Arc-Flash Study." Produce a 3-1/2-by-5-inch self-adhesive label for each work location included in the analysis.
2. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems." Produce a 3-1/2-by-5-inch self-adhesive equipment label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
    a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
        1) Location designation.
        2) Nominal voltage.
        3) Flash protection boundary.
        4) Hazard risk category.
        5) Incident energy.
        6) Working distance.
        7) Engineering report number, revision number, and issue date.
    b. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wall-Mounted Controllers: Install controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on slotted support systems complying with Section 26 05 29 "Hangers and Supports for Electrical Systems," and bolted to wall.

C. Freestanding Controllers: Provide slotted support systems complying with Section 26 05 29 "Hangers and Supports for Electrical Systems."

D. Floor-Mounted Controllers: Install controllers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete" or Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."

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E. Comply with requirements for seismic control devices specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

F. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

G. Control Wiring: Separate control wiring from power wiring. Where unavoidable, use twisted pair cabling or shielded cables for control wiring.

H. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

I. Setting of Overload Relays: Select and set overloads on the basis of FLA rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for high-torque, high-efficiency, and so on motors.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections[with the assistance of a factory-authorized service representative].

E. Tests and Inspections:

1. Comply with provisions of NFPA 70B, Chapter "Testing and Test Methods."
2. Visual and Mechanical Inspection:
    a. Compare equipment nameplate data with Drawings and the Specifications.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, and grounding.
    d. Verify that the unit is clean.
    e. Ensure that vent path openings are free from debris and that heat-transfer surfaces are clean.
    f. Verify correct connections of circuit boards, wiring, disconnects, and ribbon cables.
    g. Inspect Contactors:
        1) Verify mechanical operation.
        2) Verify that contact gap, wipe, alignment, and pressure are according to manufacturer's published data.
    h. Motor-Running Protection:
        1) Verify that motor FLA is at, or under, the controller current rating.
        2) Verify that overload element setting is correct for its application.

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3) Apply minimum- and maximum-speed set points. Verify that set points are within limitations of the load coupled to the motor.
4) If motor-running protection is provided by fuses, verify correct fuse rating.

i. Inspect bolted electrical connections for high resistance using one of the following two methods:
1) Use a low-resistance ohmmeter. Compare bolted-connection-resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12.

j. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

3. Electrical Tests:
a. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Insulation-resistance values shall be according to manufacturer's published data or NETA ATS, Table 100.1. In the absence of manufacturer's published data, use Table 100.5. Values of insulation resistance less than this table or manufacturer's written instructions shall be investigated and corrected.
b. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
c. Test motor protection devices according to manufacturer's published data.
d. Test circuit breakers as follows:
1) Operate the circuit breaker to ensure smooth operation.
2) For adjustable circuit breakers, adjust protective device settings according to the coordination study. Comply with coordination study recommendations.

e. Test the electronic motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element.
f. Test the following parameters according to NETA relay calibration procedures, or as recommended by manufacturer:
1) ANSI No. 49R, Overtemperature Protection:
a) Determine time delay at 300 percent of setting.
b) Determine a second point on the operating curve.
c) Determine pickup.
2) ANSI No. 47, Input Phase Loss and Reversed Phases Protection:
a) Determine positive sequence voltage to close the NO contact.
b) Determine positive sequence voltage to open the NC contact (undervoltage trip).
c) Verify negative sequence trip.
d) Determine time delay to close the NO contact with sudden application of 120 percent of pickup.
e) Determine time delay to close the NC contact on removal of voltage when previously set to rated system voltage.
3) ANSI No. 81, Overfrequency Protection:
a) Verify frequency set points.
b) Determine time delay.
c) Determine undervoltage cutoff.

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4) Fault Alarm Outputs: Verify that each relay contact performs its intended function in the control scheme including breaker trip tests, close inhibit tests, lockout tests, and alarm functions.

g. Perform operational tests by initiating control devices.

4. Infrared Inspection: Perform the survey during periods of maximum possible loading. Remove all necessary covers prior to the inspection.
   a. Comply with recommendations of NFPA 70B, Chapter "Testing and Test Methods," Article "Infrared Inspection."
   b. After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared inspection of the electrical power connections of each motor controller.
   c. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each motor controller 11 months after date of Substantial Completion.
   d. Report of Infrared Inspection: Prepare a certified report that identifies the testing technician and equipment used, and lists the following results:
      1) Description of equipment to be tested.
      2) Discrepancies.
      3) Temperature difference between the area of concern and the reference area.
      4) Probable cause of temperature difference.
      5) Areas inspected. Identify inaccessible and unobservable areas and equipment.
      6) Identify load conditions at time of inspection.
      7) Provide photographs and thermograms of the deficient area.
      8) Recommended action.
   e. Equipment: Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1 deg C at 30 deg C. The equipment shall detect emitted radiation and convert detected radiation to a visual signal.
   f. Act on inspection results, recommended action, and considering recommendations of NETA ATS, Table 100.18. Correct possible and probable deficiencies as soon as Owner's operations permit. Retest until deficiencies are corrected.

F. Motor controllers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.5 SYSTEM FUNCTION TESTS

A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality-control tests have been completed and all components have passed specified tests.

1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
3. Verify the correct operation of sensing devices, alarms, and indicating devices.

B. Motor controllers will be considered defective if they do not pass the system function tests and inspections.

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C. Prepare test and inspection reports.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain motor controllers.

END OF SECTION

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SECTION 262923

VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

B. Related Requirements:

1. Section 26 24 19 "Motor-Control Centers" for VFCs installed in motor-control centers.

1.3 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. LED: Light-emitting diode.

F. NC: Normally closed.

G. NO: Normally open.

H. OCPD: Overcurrent protective device.

I. PID: Control action, proportional plus integral plus derivative.

J. RFI: Radio-frequency interference.

K. VFC: Variable-frequency motor controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.

1. Include dimensions and finishes for VFCs.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

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B. Shop Drawings: For each VFC indicated.

1. Include mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required working clearances and required area above and around VFCs.
2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.
3. Show support locations, type of support, and weight on each support.
4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Seismic Qualification Certificates: For each VFC, accessories, and components, from manufacturer.

1. Certificate of compliance.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Product Certificates: For each VFC from manufacturer.

E. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
   a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
   b. Manufacturer's written instructions for setting field-adjustable overload relays.
   c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
   d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

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e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
2. Baldor Electric Company (Graham).
3. Danfoss Inc.; Danfoss Electronic Drives Div.
4. Eaton Corporation; Cutler-Hammer Products.
5. General Electric Company; GE Industrial Systems.
6. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
7. Siemens Energy and Automation; Industrial Products Division.
8. Square D.
9. Toshiba International Corporation.

2.2 SYSTEM DESCRIPTION

A. General Requirements for VFCs:

1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A or UL 508C.

B. Application: Constant torque and variable torque.

C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

F. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 3 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 65 kA.
7. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
8. Humidity Rating: Less than 95 percent (noncondensing).
9. Altitude Rating: Not exceeding 3300 feet.
10. Vibration Withstand: Comply with NEMA ICS 61800-2.

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11. Overload Capability: 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
13. Speed Regulation: Plus or minus 5 percent.
14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

G. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.

I. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.
6. <Insert adjustment and parameters>.

J. Self-Protection and Reliability Features:

1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
2. Surge Suppression: Field-mounted surge suppressors complying with Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 2.
3. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
4. Under- and overvoltage trips.
5. Inverter overcurrent trips.
6. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
7. Critical frequency rejection, with three selectable, adjustable deadbands.
8. Instantaneous line-to-line and line-to-ground overcurrent trips.
9. Loss-of-phase protection.
10. Reverse-phase protection.
11. Short-circuit protection.
12. Motor-overtemperature fault.

K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

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N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Integral Input Disconnecting Means and OCPD: UL 489, instantaneous-trip circuit breaker with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
3. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
5. NO alarm contact that operates only when circuit breaker has tripped.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified[and the unit will be fully operational after the seismic event]."

2.4 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.
7. <Insert condition>.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
   a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.

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3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Electric Input Signal Interface:
   a. A minimum of two programmable analog inputs: 0- to 10-V dc.
   b. A minimum of six multifunction programmable digital inputs.
2. Pneumatic Input Signal Interface: 3 to 15 psig.
3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:
   a. 0- to 10-V dc.
   b. 4- to 20-mA dc.
   c. Potentiometer using up/down digital inputs.
   d. Fixed frequencies using digital inputs.
4. Output Signal Interface: A minimum of one programmable analog output signal (0- to 10-V dc), which can be configured for any of the following:
   a. Output frequency (Hz).
   b. Output current (load).
   c. DC-link voltage (V dc).
   d. Motor torque (percent).
   e. Motor speed (rpm).
   f. Set point frequency (Hz).
5. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
   a. Motor running.
   b. Set point speed reached.
   c. Fault and warning indication (overtemperature or overcurrent).
   d. PID high- or low-speed limits reached.

F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.

1. Number of Loops: Two.

G. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.

1. Hardwired Points:

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a. Monitoring: On-off status.
b. Control: On-off operation.

2. Communication Interface: Comply with ASHRAE 135. Communication shall interface with DDC system for HVAC to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC.

2.5 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.

B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

2.6 BYPASS SYSTEMS

A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

B. Bypass Mode: Manual operation only; requires local operator selection at VFC. Transfer between power converter and bypass contactor, and retransfer shall only be allowed with the motor at zero speed.

C. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic-control system feedback.

D. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller[; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode].

1. Bypass Contactor: Load-break, NEMA-rated contactor.
2. Output Isolating Contactor: Non-load-break, NEMA-rated contactor.
3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

E. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.

1. Bypass Contactor: Load-break, NEMA-rated contactor.
2. Input and Output Isolating Contactors: Non-load-break, NEMA-rated contactors.
3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

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F. Bypass Contactor Configuration: Full-voltage (across-the-line) type.

1. NORMAL/BYPASS selector switch.
2. HAND/OFF/AUTO selector switch.
3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
   a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
   b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
   a. CPT Spare Capacity: 100 VA.
6. Overload Relays: NEMA ICS 2.
   a. Melting-Alloy Overload Relays:
      1) Inverse-time-current characteristic.
      2) Class 20 tripping characteristic.
      3) Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
   b. Bimetallic Overload Relays:
      1) Inverse-time-current characteristic.
      2) Class 20 tripping characteristic.
      3) Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
      4) Ambient compensated.
      5) Automatic resetting.
   c. Solid-State Overload Relays:
      1) Switch or dial selectable for motor-running overload protection.
      2) Sensors in each phase.
      3) Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
      4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
      5) Analog communication module.
   d. NO isolated overload alarm contact.
   e. External overload, reset push button.

2.7 OPTIONAL FEATURES

A. Multiple-Motor Capability: VFC suitable for variable-speed service to multiple motors. Overload protection shuts down VFC and motors served by it, and generates fault indications when overload protection activates.

1. Configure to allow two or more motors to operate simultaneously at the same speed; separate overload relay for each controlled motor.
2. Configure to allow two motors to operate separately; operator selectable via local or remote switch or contact closures; single overload relay for both motors; separate output magnetic contactors for each motor.
3. Configure to allow two motors to operate simultaneously and in a lead/lag mode, with one motor operated at variable speed via the power converter and the other at constant speed via the bypass controller; separate overload relay for each controlled motor.

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B. Damper control circuit with end-of-travel feedback capability.

C. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.

D. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.

E. Firefighter's Override (Smoke Purge) Input: On a remote contact closure from smoke-control fan controller, this password-protected input:

1. Overrides all other local and external inputs (analog/digital, serial communication, and all keypad commands).
2. Forces VFC to operate motor, without any other run or speed command, at a field-adjustable, preset speed.
3. Forces VFC to transfer to bypass mode and operate motor at full speed.
4. Causes display of override mode on the VFC display.
5. Reset VFC to normal operation on removal of override signal automatically.

F. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

G. Remote digital operator kit.

H. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

2.8 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.
3. Kitchen Areas: Type 4X, stainless steel.
4. Other Wet or Damp Indoor Locations: Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.9 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.

1. Push Buttons: Covered.
2. Pilot Lights: Push to test.
3. Selector Switches: Rotary type.
4. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

B. Reversible NC/NO bypass contactor auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

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D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

E. Supplemental Digital Meters:

1. Elapsed-time meter.
2. Kilowatt meter.
3. Kilowatt-hour meter.

F. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, [Type 4] [Type 4X] [Type 12] <Insert type> enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

G. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 3R enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

H. Cooling Fan and Exhaust System: For NEMA 250, Type 1; UL 508 component recognized: Supply fan, with stainless-steel intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.

I. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

J. Spare control-wiring terminal blocks; wired.

2.10 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

1. Test each VFC while connected to its specified motor.
2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

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C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 26 05 29 "Hangers and Supports for Electrical Systems."

B. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete" or Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.

1. Curbs and roof penetrations are specified in Section 07 72 00 "Roof Accessories."
2. Structural-steel channels are specified in Section 26 05 29 "Hangers and Supports for Electrical Systems."

D. Seismic Bracing: Comply with requirements specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

F. Install fuses in each fusible-switch VFC.

G. Install fuses in control circuits if not factory installed. Comply with requirements in Section 26 28 13 "Fuses."

H. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.

I. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

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J. Comply with NECA 1.

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices and facility's central-control system.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFC with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections[with the assistance of a factory-authorized service representative].

D. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.

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4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
   c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. VFCs will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

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E. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

F. Set field-adjustable pressure switches.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION

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SECTION 265113

ARCHITECTURAL LUMINAIRES, SOURCES & COMPONENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings, conditions of Contract (including General Conditions, Addendum to the General Conditions, Special Conditions, Division 01 Specification Sections and all other Contract Documents) apply to the work of this Section.

B. Related Sections: Division 26

1.2 SUMMARY

A. Included in the Work of this Section are labor, materials, and appurtenances required to complete the Work of this Section, as specified herein, as required by job conditions, or as indicated on drawings. The scope of this section includes general requirements for luminaires and their components, coordination, definitions, quality assurances, submittals, mockups, samples and general responsibility for a complete job.

1.3 DEFINITIONS

A. In this specification, the term "Architect" includes the Architect, Interior Designer, Landscape Architect, Construction Manager, Owner's representative and/or the Lighting Specifier, together or individually as they shall decide.

B. The term "luminaires" refers to lighting fixtures with their integrated light sources and all other components.

C. The use of the word "Approved" shall not extend the Architect's responsibilities beyond that as defined in the General Conditions.

1.4 GENERAL REQUIREMENTS

A. Provide labor, materials, and equipment for the installation of indoor and outdoor luminaires, lighting equipment, control wiring, and sources as shown on the drawings and specified herein and in Related Sections. Luminaires shall be securely attached to supports.

B. Refer to architectural drawings for locations, dimensions and details, and electrical documents for quantities. Check and verify dimensions and details on drawings before proceeding with the Work. Report any inconsistencies or discrepancies. Should it appear that the Work intended is not sufficiently detailed or explained on the drawings or in the specifications, apply for further drawings or explanations, as may be necessary. Conform to these explanations in the work. If any question arises about the true meaning of the drawings or specifications, provide timely and written questions before proceeding. Under no circumstances shall any request for extra compensation be honored where the basis of claim is such a clarification. In no case submit a bid or proceed on any Work with uncertainty. The intention of this specification and the accompanying or applicable drawings is to provide a job complete in every respect. Contractor is responsible for this result.

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C. Recycling and Disposal: Existing luminaires shall be removed as directed by scope of work. Proper disposal of components, including but not limited to fluorescent lamps and ballasts containing mercury, PCBs or other toxic materials, shall be conducted according to relevant Federal, State, Local, and EPA regulations or guidelines. Provide written verification of proper disposal. Electronic components shall be recycled as electronic equipment, or as otherwise required by relevant codes or local laws.

1.5 COORDINATION

A. Luminaire locations and mounting heights as indicated on the electrical drawings are generalized and approximate. Carefully verify locations and mounting heights with Architect's drawings, reflected ceiling plans, interior elevations and other reference data prior to installation. Check for adequacy of headroom and non-interference with other equipment, such as ducts, pipes or openings. Provide timely and written notification of such conflicts before proceeding with the Work. Although the location of equipment included in the Work of this Section may be shown on the Contract Drawings in a certain place, actual construction may disclose that the location for the Work does not make its position easily and quickly accessible. In such cases, provide timely and written notification of this situation before installing this Work, and comply with installation directions.

B. Clearly indicate the Work to be performed by other trades' contractors, and the materials that are adjacent to or abutting the Work of this Section. Coordinate as required. Give ample notice of special openings required for placing equipment in the building, in order to avoid cutting of completed Work. Provide the materials and labor for Work included under this Section in ample time, and in sufficient quantities so that all of the Work may be installed in proper sequence to avoid unnecessary cutting of the floors and walls. Schedule the Work to prevent Work of this Section being damaged by other construction operations. Remove and replace Work so damaged at no cost to the project. Coordinate and schedule the Work of this Section with the Work of other Sections and Utility Companies so that there shall be no delay in the proper installation and completion of any part of each respective Work. Construction Work shall proceed in its natural sequence without unnecessary delay caused by the Work of this Section.

C. Coordinate with other contractors regarding attachment to or openings in the materials of other trades such as pre-cast concrete, ornamental metals, or wood panels for recessed junction boxes, and other equipment.

D. Arrange the installation in proper relation to other Work and with architectural finishes so that it shall harmonize in service and appearance and so that there shall be no interference with the Work of others, including interference in location or level.

E. Where a catalog number and a narrative or pictorial description are provided, the written description shall take precedence and prevail.

F. Where Work of this Section is to be flush or concealed, install it to assure that it does not project visually or physically beyond the finished lines of floors, ceilings or walls.

G. Verify ceiling conditions and provide appropriate mounting details for each luminaire. Submit mounting details for approval.

H. Become familiarized with all equipment listed in the luminaire schedule and take responsibility for the successful completion of the entire lighting installation.

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I. Verify compatibility of supply voltage indicated on electrical drawings with voltage specified for each luminaire prior to release. Provide timely and written notification of any and all discrepancies.

J. Integration: Provide the services of a lighting controls “Integrator”, to ensure the successful coordination and performance of complex lighting systems such as digital addressable luminaires, sensors integrated into luminaires, dynamic lighting controls, DMX, scenes, shows, color-tuning and the like meets all the performance criteria of these contract document.

K. Integrator shall view the contract documents, coordinate between disciplines, preview and review the shop drawing submittals, and commission the lighting system according to the contract documents.

1.6 QUALITY ASSURANCES

A. Contractor shall comply with the General Requirements related to Quality Control, in addition to the provisions herein.

B. Manufacturers: Manufacturers listed in the APPENDIX – LUMINAIRE SCHEDULE (lighting fixture schedule) herein, shall be assumed capable of supplying the listed luminaires unless exceptions are set forth in their quotations. Provide timely and written notification of any such exceptions. Acceptable manufacturers are listed in the luminaire schedule. Acceptable manufacturers shall be capable of providing proof of satisfactory production of luminaires of the type and quality shown for a period of at least five years.

C. Statement of Application:

1. By commencing the Work of this Section, the Contractor assumes overall responsibility, as a part of the warranty of the Work, to ensure that assemblies, components and parts shown or required within the Work of this Section, comply with the Contract Documents.
2. Warranty: In addition to any warranties required by the General Requirements, the Contractor of the Work of this section shall:
   a. For a period of one year after Owner's initial acceptance and establishment of the beginning date of the warranty period, and at no additional cost, promptly provide and install replacements for luminaires or components thereof which are defective in materials or workmanship under normal operating conditions, except for sources; or successfully repair installed equipment at the job site. For any time during the warranty period that luminaires are not fully functional due to defects in materials or workmanship, provide or pay for and install and remove suitable and adequate temporary luminaires. Warrant replacement luminaires or components to be free of defects in workmanship or materials for a period of one year following replacement and replace any defective replacements.
   b. Contractor shall not be held responsible for acts of vandalism or for abnormal or accidental abuse of the luminaires or their components occurring after the beginning of the warranty period, nor shall Contractor be held responsible for deleterious effects caused by maintenance procedures performed without the concurrence of Contractor.

D. Equipment Compatibility:

1. For all similar luminaire type, provide luminaires, power supplies, LED drivers, ballasts and other components fabricated or supplied by a single manufacturer, to simplify maintenance and replacement of equipment. Under no circumstances shall sources of

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the same type, even if different wattages, be supplied by more than one manufacturer unless operable samples are submitted, reviewed and approved in writing.

2. Luminaire details shown may be modified by the manufacturer provided all of the following conditions have been met.

   a. Luminaire performance is equal or improved.
   b. Structural, mechanical, electrical, safety, and maintenance characteristics are equal or improved.
   c. Cost to the Owner is reduced or equal.
   d. No conformance to codes has been compromised.
   e. No performance criteria for, LEED, or WELL Building ratings has been compromised.
   f. Modifications have been reviewed and approved in writing.

E. Regulatory Agencies:

1. Provide luminaires constructed, wired and installed in compliance with the current edition of applicable city, state and national codes. Provide luminaires conforming to or exceeding Underwriters Laboratories (UL) standards, and to provisions of applicable codes which exceed those standards.

2. For any category of luminaire tested by any of the following labs, provide luminaires listed and labeled by an independent Nationally Recognized Testing Laboratory (NRTL) such as UL, ETL, CSA, MET

3. In addition, provide luminaires which conform to additional regulations necessary to obtain approval for use of specified luminaires in locations shown. Use only electrical components listed by the above NRTLs.

F. Recognized Standards: In addition to standards that may be referenced in Division 01 Specification Sections, luminaires shall comply with the applicable standards of the following organizations.

Underwriters Laboratories (UL)
National Electrical Code (NEC)
Certified Ballast Manufacturers Association (CBM)
Illuminating Engineering Society (IES)
American Society for Testing and Materials (ASTM)
American National Standards Institute (ANSI)

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National Electrical Manufacturers Association (NEMA)
International Electrotechnical Commission (IEC)
National Electrical Safety Code (IEEE C2)
Americans with Disabilities Act (ADA)
Canadian Standards Organization - US (CSA-US)

1.7 BIDDING

A. Follow bidding procedures as described in Division 01 of this specification.

B. Provide specified and alternate unit prices separated from installation costs as required in APPENDIX - LUMINAIRE SCHEDULE (the lighting fixture schedule).

1.8 SUBSTITUTIONS:

A. Luminaires included under this Section are specified by approved manufacturer and type. Provide equipment exactly as specified, unless substitutions are mutually agreed upon, as follows:

1. Submit a written request for luminaires proposed for substitution, at least two weeks before the end of bid period – the “substitution period”. Make the request for substitution an alternate, separate proposal, accompanied by complete descriptive and technical data. Indicate if there is any addition or deduction from the base bid. Substitutions proposed after this time, or not including proper documentation shall not be considered. Submissions of substitutions may be accepted or rejected without explanation. -.

2. Exceptions: During the construction period, no substitutions shall be considered unless compelling reasons are given - such as a specified product no longer being available. If Contractor has failed to follow the schedule presented under the Paragraph titled "Submittals" below, no substitutions will be allowed based on inability of specified manufacturer to meet delivery schedule, and the Contractor shall provide luminaires exactly as specified without delay to the project and without additional cost to Owner.

3. Substitutions shall be indicated as such in the bid documents, and operable (plug-in) samples, catalogue cuts and complete photometric reports by independent testing laboratories submitted. A complete comparison of the performance of the proposed substitution in relation to the performance of at least the first named specified product shall be included. In addition, for any luminaire type of which six (6) or more of the luminaires are to be used, submit computer generated point-by-point calculations for illumination on vertical and horizontal planes. Such calculations shall include either the typical mounting condition for the subject luminaire or a specialized mounting condition deemed critical for the success of the design.

4. Written documentation shall clearly show that the proposed manufacturer complies with each and every aspect of the specification and/or indicate any exceptions or variations. Where proposed substitutions alter the functional or visual design or change the space requirements or mounting details indicated herein or on the drawings, such changes shall be detailed in the proposal and costs indicated for revised design and construction for trades involved. Cost data shall be provided as called for in the General Requirements. Submittal shall include names and addresses of at least three (3) similar projects on which the product was used, including names and phone numbers of specifiers and owners of each project, and dates of installation.

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B. Value Engineering:

1. To the extent that Value Engineering is allowed in the General Requirements, the procedure for value engineering is the same as outlined above regarding the substitution process, with the words "value engineering proposed substitution(s)" replacing the word "substitution(s)". Value engineering submittals shall be clearly separated from substitutions, and line item cost savings for each proposed luminaire type clearly documented.

1.9 SUBMITTALS

A. General:

1. For standard catalog items with no modifications, submit catalog cut sheets prepared by the manufacturer which clearly show all elements to be supplied and all corresponding product data (including sources, manufacturer and model number of power supply, LED driver, ballast, and other components, as well as voltage; accessories, options and any miscellaneous items detailed in the written description of the specification.) If cut sheet shows more than one (1) luminaire type, all non-applicable information shall be crossed out.

2. For custom luminaires, modified luminaires or linear luminaires mounted in continuous rows, submit a layout drawing prepared by the manufacturer showing all details of construction, lengths of runs, source layout, if applicable, suspension installation hardware or components, power locations, remote power supplies, remote LED drivers, remote ballasts, remote transformers, finishes and list of materials. Drawings must be to scale. Provide manufacturer with field dimensions where required. If scallop shields, wallwash reflectors or baffles are required, drawings shall indicate relative position to wall or adjacent vertical surface.

3. When components are indicated as contractor supplied or specified (i.e. remote power supplies, remote LED drivers, ballast housings, NEMA enclosures, etc., provide submittals for components in conjunction with the luminaire submittal.

4. Provide submittals with luminaire installation instruction sheets.

B. Submittal Schedule (Note: All days, week or months listed are "calendar" days, weeks or months, and not working days, weeks or months):

1. List of Intended Manufacturers: Within fifteen (15) calendar days of the Notice to Proceed, submit a List of Intended Manufacturers, with estimated fabrication lead times. "Lead times" shall be measured in weeks, beginning from the manufacturer's receipt of approved shop drawings and release, and ending at shipment. The response to this list will indicate if any manufacturers are unacceptable.

2. Acknowledgments and standard shop drawings: Within twenty (20) days after receipt of the response to the list of Intended Manufacturers, submit copies of purchase orders and manufacturers' acknowledgments for all luminaires specified, conforming to responses. The purchase orders and the manufacturer’s acknowledgments need not list prices, but shall contain a guaranteed fabrication lead time, in weeks, as defined above. These

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fabrication times shall be adequate for the timely completion of the job. At the same time, but not less than twenty-four (24) weeks before standard manufactured luminaires are required on the site, submit shop drawings for all standard luminaires or those with minor modifications

3. Custom Shop Drawings: In order to allow for mockups and independent testing for all custom luminaires or those with major modifications, submit complete shop drawings within sixty (60) days after the Notice to Proceed, but not less than eleven (11) months prior to the time they are required on the site.

4. Release for fabrication: Within twenty (20) days after receipt of shop drawings marked "No Exceptions Taken" or "Make Corrections Noted", release luminaires for fabrication and forward verification that the luminaires have been released for fabrication, with a guaranteed shipment date for each specified luminaire. At the same time, forward finish or component samples, tests, or any outstanding data required for approval.

5. Operable luminaire samples and mockups as indicated in APPENDIX - LUMINAIRE SCHEDULE (the lighting fixture schedule) shall be received by the designated parties, or installed on the site, within forty-five (45) days after Contractor's receipt of shop drawings marked "No Exceptions Taken" or "Make Corrections Noted".

6. Re-submissions: Within fourteen (14) days after receipt of shop drawings marked "Revise and Resubmit" or "Rejected", resubmit revised shop drawings in accordance with the General Requirements regarding re-submissions.

7. Provide written notification of any potential scheduling problems, or of any submittals that have not been returned which are required to maintain the installation schedule. Such notification shall be in a timely manner and well in advance of the time such delay might affect the fabrication schedule or appropriate delivery of luminaires.

C. Shop Drawings:

1. Submit shop drawings for each type of luminaire, arranged in order of lighting type designation except where specified luminaires are standard, unmodified, "off-the-shelf" units, fully described by catalogue cuts. If comprehensive, such catalogue cuts may be substituted for shop drawings, however full shop drawing shall be submitted upon request. Submit catalogue cuts of individual lamps or replaceable source modules to be provided for each luminaire. Submit shop drawings in the quantity and format called for in the General Requirements.

2. Shop drawings shall show all luminaire components, including but not limited to lampholders, reflectors, louvers, lenses, fuses, junction boxes, power supplies, ballasts and sources. Shop drawings shall show materials, finishes, metal gauges, overall and detailed dimensions, sizes, electrical and mechanical connections, fasteners, welds, joints, any exposed hardware, and conditions, or provisions for the work of others, and similar information. Indicate complete details of the luminaire, including manufacturer's name and catalogue numbers for sockets, power supplies, LED drivers, ballasts, light shields, switches and type of wiring, and targeting and locking devices for adjustable luminaires. Indicate that source type specified is appropriate for luminaire design. Indicate maximum allowed distance between light luminaire and remote power supply. Indicate type and extent of approved inert insulating materials to prevent electrolytic corrosion at junctions of dissimilar metals. Include pertinent mounting details including hung ceiling construction. Standard catalogue cuts shall be supplemented by additional

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drawings if information or descriptions listed above are not included in the cuts. Photometric documentation and finish samples shall be provided upon request. Samples shall be provided if indicated in APPENDIX - LUMINAIRE SCHEDULE (the lighting fixture schedule). No luminaires will be approved without the previous described submission of data. Submissions may be modified during the submission review process. Luminaires or other materials shall not be fabricated, shipped, stored or installed unless prior written approval has been received.

3. Submit layouts for continuous luminaires or coves, indicating overall field measurements and proposed lengths, and condition of joints, corners, ends and any unlighted lengths.

4. Submit catalogue cuts for all lamps, power supplies, LED drivers, ballasts and emergency battery backup power supplies and ballasts.

D. Data: Submit independent laboratory photometric data in the directed number of copies and in format as directed. Photometric data shall be submitted for standard, "off-the-shelf" units at the time the manufacturer's cuts are submitted. Photometric testing and reporting shall conform to IESNA procedures. Submit additional photometric testing as required by Luminaire Schedule or upon request.

E. Manufacturer's Catalogue Sheets shall indicate input watts and electrical characteristics, ambient temperature rating, noise level rating, mounting methods and UL or ETL listing for use with required source, power supply, LED driver, transformer, lamp and/or ballast (if any).

F. For Guaranteed Maximum Pricing. Submit a detailed breakdown of bid by material cost, labor, and wiring and quantities for each luminaire, when requested.

1.10 SAMPLES

A. After shop drawings, data and any other required submissions have been approved, submit samples of each of the following components upon request:

1. Samples demonstrating the finishes of any custom metal, paint color or finish. Sample size to be a minimum of 4in (100mm) square. Place labels on the back side of finish samples only.

2. Material samples of any transmitting media, such as plastic, glass, perforated metal and the like. Sample size to be a minimum of 12in (305mm) square, to allow adequate space for label.

3. Each downlight reflector cone that differs in size or finish.

4. Any other luminaires or components requested in the luminaire descriptions, schedule, or in the contract documents.

B. Submit two (2) samples unless otherwise indicated. If luminaire samples are requested, supply a completely operable luminaire as specified in the Luminaire Schedule and/or incorporating responses to shop drawing, with the specified source and a 10ft (3m) cord and plug for standard 120-volt service. For 277-volt luminaires, also supply a completely wired or plug-wired step-up transformer to convert from 120 to 277 volts, with a 120-volt cord and plug. Provide component parts as specifically requested.

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C. Where a sample is submitted or requested, do not fabricate that luminaire type until the sample is approved. Submit and resubmit a sample as required, until samples are approved.The purpose of the sample is to review manufacturing techniques, detailing, light source, and scale. Minor modifications, if any, shall be considered part of these Specifications and shall be accomplished at no additional cost.

D. Submit complete and operable sample luminaires for any proposed substitution or value engineering proposal as indicated above. There shall be no expectation that substitution products or samples received after the substitution period will be accepted or reviewed.

E. Provide samples as called for in the General Requirements. Tag samples with the name of the project, referenced specification, paragraph or drawing number, the luminaire type number and any other identifying data. Ship the samples to two separate addresses as requested. After review, the samples shall be shipped to the project site for use as standards. All transportation charges for samples shall be paid by Contractor. Make luminaires supplied under the Work of this Section identical with approved samples. Do not install any sample luminaires in the project.

F. If sample submissions are not approved, samples shall be returned to Contractor, at Contractor's expense. Upon receipt of sample disapproval, immediately make a new submission of samples meeting the comments and contract requirements, as called for in the General Requirements.

1.11 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Luminaires and their component elements shall be delivered to the job site factory-assembled and wired to the greatest extent practical, in strict accordance with the approved shop drawings, samples, certificates and catalogue cuts, and shall be handled in a careful manner to avoid damage.

B. Exposed finishes shall be protected during fabrication, transport, storage and handling. Delivered materials shall be identical to the approved samples. Materials which become damaged shall be repaired and/or replaced as directed.

C. Luminaires shall be stored under cover, above the ground, in clean, dry areas, and shall be tagged and/or marked as to type and location.

D. Delivered luminaires shall include wiring, sockets, power supplies, LED drivers, ballasts, shielding, channels, lenses and other parts and appurtenances necessary for luminaire installation of each luminaire type.

1.12 MOCK-UP

A. As a part of the Work of this Section, when specifically called for in the Luminaire Schedule, and at no additional cost to project, temporarily install, connect and adjust a reasonable number of luminaires, three (3) unless otherwise stated. Install completely operable luminaires with all sources, power supplies, LED drivers, ballasts, etc., of each type listed in the Luminaire Schedule where a mock-up is specified, to verify the specified catalogue number and requirements. Place the mock-up luminaires where and when directed. Remove and store mock- up luminaires, when approved, as necessary to complete the work, at Contractor's expense.

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1. The mock-up installation shall closely conform to the conditions of the actual installation as to height, distance from ceiling, light source type, output and performance, number and type of sources, material, color, and space finishes, etc. Submit a written description of each proposed mock-up with drawings to obtain approval prior to commencement of each mock-up.

2. Where mounting of mockup may negatively impact existing conditions or constructed scope of Work, temporary mounting methods shall be implemented to avoid any damage.

3. The purpose of the mock-up will be to study the general appearance and performance of the intended lighting systems unless otherwise indicated. At that time, certain minimal test variations may be requested as to lamp location, source type, reflector shape, color, etc. Final modifications, if any, shall be considered as part of these Specifications and shall be accomplished with no additional cost to the project.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide materials, equipment, appurtenances and workmanship for the Work of this Section conforming to the highest commercial standards, as specified and indicated on the drawings. Make luminaire parts and components not specifically identified or indicated on the drawings, of materials most appropriate to their use or function, and resistant to corrosion and to thermal and mechanical stresses encountered in the normal application and function of the luminaires.

B. Provide recessed luminaires that are constructed to be suitable for and compatible with the ceiling, wall, pavement or other materials and construction in which they will be installed.

C. Named manufacturers, when listed in the luminaire schedule, are representative of an adequate level of quality and reputation, and are allowed to submit a product, provided that they are capable of satisfying the provisions of the specifications in every respect. This does not mean that any standard product provided by that manufacturer is automatically qualified. Manufacturers not on this list may be proposed during the substitution period if they can substantiate that their product meets every particular of the relevant specification, and are of comparable quality, experience and reputation. See the paragraph titled "Substitutions", above. Any submitted product may be rejected without explanation.

2.2 DEFINITIONS:

A. CCT: Correlated Color Temperature

B. CRI: Color Rendering Index

C. Fixture: See “Luminaire”

D. IP: International Protection or Ingress Protection Rating

E. LED: Light Emitting Diode

F. Lumen: Measured output of source and luminaire or both

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G. Luminaire: Complete lighting unit, including source, gear, reflector and housing

2.3 AGENCY OR UTILITY INCENTIVE PROGRAMS:

A. Verify if products are required to conform to agency or utility standards. If so, provide products which conform.

B. Provide written documentation, as required, related to purchases of any equipment or systems eligible for the agency or utility rebate program, within 30 days following the installation of relevant equipment, and prior to final payment for electrical work. This documentation shall include, but is not necessarily limited to, copies of invoices for material which lists the quantity of units, the cost to the Contractor, and the separate itemized unit cost of eligible components, such as power supplies, drivers, ballasts, reflectors, or sources. Documentation shall include breakout of taxes, overhead and profit to represent the actual price paid for the equipment by the Owner. Proof of payment of such invoices, and any other documentation required by the local Utility should be available upon request. The Contractor will be notified in advance which items are being proposed for the rebate program and shall proceed with the equipment ordering in an expeditious manner but shall restrain from final purchase of those items until approval has been received from the agency or utility. The Contractor shall provide regular written updates, including any specific impact that a delay in purchasing may have on the cost or timely completion of the work.

2.4 MARKING OF LUMINAIRES

A. Luminaires shall be equipped with markings showing safety specifications, construction safeguards, and minimum resistance to hazard sources operation under fault conditions. Marking shall include manufacturer/distributor’s name, related voltage or voltage range, rated wattage, light output, optical distribution and rated frequency. LED luminaires not suitable for dimming control are required to indicate this clearly in installation instructions or package labelling. Mark luminaires with replaceable sources according to proper source type. Provide markings that are clear and that are located to be readily visible to service personnel, but invisible from normal viewing angles when sources are in place.

2.5 MATERIALS AND FABRICATION

A. Provide luminaires completely factory-assembled and wired and equipped with necessary sockets, power supplies, LED drivers, ballasts, wiring, shielding, reflectors, channels, lenses, integral emergency battery packs (if required) and other parts and appurtenances necessary. Deliver to project site ready for installation and to complete the luminaire installation.

B. Use only completely concealed hardware, unless otherwise noted. Latching of luminaire door frames shall be unobtrusive. Make luminaire free from light leaks by the inherent design of the luminaire body and frame. Bond gaskets, when used, to the luminaire metal. Weld power supply support studs, socket saddle studs and reflector support studs to luminaire body. Flexible leads shall enter luminaires at sides, unless otherwise noted.

C. Minimum gauges sheet steel: 22-gauge for recessed LED and fluorescent, unless thicker gauge required by regulating agency; 18 gauge for unit downlights, unless otherwise specified.

D. Construct luminaires with the minimum number of joints. Make unexposed joints by approved

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method such as welding, brazing, screwing or bolting. Soldered joints are not acceptable.

E. Provide metallic cast or extruded parts of luminaires that are close grained, sound, and free from imperfections or discoloration. Provide cast or extruded parts that are rigid, true to pattern, and of ample weight and thickness. Provide cast or extruded parts that are properly fitted, filed, ground, and buffed finished surfaces and joints free of imperfections. Make thickness on cast parts not less than 1/8in (3mm).

F. Provide housings that make electrical components easily accessible and replaceable, without removing the luminaire body from its mounting.

G. Provide luminaires indicated as "continuous" on drawings or specifications with finished end-to-end or wall-to-wall appearance. Verify run lengths per field conditions prior to ordering. Maximize lighted length to nearest six inches (152mm), with equally spaced unlighted portions at each end, not to exceed 3 inches (76mm) each. Provide continuous louvers and/or lenses into unlighted ends and at corners.

H. Wiring:

1. Provide luminaire wiring between sources, lampholders and associated operating and starting equipment in compliance with UL 1570 and NEC, UL 8750 for LED’s.

2. Make connections of wires to terminals of sources, lampholders and other accessories in a neat and workmanlike manner and which are electrically and mechanically secure, with no loose strands protruding. Provide of the appropriate amount of wires extending to or from the terminals of a source, lampholder or other accessory. These wires shall not be in excess of the number which the accessory is designed to accommodate.

3. Provide wiring channels and wireways free from projections and rough or sharp edges throughout. At points or edges over which conductors shall pass and may be subject to injury or wear, grind to make a smooth contact surface with the conductors. Install insulated bushings at points of entrances and exit of flexible wiring.

I. All interior luminaires shall be UL/ETL/CSA-US listed, “Damp Location” rated at a minimum, with greater protection (UL/ETL/CSA-US “Damp Location” or “Wet Location”) as appropriate or required by code for the application.

J. All exterior luminaires shall be UL/ETL/CSA-US listed, “Wet Location” rated at a minimum (unless otherwise specified). All hardware, including bolts imbedded in lighting pole foundations, shall be stainless steel or equivalent marine grade resistant.

2.6 FINISHES

A. The paint finish/color may affect the heat dissipation from luminaires. Apply luminaire finishes after fabrication in a manner that assures a durable wear-resistant surfacing. Prior to finishing, hot clean the surfaces by accepted chemical means, and treat them with corrosion inhibiting (phosphating) treatment to assure positive paint-adhesion. Give exposed metal surfaces (brass, bronze, aluminum and others) and finished castings except chromium-plated or stainless-steel parts an even coat of high-grade methacrylate lacquer, or transparent epoxy. Anodize exposed aluminum surfaces for corrosion resistance. Make sheet steel luminaire housing, and iron and steel parts which have not received phosphating treatment, or which are to be utilized in exterior applications corrosion resistant by zinc or cadmium plating or hot-dip zinc galvanizing after completion of all forming, welding, or drilling operations.

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B. Electroplate parts operated under temperatures injurious to hot-dipped galvanizing.

C. Cadmium plate screws, bolts, nuts and other fastening or latching hardware.

D. Except where otherwise indicated provide luminaires with a final synthetic, high-temperature baked enamel coating of color and finish as specified or directed. Unless otherwise specified, provide white baked enamel "reflective" surfaces, with a minimum reflectance of 86 percent. Unless otherwise specified, provide potentially visible non-reflective surfaces with a matte-black baked enamel finish. Prior to painting give all parts proper etched surface preparation to assure paint adherence and durability.

2.7 COMPONENTS

A. General:

1. Provide identical power supply and gear within each luminaire type. Provide power supplies and gear that are suitable and UL-listed for the electrical characteristics of the supply circuits to which they are to be connected and which are suitable for operating LED or relevant light sources, including future LED replacement lamps.

2. Unless otherwise specified, provide power supplies and control gear of same type and same manufacturer for ease of stocking and replacement.

3. Components shall be configured and installed in luminaire by the luminaire manufacturer.

4. Components shall not contain Polychlorinated biphenyls (PCBs) and shall be labeled “No PCBs”.

5. Gear housing shall be constructed of painted metal with no sharp edges.

6. Provide only luminaires whose design, fabrication and assembly prevent overheating or cycling of light engines or power supplies under any condition of use.

7. Electronic ballasts shall meet the requirements of the Federal Communications Commission Rules and Regulations, Part 18, Part C (RF Lighting Devices) Non-consumer equipment, regarding radio frequency interference (RFI) (radiated) and electromagnetic interference (EMI) (power line conducted).

8. Submit gear details with luminaire shop drawings.

2.8 TRANSFORMERS FOR LOW-VOLTAGE LUMINAIRES

A. General:

1. Each transformer controlled by a dimmer shall have a suitable choke to eliminate noise during dimming.

2. Secondary wiring shall meet all requirements of this Division and of all applicable local codes. Additionally, secondary wiring shall be sized so that the total average voltage drop on the transformer secondary side does not exceed 3 percent.

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3. Source operating voltage, as measured at the socket, shall be between 11.5-12.1 volt for nominal 12-volt sources, and between 23.0-24.2 volt for nominal 24-volt sources. Contractor shall demonstrate that voltage is within this range if requested.

B. Where a remote transformer is required for interior installations, provide a UL listed remote low voltage power supply which meets or exceeds the following requirements, in addition to those of Paragraph A above.

1. Power supply shall contain a toroidal transformer, primary circuit breaker, and thermal protection.

2. Power supply shall be UL listed, suitable for surface or recessed mounting in both walls and ceilings and require zero clearance to combustible materials.

2.9 SOURCES

A. General:

1. Provide electric sources as required, during construction, including sources for luminaires provided by others.

2. Submit catalogue cuts of all sources to be used in the Work, along with the shop drawing submittal.

B. Solid State Lighting / Light Emitting Diode (LED) Light Sources and Luminaires:

1. General:

a. Luminaire manufacturer shall have a minimum of five (5) years' experience in the manufacture and design of LED products and systems and no less than one hundred (100) North American installations.

b. Unless otherwise specified, luminaire fabrication shall integrate all LED light sources and power/data supplies fabricated by a single manufacturer to ensure compatibility.

c. All components peripheral devices, integrated photosensors, occupancy/vacancy sensors, controllers, even if manufactured or provided by others, shall be the responsibility of a single entity, the luminaire manufacturer. All components shall perform successfully as a complete system. Integrated controls shall be programmed onsite to operate as described in Lighting Control Intent Narrative documents or Appendix - Luminaire Schedule.

d. Provide submittals as described in Part 1 above.

e. Provide two (2) samples of each separate manufacturer and type of LED luminaire if requested in Appendix - Luminaire Schedule. Follow procedure for submitting samples as described in Part 1 above.

f. Include all components necessary for a complete installation. Provide all power supplies, synchronizers, data cables, and data terminators for a complete working system.

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g. All white light LED sources within the same luminaire type shall be within two (2) MacAdam ellipses/steps of each other.

h. All LED sources used in the LED luminaire shall be of proven quality from established and reputable LED manufacturers and shall have been fabricated within 12 months before installation per the date code on the module. Acceptable LED component or module manufacturers unless otherwise noted are:

Cree, Inc. Lumileds
Nichia Corporation Norlux
Lextar
Osram Optronic Semiconductors Xicato
Bridgelux Epistar San'an
Citizen Electronics General Electric Company Soraa
Samsung
Seoul Semiconductor Lumenetix
Ledengin

2. Replacement and Spares:

a. Manufacturer shall provide written guarantee of the following:

1) Manufacturer's LED system or equivalent system will be available for ten (10) years: Manufacturer will provide exact replacement parts, complete replacement luminaires, or provide upgraded parts that are designed to fit into the original luminaire and provide equivalent distribution and lumen output to the original, without any negative consequences.
2) Manufacturer will keep record of original chromaticity coordinates for each LED module and have replacement modules or luminaires from within two (2) MacAdam Ellipses/ steps of the same coordinates available.
3) Manufacturer will keep an inventory or ability to supply replacement parts or complete fixtures within two (2) weeks for component parts or the standard lead time of the original fixture for a complete fixture for duration of warranty period.

b. All parts of system shall be replaceable in the field as specified in Appendix - Luminaire Schedule.

c. System shall carry a full warranty for a minimum of three (3) years from the date of shipment (or longer if required by the project, also refer to Division 1 – General Requirements for further warranty requirements). Manufacturer shall be responsible for a cost of labor and shipping as agreed between parties, to replace any component of the system that fails within the warranty period.

3. Products and Components – Performance

a. LED luminaires and components shall be approved by an NRTL facility such as UL, ETL or CSA/US.

b. For applicable fixtures: all products included in system shall use Mil-Std 810F, Random Vibration 7.698g as a minimum standard. In installations subject to vibration, luminaire shall be installed with vibration isolation hardware to sufficiently dampen vibrations.

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c. All LED components shall be mercury and lead-free.

d. All manufacturing processes and electronic materials shall conform to the requirements of the European Union's Restriction on the Use of Hazardous Substances in Electrical and Electronics Equipment (RoHS) Directive, 2002/95/EC.

e. LEDs shall comply with ANSI/NEMA/ANSLG C78.377-2008 – Specifications for the Chromaticity of Solid-State Lighting Products. Color shall remain stable throughout the life of the source. The chromaticity of the installed product shall match IES LM-80 data showing that the LED's do not shift more than .005 DuV from an approved sample or submitted documentation.

f. LEDs testing shall be performed in accordance with IES LM-80 - Approved Method for Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules.

g. LEDs shall have a minimum rated source life of 50,000 hours or as specified in Appendix: Luminaire Schedule. LED "rated source life" shall be determined per IES TM-21 - Projecting Long Term Lumen Maintenance of LED Light Sources based on LM-80 test data. Calculated lifetimes not exceeding testing hours per TM-21 are not accepted.

h. Luminaire assembly shall include a method of dissipating heat to prevent degradation of source life, electronic equipment, or lenses. LED luminaire housing shall be designed to transfer heat from the LED board to the outside environment. Luminaire housing shall have no negative impact on life of components. High power LED luminaires shall be thermally protected using one or more of the following thermal management techniques: metal core board, gap pad, and/or internal monitoring firmware

i. Luminaire shall be tested and suitable to operate under a minimum of two (2) case temperatures: 55°C (131°F) and 85°C (185°F) and a relative humidity under 65 percent.

j. Manufacturer shall supply in writing a range of permissible operating temperatures and relative humidity levels in which system will perform optimally. LEDs shall be adequately protected from moisture or dust in interior applications.

k. All hardwired power connections to LED luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed, shorted or otherwise mis-wired during the installation process.

l. LEDs shall not be overdriven beyond their specified nominal voltage and current.

m. Manufacturer shall be able to provide supporting documentation of the product meeting third party regulatory compliance.

n. Manufacturer shall ensure that products undergo and successfully meet appropriate design and manufacturability testing including Design Failure Mode & Effects Analysis, Process Failure Mode & Effects Analysis, Environmental Engineering Considerations and Laboratory Tests, IEC standards and UL/CE testing.

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o. Manufacturer shall provide Luminaire Efficacy (lm/W), total luminous flux (lumens), luminous intensity (candelas), chromaticity coordinates, CCT and CRI. optical performance, polar diagrams, and relevant luminance and illuminance photometric data. Provide data in IES file format in accordance with testing standards IES LM-79-08 and IES LM-82-12, based on test results from an independent Nationally Recognized Testing Laboratory or National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory.

4. All color characteristics, CCT, CRI, Color Fidelity, CIE Chromaticity Coordinates shall be consistent across the entire dimming range.

5. Luminaires shall have less than 30 percent flicker at frequencies of 200Hz or below at 100 percent and percent light output and/or meet IEEE standard PAR 1789.

C. LED Power Supplies/ Drivers:

1. LED driver shall have a minimum 50,000 hour published life while operating at maximum case temperature and 65 percent non-condensing relative humidity.
2. Driver shall be Sound Rated A+.

3. Driver shall be > 80 percent efficient at full load across all input voltages.

4. Driver shall include ability to turn off at low control input rather than holding at a minimum dimming level and shall consume 0.5 Watts or less in standby/off mode. Control deadband at low control input shall be included to allow for voltage variation of incoming signal without causing noticeable variation in luminaire to luminaire output.

5. Drivers shall track evenly across multiple luminaires at all light levels and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range.

6. Control Input:

a. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers
   1) Must meet IEC 60929 Annex E for General White Lighting LED drivers.
   2) Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V.
   3) Must meet ESTA E1.3 for RGBW LED drivers.
b. Digital (DALI Low Voltage Controlled) Dimming Drivers
   1) Must meet IEC 62386.
c. Digital Multiplex 512 (DMX Low Voltage Controlled) Dimming Drivers
   1) Must meet DMX / RDM: USITT DMX512A and ANSI E1.20 (Explore & Address).
   2) Must be capable of signal interpolation and smoothing of color and intensity transitions.

D. Other:

1. For other luminaires, provide sources as specified. If specification is not complete, request clarification before ordering equipment.

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2.10 REFLECTORS

A. Reflectors:

1. Provide reflectors and reflecting cones or baffles fabricated from aluminum/plastic reflector sheet no less than minimum thickness listed below for each application, Reflector shall be absolutely free of tooling marks including spinning lines, and free of marks or indentation caused by riveting or other assembly techniques. No rivets, springs, or other hardware shall be visible after installation.

    a. Cones: 0.0500in (1.27mm)
    b. Wall wash kicker panels in cones: 0.0400in (1.01mm)
    c. Reflectors (non-structural: 0.0235in (0.59mm)
    d. Louvers/Baffles: 0.0200in (0.50mm)

2. Provide reflectors and baffles of first-quality polished, buffed and anodized finish, "Alzak" or approved equal, and with specular or semi-specular finish color to be clear, unless specified otherwise. Provide reflector and baffles which produce no apparent brightness nor a source image, nor shall any part of the source be visible from 50° above nadir to 90° above nadir (vertical). That is, the reflector shall have a maximum 50° cutoff angle and a minimum 40° shielding angle.

3. Provide other aluminum reflectors where required and formed and finished as noted on drawings and elsewhere in the specifications. Provide only reflectors free from blemishes, scratches, or indentations which would distort their reflective function and finished by means of the "Alzak" process, or approved equal, unless otherwise noted. No rivets, springs, or other hardware shall be visible after installation.

4. For luminaires employing multi-color sources or sources emitting more than one distinct frequency of color, provide reflectors, cones, or baffles with low iridescent coating on all surfaces seen from normal viewing angles.

5. Anodized aluminum reflectors shall have the following characteristics:

    a. Specular:
        1) 2 mg/in^2 (0.31 mg/cm^2) minimum Weight of Coating (Anodizing process. Coating of aluminum oxide: Reference ASTM Test Method B-137)
        2) 86 minimum Total Hemispherical Reflectance and 70 minimum Specular Component (Reference ASTM Test Method E-903-82 (testing utilizing a TR1 or TR2 Total Reflectometer is also acceptable pending issuance of ASTM standard))
        3) 90 minimum Visual Clarify and 0.03 minimum Diffuseness at 15° (c) (Reference ASTM Test Method E-430-78 (1983))

B. Painted Reflectors:

1. Reflectors shall be completely formed before application of primer and enamel color coat or coats.

2. When requested, submit a sufficient quantity of flat steel panels having the identical primer and color coat or coats applied in the same manner as proposed for the contract items.

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3. Tests will be required only in case of dispute about reflector characteristics. Tests may be required at any time before or during Contractor's warranty period. Contractor will pay the cost of tests, if required. Reflectors which do not meet the criteria expressed here will be replaced at Contractor's expense, with reflectors meeting specified requirements.

4. Tests:
   a. Painted reflectors shall have an initial reflection factor not less than 86 percent in the visible range of 400-700 nanometers as per ASTM Method E-424-71 as determined by independent laboratory test of fading, tested in the following manner: One half of sample shall be covered and remaining half shall be exposed to a 150 watt sunlamp placed 1/2in (12.7mm) above reflective surface for 72 hours. Comparison of exposed and unexposed sides shall show no visible fading or deterioration in appearance or reflectance.
   b. The percentage of Specular Gloss shall be a minimum of 80 percent as determined by ASTM Method D-532-T, Procedure A.

2.11 LENSES / FACEPLATES / TRIM

A. Where plastic lens is indicated, provide lens of 100 percent virgin acrylic (polymethyl methacrylate), nominal 0.125in (3mm) thick, unless otherwise indicated. Lens is to be strain-free, uniform in appearance, and destaticized.

B. Where clear acrylic lens is indicated, provide lens with a minimum visible light transmittance of 92 percent, unless otherwise indicated.

C. Where prismatic acrylic lens is indicated, lens shall be composed of 3/16in (4.7mm) square non- convex prismatic cones of maximum 0.080in (2mm) depth and aligned 45 degrees to the length and width of the lens panel, unless otherwise specified. Lens shall be a minimum of 7.5 oz. per square foot (2289g/m2). Lens shall have minimum 80 percent visible light transmittance.

D. Where diffuse acrylic lens is indicated, lens shall be diffuse frosted white, high transmission acrylic with a minimum 73 percent visible light transmittance unless otherwise indicated. Provide nominal 0.125in (3mm) thick lens unless otherwise specified.

E. Where acrylic “overlay” is indicated, lens shall be supported by other rigid luminaire members, such as louvers or shelves. Lens shall be white or clear, as specified, with a minimum 79 percent visible light transmission for white lenses, and a minimum 83 percent transmission for clear lenses. Provide 0.040in (1mm) thick lens unless otherwise indicated.

F. Make lenses, louvers, or other light diffusing elements contained in frames removable, but positively held within the frames so that hinging or other motion of the frame will not cause the diffusing element to drop out.

G. For recessed luminaires with trim that is removable or open for access to the interior of the luminaire, and serves as a ceiling trim, provide trim that is positively held to the luminaire body by adjustable means that permit the trim to be drawn up to the ceiling as tight as necessary to insure complete contact of faceplate with ceiling surrounding the luminaire.

2.12 RATED LOCATION LUMINAIRES

A. General:

1. Provide luminaires designed and manufactured specifically for “rated” (e.g., damp, wet,

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shower, hazardous) location service. Components, including nuts, bolts, rivets, springs, and similar parts shall be made of materials of effective corrosion resistance, or of materials which have been subjected to finishing treatment which will assure such resistance.

2. Provide anodized aluminum for aluminum parts of exterior luminaires that are not specified as requiring a painted finish.

3. All luminaires shall be constructed according to UL procedures and listed by UL ETL or CSA-US for the appropriate category.

B. Damp Location:

1. In addition to the requirements of paragraph, above, damp location luminaires shall meet or exceed the following criteria:

a. Provide metal parts of luminaires, which are specified as requiring painting, for use in indoor, outdoor or damp locations, which are painted with suitable weather and/or moisture resisting qualities.
b. Provide luminaires for use outdoors, or in areas designated as damp locations, which are suitably and effectively gasketed to prevent access of moisture into electrical components or enclosing diffusers, lenses or globes.
c. Luminaires shall be UL, ETL or CSA-US listed for damp locations.

C. Wet Location:

1. In addition to the requirements of Paragraphs above, wet location luminaires shall meet or exceed the following criteria:

a. Any exposed luminaires shall be UL, ETL or CSA/US rated for wet locations.
b. Provide luminaires for use outdoors, or in areas designated as wet locations, which are suitably and effectively gasketed to prevent access of moisture into electrical components or enclosing diffusers, lenses or globes.

D. Bathtub and Shower Locations:

1. In addition to the relevant requirements of paragraphs above, “Bathtub and Shower” location luminaires shall meet all applicable local codes and standards.

a. Luminaire shall be damp location rated.
b. Luminaire shall be recessed or surface-mounted at or above 8 feet (2.43m) above and at least 3 feet (0.91m) horizontally from the highest point in the shower (threshold) or the tub (tub rim).
c. Luminaires used in or near showers, or in similar locations, shall be UL or ETL listed specifically for such use.
d. Provide damp/wet location luminaires with a suitable IP rating for their planned environment, unless otherwise specified in Appendix – Luminaire Schedule.
1) Luminaires located in bathtub and showers shall have a minimum IP65 rating.

2.13 LUMINAIRE DESCRIPTIONS

A. General:

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1. Provide luminaires which conform to the above standards and criteria, as indicated on the drawings, and as indicated below and in APPENDIX - Luminaire Schedule.

2. Verify mounting conditions and trim for all luminaire types.

3. Verify all voltages, and verify which luminaires require ducted or plenum air supply or return capability or are to be static.

4. Catalogue or series numbers, when shown herein, are intended to assist in establishing general type or category of luminaires. Provide a luminaire that meets the complete performance descriptions, as well as information provided by detail drawings. Standard catalogue cuts, when included, are for general assistance. Written luminaire descriptions are the primary basis for luminaire specification. The Luminaire Schedule in the Appendix supersedes any legend or schedule on the Electrical Drawings.

5. The terminology "Or Approved Equal" if and only if used on the Luminaire Schedule, means the following: Products fabricated by alternative manufacturers to those listed may be submitted under the terms of the substitution clauses outlined in this Section. The products must meet the specifications in every way. Any substitutions or alternatives may be accepted or rejected without a detailed explanation.

6. Provide timely and written notification of any discrepancies between drawing and specifications before submitting bids. If such discrepancies are not resolved prior to the end of the bid period, the more costly alternative will be considered as included in the bid price. See paragraph above regarding definition of Acceptable Manufacturers.

7. All finishes are to be factory applied, including colored flanges and trims.

B. LUMINAIRE SCHEDULE: SEE SECTION 26 51 13 APPENDIX LUMINAIRE SCHEDULE AT THE END OF THIS SECTION.

1. Complete specifications for the components (sources, power supplies, LED drivers, ballasts, reflectors, lenses, etc.) of luminaires described below are found above in Part 2. The Luminaire Schedule below supersedes any similar legend or schedule issued previously or issued concurrently on the Drawings. Provide timely and written notification of any discrepancies before preparing any bids or proceeding with any work.

2. Descriptions for additional luminaire types, specified by the Electrical Engineer, may be located on the Electrical Drawings.

2.14 POLE/LUMINAIRE ASSEMBLIES

A. Supply luminaires, davit arms, brackets, poles, handhole covers, base components, and all other accessories complete by specified manufacturer who will be responsible for proper fitting of all elements.

B. Manufacturer will supply assembly to withstand 100 mph winds with a 1.3 gust factor without permanent deflection.

C. Manufacturer shall be responsible for design of and structural integrity of pole and complete base (i.e., concrete dimensions, rebar requirements, grounding and conduit requirements,

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drainage and ground compaction requirements under the specific installation conditions for the project).

PART 3 - EXECUTION

3.1 GENERAL

A. Install luminaires complete with light sources, as indicated, and with equipment, materials, parts, attachments, devices, aligner and filler clips, hardware, hangers, cables, supports, channels, frames and brackets necessary to make a safe, complete, and fully operative installation.

B. Verify and provide luminaires that are appropriate for the ceiling and mounting conditions of the project.

C. Coordinate with other trades as appropriate to properly interface installation of luminaires with other work.

D. Reject and do not install blemished, damaged, or unsatisfactory luminaires. Replace imperfect or unsatisfactory luminaires, if installed, as directed.

E. Set luminaires, when installed, to be true, and free of light leaks, warps, dents, or other irregularities. No light leaks are permitted at the ceiling line or from any visible part or joint of the luminaires. Install luminaires plumb, square, and level with ceiling and walls, in alignment with adjacent luminaires, and secure in accordance with manufacturers' directions and approved shop drawings. Install all adjacent and continuous luminaires straight and trued, aligned in both plan and elevation. Supply and install alignment rods or joint straps as required to achieve this effect.

F. Provide finish for exposed parts or trims as specified. If not indicated, provide a finish as directed.

G. Do not install reflector cones, aperture plates, lenses, diffusers, louvers, and decorative elements of luminaires until completion of wet work, plastering, painting and general clean-up in the area of the luminaires.

H. Mount luminaires at heights and locations indicated on the Contract Drawings, or as required by Architect. Mounting heights specified or indicated are to be to the bottom of each luminaire for suspended and ceiling-mounted luminaires, and to the center of each luminaire for wall-mounted luminaires, unless otherwise noted. Obtain approval of the exact mounting for luminaires on the job before installation is commenced and, where applicable, after coordinating with the type, style, and pattern of the surface being installed.

I. Conform to the requirements of NFPA 70, and all other relevant codes. Supports shall be suitable for local seismic zone.

J. In Mechanical Equipment Rooms, luminaires shall be hung from ceilings after piping and equipment therein has been installed. Exact locations for such luminaires shall be determined at the job site during the course of the Work, in coordination with the mechanical work.

K. Adequately protect the housing of recessed luminaires during installation by internal blocking or framing to prevent distortion of sides, or dislocation of threaded lugs, which, upon completion, shall be in perfect alignment and match the corresponding holes in frames or rims. Holding

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screws shall be inserted freely without forcing and shall remain easily removable for servicing.

L. Ground non-current-carrying parts of electrical equipment in accordance with UL and NEC provisions.

M. Upon completion of installation of luminaires, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at the site, then re-test to demonstrate compliance. Otherwise, remove and replace with new units, and proceed with re-testing. Coordinate all test times and requirements with the Architect or Construction Manager.

1. For normal and emergency building lighting, upon completion of the installation, conduct an operating test to show that the equipment operates in accordance with the requirements of this and other relevant sections.
2. Test all wiring with an insulation testing instrument, both before and after connection of luminaires and equipment. The minimum resistance shall be 250,000 ohms.

N. Upon completion of the installation, the luminaires and lighting equipment shall be in first class operating order and free from defects in condition and finish. At time of final inspection, all luminaires and equipment shall be clean, fully lamped, and be complete with required lenses or diffusers, reflectors, side panels, louvers, or other components necessary for the function of the luminaires. Any reflectors, lenses, diffusers, side panels or other parts damaged prior to the final inspection shall be replaced prior to inspection.

O. At the time of substantial completion and prior to field tests, replace lamps (excluding LED lamps and light engines) in interior luminaires which have been operating more than six months, or as work lights, or which are observed to be noticeably dimmed after use and testing during the construction period.

P. Luminaires and sources that are part of the Work of this section shall not be used for work lights during construction, except in Mechanical Equipment rooms. Provide adequate portable or temporary lighting for construction.

Q. Vibration Isolation: Mount and support all luminaires in such a manner to isolate the luminaire from structure-borne vibration, including but not limited to vibration caused by fans, motors, moveable tracks, moveable partitions, portable carts, vehicles, etc.

3.2 ACCESSIBILITY

A. Install equipment such as junction and pull boxes, luminaire housings, transformers, power supplies, ballasts, switches and controls, and other apparatus that shall be reached from time to time for operation and maintenance, to be easily accessible and appropriate for mounting and ceiling conditions.

3.3 SUPPORTS

A. Luminaires shall be securely fastened as per manufacturer's instructions. Provide plaster frames or mounting frames for luminaires that require them. Such frames shall be appropriate for the ceiling construction in which they are installed.

B. Provide necessary hardware with luminaires, such as stems, plates, plaster frames, hangers and similar items, for safe support of the luminaire. Provide plaster frames made of non-ferrous

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metal, or of steel that has been suitably rustproofed after fabrication, as described above.

C. Provide supports for luminaires that are adequate to support the weight of the luminaires.

D. Provide hanging devices which, if visible from normal viewing angles, exactly match luminaire finishes specified, unless otherwise noted.

E. Where necessary to meet fire resistance requirements of Building Code authorities, provide enclosures housing recessed luminaires that are constructed to meet or exceed required fire resistance rating.

F. Provide attachment devices including brackets and cast metal shapes with the requisite rigidity and strength to maintain continuous alignment of installed luminaires. Attach luminaires to ceiling support members, and do not depend upon lathing, plaster or ceiling tile for alignment or support.

G. Provide luminaires mounted in suspended ceilings that are supported by saddle hangers or the bars attached to runners or between crossbars of ceiling systems. Provide mounting splines or other positive means of maintaining alignment and rigidity.

H. Provide supporting members that are surface passivated, and which are primed or paint-dipped to resist corrosion.

I. Provide fastening devices of a positive locking type, which do not require special tools to apply or remove them. Do not use tie wires in place of fastening devices.

J. Contractor is responsible for the necessary suspension system. Contractor shall ascertain the structural reliability of supports provided under other Sections of the specification.

K. Attach reflectors to housings by means of safety chains, which shall prevent reflectors from falling. No part of the chain may be visible after installation, when viewed from any angle up to 50 degrees from the vertical.

L. Provide pendant or surface mounted luminaires with required mounting devices and accessories, including hickeys, stud-extensions, ball aligners, canopies, and stems. Uniformly maintain the luminaire heights shown on the Contract Drawings or established in the field. The allowable tolerances in individual luminaire mounting shall not exceed 1/4 inch (7mm) and may not vary more than 1/2 inch (14mm) from the mounting height shown on the drawings. Install luminaires hung in continuous runs absolutely level, and in line with each other. Hanging devices shall comply with code requirements.

M. Provide an approved ceiling canopy for each stem, exactly matching specified finishes.

N. Place stems to be vertical and plumb.

O. Provide at least two rigid supports for individually mounted suspended linear luminaires. Where luminaires are ganged, provide supports at 8-0 inch (2438mm) intervals, unless otherwise indicated.

P. Recessed and semi-recessed luminaires:

1. Support rods or wires shall be provided with a minimum of four rods or wires per luminaire and located not more than 6 inch (152mm) from each corner of each luminaire.

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2. Do not support luminaires by ceiling acoustical panels.
3. Where luminaires of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such luminaires independently or with at least 2 ¾ inch (19mm) metal channels spanning and wired to the ceiling tees.
4. Provide rods or wires for luminaire support under this section of the specifications.

Q. Seismic Protection for Lighting Luminaires: Provide luminaires and support to meet all applicable local codes and standards.

3.4 AIMING AND ADJUSTMENT:

A. Provide labor and tools for final aiming, focusing and adjustment, under the Architect's and Lighting Consultant's supervision, of all adjustable luminaires after regular working hours, and after dark in daylighted areas, whenever necessary, at no additional cost to the project. All luminaires shall be locked into place so that the aiming is not disturbed during future replacement of light source or power supply.

B. Request preliminary aiming diagrams during the shop drawing submittals. If aiming diagrams are provided, pre-aim those luminaires during installation or prior to final aiming.

C. If colored or diffusing filters are specified, supply up to four (4) theatrical gels for each luminaire type, in colors to be selected by the Architect after installation. Place alternate gels over the luminaires as requested. When the final colors are selected, order the filters from the manufacturer, and install them. Note that the time between ordering and shipping may be approximately four weeks.

D. When extra lenses, louvers or shields are specified, change accessories until a final selection is made.

E. Note final aiming and locked positions and include that information in the O&M manual.

3.5 CLEANING

A. Immediately prior to occupancy, clean reflector cones, reflectors, aperture plates, lenses, louvers, sources and decorative elements. As per manufacturer's instructions, de-staticize lenses after cleaning, installing them to leave no finger or dirt marks.

B. Upon completion of the luminaire installation and at the time of final inspection, luminaires shall be clean, and free from marks, dust, spotting or other defects. Replace any broken or defective parts prior to final inspection. Replace or make good all defects revealed by final inspection.

C. Protect installed luminaires from damage during the remainder of construction period.

3.6 COMMISSIONING

A. For any luminaire, power supply, LED driver, ballast, or lighting control system, provide a complete and operational system which meets or exceeds the performance specified.

B. The Owner shall provide for or engage an independent commissioning agent to verify that all components and system as a whole meets design intent and to evaluate the Contractor's work. This includes evaluation and verification of all adjustable features, such as aiming angles, time

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clock settings, sensitivity settings, high end trim, fine tuning, customized settings, etc. Provide labor and equipment after normal working hours to correct and adjust system, working with or without direct supervision of commissioning agent until reasonable satisfaction has been achieved.

C. Provide Spares, as described in Part 2 above.

D. Submit a maintenance manual and operational submittals, as called for in Part 1 above, and under the conditions of the relevant General Requirements. After submittal is reviewed, make changes and resubmit, if necessary. After review and approval, this manual will be kept on site for reference use by facility maintenance personnel.

E. Assemble and submit in either a bound 8.5in x 11in (216mm x 279mm) format or electronic format, as confirmed by Owner, an Operation and Maintenance Manual that includes the following:

1. A chart clearly documenting the luminaire, source, power supply, LED driver and/or ballast actually installed for each luminaire type, with product designations sufficient for reordering new product and components to match those installed.

    a. For Digital Addressable Fixtures: A chart clearly documenting luminaire type, Make/Model, location, digital address, control address, for client operation and for future maintenance.

2. A current list of lighting distributors, manufacturers and manufacturer's representatives, (for the purposes of replacement, reordering or trouble-shooting). This list shall be keyed to the list of luminaires, sources, power supplies, LED drivers and ballasts, so that the Owner has a name, address and phone number of at least two (2) contacts for each product or component.

3. Shop drawings, technical data sheets, product technical documents, installation instructions, cut sheets, operating instructions, calibration instructions, andtroubleshooting guides in the installation, including but not limited to sources, power supplies, LED drivers, ballasts and lighting control devices.

4. Color-coded as-built drawings showing all source, power supply, LED drivers and ballast types, to facilitate replacement. O&M Walk-through: Transfer of the O&M document will include a thorough walk-through and demonstration of equipment by Contractor for facility personnel.

F. Owner Training: At the Owner's convenience, provide a minimum of four (4) hours, not to exceed eight (8) hours, of expertise and training concerning the installation, characteristics, operations and maintenance of the Work of this Section. Such training shall take place after the Owner has been provided the final approved maintenance and operational submittals mentioned above.

G. Video-tape the training session and provide two (2) copies on flash/thumb drives, or DVD. Alternative electronic formats may be provided if mutually agreed upon.

H. Solid State Lighting / Light Emitting Diode LED luminaires:

1. Color Changing or Programming Support
    a. Manufacturer shall provide installation and commissioning support to the electrical

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contractor as required to achieve a complete and operational system that meets the intent of the Control Intent Narrative.

b. The lighting controls Integrator shall assist the Contractor and ensure that the color changing system is installed, programmed and operating correctly, that all integral sensors are functioning properly and to verify luminaire performance. Integrator shall coordinate with contractors, other required disciplines and with luminaire manufacturers to ensure that the lighting color-changing and/or control system is coordinated between the various disciplines for a fully functioning system. Commissioning shall include intermittent testing of lighting system and other components during the process of construction, as well as up to__(X) full days of programming sessions with the owner's representatives and lighting designer This shall be subsequent to the final completion of system start-up. Additional programming days may be added as required.

c. Two (2) full day follow up site visits shall be provided by the Commissioning Agent and Integrator to ensure lasting functionality update of the lighting control system. The first visit shall take place three (3) months after installation and the second shall take place one (1) year after the installation.

END OF SECTION

APPENDIX A: LUMINAIRE SCHEDULE

APPENDIX B: LUMINAIRE CUTSHEET PACKAGE

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SECTION 270000

BASIC COMMUNICATIONS REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes general administrative and procedural requirements for Division 27, and is intended to supplement, not supersede, the general requirements specified in Division 00.

B. The requirements described herein include the following:
1. References
2. Definitions
3. System Description and Project Conditions
4. Submittals
5. Quality Assurance
6. Delivery, Storage, and Handling
7. Sequencing
8. Owner's Instructions
9. Scheduling
10. Warranty
11. Start Up
12. Commissioning
13. Maintenance
14. Product Substitutions
15. Project Management and Coordination Services
16. Permits and Inspections
17. Field Quality Control
18. Project Closeout and Record Documents

C. Related Items
1. General and Supplementary Conditions: General provisions of the Prime Contract and Divisions 00 and 01 apply to Division 27.
2. Consult other Divisions and Sections, determine the extent and character of related work, and coordinate Work of Division 27 with that specified elsewhere to produce a complete and operable installation.
1. Section 270526, "Communications Common Bonding Network"
1. Section 270528, "Communications ISP Pathways"
3. Section 270529, "Communications Supports and Hangers"
4. Section 270533, "Communications Building Pathways – Conduits and Boxes"
5. Section 270811, "Communications Twisted Pair Testing"
6. Section 270821, "Communications Fiber Optic Testing"
7. Section 271100, "Communications Equipment Rooms"
8. Section 271323, "Communications Bkbn ISP Fiber Cabling"
9. Section 271513, "Communications Horizontal Twisted Pair Cabling"
10. Section 274116, "Integrated Audio Video Equipment"

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SECTION 270526

COMMUNICATIONS COMMON BONDING NETWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Common bonding network for telecommunications,

B. Work Includes
1. The work under this section includes materials, accessories, labor and associated services required to form a common bonding network for telecommunications systems that will accept connections from telecommunications infrastructure and ITE for the purpose of proving a low impedance path to the building's grounding electrode system. The work under this section also includes coordination through the General Contractor with other trades. This specification lists major equipment but not every wire support, fastener, hardware, etc., required for a complete and professional installation.
2. Refer to "System Description" for a detailed description of the base bid work.
3. Provide labeling consisting of, in general, 1 label at each end of each bonding conductor and each busbar.
4. Testing of the completed system.

C. Related Sections
1. Comply with the Related Sections requirements of section 270000.
2. Section 260526, "Grounding"

1.2 REFERENCES

A. Comply with the References requirements of section 270000.

B. In addition to the codes and standards listed in section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
1. California Administrative Code, Title 24, Part 3, "California Electrical Code" (CEC)
2. National Fire Protection Agency (NFPA) 780, "Installation of Lightning Protection Systems"
3. Telecommunications Industry Association (TIA) ANSI/TIA-607-D, "Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises"
4. Building Industry Consulting Services, Inc. (BICSI) "Telecommunications Distribution Methods Manual" (TDMM)
5. Underwriters Laboratories, Inc. (UL):
   a. UL 467, "Grounding and Bonding Equipment"
6. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. IEEE 142 "Recommended Practice for Grounding of Industrial and Commercial Power Systems"
   b. IEEE P1100, "Recommended Practice for Powering and Grounding Electronic Equipment in Industrial and Commercial Power Systems"

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SECTION 270528

COMMUNICTIONS BUILDING PATHWAYS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Pathway systems within buildings to support telecommunications, Security, Audio Visual and other signal systems' cables.

B. Work Includes:
1. The work of this section includes planning and coordination with General Contractor and other trades of inside plant pathway systems and components, furnishing necessary materials, and labor and associated services required to install these pathways.
2. Acoustical Mitigation: The work of this section shall meet the project's acoustical requirements, where applicable to construction assemblies and penetrations. For example, fire rated sleeves through walls shall not reduce the sound isolation below the wall's specified value. Check each penetration instance against the acoustical requirements to ensure that the composite sound isolation performance of the penetration meets or exceeds the minimum performance. If needed to mitigate acoustical performance issues, provide acoustical treatments as specified in the project's documentation.
3. Cable Hangers
   a. Provide cable hangers between primary pathways or telecommunications rooms and work area pathways and/or outlet locations as needed to properly support communications and signal systems cables. Provide dedicated supports and attachments for cable hangers.
      1) "As needed" - The contract drawings do not explicitly show quantities and locations of hangers. Provide hangers, supports, and related work to meet the requirements of this section and related sections.
      2) Refer to section 270529 for information and requirements covering supports applicable to cable hangers, including drop wires and drop rods with their associated attachment methods.
4. Fire Rated Sleeves / Firestopping Systems
   a. Provide fire rated sleeve systems where cables penetrate fire-rated walls whether or not explicitly shown on the contract drawings.
   b. Provide a system label at each penetration instance.
5. Smoke and Acoustic Rated Sleeves
   a. Provide 'smoke and acoustic' sleeves where cables penetrate a non-fire-rated smoke partition and where cables penetrate a non-fire-rated acoustically rated partition whether or not explicitly shown on the contract drawings.
   b. Provide a system label at each penetration instance.
   c. Provide surface raceway system as shown on the contract drawings or where approved to support, protect, and conceal communications and signal cables.
   d. Per instance, paint surface raceway to match existing walls and as directed by the project's architect.
6. Spiral Wrap
   a. Provide spiral wrap to support and dress cables from feed pathways to the point where the cables enter the furniture system.

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SECTION 270529

COMMUNICATIONS SYSTEMS SUPPORTS AND HANGERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Supports, hangers, attachments, anchors, and fasteners for communications and signal systems' pathway systems (such as conduit systems), equipment racks and cabinets, enclosures, panels, equipment, and devices, including the following:
   1. Trapeze supports for cable trays, conduits, and cables
   2. Threaded rod supports for cable trays, conduits, cable hangers ("J-hooks"), and cables
   3. Drop wire and drop rod supports for cable hangers ("J-hooks")
   4. Anchoring and fastening for supports, hangers to building structure
   5. Non-penetrating roof mounts and supports

B. Work Included
   1. In general, the base bid work includes:
      a. Project management services through closeout
      b. Pre-construction and construction planning and coordination with the General Contractor and other trades
      c. Structural calculations performed by a state licensed structural engineer
      d. Coordination with other trades, including potential construction efficiencies
      e. Submittals
      f. Construction of supports, hangers, fasteners, anchors, attachment means, and related components associated with communications pathways and equipment
      g. Testing: Where required by code and/or AHJs, provide lab testing and/or field testing to satisfy requests for additional information or proof of performance (such as strength test, pull-out test, and the like).
      h. Post-installation adjusting and testing (where applicable)
      i. Identification and labeling (where applicable)
      j. Closeout documents
      k. Warranty
   2. The contract drawings do not show each and every required support and hanger. The scope of work includes reasonably inferred basic construction materials components, labor, and associated services as required to satisfy the design intent, including but not limited to the following:
      a. Threaded rod and associated hardware (nuts, washers, etc.)
      b. Channel/strut
      c. Concrete anchors, drop-in inserts, and/or expansion bolts
      d. Concrete fasteners, powder-actuated pins
      e. Beam clamps, beam clips, purlin clips

C. Work Provided Under Other Sections
   1. Conduit systems, including pull boxes
   2. Cable hangers ("J-hooks")
   3. Enclosures, system panels, and system equipment
   4. Equipment racks, IT cabinets
   5. Fire-rated sleeves and firestopping systems

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SECTION 270533

COMMUNICTIONS BUILDING PATHWAYS – CONDUITS AND BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Conduit and box systems as pathways within buildings to support communications and signal systems

B. Work Includes

1. Provide materials and labor, whether explicitly mentioned herein or not, needed for complete conduit systems to satisfy the requirements of this section and the related drawings. “Complete” shall include reasonably inferred conduits, elbows, supports, fittings, connectors, couplers, straps, pull boxes, box supports, etc., necessary for a complete installation. The work includes supports, hangers, and basic construction materials that may not be explicitly specified herein or called out on the drawings, such as: concrete anchors, inserts, and/or expansion bolts; concrete fasteners; powder-actuated pins; construction channel/strut; threaded rod; wood fasteners (lag screws); beam clamps; purlin clips; stud box supports/brackets; floor-mount box supports; T-bar ceiling box support bar; channel-mount box supports; bonding pigtails; drywall ring (for ring & string); etc. Refer to section 270529 for supports and hangers. This specification lists major equipment but not every accessory, support, strap, clamp, U-bolt, fastener, etc., needed to complete the work. Further, the drawings do not explicitly show each and every conduit run needed for the project. Apply the guidelines described in this section and on the drawings to support the cabling described in Division 27 and shown on the technology systems drawings, and provide reasonably inferred standard conduits, fittings, and products required to complete the conduit installation to meet the design intent.
2. Expansion Joints/Fittings: Provide expansion joints as approved by a state-licensed structural engineer and/or fittings to conduit where required per CEC and where necessary.
3. Conduit bodies or ‘condulets’ (LBs, etc.) are prohibited in conduit systems for use to support telecommunications and audiovisual cables.
3. Acoustic Treatments: Provide acoustic treatments and/or acoustically rated systems where conduits penetrate acoustically rated walls/partitions/assemblies.
4. Innerduct / Subducting
   a. Provide innerduct/subducting within backbone conduits in accordance with CEC and the UL listing information.
   b. Refer to drawings for routes requiring innerduct/subducting and innerduct/subducting sizes and types.
4. First-In-Place: Install a single unit of work. As requested by the Owner, Owner’s Representative, Engineer, or the General Contractor, install a conduit bank with trapeze support as a first-in-place using the approved products and installation means intended to be used throughout the building. The installation shall demonstrate conduit racking, support means, connections, seismic bracing (as applicable), and quality. Coordinate a meeting for the Owner and Engineer to review the installation. Proceed after obtaining written approval from either the Engineer or the Owner.
5. Labeling: Provide permanent labels on conduit ends and pull box lids.

C. Related Sections

1. Comply with the “Related Sections” paragraph of section 270000.

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SECTION 270811

COMMUNICATIONS TWISTED PAIR TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Testing of Communications Twisted Pair Cabling (both Backbone and Horizontal Cabling subsystems).

B. Work Includes
   1. Testing of a completed communication infrastructure cabling system, which includes:
      a. Submittals
      b. Testing of the twisted pair cabling as follows:
      c. Record Documents, including test results.

C. Work Provided Under Other Sections
   1. Backbone twisted pair cabling
   2. Horizontal twisted pair cabling
   3. HDBaseT cabling

D. Related Sections
   1. Comply with the Related Sections paragraph of section 270000.
   2. Section 271314, “Communication Backbone OSP Twisted Pair Cabling”
   3. Section 271513, “Communication Horizontal Twisted Pair Cabling”

1.2 REFERENCES

A. Comply with the References requirements of section 270000.

B. In addition to the References of section 270000, the following references apply to this specification:
   1. ANSI/TIA-1152, “Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling”

1.3 DEFINITIONS

A. Refer to Definitions of section 270000.

B. In addition to those Definitions of section 270000, the following list of terms as used in this specification defined as follows:
   1. “CAT6A”: Shall mean Augmented Category 6 cabling (per TIA-568)
   2. “Channel”: Shall mean a testing configuration which includes the Permanent Link and the line cord (at the workstation), the equipment cord, and, if a full crossconnection is implemented, a patch cord and the crossconnect termination/connecting apparatus.
   3. “Connect”: Shall mean install all required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.

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SECTION 270821

COMMUNICATIONS FIBER OPTIC TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Testing of telecommunications fiber optic cabling.

B. Work Includes:
1. Pre-Testing Submittals (also see “Submittals” for more details)
2. Inspection of completed fiber optic passive link segment(s) per IEC 61300-3-35.
3. Testing of completed fiber optic passive link segment(s) per the following table (also see “Part 3” for elaboration of testing requirements), according to ANSI/TIA-568-C.0 Annex E:
4. Pre-Acceptance Submittals

C. Work Provided Under Other Sections
1. Fiber optic cabling and patching

D. Related Sections
1. Comply with the Related Sections paragraph of Section 270000.
2. Section 271323, “Communication Backbone ISP Fiber Optic Cabling”
3. Section 271523, “Communication Horizontal Fiber Optic Cabling”

1.2 REFERENCES

A. Comply with the References requirements of Section 270000.

B. In addition, the following standards are referenced to this Section:
1. American National Standards Institute (ANSI) Z136.2, “American National Standard for the safe use of optical fiber communication systems utilizing laser diode and LED sources”
2. TIA-526-7-A, “Measurement of Optical Power Loss of Installed Singlemode Fiber Cable Plant”
3. TIA-526-14-D, “Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant”
4. TIA-TSB-4979, “Practical Considerations for Implementation of Multimode Launch Conditions in the Field”
5. BICSI Telecommunication Distribution Methods Manual (TDMM)

1.3 DEFINITIONS

A. Refer to Definitions of sections 270000, and 271323. The definitions of these sections apply to this section.

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SECTION 271100

COMMUNICATIONS EQUIPMENT ROOMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Buildout / fit-up of communications equipment rooms.

B. Work Includes

1. The work under this section includes materials, accessories, fasteners, etc., and the labor and associated services required to buildout / fit-up telecommunications equipment rooms, and includes coordination through the General Contractor with other trades. This specification lists major equipment but not every fastener, anchor, assembly hardware, support, brace, etc., required for a complete and professional installation.
2. Submittals – pre-construction and closeout submittals
3. Coordination Requirements and Final Layout
    a. The contract drawings show basic room layouts and the minimum anticipated equipment. The layouts and equipment shown are neither final nor exhaustive. Undoubtedly, there will be more equipment, other building system equipment panels, etc., that will end up in telecom rooms. Therefore, it is imperative that an entity coordinate the final constructed layout of telecom rooms and placement of inevitable equipment and services that ultimately land in these rooms. The work of this section includes assuming responsibility for coordinating final layout for other equipment not necessarily identified in the contract drawings (or even known at this time, such as equipment panels for other systems) within telecom rooms as required for a complete and professional installation. Coordinate throughout the entire construction team regarding others' needs to house equipment (such as equipment panels and control panels – BMS, fire alarm, etc.) within telecom rooms. Determine the final layout for telecom rooms.
    b. Electrical: Coordinate the power service with electrical contractor to ensure proper placement of lighting, sequencing of power service to rack bay, and other issues related to electrical trade.
    c. Mechanical: Coordinate the cooling service with mechanical contractor to ensure proper placement of equipment, ducts, etc., and other issues related to mechanical trade.
    d. Owner: Coordinate room-ready requirements and schedule with Owner (to allow Owner to plan and execute installation of OFOI telecommunications/network equipment).
4. Backboards:
    a. Provide sheet hardwood/plywood and fasteners as a backboard within telecom rooms as shown on the drawings. If not explicitly shown, provide backboard on portions of walls greater than 18 inches.
    b. Provide painting of the plywood as a finish and to improve space illumination.
5. Rack Bays:
    a. Provide completely assembled equipment racks, including seismic anchoring of the racks to the building structure. Provide fasteners and parts required to complete the installation.
    b. Provide vertical management sections as shown on the drawings.

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SECTION 271323

COMMUNICATIONS BACKBONE ISP FIBER OPTIC CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Backbone ISP (indoor) fiber optic cabling.

B. Work Includes:
1. Provide pre-construction services (e.g., submittals, coordination with other trades, etc.), materials, apparatus, labor, tools, equipment, and transportation required for complete communications backbone fiber optic cabling described in this section and shown on the related contract drawings.
2. The contract drawings are diagrammatic in nature, and require shop drawings to complete the detailed design of the telecommunications infrastructure.
3. In general, the base bid work includes:
   a. Submittals
   b. Backbone inside plant (riser) fiber optic cables and terminations
   c. Cable management
   d. Crossconnections / patching.
   e. Cable identification tags and system labeling
   f. Record Documents
   g. Warranty

C. Related Sections
1. Comply with the Related Sections paragraph of section 270000.
2. 270821 Communication Fiber Optic Testing

D. Work Covered Under Other Sections
1. Pathways: The communications pathways (backbone conduits, riser sleeves, etc.) work will be covered under another section. Refer to the drawings for size/capacity and route information.
2. Rooms: Build out (e.g., backboards, overhead and vertical cable support, etc.) of the telecommunications rooms will be covered under another section. Refer to the drawings for build out information.

1.2 REFERENCES

A. Comply with References requirements of section 270000.

B. In addition to the codes and standards listed in section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
1. National Fire Protection Agency (NFPA)
2. Underwriters Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
   a. UL 1651, “Optical Fiber Cable”

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SECTION 271513

COMMUNICATIONS HORIZONTAL TWISTED PAIR CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Horizontal twisted pair cabling

B. Work Includes:
1. Provide pre-construction services (e.g., submittals, coordination with other trades, etc.), materials, apparatus, labor, tools, equipment, and transportation required for complete communications horizontal twisted pair cabling described in this section and shown on related drawings.
2. In general, the base bid work includes:
   a. Submittals
   b. Horizontal cables, terminations, and outlets
   c. Cable support and management
   d. Patch cords and crossconnections, and cord management
   e. Cable identification tags and system labeling
   f. Closeout documents
   g. Warranty
3. Identifiers and Labeling: The scope of work herein includes the responsibility for assigning identifiers to each horizontal cabling link and related cabling media in addition to providing physical labeling to each component.

C. Related Divisions and Sections
1. Comply with the Related Divisions and Sections requirements of section 270000
2. 270529, “Communicatiosn Supports and Hangers”
3. 270533, “Communications Bldg Pathways – Conduits and Boxes”
4. 270811, “Communications Twisted Pair Testing”
5. 271100, “Communications Rooms”

D. Work Provided Under Other Sections
1. Pathways: Communications pathways (cable tray, conduits, stubs, etc.) are covered under another section. Refer to the drawings for type, size/capacity and route information. Refer to sections 270529 or 270533 and to the drawings for requirements, buildout information and layouts.
2. Rooms: Telecommunications room buildout (e.g., backboards, rack bays, overhead and vertical cable support, etc.) is covered under another section. Refer to section 271100 and to the drawings for requirements, buildout information and layouts.
3. Testing: The horizontal cabling system testing requirements are covered under another section. Refer to section 270811 for testing requirements.

1.2 REFERENCES

A. Comply with the ‘References’ requirements of section 270000.

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SECTION 274116

INTEGRATED AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Audiovisual systems – presentation systems, conference systems, control systems, and interface with other systems. Refer to article 1.04 “System Description” for more information.

B. Work Includes:
1. Provide equipment and materials, whether specifically mentioned herein or not, needed for a complete and operating audiovisual systems to satisfy the requirements of this section and related drawings. This specification lists major equipment but not every wire, connector, extender, converter, fastener, etc., needed to complete the work.
2. Cooling Provisions
   a. Provide cooling provisions (means to move heat out of enclosed spaces to prevent temperatures from exceeding equipment manufacturers’ specified maximums). Ensure equipment operates within manufacturer’s cooling guidelines. Provide only code-compliant cooling provisions (e.g., exhausting from one space to another).
   b. In racks, enclosures, millwork, cabinets, and other spaces where equipment will be installed and prone to heat buildup, provide thermostatically-controlled active cooling devices to create adequate airflow through the enclosed space. Examples of active cooling devices include vent fans. At a minimum, ensure airflow by installing active cooling devices or systems such as fans.
3. Provide power controllers (such as an IP power strip connected to the network or controllable through the room control system) to devices that cannot inherently be remotely controlled for power cycling. Verify functional operation for specified control operations.
4. Provide audio transformers, whether or not explicitly shown on the drawings, with appropriate impedance ratios and power handling capacities as required for the intended function of the System.
5. Labeling: Provide labeling for audiovisual system components. The components include, but are not limited to, the following:
   a. Equipment racks and equipment enclosures
   b. Rack-mounted equipment and devices: Provide a label on the back of each piece of equipment. If a serial number (of a given piece of equipment) is not visible in a final installed condition, provide a label on the equipment on a visible location duplicating the serial number.
   c. Wall-mounted equipment and devices: Provide an equipment label on the back of each piece of equipment. If a serial number (of a given piece of equipment) is not visible in a final installed condition, provide a label on the equipment on a visible location duplicating the serial number.
   d. Provide an equipment plate for each piece of equipment.
   e. Provide a label for each control that is not inherently labeled, such as those in racks and user spaces.
   f. Wires and cables: Provide a cable label at each end of each piece of wire, cable and cord.

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APPENDIX A

LUMINAIRE SCHEDULE

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LUMINAIRE SCHEDULE

TYPE	LOCATION	QTY	REFERENCE IMAGE	DESCRIPTION	MANUFACTURER	FIXTURE FINISH	LAMPS/SOURCE	POWER SUPPLY/ DRIVER	INPUT WATTS	INPUT WATT UNITS	NOTES
INTERIOR LUMINAIRES											
F1	Courtrooms	200'		3" recessed linear LED downlight with high output, 90 CRI, 3500K CCT, lambertian distribution, acrylic satin lens, length per plan, universal voltage, provide dimming driver, dimming to 10%, provide .5 trim flange, and white finish in high gloss. Housing is made from extruded aluminum. Fixture fange underlaps Ecophon Focus DS pnales and fixture includes grid interface brackets. Dimensions: (Length per Drawings) x 3" W x 3-25/32" H UL Listed for Dry Locations	GAMMALUX G-Beam Series GB34RC2-HL359-UNIV-ZTV10-LENGTH PER PLAN-N-REC/GFR-ASLMD-WSG-REC/GFR/MOD	White	LED 3500K +80 CRI L70@60,000hrs 692.5 Delivered Lm/Foot	Integral Dim to 10% 0-10V	8W	LF	1. Fixtures shown in courtrooms, lengths are: Courtroom 1: (5) x (~25') = ~125' approximately Courtroom 2: (5) x (~20') = ~100' approximately Refer to Architectural drawings and ceiling specifications to verify fixture lengths. 2. Architect to confirm fixture finish.
F1a	Conference Rooms	89'		Same as F1 except for 80 CRI. Dimensions: (Length per Drawings) x 3" W x 3-25/32" H UL Listed for Dry Locations	GAMMALUX G-Beam Series GB34RC2-HL358-UNIV-ZTV10-LENGTH PER PLAN-N-REC-GRF-ASLMD-WSG	White	LED 3500K +80 CRI L70@60,000hrs 600 Delivered Lm/Foot	Integral Dim to 10% 0-10V	8W	LF	1. Fixtures shown in meeting rooms, lengths are: Small Meeting Rooms: (6) x (4') = 24' Medium Meeting Rooms: (2) x (14') + (2) x (12) = 52' Refer to Architectural drawings and ceiling specifications to verify fixture lengths. 2. Architect to confirm fixture finish.
F2	Courtrooms and Conference Rooms	121'		3" recessed perimeter linear LED with high output distribution, acrylic satin lens with heavy diffusion, 3500K CCT, 90 CRI, length per plan, provide field adjustable housing, finish to be white in semi gloss, provide dimming driver, dim to 10%, and universal voltage. Provide gyp. board and gird with .5 flange ceiling interface with 3" regress and adjustable wall bracket. Provide mounting hardware as needed per condition. Housing is made from extruded aluminum. Dimensions: (Length per Drawings) x 3" W x 7" H UL Listed for Dry Locations	GAMMALUX Perimeter Series GPD3-HL359EZT-UNIV-ZTV10-(LENGTH PER PLAN)N-(REC+RECW)-A-GFR3-ASLHD-WSG	White	LED 3500K +80 CRI L70@50,000hrs 644.8 Delivered Lm/Foot	Integral Dim to 10% 0-10V	8W	LF	1. Refer to Architectural drawings for preliminary length(s) and mounting details. 2. Contractor to field verify length(s) prior to ordering. 3. Architect to confirm fixture finish.
F3	Courtrooms, Breakroom Undercabinet, Judges Chamnbers	258'		.49" surface-mounted linear LED with high output, 579 lumen per foot, 3500K CCT, provide concealed brackets, length per plan, finish per architect, dry rated, provide back position type with dual quick connect power feed. Housing is made from extruded aluminum and frosted polycarbonate lens. Provide dimming drivers as needed, dimming to 1%, remote driver to be located in accessible area. Provide all hardware and accessires for a full functional system. Dimensions: (Length per Drawings) x .49" W x .49" H UL Listing for Dry Locations	Luminii Myka - Static White MK-LENGTH PER PLAN-HE48HO-35K-F-CB-(finish)-B-4-FMA Power Feeds + Connectors PSU: PS010V-(watts)-24-(dimming) or PDCU-D-(watts)-24	Architect to confirm	LED 3500K +92 CRI L70@50,000hrs 579 Delivered Lm/Foot	Remote Dim to 1% 0-10V 24VDC	6.5W	LF	1. Luminaire shall be concealed in architectural cove. Refer to architectural drawings for mounting details. 2. Contractor shall coordinate mounting and luminaire lengths with millwork details. 3. At cabinet locations, provide cabinet fascia to conceal view of luminaire. 4. Refer to architectural drawing for run lengths. Contractor to fiel verify luminaire length(s) prior to ordering. 5. Maximum run length is 21' per manufacturer's cutsheet. Provide combination of fixture length(s) to complete runs. Luminaires shall be installed end-to-end with no gaps in between with the use of side feeds. Luminaris shall be centered in the cove, with no more than 3" at the end of entire run. 6. Architect to confirm fixture finish. 7. Provide 3' sample of fixture with dimming driver, cord and plug.
F4	Courtrooms, Chamber, and Breakroom	3		2 5/8" square recessed adjustable LED downlight with 1,200 lumen output, 92 CRI, 3500K CCT, wide distribution, 48deg optics, provide 5/8" regress trim, white reflector finish, self flanged, damp rated, provide dimming driver, dim to 1% and universal voltage. Housing made from power-coated 18 gauge steel. IC Housing Dimensions: 14-5/8" L x 4-9/16"" W x 5" H ETL Listing for Damp Locations	Intense 2" Gravity Square LED Adjustable GD2AS-NC-L3-359-D101-WF-ISRT200-W-SF-GD2S-MR-PFL4-45	White	LED 3500K +92 CRI L70@50,000hrs 1080 Delivered Lm	Integral Dim to 1% 0-10V	20W	EA	1. Architect to confirm fixture finish. 2. Fixture requires aiming by Contractor prior to review of installation during site visit. Aiming diagrams will be provided.
F4a	Courtrooms	2		Similar to Type F4 but with 16deg optics.	Intense 2" Gravity Square LED Adjustable GD2AS-NC-L3-359-D101-SP-ISRT200-W-SF-GD2S-MR-PFL4-45	White	LED 3500K +92 CRI L70@50,000hrs 1346 Delivered Lm	Integral Dim to 1% 0-10V	20W	EA	1. Architect to confirm fixture finish. 2. Fixture requires aiming by Contractor prior to review of installation during site visit. Aiming diagrams will be provided.
F5	Courtrooms, Vestibule, Breakroom, Jury, Chamber, Office, and Restrooms	58		2 5/8" square recessed LED downlight with 1,200 lumen output, 92 CRI, 3500K CCT, wide distribution, 48deg optics, provide 5/8" regress trim, white reflector finish, self flanged with square trimless mud ring, damp rated, provide dimming driver, dim to 1% and universal voltage. Housing made from power-coated 18 gauge steel. Dimensions: 14-5/8" L x 8-5/8" W x 5" H ETL Listing for Damp Locations	Intense 2" Gravity Square LED Downlight GD2DS-NC-L3-359-D101-WF-ISRT200-W-SF-GD2S-MR-PFL4-45	White	LED 3500K +92 CRI L70@50,000hrs 1080 Delivered Lm	Integral Dim to 1% 0-10V	20W	EA	1. Architect to confirm fixture finish.

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LUMINAIRE SCHEDULE

TYPE	LOCATION	QTY	REFERENCE IMAGE	DESCRIPTION	MANUFACTURER	FIXTURE FINISH	LAMPS/SOURCE	POWER SUPPLY/ DRIVER	INPUT WATTS	INPUT WATT UNITS	NOTES
INTERIOR LUMINAIRES											
F6	Electric room, AV/IT, Storage and Janitor	7		4' surfaced mounted linear LED with 2,100 lumen output, 3500K CCT, 80 CRI, high transmission impact-resistant acrylic lens, with integrated occupancy sensor, provide dimming driver, dim to 1%, default standy power, and universal voltage. Housing is made from 20GA cold rolled steel. Dimensions: 48" L x 4-11/16" W x 4" H UL Listed for Damp Locations	MERCURY LW14STR LW14STR-4-2100-35K-HTA20-1%-20-UNI	White	LED 3500K +80 CRI L80@60,000hrs 2100 Delivered Lm	Integral Dim to 1% 0-10V	15W	EA	1. Architect to confirm fixture finish.
F7	Corridors, Storage, Copy Room	35		2'x2' recessed-mounted troffer with hig performance 2,300 lumen output, 80CRI, 3500K CCT, provide dimming driver, dimming to 1%, and universal voltage. Housing is made from cold rolled steel and extruded high transmission acrylic material. Dimensions: 23-3/4" L x 23-3/4" W x 4" H UL Listed for Damp Locations	MERCURY LR5 LR5-22G-2300-35K-1%-UNI	White	LED 3500K +80 CRI L80@60,000hrs 2236 Delivered Lm	Integral Dim to 1% 0-10V	20W	EA	1. Refer to Architectural Drawings for grid ceiling specifications.
F8	Bathrooms	5		27 1/2" wall-mounted linear LED sconce with 1,210 lumen output, 3500K CCT, hand blown three-ply opal glass lens, chrome finish, provide dimming driver, dimming to 10%, and universal voltage. Housing is made from aluminum. Provide narrow opening wiring box. Mounting orientaion per architectural drawings. Dimensions: 27-1/2" L x 4-1/8" W x 2 3/4" H NRTL Listed for Interiors	BEGA Linear Wall Luminare B23256-K35-B19537	Chrome	LED 3500K +90 CRI L70@60,000hrs 1210 Delivered Lm/Foot	Integral Dim to 10% 0-10V	20W	EA	1. Refer to architectural drawings for mounting height AFF. Luminaire shall be mounted over a recessed junction box (by electrician). 2. Architect to confirm fixture finish.
F9	NOT USED										
F10	Courtrooms	34		2-1/2" square recessed LED adjustable downlight with 1,200 lumen output, 92 CRI, 3500K CCT, wide distribution, 48deg optics, provide 5/8" regress trim, white reflector finish, self flanged, damp rated, provide dimming driver, dim to 1% and universal voltage. Housing made from power-coated 18 gauge steel. IC Housing Dimensions: 14-5/8" L x 8-5/8" W x 5" H UL Listed for Damp Locations	Intense 2" Gravity Square LED Adjustable GD2AS-NC-L3-359-D101-WF-ISRT200-W-SF	White	LED 3500K +80 CRI L70@50,000hrs 1080 Delivered Lm	Integral Dim to 1% 0-10V	20W	EA	1. Contractor shall verify and coordinate luminaire installation and mounting with architectural details, housing type, field conditions, and ceiling system details including ceiling thickness, grid type, flange, and insulation clearance requirements. 2. Architect to confirm fixture finish. 3. Fixture requires aiming by Contractor prior to review of installation during site visit. Aiming diagrams will be provided.
X	EXIT SIGN	19		Recessed mounted LED Exit Sign with extruded aluminum housing and injection-molded acrylic panel, with 100ft viewing range. Dimensions: 13.25" L x 1.75" W x 20.3" H UL Listed	LITHONIA LRP Series LRP-(finish)-(faces per plans)-RW-(directions per plans)-120/277-EL N-TM	Red on White	LED	120/277v	2.3W	EA	1. Architect to confirm fixture mounting. 2. Architect to confirm Exit Sign display color.

GENERAL NOTES -

- This fixture schedule may include images that generally represent each luminaire. However, the descriptions provided may differ from the images, particularly regarding finishes and accessories. In all cases, the written descriptions shall take precedence over the images to ensure accuracy and clarity in specifications.
- All luminaires shall have a minimum of 3 years in warranty. Luminaires from alternative manufacturers that do not meet this requirement will not be approved as substitutes during the bidding and/or submittal process.
- The LED sources within the luminaire shall fall within two (2) McAdam ellipses (steps) as specified by ANSI standards. Luminaires from alternative manufacturers that do not meet this requirement will not be approved as substitutes during the bidding and/or submittal process.
- For every visible luminaire, the Architect must review the luminaire finish in this Fixture Schedule and/or provide the fixture finish for implementation in the Fixture Schedule. All visible accessories, such as trim, flange, and canopy plates, shall also be reviewed by the Architect for finish options
- The manufacturer must submit detailed shop drawings for all fixture types that feature continuous runs, including track lighting. Shop drawings shall include layouts showing run lengths, mounting details, accessories, gear, and finishes for review by the Architect and Lighting Designer during the submittal process and prior to fabrication.
Luminaires with continuous runs that require field verification of lengths before the closing of ceilings shall be submitted in the shop drawings for the Architect's and Lighting Designer's review.
- All lighting systems shall be ordered with all necessary components, including gear, power feeds, and mounting accessories, to ensure the installation of a fully functional and complete system.
- All remote gear shall be placed in a secure, concealed, accessible, and well-ventilated location, in accordance with the manufacturer's guidelines. The Electrical Contractor and manufacturer must coordinate to ensure the appropriate size and location of the remote gear, as well as the correct wire gauge, to maintain a voltage drop of less than 2% over the entire length of the run.
- Luminaire samples shall be provided as required in the fixture schedule and in accordance with specifications for the Architect's and/or Lighting Designer's review. All samples shall be provided with a 120V plug and cord.
- The Electrical Contractor shall verify that the specified lighting fixtures dimming protocol in this fixture schedule is compatible with the project's controls system.
- During pricing exercises, the Electrical Contractor shall provide the Lighting Designer and Architect with accurate pricing for each fixture type, covering equipment only, with labor and installation listed as separate line items. Sharing equipment costs helps the design team align with the project's budget goals and improves communication with the manufacturers.

Installation Notes:
- The Electrical Contractor shall verify and coordinate the installation and mounting of all luminaires with architectural details and field conditions.
- All recessed luminaires installation shall be coordinated with the architectural details, housing type, field conditions, and ceiling system specifications. This includes ensuring compatibility with grid type and flange requirements. The installation must be executed in such a manner that there are no light leaks between the luminaire and the ceiling system. Ceiling thickness and trim compatibility shall be also verified by the Electrical Contractor.
- The Electrical Contractor shall provide all required elements, accessories, and components to ensure a safe and code-compliant installation of luminaires at no additional cost to the project.
- The Electrical Contractor shall ensure that adequate cord length is provided for suspended luminaires to meet the suspension heights specified in the architectural drawings or indicated in the lighting fixture schedule.
- The Electrical contractor shall follow all manufacturer installation instructions.
- The Electrical Contractor shall deliver a fully functional lighting installation with all luminaires in perfect condition. The final installation shall include a minimum one-year warranty from the Electrical Contractor, starting from the project's delivery date. Any luminaires or aspects of the installation found to be defective during the warranty period shall be repaired or replaced by the Electrical Contractor at no cost to the Owner.
- The installation of luminaires shall be in accordance with and meet the standards and regulations of the following: Underwriters Laboratories, National Electric Code, & Local Building and Life Safety Code Agencies.

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APPENDIX B

FIXTURE CUTSHEET PACKAGE

GAMMALUX® Lighting Systems "Your design intent"

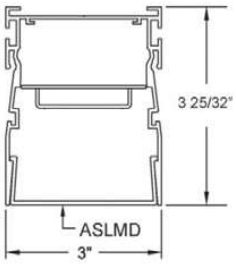
G-Beam Series GB34RC2-LED-LENS
General Illumination - Recessed in Grid or Hard Ceiling
Direct Distribution with Flush Lens

Click or scan QR code to view latest spec sheet

Click for: **Asymmetric Version**

Revision Date: July 08, 2024

Gammalux Lighting Systems reserves the right to change details of fixture designs and construction at any time.



LED LAMPING



Click photo to view product page

Page 1: Overview & Nomenclature
Pages 2-3: Specifications
Pages 4-5: Photometric Info / Downloads
Page 6: Mounting Details
Pages 8-9: Mud Flange & Images
Pages 10-11: Custom Programming

Product Overview (for complete specifications, see pages 2 & 3) ******NEW****** See last page for APPROVED CUT RELEASE.

Quick Ship: Most product options are shippable within 2-3 weeks! **Check our Quick Ship Guide for details**.

Construction: I.C. rated. ARRA, RoHS, REACH and Prop 65 compliant. Extruded aluminum housing for superior fit and finish. Grid mounted version can be installed from below. Runs and patterns have a single item # and can be built to field dims.

Unbroken Illumination: Continuous illumination in custom-length runs and patterns with illuminated corners.

Electrical: LED components by major manufacturers, may be upgraded in the field to increase energy efficiency. Fixtures can be fitted with specialty LED and control components (consult factory). Standard Output, High Output and Custom Output options available.

Standard Nomenclature

Quick Ship Eligible^ Most options 2-3 weeks^

Manufacturer
Gammalux

Cross Section (nom)
3"x 4"

Output
S Standard Output
H High Output
C Custom Output
(see addendum page)

Color Temp. (nom)
27 2700K **50** 5000K
30 3000K **RGB***
35 3500K **RGBW___***
40 4000K

Driver
ZTV10 0-10V Dim to 10%
ZTV1 0-10V Dim to 1%
For all options, see next page

Length Option
S Specific
N Nominal
(Nominal is recommended for grid mount)

Ceiling Interface
EFD CertainTeed Ecophon Focus DG/DS
GFR Gyp w/ .5" cover flange
GMR Gyp w/ mud flange
NFR No flange or interface
T1W 15/16" flat grid w/ flat tiles
T1TW 15/16" flat grid w/ tegular tiles
T9W 9/16" flat grid w/ flat tiles
T9TW 9/16" flat grid w/ tegular tiles
TSW 9/16" slot grid

Paint Colors
W White (See color chart for other colors)
CCM Custom Color Match

Paint Finish
H High Gloss
SG Semi-Gloss

GB34RC2 – SL358 – UNIV – ZTV10 – 4'N – REC/XXXX – ASLMD – WSG –

Model
2nd Gen

Housing
RC Recessed

Series
Beam

CRI**
8 for 80+
9 for 90+

Lamp
LED

Voltage
120V, 277V, UNIV

Run or Pattern
Specify total run length (i.e. **43' 5 1/8"**)
For illuminated patterns, follow overall length with **L, T, X, U, RECT** or **SQ.** Examples:
23'6" x 17'2" L Pattern would be **41'LPTTN**.
12' x 12' Square Pattern would be **48'SQPTTN**.
Provide leg dimensions as a line note in the spec.

Mounting
REC Recessed in ceiling.
Consult factory for in-wall.

Shielding
ASLMD Acrylic Satin Lens, Medium Diffuse
Consult factory for other options

Options
BPE Battery Pack (4' section)
DL UL Damp Label
EMERG Emergency Ckt
2CKT Dual Circuiting
SBO Sensor By Others#

** 90+ CRI increases watts nom. 14.5%. # Sensor by Others (consult factory).
^Some restrictions apply. **Check our Quick Ship Guide for details**.

c UL us PROUD MEMBER OF IALDLIRC MADE IN U.S.A

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GAMMALUX® Lighting Systems "Your design intent"

G-Beam Series GB34RC2-LED-LENS
General Illumination - Recessed in Grid or Hard Ceiling
Direct Distribution with Flush Lens

Specifications (continued on next page)

Electrical

Output: Standard (**S**) and high (**H**) options deliver a pre-set lumen package (see chart below). Custom-programmed output (**C**) is specified as LPF, WPF or % of High Output (see Custom Programmed Output page).
Static Driver: eldoLED Optotronic* programmable driver, wired for static operation (**DVR**).
0-10V Dimming: eldoLED Optotronic* programmable driver, wired for 0-10v control and dimming to 10% (**ZTV10**) or to 1% (**ZTV1**).
Step Dimming: Generic step dimming driver, two hot inputs for 100% and 50% output (**SD2**).
DALI Dimming: Generic DALI driver with two loose control wires exiting fixture at power feed location (**DALI**).
Lutron Dimming: Hi-Lume dim to 1% EcoSystem with Soft-On, Fade-to-Black (**LDE1**).
White Emitter: Nichia 757G emitters* binned within 3 MacAdam ellipses in Osram or Gammalux proprietary array. 90+ CRI option with extended lead time (CRI code **9**) results in nominal 14.5% drop in efficacy; increase calculated watts 14.5%.
Battery Pack: Bodine BSL10T3* (**BPE**). 4W max input, 10W initial output, delivers min. 27% of High Output value per 4' length.
LED System: 70% lumen output (L70) at max 85 degrees C calculated at >60k hours. Fixtures are shipped with anti-static gloves to minimize the risk of damage to LEDs during installation. 5 year limited warranty.
Sensors: Sensors are as specified, confirmed by Gammalux prior to factory quote. Examples are Enlighted Micro Sensor, Lutron Athena Wireles Node, Lutron Vive, Wattstopper FS-205.
Upgrade Capability: LED assemblies can be replaced in the future with the latest factory-provided and fully warranted components. On-board sensors, control interface devices and alternate LED components may be specified (consult factory). Fixtures bear UL & cUL Dry Location label. Damp Location label available (**DL**).
*Subject to availability; may be substituted by Gammalux. Components and specifications may be changed without notice.

LUMENS AND WATTS BY OUTPUT OPTION AND LED COLOR @ 80+ CRI*

STANDARD OUTPUT LED						HIGH OUTPUT LED					
MEDIUM DIFFUSE LENS (ASLMD) DELIVERS: 519.4 LPF HEAVY DIFFUSE (ASLHD) DELIVERS: 446 LPF						MEDIUM DIFFUSE LENS (ASLMD) DELIVERS: 692.5 LPF HEAVY DIFFUSE (ASLHD) DELIVERS: 594.7 LPF					
CCT	2700 K	3000 K	3500 K*	4000 K	5000 K	CCT	2700 K	3000 K	3500 K*	4000 K	5000 K
WATTS / FT.	6.3	5.9	5.8	5.7	5.4	WATTS / FT.	8.6	8.2	8	7.8	7.4

* IES FILES WERE CREATED USING 3500 K DIODES @ 80+ CRI. WATTAGE IS MULTIPLIED BY 1.06 FOR 2700 K, 1.02 FOR 3000 K , .98 FOR 4000 K AND .93 FOR 5000 K DIODES TO MAINTAIN THE SAME DELIVERED LUMENS THROUGHOUT ALL COLOR TEMPERATURES. FOR 90+ CRI, INCREASE WATTAGE BY 14.5%. SEE ADDENDUM FOR CUSTOM PROGRAMMING.

Construction

Housing: I.C. rated. ARRA, RoHS, REACH and Prop 65 compliant. Extruded aluminum body 3.00" wide x 3.78" high, 6063T5, 0.070" min thickness. Each housing is 12' max unless longer housings are pre-coordinated with the factory to reduce joints and installation labor. Fixtures are built per approved factory drawings and tested as a complete system at the factory. Continuous runs and patterns are ordered, built and shipped with a single item #. Fixtures ordered as individuals are not designed to be joined together in the field.

Joiner System: Automatic alignment, no loose parts, one tool to tighten factory installed bolts for hairline seam. No light leaks.

Lamping: Patterns are fully illuminated. Runs ordered in Specific Length (Length Option **S**) will be built to the exact dimension shown on signature-approved shop drawings. Runs ordered in Nominal Length (Option **N**) may be factory-adjusted to accomodate standard mounting positions or grid centers. Factory drawings will show all dimensions of mounting and power feed locations. Fixtures built to less than 4' may require remote driver installation - consult factory.

Mounting: Recessed into a ceiling system (**REC**). Fixtures surrounded by grid should be ordered in Nominal length (Length Option **N**) and can be installed from below. Consult factory for in-wall installation. Mud flange (**GMR**) includes integral expansion gap to allow for heat expansion with no pressure on surrounding plaster. GMR FIXTURE MUST BE INSTALLED PRIOR TO GYP.

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Direct Distribution with Flush Lens

Specifications (continued)

Optical

Reflectors: Shall be formed diffuse high reflectance aluminum.

Acrylic Satin Lens, Medium Diffuse: Snap-in. Shall be 100% DR acrylic.

Acrylic Satin Lens, Heavy Diffuse: Snap-in. Shall be 100% DR acrylic (**ASLHD**).

See lens images on photometric pages.

Finish

Acid etched or clear annodized housing electrostatically sprayed with high solids aliphatic two component polyurethane high (**H**) or semi-gloss (**SG**) to an avg. thickness of 2 mils. Unless specified otherwise, cable mount canopies are white semi-gloss and all other painted mounting components match the fixture finish. Custom finish, consult factory. Wood Finishes, back page.



Packing and Shipping

Fixtures built for continuous rows and patterns are given a specific location identifier, clearly identified on factory layout drawings, the fixture's ID Label, protective wrapping and on each end of fixture carton. Shipping pallets are built with 2" clearance, extending beyond the length and width of cartons, providing shipping protection.

Approx. weight of 4' module is 13 lbs. including carton. Weight of pallet and supplemental packing materials not factored in.

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Direct Distribution with Flush Lens

Photometric Reports for
STANDARD OUTPUT FIXTURES

FIXTURE USES LENS ASLMD (MEDIUM DIFFUSE) AND 3500 K BOARDS. @ 80+ CRI

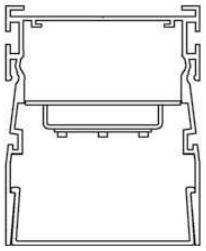
IESNA: LM 79-2008
ISSUEDATE: 04/17/13
TEST: ITL76971 mod to 2016 COMP
TESTLAB: Photopia 3.2.6
MANUFAC: GAMMALUX LIGHTING SYSTEMS
LUMCAT: GB34D2-SOLED35-4'-ASLMD
LAMPS: 73571 PLPG2-Bar-1100-835-289x38-DC

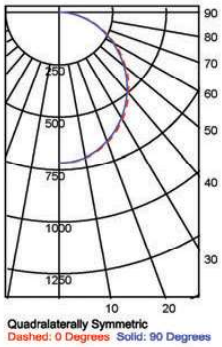
EFFICACY (Total): 86.8 LPW
DISTRIBUTION % UP: 0%
DISTRIBUTION % DOWN: 100%
CIE CLASSIFICATION: DIRECT

LUMINOUS OPENING: RECTANGULAR
Width: 0.24 (Feet)
Length: 3.96
Height: 0.00
INPUT WATTS: 25.4



Acrylic Satin Lens, Medium Diffuse (ASLMD)





FIXTURE USES LENS ASLHD (HEAVY DIFFUSE) AND 3500 K BOARDS. @ 80+ CRI

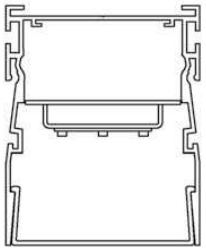
IESNA: LM 79-2008
ISSUEDATE: 04/18/13
TEST: ITL76972 mod to 2016 COMP
TESTLAB: ITL, INC
MANUFAC: GAMMALUX LIGHTING SYSTEMS
LUMCAT: GB34D2-SOLED35-4'-ASLHD
LAMPS: 73571 PLPG2-Bar-1100-835-289x38-DC

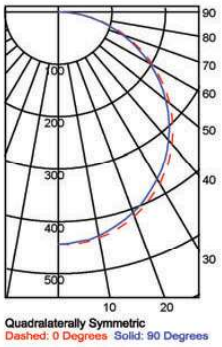
EFFICACY (Total): 63.5 LPW
DISTRIBUTION % UP: 0%
DISTRIBUTION % DOWN: 100%
CIE CLASSIFICATION: DIRECT

LUMINOUS OPENING: RECTANGULAR
Width: 0.24 (Feet)
Length: 3.96
Height: 0.00
INPUT WATTS: 25.4



Acrylic Satin Lens, Heavy Diffuse (ASLHD)





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General Illumination - Recessed in Grid or Hard Ceiling
Direct Distribution with Flush Lens

Photometric Reports for
HIGH OUTPUT FIXTURES

FIXTURE USES LENS ASLMD (MEDIUM DIFFUSE) AND 3500 K BOARDS. @ 80+ CRI

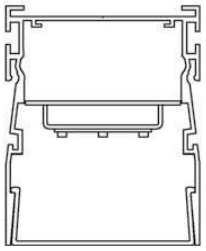
IESNA: LM 79-2008
ISSUEDATE: 04/16/13
TEST: ITL76971 mod to 2016 COMP
TESTLAB: ITL, INC
MANUFAC: GAMMALUX LIGHTING SYSTEMS
LUMCAT: GB34D2-HOLED35-4'-ASLMD
LAMPS: 73571 PLPG2-Bar-1100-835-289x38-DC

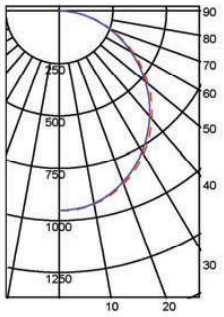
EFFICACY (Total): 83.3 LPW
DISTRIBUTION % UP: 0%
DISTRIBUTION % DOWN: 100%
CIE CLASSIFICATION: DIRECT

LUMINOUS OPENING: RECTANGULAR
Width: 0.24 (Feet)
Length: 3.96
Height: 0.00
INPUT WATTS: 35.3



Acrylic Satin Lens, Medium Diffuse (ASLMD)





Quadralaterally Symmetric
Dashed: 0 Degrees Solid: 90 Degrees

FIXTURE USES LENS ASLHD (HEAVY DIFFUSE) AND 3500 K BOARDS. @ 80+ CRI

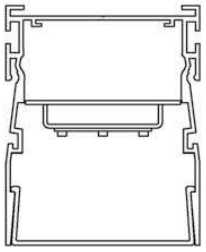
IESNA: LM 79-2008
ISSUEDATE: 04/16/13
TEST: ITL76972 mod to 2016 COMP
TESTLAB: ITL, INC
MANUFAC: GAMMALUX LIGHTING SYSTEMS
LUMCAT: GB34D2-HOLED35-4'-ASLHD
LAMPS: 73571 PLPG2-Bar-1100-835-289x38-DC

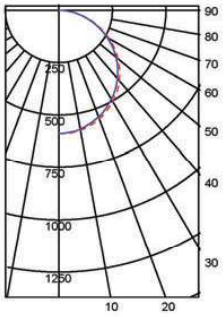
EFFICACY (Total): 60.9 LPW
DISTRIBUTION % UP: 0%
DISTRIBUTION % DOWN: 100%
CIE CLASSIFICATION: DIRECT

LUMINOUS OPENING: RECTANGULAR
Width: 0.24 (Feet)
Length: 3.96
Height: 0.00
INPUT WATTS: 35.3



Acrylic Satin Lens, Heavy Diffuse (ASLHD)





Quadralaterally Symmetric
Dashed: 0 Degrees Solid: 90 Degrees

GAMMALUX® Lighting Systems "Your design intent"

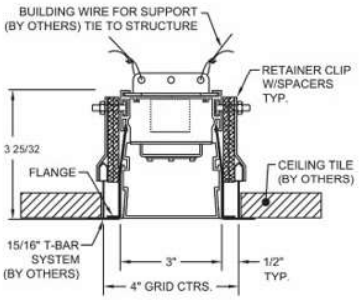
G-Beam Series GB34RC2-LED-LENS
General Illumination - Recessed in Grid or Hard Ceiling
Direct Distribution with Flush Lens

Mounting Details

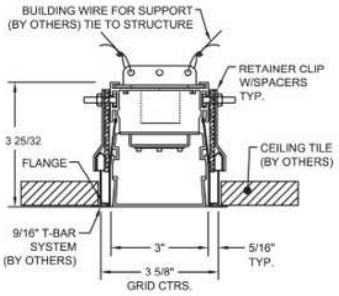
Factory Drawings: Fully dimensioned factory drawings will be provided upon receipt of purchase order.

Grid Mount

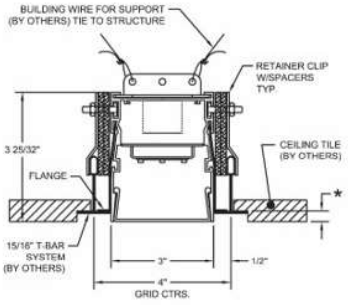
15/16" Flat TBar:
Specify **T1W** code in catalog #



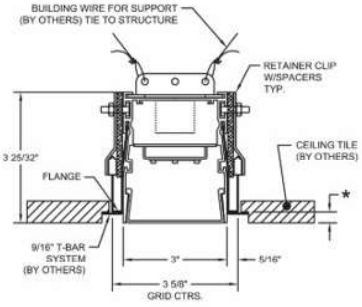
9/16" Flat TBar:
Specify **T9W** code in catalog #



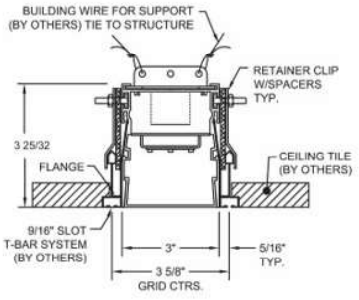
15/16" Flat TBar with Tegular Tiles:
Specify **T1TW** code in catalog #



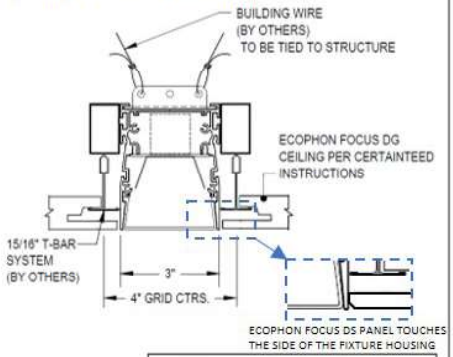
9/16" Flat TBar with Tegular Tiles:
Specify **T9TW** code in catalog #



9/16" Slot Grid:
Specify **TSW** code in catalog #



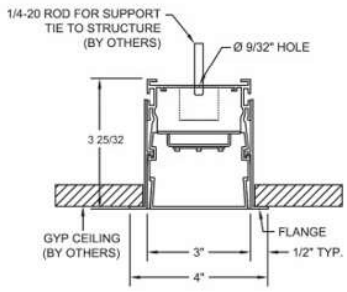
CertainTeed Ecophon Focus (DG and DS):
Specify **EFD** code in catalog #



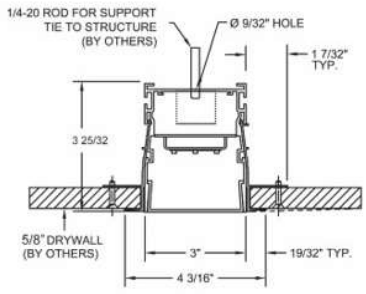
*Contractor must provide dimensions to Gammalux.

Hard Ceiling Mount

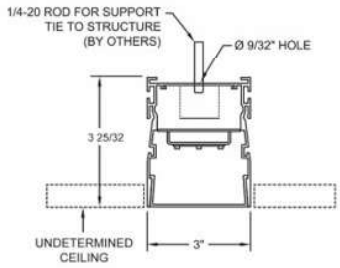
Gyp type ceiling with cover flange:
Specify **GFR** code in catalog #



Gyp type ceiling Mud Flange:
Specify **GMR** code in catalog #



Undetermined ceiling, Flangeless:
Specify **NFR** code in catalog #



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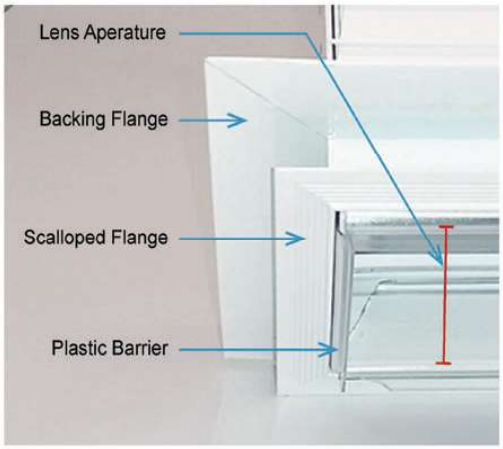
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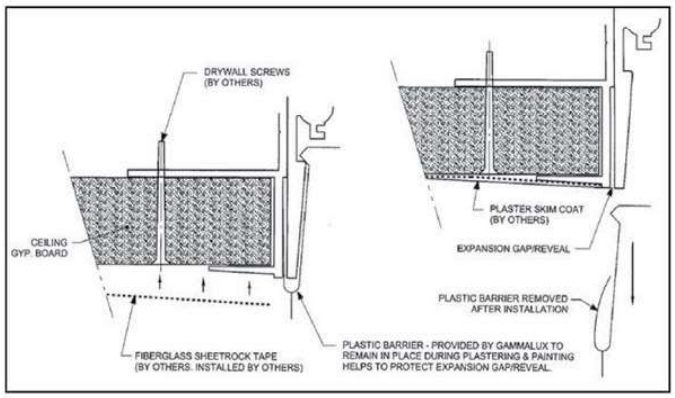
Mud Flange Detail



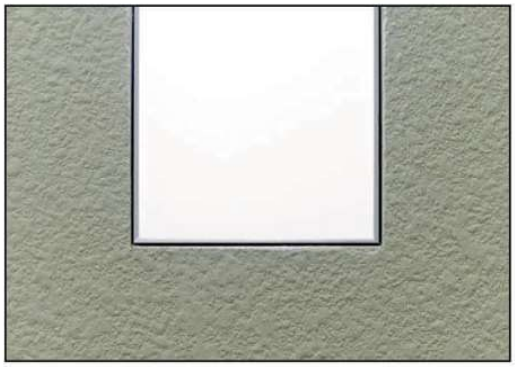
Fixture ships with steel spacer bracket to maintain aperture integrity during installation.



Mud flange assembly consists of a backing flange and scalloped flange. Plastic barriers protect the integral expansion gap from mud and paint.



Gyp material is embedded between the backing flange and scalloped flange, then drywall screws secure the drywall to the backing flange. Fiberglass tape, skim coat of plaster and paint are added on top of the scalloped flange with the plastic barrier installed throughout all procedures. After paint is dry, plastic barrier is removed, revealing clean expansion gap.



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Sample Installations



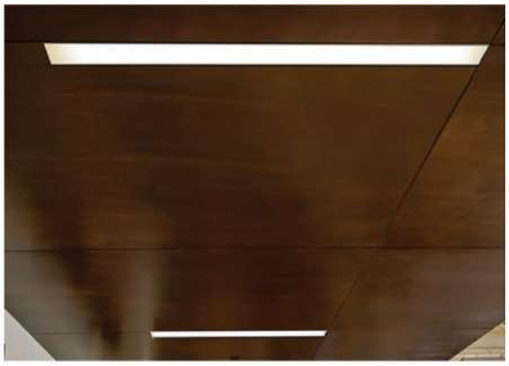
Flush with 15/16" grid (T1W)



Modified per spec



Dropped with tegular tiles in 9/16" grid (T9TW)



No flange (NFR)



Cover flange (GFR)



Mud flange in gyp wall (GMU)



Mud flange in gyp ceiling (GMR)

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Custom Programmed Output

Custom Programmed Output can be specified to produce approximate Delivered Lumens per Foot, Percentage of High Output Value or Maximum Watts per Foot.

Delivered Lumens Per Foot
Gammalux deals only in delivered lumens per foot. When working to match or exceed a competitor product's Lumens Per Foot package, be sure you are looking at their Delivered (through the lens) lumens per foot, not their System (bare board) lumens per foot.

In the Gammalux item #, use **C** as the Output designator and add a fixture description stating the required Lumens Per Foot value (ie: if you need 600 lumens per foot delivered by the fixture, the line note would read "Program = 600 LPF").

Percentage of High Output Value
If the required delivered lumens per foot are not known, run lighting calculations using our High Output IES file and identify the percentage of increase or decrease required to produce the correct lighting in the space.

In the Gammalux item #, use **C** as the Output designator and add a fixture description stating the required percentage of decrease from our High Output value (ie: for 60% of our High Output value, the line note would read "Program = 60% of High Output").

Maximum Watts Per Foot
In the Gammalux item #, use **C** as the Output designator and add a fixture description stating the required Maximum Watts per Foot (ie: if you need the fixtures capped at a maximum of 7 watts per foot, the line note would read "Program = 7 WPF").

For all three methods, custom programming capability is currently 25-200% of our High Output value. For requirements outside of this range, consult factory.

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Approved Cut Release option

If offered for Approved Cut Release in the Gammalux factory quote, the product in the accompanying purchase order is authorized by the GC to be released to production without the need for factory drawings for approval.

I confirm that:

- all ordering options are clearly noted (highlighted, boxed, written in, etc.) on page 1 of this fixture cut sheet
- quoted leadtime begins upon Gammalux's confirmation that the P.O. and marked cut sheet match their quote.
- the order will be released to production and a "record only" drawing will be provided prior to product shipment
- changes after Gammalux's release to production will result in a minimum 25% change fee which increases as production progresses.

General Contractor_____

GC's authorized Signature (or stamp below)_____

Signatory's printed name_____

GAMMALUX® Lighting Systems "Your design intent"

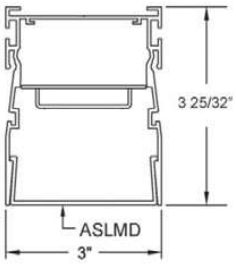
G-Beam Series GB34RC2-LED-LENS
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Click or scan QR code to view latest spec sheet

Click for: **Asymmetric Version**

Revision Date: July 08, 2024

Gammalux Lighting Systems reserves the right to change details of fixture designs and construction at any time.



LED LAMPING



Click photo to view product page

Page 1: Overview & Nomenclature
Pages 2-3: Specifications
Pages 4-5: Photometric Info / Downloads
Page 6: Mounting Details
Pages 8-9: Mud Flange & Images
Pages 10-11: Custom Programming

Product Overview (for complete specifications, see pages 2 & 3) ******NEW****** See last page for APPROVED CUT RELEASE.

Quick Ship: Most product options are shippable within 2-3 weeks! **Check our Quick Ship Guide for details**.

Construction: I.C. rated. ARRA, RoHS, REACH and Prop 65 compliant. Extruded aluminum housing for superior fit and finish. Grid mounted version can be installed from below. Runs and patterns have a single item # and can be built to field dims.

Unbroken Illumination: Continuous illumination in custom-length runs and patterns with illuminated corners.

Electrical: LED components by major manufacturers, may be upgraded in the field to increase energy efficiency. Fixtures can be fitted with specialty LED and control components (consult factory). Standard Output, High Output and Custom Output options available.

Standard Nomenclature

Quick Ship Eligible^ Most options 2-3 weeks^

Manufacturer: Gammalux

Cross Section (nom): 3"x 4"

Output: **S** Standard Output; **H** High Output; **C** Custom Output (see addendum page)

Color Temp. (nom): **27** 2700K; **30** 3000K; **35** 3500K; **40** 4000K; **50** 5000K; **RGB***; **RGBW___***

Driver: **ZTV10** 0-10V Dim to 10%; **ZTV1** 0-10V Dim to 1%; For all options, see next page

Length Option: **S** Specific; **N** Nominal (Nominal is recommended for grid mount)

Ceiling Interface: **EFD** CertainTeed Ecophon Focus DG/DS; **GFR** Gyp w/ .5" cover flange; **GMR** Gyp w/ mud flange; **NFR** No flange or interface; **T1W** 15/16" flat grid w/ flat tiles; **T1TW** 15/16" flat grid w/ tegular tiles; **T9W** 9/16" flat grid w/ flat tiles; **T9TW** 9/16" flat grid w/ tegular tiles; **TSW** 9/16" slot grid

Paint Colors: **W** White (See color chart for other colors); **CCM** Custom Color Match

Paint Finish: **H** High Gloss; **SG** Semi-Gloss

GB34RC2 – SL358 – UNIV – ZTV10 – 4'N – REC/XXXX – ASLMD – WSG –

Model: 2nd Gen

Housing: **RC** Recessed

Series: Beam

CRI**: **8** for 80+; **9** for 90+

Lamp: LED

Voltage: **120V, 277V, UNIV**

Run or Pattern: Specify total run length (i.e. **43' 5 1/8"**)
For illuminated patterns, follow overall length with **L, T, X, U, RECT** or **SQ.** Examples:
23'6" x 17'2" L Pattern would be **41'LPTTN**.
12' x 12' Square Pattern would be **48'SQPTTN**.
Provide leg dimensions as a line note in the spec.

Mounting: **REC** Recessed in ceiling. Consult factory for in-wall.

Shielding: **ASLMD** Acrylic Satin Lens, Medium Diffuse
Consult factory for other options

Options: **BPE** Battery Pack (4' section); **DL** UL Damp Label; **EMERG** Emergency Ckt; **2CKT** Dual Circuiting; **SBO** Sensor By Others#

** 90+ CRI increases watts nom. 14.5%. # Sensor by Others (consult factory).
^Some restrictions apply. **Check our Quick Ship Guide for details**.

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Docusign Envelope ID: 37D6996E-9788-4CCD-AC87-6F1095B8D128

GAMMALUX® Lighting Systems "Your design intent"

G-Beam Series GB34RC2-LED-LENS
General Illumination - Recessed in Grid or Hard Ceiling
Direct Distribution with Flush Lens

Specifications (continued on next page)

Electrical

Output: Standard (**S**) and high (**H**) options deliver a pre-set lumen package (see chart below). Custom-programmed output (**C**) is specified as LPF, WPF or % of High Output (see Custom Programmed Output page).
Static Driver: eldoLED Optotronic* programmable driver, wired for static operation (**DVR**).
0-10V Dimming: eldoLED Optotronic* programmable driver, wired for 0-10v control and dimming to 10% (**ZTV10**) or to 1% (**ZTV1**).
Step Dimming: Generic step dimming driver, two hot inputs for 100% and 50% output (**SD2**).
DALI Dimming: Generic DALI driver with two loose control wires exiting fixture at power feed location (**DALI**).
Lutron Dimming: Hi-Lume dim to 1% EcoSystem with Soft-On, Fade-to-Black (**LDE1**).
White Emitter: Nichia 757G emitters* binned within 3 MacAdam ellipses in Osram or Gammalux proprietary array. 90+ CRI option with extended lead time (CRI code **9**) results in nominal 14.5% drop in efficacy; increase calculated watts 14.5%.
Battery Pack: Bodine BSL10T3* (**BPE**). 4W max input, 10W initial output, delivers min. 27% of High Output value per 4' length.
LED System: 70% lumen output (L70) at max 85 degrees C calculated at >60k hours. Fixtures are shipped with anti-static gloves to minimize the risk of damage to LEDs during installation. 5 year limited warranty.
Sensors: Sensors are as specified, confirmed by Gammalux prior to factory quote. Examples are Enlighted Micro Sensor, Lutron Athena Wireles Node, Lutron Vive, Wattstopper FS-205.
Upgrade Capability: LED assemblies can be replaced in the future with the latest factory-provided and fully warranted components. On-board sensors, control interface devices and alternate LED components may be specified (consult factory). Fixtures bear UL & cUL Dry Location label. Damp Location label available (**DL**).
*Subject to availability; may be substituted by Gammalux. Components and specifications may be changed without notice.

LUMENS AND WATTS BY OUTPUT OPTION AND LED COLOR @ 80+ CRI*

STANDARD OUTPUT LED						HIGH OUTPUT LED					
MEDIUM DIFFUSE LENS (ASLMD) DELIVERS: 519.4 LPF HEAVY DIFFUSE (ASLHD) DELIVERS: 446 LPF						MEDIUM DIFFUSE LENS (ASLMD) DELIVERS: 692.5 LPF HEAVY DIFFUSE (ASLHD) DELIVERS: 594.7 LPF					
CCT	2700 K	3000 K	3500 K*	4000 K	5000 K	CCT	2700 K	3000 K	3500 K*	4000 K	5000 K
WATTS / FT.	6.3	5.9	5.8	5.7	5.4	WATTS / FT.	8.6	8.2	8	7.8	7.4

* IES FILES WERE CREATED USING 3500 K DIODES @ 80+ CRI. WATTAGE IS MULTIPLIED BY 1.06 FOR 2700 K, 1.02 FOR 3000 K , .98 FOR 4000 K AND .93 FOR 5000 K DIODES TO MAINTAIN THE SAME DELIVERED LUMENS THROUGHOUT ALL COLOR TEMPERATURES. FOR 90+ CRI, INCREASE WATTAGE BY 14.5%. SEE ADDENDUM FOR CUSTOM PROGRAMMING.

Construction

Housing: I.C. rated. ARRA, RoHS, REACH and Prop 65 compliant. Extruded aluminum body 3.00" wide x 3.78" high, 6063T5, 0.070" min thickness. Each housing is 12' max unless longer housings are pre-coordinated with the factory to reduce joints and installation labor. Fixtures are built per approved factory drawings and tested as a complete system at the factory. Continuous runs and patterns are ordered, built and shipped with a single item #. Fixtures ordered as individuals are not designed to be joined together in the field.

Joiner System: Automatic alignment, no loose parts, one tool to tighten factory installed bolts for hairline seam. No light leaks.

Lamping: Patterns are fully illuminated. Runs ordered in Specific Length (Length Option **S**) will be built to the exact dimension shown on signature-approved shop drawings. Runs ordered in Nominal Length (Option **N**) may be factory-adjusted to accomodate standard mounting positions or grid centers. Factory drawings will show all dimensions of mounting and power feed locations. Fixtures built to less than 4' may require remote driver installation - consult factory.

Mounting: Recessed into a ceiling system (**REC**). Fixtures surrounded by grid should be ordered in Nominal length (Length Option **N**) and can be installed from below. Consult factory for in-wall installation. Mud flange (**GMR**) includes integral expansion gap to allow for heat expansion with no pressure on surrounding plaster. GMR FIXTURE MUST BE INSTALLED PRIOR TO GYP.

GAMMALUX® Lighting Systems "Your design intent"

G-Beam Series GB34RC2-LED-LENS
General Illumination - Recessed in Grid or Hard Ceiling
Direct Distribution with Flush Lens

Specifications (continued)

Optical

Reflectors: Shall be formed diffuse high reflectance aluminum.

Acrylic Satin Lens, Medium Diffuse: Snap-in. Shall be 100% DR acrylic.

Acrylic Satin Lens, Heavy Diffuse: Snap-in. Shall be 100% DR acrylic (**ASLHD**).

See lens images on photometric pages.

Finish

Acid etched or clear annodized housing electrostatically sprayed with high solids aliphatic two component polyurethane high (**H**) or semi-gloss (**SG**) to an avg. thickness of 2 mils. Unless specified otherwise, cable mount canopies are white semi-gloss and all other painted mounting components match the fixture finish. Custom finish, consult factory. Wood Finishes, back page.



Packing and Shipping

Fixtures built for continuous rows and patterns are given a specific location identifier, clearly identified on factory layout drawings, the fixture's ID Label, protective wrapping and on each end of fixture carton. Shipping pallets are built with 2" clearance, extending beyond the length and width of cartons, providing shipping protection.

Approx. weight of 4' module is 13 lbs. including carton. Weight of pallet and supplemental packing materials not factored in.

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Direct Distribution with Flush Lens

Photometric Reports for
STANDARD OUTPUT FIXTURES

FIXTURE USES LENS ASLMD (MEDIUM DIFFUSE) AND 3500 K BOARDS. @ 80+ CRI

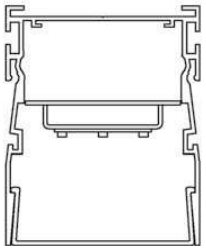
IESNA: LM 79-2008
ISSUEDATE: 04/17/13
TEST: ITL76971 mod to 2016 COMP
TESTLAB: Photopia 3.2.6
MANUFAC: GAMMALUX LIGHTING SYSTEMS
LUMCAT: GB34D2-SOLED35-4'-ASLMD
LAMPS: 73571 PLPG2-Bar-1100-835-289x38-DC

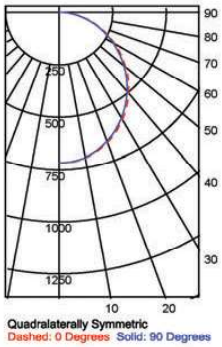
EFFICACY (Total): 86.8 LPW
DISTRIBUTION % UP: 0%
DISTRIBUTION % DOWN: 100%
CIE CLASSIFICATION: DIRECT

LUMINOUS OPENING: RECTANGULAR
Width: 0.24 (Feet)
Length: 3.96
Height: 0.00
INPUT WATTS: 25.4



Acrylic Satin Lens, Medium Diffuse (ASLMD)





FIXTURE USES LENS ASLHD (HEAVY DIFFUSE) AND 3500 K BOARDS. @ 80+ CRI

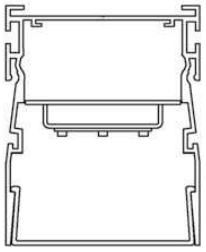
IESNA: LM 79-2008
ISSUEDATE: 04/18/13
TEST: ITL76972 mod to 2016 COMP
TESTLAB: ITL, INC
MANUFAC: GAMMALUX LIGHTING SYSTEMS
LUMCAT: GB34D2-SOLED35-4'-ASLHD
LAMPS: 73571 PLPG2-Bar-1100-835-289x38-DC

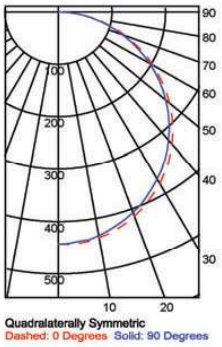
EFFICACY (Total): 63.5 LPW
DISTRIBUTION % UP: 0%
DISTRIBUTION % DOWN: 100%
CIE CLASSIFICATION: DIRECT

LUMINOUS OPENING: RECTANGULAR
Width: 0.24 (Feet)
Length: 3.96
Height: 0.00
INPUT WATTS: 25.4



Acrylic Satin Lens, Heavy Diffuse (ASLHD)





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Direct Distribution with Flush Lens

Photometric Reports for
HIGH OUTPUT FIXTURES

FIXTURE USES LENS ASLMD (MEDIUM DIFFUSE) AND 3500 K BOARDS. @ 80+ CRI

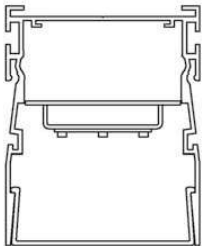
IESNA: LM 79-2008
ISSUEDATE: 04/16/13
TEST: ITL76971 mod to 2016 COMP
TESTLAB: ITL, INC
MANUFAC: GAMMALUX LIGHTING SYSTEMS
LUMCAT: GB34D2-HOLED35-4'-ASLMD
LAMPS: 73571 PLPG2-Bar-1100-835-289x38-DC

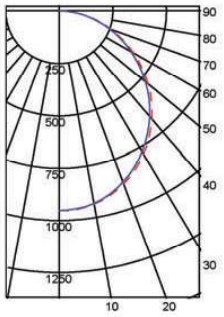
EFFICACY (Total): 83.3 LPW
DISTRIBUTION % UP: 0%
DISTRIBUTION % DOWN: 100%
CIE CLASSIFICATION: DIRECT

LUMINOUS OPENING: RECTANGULAR
Width: 0.24 (Feet)
Length: 3.96
Height: 0.00
INPUT WATTS: 35.3



Acrylic Satin Lens, Medium Diffuse (ASLMD)





Quadralaterally Symmetric
Dashed: 0 Degrees Solid: 90 Degrees

FIXTURE USES LENS ASLHD (HEAVY DIFFUSE) AND 3500 K BOARDS. @ 80+ CRI

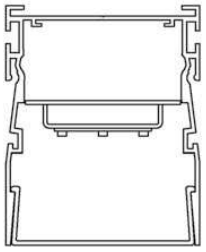
IESNA: LM 79-2008
ISSUEDATE: 04/16/13
TEST: ITL76972 mod to 2016 COMP
TESTLAB: ITL, INC
MANUFAC: GAMMALUX LIGHTING SYSTEMS
LUMCAT: GB34D2-HOLED35-4'-ASLHD
LAMPS: 73571 PLPG2-Bar-1100-835-289x38-DC

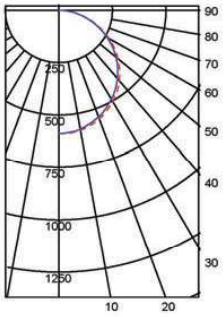
EFFICACY (Total): 60.9 LPW
DISTRIBUTION % UP: 0%
DISTRIBUTION % DOWN: 100%
CIE CLASSIFICATION: DIRECT

LUMINOUS OPENING: RECTANGULAR
Width: 0.24 (Feet)
Length: 3.96
Height: 0.00
INPUT WATTS: 35.3



Acrylic Satin Lens, Heavy Diffuse (ASLHD)





Quadralaterally Symmetric
Dashed: 0 Degrees Solid: 90 Degrees

GAMMALUX® Lighting Systems "Your design intent"

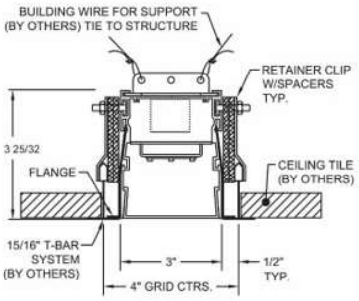
G-Beam Series GB34RC2-LED-LENS
General Illumination - Recessed in Grid or Hard Ceiling
Direct Distribution with Flush Lens

Mounting Details

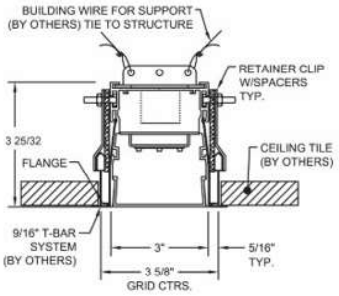
Factory Drawings: Fully dimensioned factory drawings will be provided upon receipt of purchase order.

Grid Mount

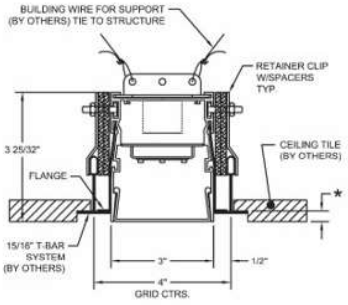
15/16" Flat TBar:
Specify **T1W** code in catalog #



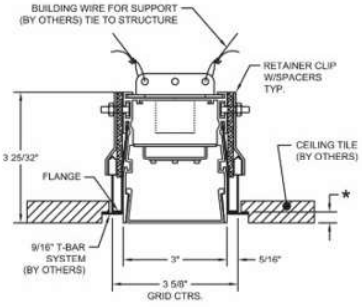
9/16" Flat TBar:
Specify **T9W** code in catalog #



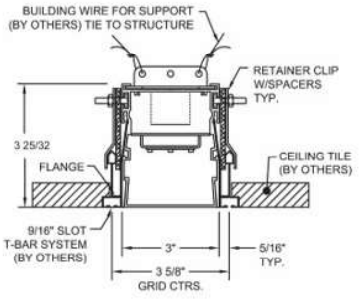
15/16" Flat TBar with Tegular Tiles:
Specify **T1TW** code in catalog #



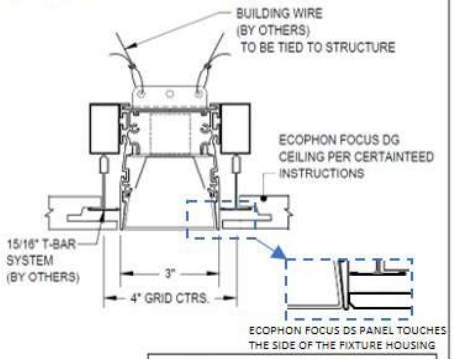
9/16" Flat TBar with Tegular Tiles:
Specify **T9TW** code in catalog #



9/16" Slot Grid:
Specify **TSW** code in catalog #



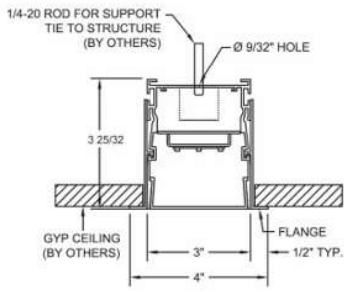
CertainTeed Ecophon Focus (DG and DS):
Specify **EFD** code in catalog #



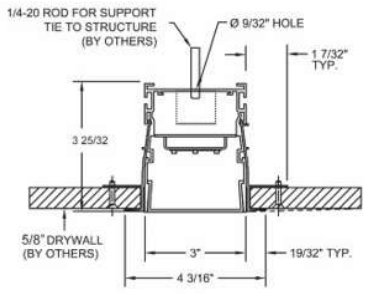
*Contractor must provide dimensions to Gammalux.

Hard Ceiling Mount

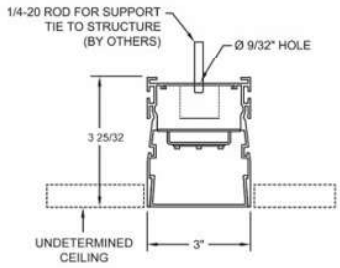
Gyp type ceiling with cover flange:
Specify **GFR** code in catalog #



Gyp type ceiling Mud Flange:
Specify **GMR** code in catalog #



Undetermined ceiling, Flangeless:
Specify **NFR** code in catalog #



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Docusign Envelope ID: 37D6996E-9788-4CCD-AC87-6F1095B8D128

GAMMALUX® Lighting Systems "Your design intent"

G-Beam Series GB34RC2-LED-LENS
General Illumination - Recessed in Grid or Hard Ceiling
Direct Distribution with Flush Lens

Sample Installations



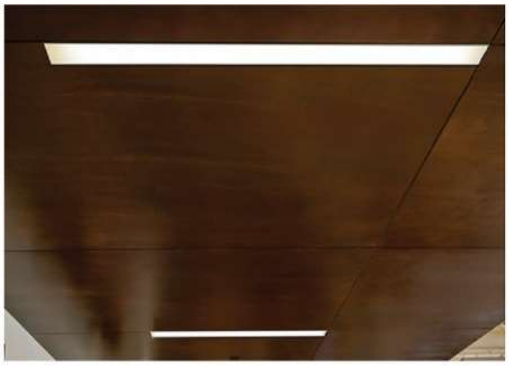
Flush with 15/16" grid (T1W)



Modified per spec



Dropped with tegular tiles in 9/16" grid (T9TW)



No flange (NFR)



Cover flange (GFR)



Mud flange in gyp wall (GMU)



Mud flange in gyp ceiling (GMR)

248 East Arrow Highway, San Dimas, CA 91773 Tel 909.599.9669 | 800.356.3275
Fax 909.599.5288 E-mail: info@gammalux.com

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Docusign Envelope ID: 37D6996E-9788-4CCD-AC87-6F1095B8D128

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Custom Programmed Output

Custom Programmed Output can be specified to produce approximate Delivered Lumens per Foot, Percentage of High Output Value or Maximum Watts per Foot.

Delivered Lumens Per Foot
Gammalux deals only in delivered lumens per foot. When working to match or exceed a competitor product's Lumens Per Foot package, be sure you are looking at their Delivered (through the lens) lumens per foot, not their System (bare board) lumens per foot.

In the Gammalux item #, use **C** as the Output designator and add a fixture description stating the required Lumens Per Foot value (ie: if you need 600 lumens per foot delivered by the fixture, the line note would read "Program = 600 LPF").

Percentage of High Output Value
If the required delivered lumens per foot are not known, run lighting calculations using our High Output IES file and identify the percentage of increase or decrease required to produce the correct lighting in the space.

In the Gammalux item #, use **C** as the Output designator and add a fixture description stating the required percentage of decrease from our High Output value (ie: for 60% of our High Output value, the line note would read "Program = 60% of High Output").

Maximum Watts Per Foot
In the Gammalux item #, use **C** as the Output designator and add a fixture description stating the required Maximum Watts per Foot (ie: if you need the fixtures capped at a maximum of 7 watts per foot, the line note would read "Program = 7 WPF").

For all three methods, custom programming capability is currently 25-200% of our High Output value. For requirements outside of this range, consult factory.

GAMMALUX® Lighting Systems "Your design intent"

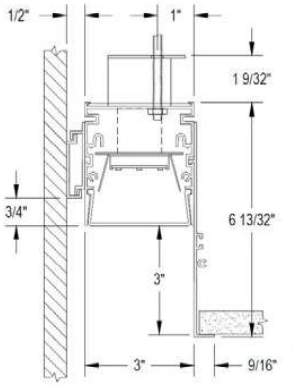
Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

Click or scan QR code to view latest spec sheet

Click for: **Asymmetric To Room**

Revision Date: April 29, 2024

Gammalux Lighting Systems reserves the right to change details of fixture designs and construction at any time.



LED Lamping



Click photo to view product page

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Pages 4-11: Photometric Info / Downloads
Pages 12-14: Mounting Details
Page 16: Custom Programming
Pages 17-20: Length and GAMMALUX EZ-TELE™

Product Overview (for complete specifications, see pages 2 & 3) ******NEW****** See last page for APPROVED CUT RELEASE.

Quick Ship: Most product options are shippable within 2-3 weeks! **Check our Quick Ship Guide for details**.

Why specify Gammalux Perimeter Systems?
Let's start with the broadest array of apertures sizes; 1", 2", 3" ,4", 5" & 6" along with your choice of regress depths. Also, note the shallow housing cross section heights. All of that with our new GAMMALUX *EZ-TELE*™ telescoping module for fast installation (U.S. PATENT No. 11,384,923, pg. 15) with Chicago Plenum compliance.
The result? The GPD series is your versatile, affordable linear wall slot system. Gammalux understands quality of light, & what's important for "your design intent"!

Construction: I.C. rated. ARRA, RoHS, REACH and Prop 65 compliant. Extruded aluminum housing for superior fit and finish. Runs and patterns have a single item # and can be built to field dims. Up to 3" lens regress with continuous illumination in custom-length runs and patterns with illuminated corners.

Standard Nomenclature

Quick Ship Eligible^ Most options 2-3 weeks

Manufacturer: Gammalux
Housing width: 3"
Output: S Standard Output; H High Output; C Custom Output see addendum page
Color Temp. (nom): 27 2700K; 30 3000K; 35 3500K; 40 4000K; 50 5000K; RGB/RGBW consult factory
Driver: ZTV10 0-10V Dim to 10%; ZTV1 0-10V Dim to 1%; For all options, see next page
Length Option (length details page): N Nominal; VIF Verify In Field (do not use VIF with EZT)
Ceiling Interface and Regress: GFR Gyp or grid w/ .5" flange; GMR Gyp w/ mud flange; 0 No regress; 1 1" regress; 2 2" regress; 3 3" regress
Wall Interface: A Adjustable wall bracket
Paint Option: A Antimicrobial; Blank Standard
Paint Finish: H High Gloss; SG Semi-Gloss
Paint Colors: W White (see color chart for other colors); CCM Custom Color Match

GPD3 – SL358EZT – UNIV – ZTV10 – 4'N – RECW/A/GFR3 – ASLMD – WSGA –

Distribution: Direct
Series: Perimeter
Lamp: LED
CRI**: 8 for 80+; 9 for 90+
Voltage: 120V, 277V, 347V, UNIV (120-277V)
LED/Housing Option: Blank Run is non-telescoping. EZT Telescoping module allows nominal 6" field adjustability for fast installation. (see page 14)
Run or Pattern: Specify total run length (i.e. **43' 5 1/8"**). For runs with *EZ-TELE*™, indicate designed run length. Factory drawings will show field adjustability + and -. For patterns, indicate pattern dimension (i.e. **4'X12'6"L, 3'3"x17'T, 2'X4'X, 6'X13'REC, 10'X10'SQ**). Consult factory for complex or multi-plane patterns.
Mounting: REC Recessed intra-wall (images, pg. 13); RECW*** Recessed wall-to-wall (images, pg. 14)
Shielding: ASLMD Acrylic Satin Lens, Medium Diffuse; ASLHD Acrylic Satin Lens, Heavy Diffuse
Options: BPE Battery Pack (4' section); DL UL Damp Label; EMERG Emergency Ckt; 2CKT Dual Circuiting; SBO Sensor By Others#; CP Chicago Plenum

** 90+ CRI increases watts nom. 14.5%. *** Field dims. required if not using GAMMALUX *EZ-TELE*™. # Sensor by Others (consult factory).
^Some restrictions apply. **Check our Quick Ship Guide for details**.

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Docusign Envelope ID: 37D6996E-9788-4CCD-AC87-6F1095B8D128

GAMMALUX® Lighting Systems "Your design intent"

Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

Specifications (continued on next page)

Electrical

Output: Standard (**S**) and high (**H**) options deliver a pre-set lumen package (see chart below). Custom-programmed output (**C**) is specified as LPF, WPF or % of High Output (see Custom Programmed Output page).
Static Driver: eldoLED Optotronic* programmable driver, wired for static operation (**DVR**).
0-10V Dimming: eldoLED Optotronic* programmable driver, wired for 0-10v control and dimming to 10% (**ZTV10**) or to 1% (**ZTV1**).
Step Dimming: Generic step dimming driver, two hot inputs for 100% and 50% output (**SD2**).
DALI Dimming: Generic DALI driver with two loose control wires exiting fixture at power feed location (**DALI**).
Lutron Dimming: Hi-Lume dim to 1% EcoSystem with Soft-On, Fade-to-Black (**LDE1**).
White Emitter: Nichia 757G emitters* binned within 3 MacAdam ellipses in Osram or Gammalux proprietary array. 90+ CRI option with extended lead time (CRI code **9**) results in nominal 14.5% drop in efficacy; increase calculated watts 14.5%.
Battery Pack: Bodine BSL10T3* (**BPE**). 4W max input, 10W initial output, delivers min. 27% of High Output value per 4' length.
LED System: 70% lumen output (L70) at max 85 degrees C calculated at >60k hours. Fixtures are shipped with anti-static gloves to minimize the risk of damage to LEDs during installation. 5 year limited warranty.
Sensors: Sensors are as specified, confirmed by Gammalux prior to factory quote. Examples are Enlighted Micro Sensor, Lutron Athena Wireles Node, Lutron Vive, Wattstopper FS-205.
Upgrade Capability: LED assemblies can be replaced in the future with the latest factory-provided and fully warranted components. On-board sensors, control interface devices and alternate LED components may be specified (consult factory). Fixtures bear UL & cUL Dry Location label. Damp Location label available (**DL**).
*Subject to availability; may be substituted by Gammalux. Components and specifications may be changed without notice.

LUMENS AND WATTS BY OUTPUT OPTION AND LED COLOR @ 80+ CRI*

STANDARD OUTPUT LED						HIGH OUTPUT LED					
0" REGRESS & ASLMD **519.4 LPF**		0" REGRESS & ASLHD **446 LPF**				0" REGRESS & ASLMD **692.5 LPF**		0" REGRESS & ASLHD **597.7 LPF**			
1" REGRESS & ASLMD **505.1 LPF**		1" REGRESS & ASLHD **416.6 LPF**				1" REGRESS & ASLMD **673.4 LPF**		1" REGRESS & ASLHD **557 LPF**			
2" REGRESS & ASLMD **490.7 LPF**		2" REGRESS & ASLHD **387.2 LPF**				2" REGRESS & ASLMD **654.3 LPF**		2" REGRESS & ASLHD **516.3 LPF**			
3" REGRESS & ASLMD **483.5 LPF**		3" REGRESS & ASLHD **372.5 LPF**				3" REGRESS & ASLMD **644.8 LPF**		3" REGRESS & ASLHD **496 LPF**			
CCT	2700 K	3000 K	3500 K*	4000 K	5000 K	CCT	2700 K	3000 K	3500 K*	4000 K	5000 K
WATTS / FT.	6.3	5.9	5.8	5.7	5.4	WATTS / FT.	8.6	8.2	8	7.8	7.4

* IES FILES WERE CREATED USING 3500 K DIODES @ 80+ CRI. WATTAGE IS MULTIPLIED BY 1.06 FOR 2700 K, 1.02 FOR 3000 K , .98 FOR 4000 K AND .93 FOR 5000 K DIODES TO MAINTAIN THE SAME DELIVERED LUMENS THROUGHOUT ALL COLOR TEMPERATURES. FOR 90+ CRI, INCREASE WATTAGE BY 14.5%. SEE ADDENDUM FOR CUSTOM PROGRAMMING.

Construction

Housing: I.C. rated. ARRA, RoHS, REACH and Prop 65 compliant. Extruded aluminum body 3" wide x nominal 3.3" high, 6063T5, 0.070" min thickness. Each housing is 12' max unless longer housings are pre-coordinated with the factory to reduce joints and installation labor. Fixtures are built per approved factory drawings and tested as a complete system at the factory. Continuous runs and patterns are ordered, built and shipped with a single item #. Fixtures ordered as individuals are not designed to be joined together in the field. **Chicago Plenum** compliant construction (option code **CP**) does not exclude GAMMALUX *EZ-TELE*™ capability.

Joiner System: Automatic alignment, no loose parts, one tool to tighten factory installed bolts for hairline seam. No light leaks.

Lamping: Patterns are fully illuminated. Runs ordered as Verify In Field (Length Option **VIF**) will be built to the exact dimension shown on signature-approved shop drawings. Runs ordered in Nominal Length (Option **N**) may be factory-adjusted to accomodate standard mounting positions or grid centers. GAMMALUX *EZ-TELE*™ (LED/Housing Option **EZT**) allows a minimum of 4" field adjustability above and below the ordered run length with complete illumination throughout (see page 15). Factory drawings will show all dimensions of mounting and power feed locations. GAMMALUX *EZ-TELE*™ runs built to less than 5' require remote driver installation - consult factory.

Mounting: Shall be perimeter mounted to wall via Adjustable Wall Bracket (**A**) and recessed into a grid or hard ceiling with up to 3" regress. Power feed is accomplished through knockouts in housing. Fixtures can be ganged together mechanically and electrically in continuous rows. Fixtures surrounded by grid should be ordered in Nominal length (Length Option **N**).

GAMMALUX® Lighting Systems "Your design intent"

Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

Specifications (continued)

Optical

Reflectors: Shall be formed diffuse high reflectance aluminum.

Acrylic Satin Lens, Medium Diffuse: Snap-in. Shall be 100% DR acrylic (**ASLMD**).

Acrylic Satin Lens, Heavy Diffuse: Snap-in. Shall be 100% DR acrylic (**ASLHD**). See lens images on photometric pages.

Finish

High solids aliphatic two component polyurethane high (**H**) or semi-gloss (**SG**), avg. thickness of 2 mils. Unless specified otherwise, cable mount canopies are white semi-gloss and all other painted mounting components match the fixture finish. Antimicrobial paint option (code **A**).



Packing and Shipping

Fixtures built for continuous rows and patterns are given a specific location identifier, clearly identified on factory layout drawings, the fixture's ID Label, protective wrapping and on each end of fixture carton. Shipping pallets are built with 2" clearance, extending beyond the length and width of cartons, providing shipping protection.

Approx. weight of 4' module is 10 lbs. including carton. Weight of pallet and supplemental packing materials not factored in.

Instructions

Click here for written instructions and videos.

GAMMALUX® Lighting Systems "Your design intent"

Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

Photometric Reports for
STANDARD OUTPUT FIXTURES

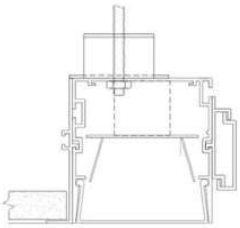
0" REGRESS, ASLMD (MEDIUM DIFFUSE) AND 3500K LEDs @ 80+ CRI

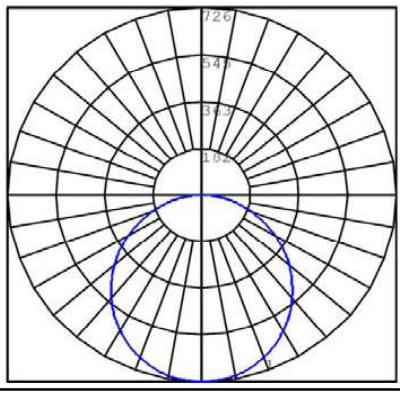
IESNA: LM-63-2002
ISSUEDATE: 8/14/2018
TEST: 12773298.02 MOD SO, 57452, PREVALE
TESTLAB: UL VERIFICATION SVCS, INC.
MANUFAC: GAMMALUX LTG SYS
LUMCAT: GPD3SL358GFR0ASLMD
LAMPS: 192 WHITE LEDs

MAX. UGR (NO WALL)	26.2
EFFICACY (TOTAL):	89.1 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (519.4 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48.5 in.
INPUT WATTS:	23.31 per 4'



Acrylic Satin Lens, Medium Diffuse (ASLMD)





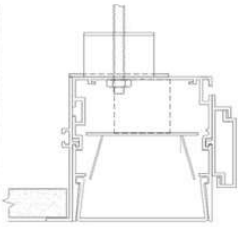
0" REGRESS, ASLHD (HEAVY DIFFUSE) AND 3500K LEDs @ 80+ CRI

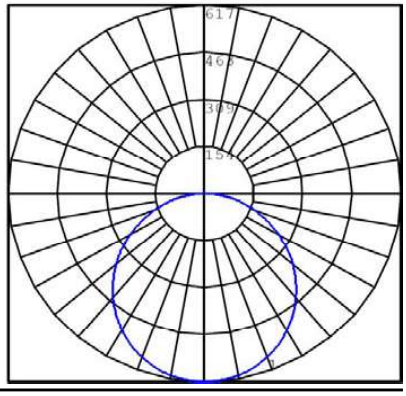
IESNA: LM-63-2002
ISSUEDATE: 8/14/2018
TEST: 12773298.02 HD, SO, 57452, PREVALED
TESTLAB: UL VERIFICATION SVCS, INC.
MANUFAC: GAMMALUX LTG SYS
LUMCAT: GPD3SL358GFR0ASLHD
LAMPS: 192 WHITE LEDs

MAX. UGR (NO WALL)	25.7
EFFICACY (TOTAL):	75.7 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (441.4 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48.5 in.
INPUT WATTS:	23.31 per 4'



Acrylic Satin Lens, Heavy Diffuse (ASLHD)





SEE NEXT PAGE FOR STANDARD OUTPUT FIXTURES WITH 1" REGRESS

GAMMALUX® Lighting Systems "Your design intent"

Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

Photometric Reports for
STANDARD OUTPUT FIXTURES

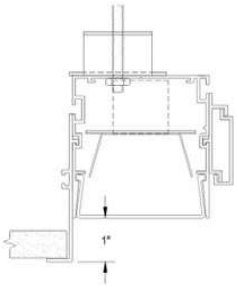
1" REGRESS, ASLMD (MEDIUM DIFFUSE) AND 3500K LEDs @ 80+ CRI

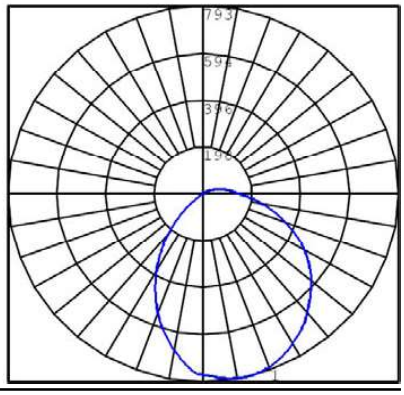
IESNA: LM-63-2002
ISSUEDATE: 8/14/2018
TEST: 13682237.03, SO, GFR1, PREVALED
TESTLAB: UL VERIFICATION SVCS, INC.
MANUFAC: GAMMALUX LTG SYS
LUMCAT: GPD3SL358GFR1ASLMD
LAMPS: 192 WHITE LEDs

MAX. UGR (NO WALL)	26.8
EFFICACY (TOTAL):	86.7 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (505.5 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48.5 in.
INPUT WATTS:	23.31 per 4'



Acrylic Satin Lens, Medium Diffuse (ASLMD)





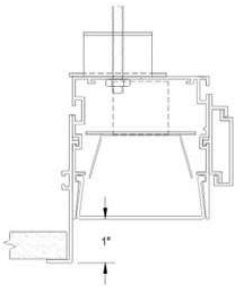
1" REGRESS, ASLHD (HEAVY DIFFUSE) AND 3500K LEDs @ 80+ CRI

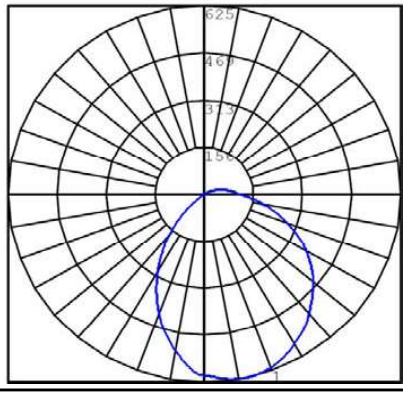
IESNA: LM-63-2002
ISSUEDATE: 8/14/2018
TEST: 13682237.03, SO, HD, GFR1, PREVALED
TESTLAB: UL VERIFICATION SVCS, INC.
MANUFAC: GAMMALUX LTG SYS
LUMCAT: GPD3SL358GFR1ASLHD
LAMPS: 192 WHITE LEDs

MAX. UGR (NO WALL)	25.9
EFFICACY (TOTAL):	68.4 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (398.8 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48.5 in.
INPUT WATTS:	23.31 per 4'



Acrylic Satin Lens, Heavy Diffuse (ASLHD)





SEE NEXT PAGE FOR STANDARD OUTPUT FIXTURES WITH 2" REGRESS

GAMMALUX® Lighting Systems "Your design intent"

Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

Photometric Reports for
STANDARD OUTPUT FIXTURES

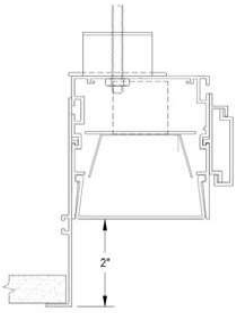
2" REGRESS, ASLMD (MEDIUM DIFFUSE) AND 3500K LEDs @ 80+ CRI

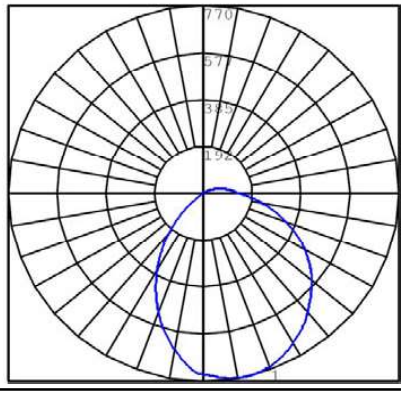
IESNA: LM-63-2002
ISSUEDATE: 8/14/2018
TEST: 13682237.03 MOD TO SO, PREVALED
TESTLAB: UL VERIFICATION SVCS, INC.
MANUFAC: GAMMALUX LTG SYS
LUMCAT: GPD3SL358GFR2ASLMD
LAMPS: 192 WHITE LEDs

MAX. UGR (NO WALL)	26.7
EFFICACY (TOTAL):	84.2 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (490.8 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48.5 in.
INPUT WATTS:	23.31 per 4'



Acrylic Satin Lens, Medium Diffuse (ASLMD)





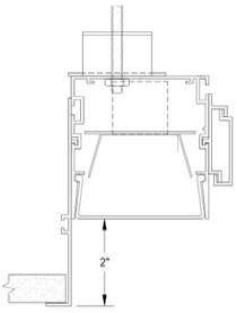
2" REGRESS, ASLHD (HEAVY DIFFUSE) AND 3500K LEDs @ 80+ CRI

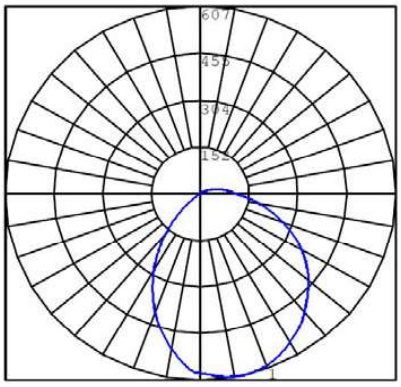
IESNA: LM-63-2002
ISSUEDATE: 8/14/2018
TEST: 13682237.03 MOD SO, HD, PREVALED
TESTLAB: UL VERIFICATION SVCS, INC.
MANUFAC: GAMMALUX LTG SYS
LUMCAT: GPD3SL358GFR2ASLHD
LAMPS: 192 WHITE LEDs

MAX. UGR (NO WALL)	25.8
EFFICACY (TOTAL):	66.4 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (387.2 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48.5 in.
INPUT WATTS:	23.31 per 4'



Acrylic Satin Lens, Heavy Diffuse (ASLHD)





SEE NEXT PAGE FOR STANDARD OUTPUT FIXTURES WITH 3" REGRESS

GAMMALUX® Lighting Systems "Your design intent"

Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

Photometric Reports for
STANDARD OUTPUT FIXTURES

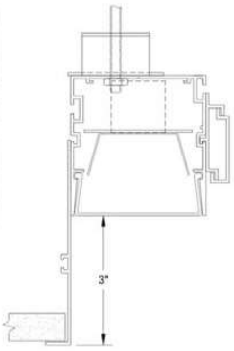
3" REGRESS, ASLMD (MEDIUM DIFFUSE) AND 3500K LEDs @ 80+ CRI

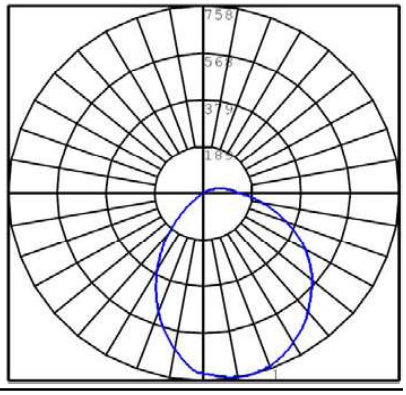
IESNA: LM-63-2002
ISSUEDATE: 01/26/2021
TEST: 13682237.03 MOD SO, GFR3, PREVALED
TESTLAB: UL VERIFICATION SVCS, INC.
MANUFAC: GAMMALUX LTG SYS
LUMCAT: GPD3SL358GFR3ASLMD
LAMPS: 192 WHITE LEDs

MAX. UGR (NO WALL)	26.6
EFFICACY (TOTAL):	83 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (483.4 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48 in.
INPUT WATTS:	23.31 per 4'



Acrylic Satin Lens, Medium Diffuse (ASLMD)





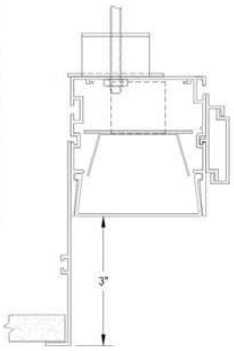
3" REGRESS, ASLHD (HEAVY DIFFUSE) AND 3500K LEDs @ 80+ CRI

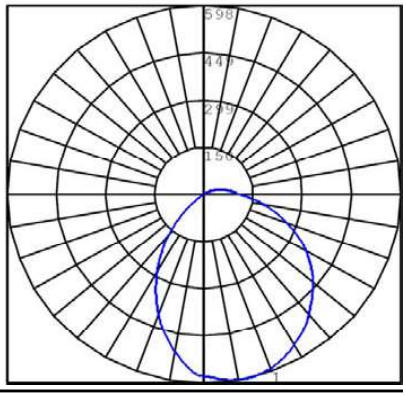
IESNA: LM-63-2002
ISSUEDATE: 01/26/2021
TEST: 13682237.03 SO, HD, GFR3, PREVALED
TESTLAB: UL VERIFICATION SVCS, INC.
MANUFAC: GAMMALUX LTG SYS
LUMCAT: GPD3SL358GFR3ASLHD
LAMPS: 192 WHITE LEDs

MAX. UGR (NO WALL)	25.8
EFFICACY (TOTAL):	65.4 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (381.4 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48 in.
INPUT WATTS:	23.31 per 4'



Acrylic Satin Lens, Heavy Diffuse (ASLHD)





GAMMALUX® Lighting Systems "Your design intent"

Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

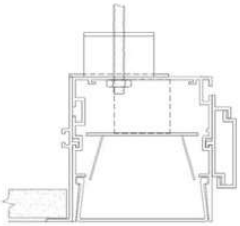
Photometric Reports for
HIGH OUTPUT FIXTURES

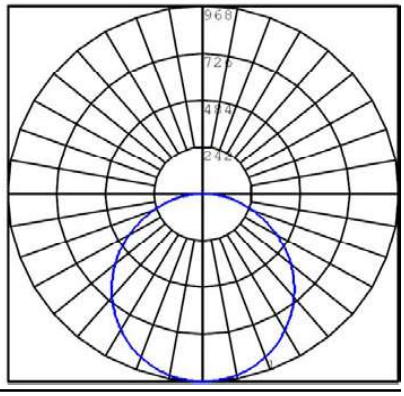
0" REGRESS, ASLMD (MEDIUM DIFFUSE) AND 3500K LEDs @ 80+ CRI

IESNA:	LM-63-2002
ISSUEDATE:	8/14/2018
TEST:	12773298.02, 57452, PREVALED
TESTLAB:	UL VERIFICATION SVCS, INC.
MANUFAC:	GAMMALUX LTG SYS
LUMCAT:	GPD3HL358GFR0ASLMD
LAMPS:	192 WHITE LEDs
MAX. UGR (NO WALL)	27.2
EFFICACY (TOTAL):	86.2 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (692.4 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48.5 in.
INPUT WATTS:	32.12 per 4'



Acrylic Satin Lens, Medium Diffuse (ASLMD)



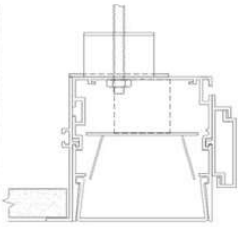


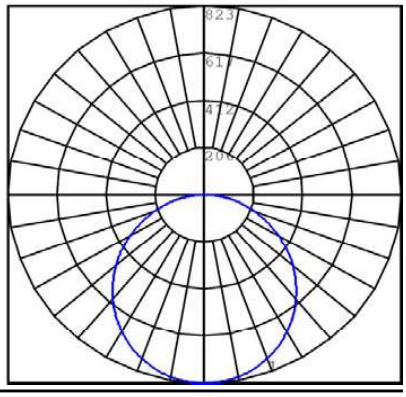
0" REGRESS, ASLHD (HEAVY DIFFUSE) AND 3500K LEDs @ 80+ CRI

IESNA:	LM-63-2002
ISSUEDATE:	8/14/2018
TEST:	12773298.02 HD, 57452, PREVALED
TESTLAB:	UL VERIFICATION SVCS, INC.
MANUFAC:	GAMMALUX LTG SYS
LUMCAT:	GPD3HL358GFR0ASLHD
LAMPS:	192 WHITE LEDs
MAX. UGR (NO WALL)	26.7
EFFICACY (TOTAL):	73.3 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (588.5 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48.5 in.
INPUT WATTS:	32.12 per 4'



Acrylic Satin Lens, Heavy Diffuse (ASLHD)





SEE NEXT PAGE FOR HIGH OUTPUT FIXTURES WITH 1" REGRESS

GAMMALUX® Lighting Systems "Your design intent"

Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

Photometric Reports for
HIGH OUTPUT FIXTURES

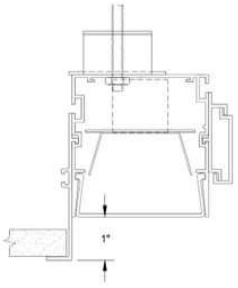
1" REGRESS, ASLMD (MEDIUM DIFFUSE) AND 3500K LEDs @ 80+ CRI

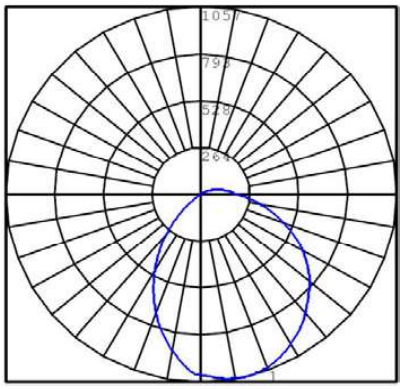
IESNA: LM-63-2002
ISSUEDATE: 8/14/2018
TEST: 13682237.03, GFR1, PREVALED
TESTLAB: UL VERIFICATION SVCS, INC.
MANUFAC: GAMMALUX LTG SYS
LUMCAT: GPD3HL358GFR1ASLMD
LAMPS: 192 WHITE LEDs

MAX. UGR (NO WALL)	27.8
EFFICACY (TOTAL):	83.9 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (673.9 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48.5 in.
INPUT WATTS:	32.12 per 4'



Acrylic Satin Lens, Medium Diffuse (ASLMD)





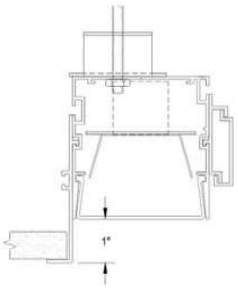
1" REGRESS, ASLHD (HEAVY DIFFUSE) AND 3500K LEDs @ 80+ CRI

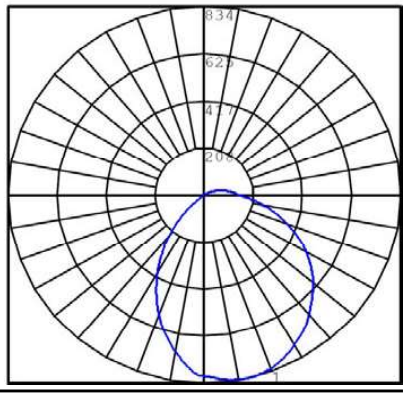
IESNA: LM-63-2002
ISSUEDATE: 8/14/2018
TEST: 13682237.03 MOD HD, GFR1, PREVALED
TESTLAB: UL VERIFICATION SVCS, INC.
MANUFAC: GAMMALUX LTG SYS
LUMCAT: GPD3HL358GFR1ASLHD
LAMPS: 192 WHITE LEDs

MAX. UGR (NO WALL)	26.9
EFFICACY (TOTAL):	66.2 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (531.8 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48.5 in.
INPUT WATTS:	32.12 per 4'



Acrylic Satin Lens, Heavy Diffuse (ASLHD)





SEE NEXT PAGE FOR HIGH OUTPUT FIXTURES WITH 2" REGRESS

GAMMALUX® Lighting Systems "Your design intent"

Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

Photometric Reports for
HIGH OUTPUT FIXTURES

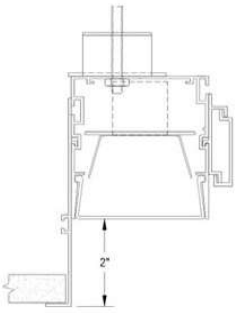
2" REGRESS, ASLMD (MEDIUM DIFFUSE) AND 3500K LEDs @ 80+ CRI

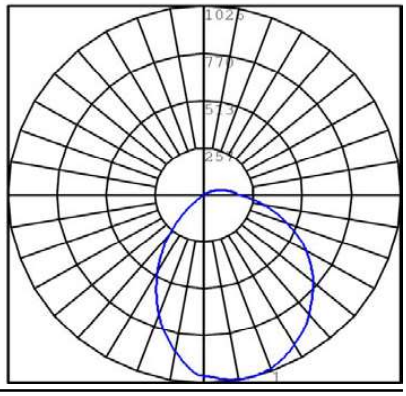
IESNA: LM-63-2002
ISSUEDATE: 8/14/2018
TEST: 13682237.03, PREVALED
TESTLAB: UL VERIFICATION SVCS, INC.
MANUFAC: GAMMALUX LTG SYS
LUMCAT: GPD3HL358GFR2ASLMD
LAMPS: 192 WHITE LEDs

MAX. UGR (NO WALL)	27.7
EFFICACY (TOTAL):	81.5 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (654.3 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48.5 in.
INPUT WATTS:	32.12 per 4'



Acrylic Satin Lens, Medium Diffuse (ASLMD)





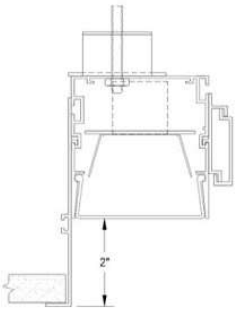
2" REGRESS, ASLHD (HEAVY DIFFUSE) AND 3500K LEDs @ 80+ CRI

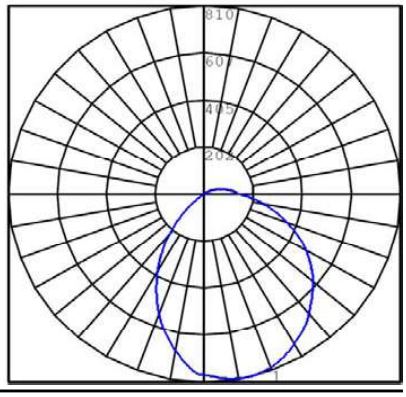
IESNA: LM-63-2002
ISSUEDATE: 8/14/2018
TEST: 13682237.03, HD, PREVALED
TESTLAB: UL VERIFICATION SVCS, INC.
MANUFAC: GAMMALUX LTG SYS
LUMCAT: GPD3HL358GFR2ASLHD
LAMPS: 192 WHITE LEDs

MAX. UGR (NO WALL)	26.8
EFFICACY (TOTAL):	64.3 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (516.3 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48.5 in.
INPUT WATTS:	32.12 per 4'



Acrylic Satin Lens, Heavy Diffuse (ASLHD)





SEE NEXT PAGE FOR HIGH OUTPUT FIXTURES WITH 3" REGRESS

GAMMALUX® Lighting Systems "Your design intent"

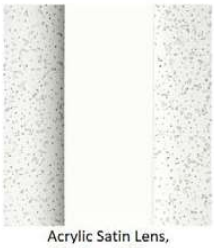
Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

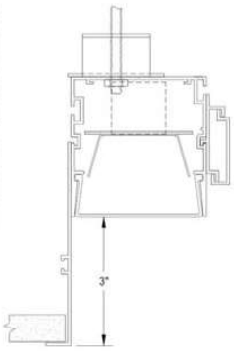
Photometric Reports for
HIGH OUTPUT FIXTURES

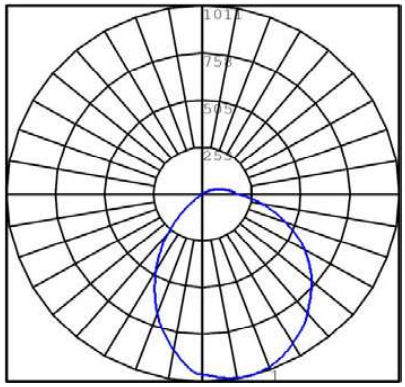
3" REGRESS, ASLMD (MEDIUM DIFFUSE) AND 3500K LEDs @ 80+ CRI

IESNA: LM-63-2002
ISSUEDATE: 01/26/2021
TEST: 13682237.03, GFR3, PREVALED
TESTLAB: UL VERIFICATION SVCS, INC.
MANUFAC: GAMMALUX LTG SYS
LUMCAT: GPD3HL358GFR3ASLMD
LAMPS: 192 WHITE LEDs

MAX. UGR (NO WALL)	27.6
EFFICACY (TOTAL):	80.3 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (644.5 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48 in.
INPUT WATTS:	32.12 per 4'


Acrylic Satin Lens, Medium Diffuse (ASLMD)



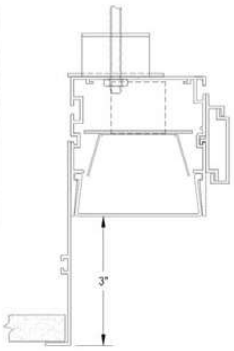


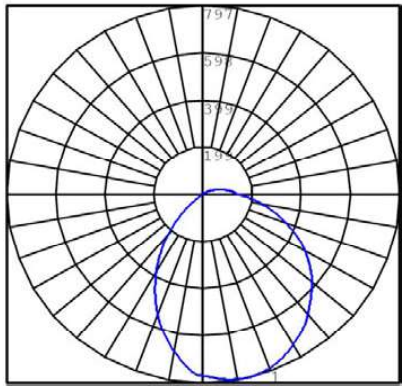
3" REGRESS, ASLHD (HEAVY DIFFUSE) AND 3500K LEDs @ 80+ CRI

IESNA: LM-63-2002
ISSUEDATE: 01/26/2021
TEST: 13682237.03, HD, GFR3, PREVALED
TESTLAB: UL VERIFICATION SVCS, INC.
MANUFAC: GAMMALUX LTG SYS
LUMCAT: GPD3HL358GFR3ASLHD
LAMPS: 192 WHITE LEDs

MAX. UGR (NO WALL)	26.8
EFFICACY (TOTAL):	63.3 LPW
DISTRIBUTION % UP:	0%
DISTRIBUTION % DN:	100% (508.5 LPF)
CIE CLASSIFICATION:	DIRECT
LUMINOUS OPENING:	RECTANGULAR
WIDTH:	3 in.
LENGTH:	48 in.
INPUT WATTS:	32.12 per 4'


Acrylic Satin Lens, Heavy Diffuse (ASLHD)





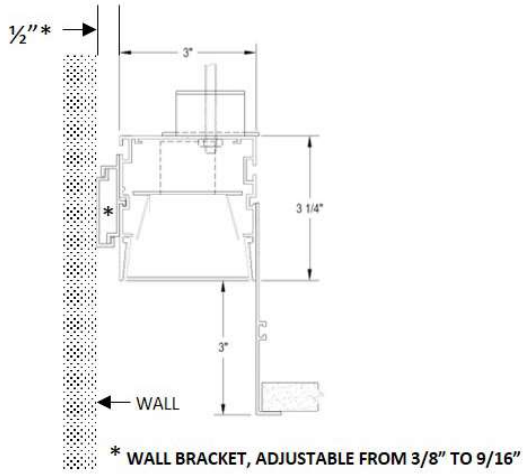
GAMMALUX® Lighting Systems "Your design intent"

Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

Mounting Details

Factory Drawings: Fully dimensioned factory drawings will be provided for approval or record. Click here for complete written instructions and videos.

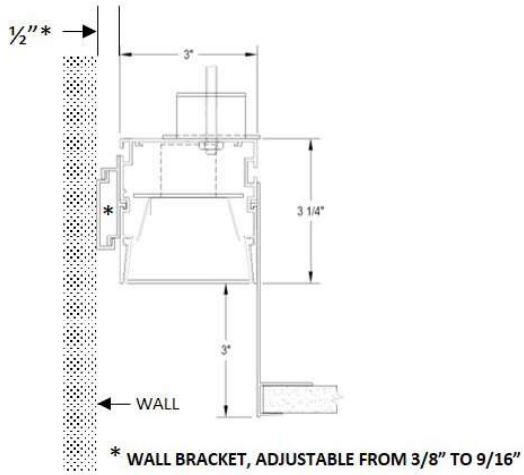
Perimeter Mount: Flanged
(REC/A/GFR3 shown)



Installation Summary

1. Pre-install threaded rod and power at locations shown on Gammalux shop drawings.
2. Install wall bracket per shop drawings.
3. If using optional exterior rod support bracket, raise fixture into place and support on wall bracket, then apply nut on threaded rod and level fixture.
   If NOT using optional exterior rod support bracket, remove LED array and backing plate from locations indicated inside fixture, raise fixture into place and support on wall bracket, then apply nut on threaded rod and level fixture. Trim threaded rod and reinstall LED backing plate and LED array.
4. Make electrical and control connections.
5. Join continuous runs and test fixtures.
6. Install ceiling.

Perimeter Mount: Mud-in
(REC/A/GMR3 shown)



Installation Summary

1. Pre-install threaded rod and power at locations shown on Gammalux shop drawings.
2. Install wall bracket per shop drawings.
3. If using optional exterior rod support bracket, raise fixture into place and support on wall bracket, then apply nut on threaded rod and level fixture.
   If NOT using optional exterior rod support bracket, remove LED array and backing plate from locations indicated inside fixture, raise fixture into place and support on wall bracket, then apply nut on threaded rod and level fixture. Trim threaded rod and reinstall LED backing plate and LED array.
4. Make electrical and control connections.
5. Join continuous runs and test fixtures.
6. Insert gyp between upper and lower flanges, secure to upper flange with self-tapping drywall screws.
7. Apply joint tape and joint compound on lower flange and finish per architectural instructions.

Gammalux Lighting Systems reserves the right to change the details of fixture design and construction at any time.

Docusign Envelope ID: 37D6996E-9788-4CCD-AC87-6F1095B8D128

GAMMALUX® Lighting Systems "Your design intent"

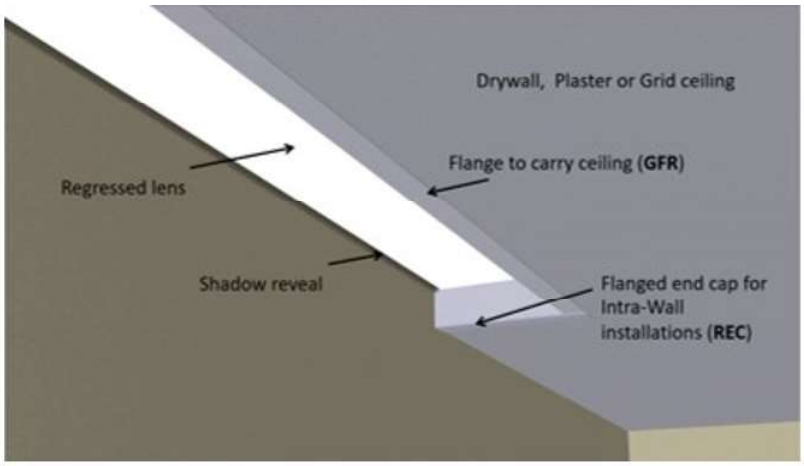
Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

Mounting Details

Factory Drawings:

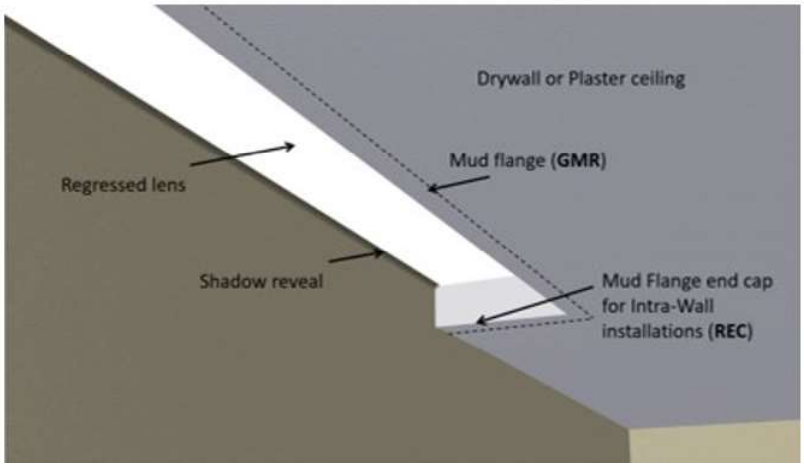
Mounting style from page 1: REC/A/GFR

Fixture is recessed above the ceiling line and IS NOT touching a side wall (**REC**). The fixture attaches to back wall via Gammalux-provided Wall Rail which is mounted above the ceiling line per approved shop drawings. The fixture bottom features a 1" flange (**GFR**) on three sides, allowing it to rest under the ceiling material.



Mounting style from page 1: REC/A/GMR

Fixture is recessed above the ceiling line and IS NOT touching a side wall (**REC**). The fixture attaches to back wall via Gammalux-provided Wall Rail which is mounted above the ceiling line per approved shop drawings. The fixture bottom features a mud flange (**GMR**) on three sides, allowing it to be 'mudded' into the drywall or plaster ceiling.



Gammalux Lighting Systems reserves the right to change the details of fixture design and construction at any time.

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Fax 909.599.5288 E-mail: info@gammalux.com
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GAMMALUX® Lighting Systems "Your design intent"

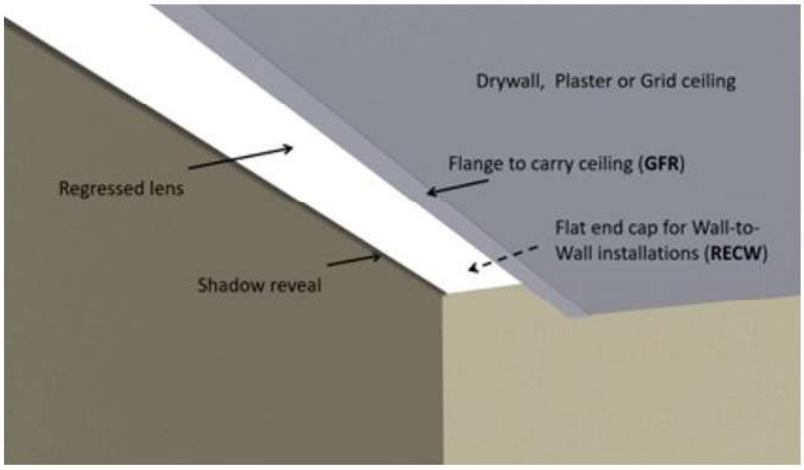
Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

Mounting Details

Factory Drawings:

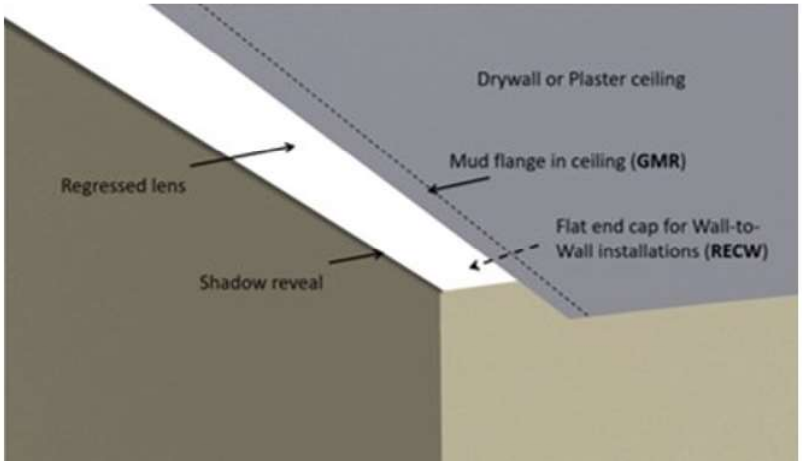
Mounting style from page 1: RECW/A/GFR

Fixture is recessed above the ceiling line and terminates at a side wall (**RECW**). The exposed portion of the side wall above the ceiling line should be finished to match the rest of the wall. The fixture attaches to back wall via Wall Rail which is mounted above the ceiling line per approved shop drawings. The fixture bottom features a 1" flange (**GFR**), allowing it to rest under the ceiling material.



Mounting style from page 1: RECW/A/GMR

Fixture is recessed above the ceiling line and terminates at a side wall (**RECW**). The exposed portion of the side wall above the ceiling line should be finished to match the rest of the wall. The fixture attaches to back wall via Wall Rail which is mounted above the ceiling line per approved shop drawings. The fixture bottom features a mud flange (**GMR**), allowing it to be 'mudded' into the drywall or plaster ceiling.



Gammalux Lighting Systems reserves the right to change the details of fixture design and construction at any time.

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GAMMALUX® Lighting Systems "Your design intent"

Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

Custom Programmed Output

Custom Programmed Output can be specified to produce approximate Delivered Lumens per Foot, Percentage of High Output Value or Maximum Watts per Foot.

Delivered Lumens Per Foot
Gammalux deals only in delivered lumens per foot. When working to match or exceed a competitor product's Lumens Per Foot package, be sure you are looking at their Delivered (through the lens) lumens per foot, not their System (bare board) lumens per foot.

In the Gammalux item #, use **C** as the Output designator and add a fixture description stating the required Lumens Per Foot value (ie: if you need 600 lumens per foot delivered by the fixture, the line note would read "Program = 600 LPF").

Percentage of High Output Value
If the required delivered lumens per foot are not known, run lighting calculations using our High Output IES file and identify the percentage of increase or decrease required to produce the correct lighting in the space.

In the Gammalux item #, use **C** as the Output designator and add a fixture description stating the required percentage of decrease from our High Output value (ie: for 60% of our High Output value, the line note would read "Program = 60% of High Output").

Maximum Watts Per Foot
In the Gammalux item #, use **C** as the Output designator and add a fixture description stating the required Maximum Watts per Foot (ie: if you need the fixtures capped at a maximum of 7 watts per foot, the line note would read "Program = 7 WPF").

For all three methods, custom programming capability is currently 25-200% of our High Output value. For requirements outside of this range, consult factory.

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GAMMALUX® Lighting Systems "Your design intent"

Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

Length Details

GAMMALUX *EZ-TELE*™ (LED/Housing option EZT)
This patented option is recommended when exact run lengths cannot be determined prior to product release or when flexibility is required. Additional manufacturing costs apply.

Factory drawings will be provided showing the run at the ordered length with field adjustability of up to 6" in either direction.

- GPD3 through GPD6: Minimum run length is 3', driver is integral.
- GPD1 and GPD2: Minimum run with integral driver is 5'. Minimum with remote driver is 3'.
    - If remote driver is needed, add "/R" after driver code (ex. ZTV10/R)

Contact us at Gammalux to discuss your project and let us help you determine the best way to specify and order your fixtures for a beautiful installation that meets *your design intent.*

Nominal Length (Length option N)
This option is recommended when GAMMALUX *EZ-TELE*™ is used or when meeting an exact dimension is not required.

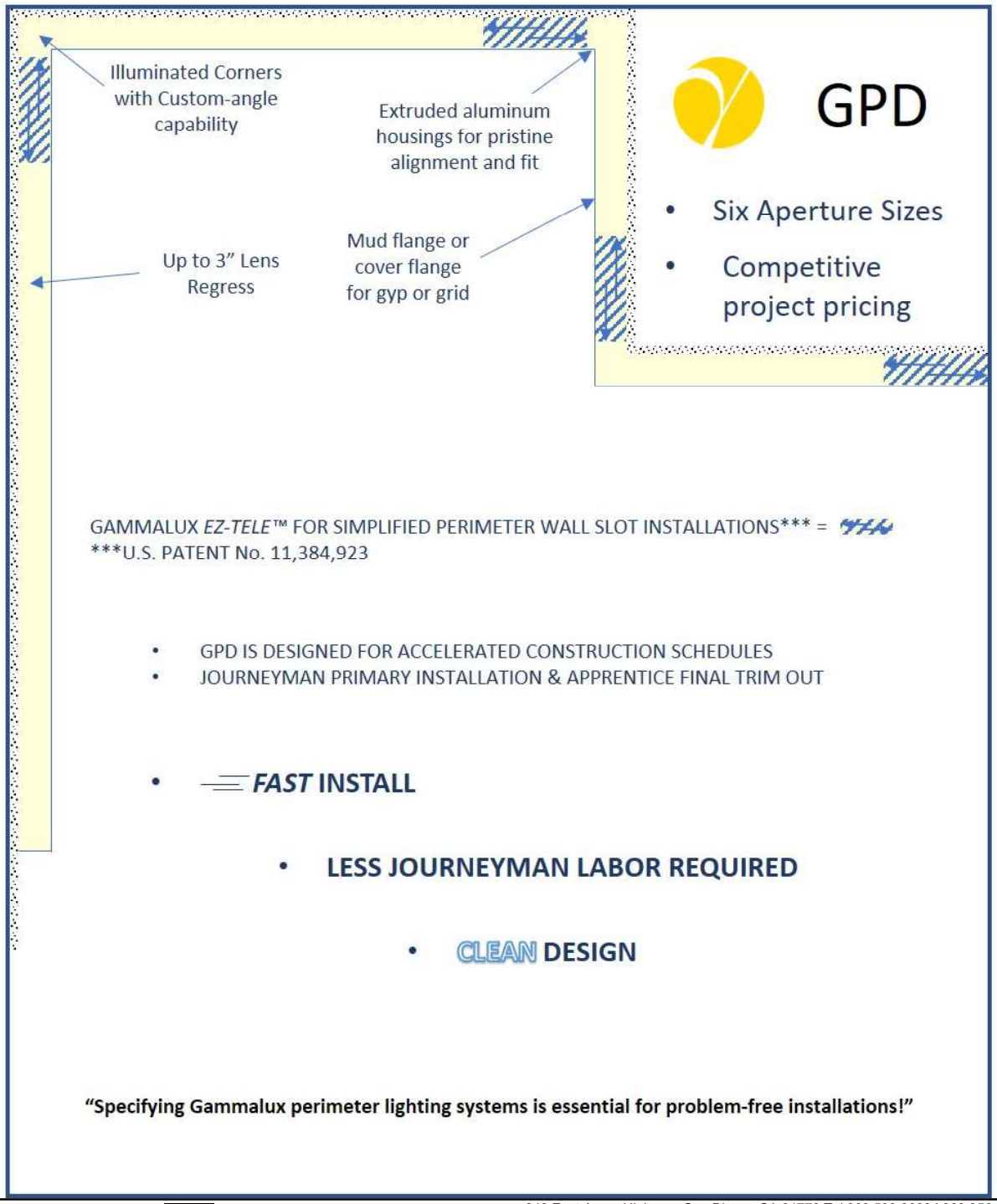
Verify in Field (Length option VIF)
This option is recommended when GAMMALUX *EZ-TELE*™ is not used, but fixtures must still be built to an exact dimension for patterns, wall-to-wall installations or to match an architectural feature. Field verification is required prior to release to production.

Docusign Envelope ID: 37D6996E-9788-4CCD-AC87-6F1095B8D128

GAMMALUX® Lighting Systems "Your design intent"

Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

GAMMALUX *EZ-TELE*™



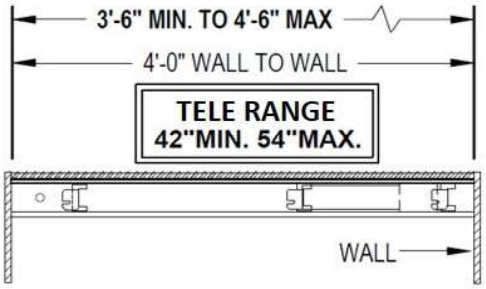
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Fax 909.599.5288 E-mail: info@gammalux.com
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GAMMALUX® Lighting Systems "Your design intent"

Perimeter Series GPD3-LED-LENS
Perimeter Lighting - Recessed in Grid or Hard Ceiling
Direct Illumination

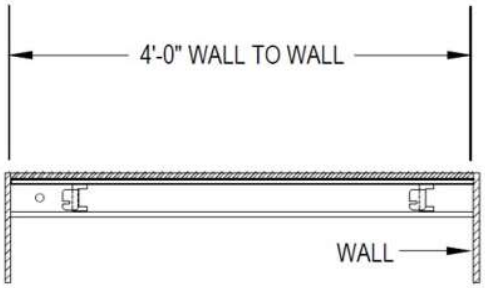
Ordering Guide

Nominal Length (with EZT) or Verify In Field



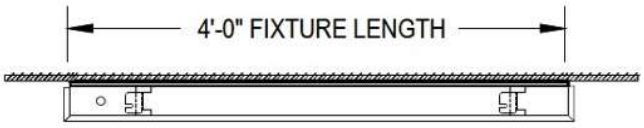
With GAMMALUX *EZ-TELE*™, the run or fixture has 6" of adjustability above and below the ordered (example 4') dimension. If the final dimension is within the fixture's adjustability, no field dimension is required.

Fixtures or runs ordered without GAMMALUX *EZ-TELE*™ and in Nominal length will have no field adjustability and may be built slightly shorter or longer than the ordered length to accommodate standard components.

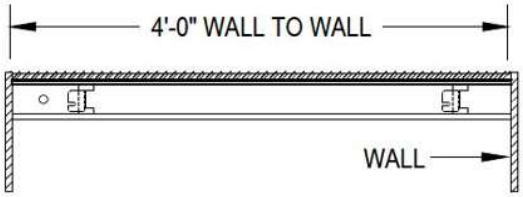


If GAMMALUX *EZ-TELE*™ is not selected, the run or fixture is built to the exact dimension provided and will have no field adjustability. The exact fixture dimension must the signature approved (Verify In Field) to allow Release to Production.

Intra-Wall (REC) or Wall-To-Wall (RECW)

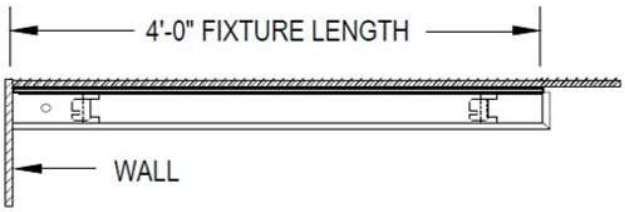


Neither end touches an adjacent wall. End caps have the same ceiling trim as the front of the fixture.

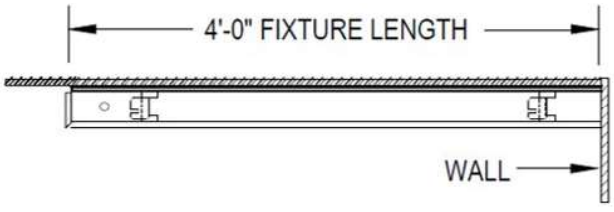


Each end touches an adjacent wall. End caps do not have a ceiling trim and terminate at the bottom of the fixture housing (see mounting detail illustrations).

RECW Variations



RECW**L** = only the left end of the fixture touches an adjacent wall. The other end will have the same ceiling trim as the front of the fixture.



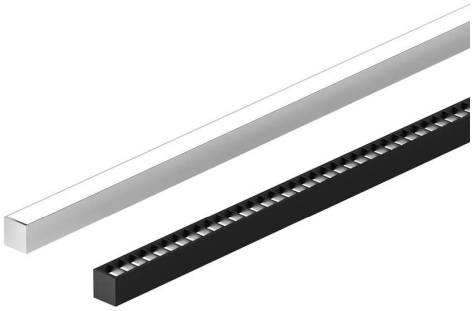
RECW**R** = only the right end of the fixture touches an adjacent wall. The other end will have the same ceiling trim as the front of the fixture.

248 East Arrow Highway, San Dimas, CA 91773 Tel 909.599.9669 | 800.356.3275
Fax 909.599.5288 E-mail: info@gammalux.com
Gammalux products comply with ARRA Buy American requirements

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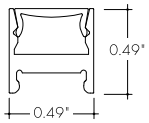
Myka - Static White | Linear Illumination System

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Features

- 24VDC Class 2 fixtures made to order up to 144". Fixtures can be linked up to 48' depending on output
- Suitable for undercabinet, millwork, direct view, vanity, architectural reveals, accent lighting and surface mount applications
- Approved for closet/storage space installation per NEC 410.16(A)(3) and 410.16(C)(5)*
- Dot free even illumination with frosted lens and high color quality outputs
- Class 2 listed for damp locations
- High Color Quality options offer premium quality and vibrant colors with R9 values up to 97
- High Efficacy options offer best in class output and efficacy with over 570 lm/ft and up to 103 lm/W
- Proprietary strong bond solder method handles up to 50 lbs of pull force on wire leads and connectors
- 7 Year warranty



Finish Options (see page 2 for additional information)

Base	Silver Anodized				
Standard	Black	Bronze	White		
Premium	Matte Black	Warm Nickel	Aged Brass	Polished Gold	Chrome

MADE IN U.S.A | CE | Single Bin +/- 30 CCT | Declare | RoHS | cULus LISTED | TITLE 24 JA8 COMPLIANT | DIM

Technical Information

TYPE	High Color Quality			High Efficacy			
OUTPUT OPTIONS	**72SO**	**72HO**	**72VHO**	**HE48LO**	**HE48SO**	**HE48MO**	**HE48HO**
Lumens Output (3000K) (with a Clear Lens)	201 lm/ft	326 lm/ft	396 lm/ft	195 lm/ft	271 lm/ft	361 lm/ft	579 lm/ft
Average Power Consumption (for a 4' section)	2.8 W/ft	4.8 W/ft	6 W/ft	1.9 W/ft	2.8 W/ft	3.5 W/ft	6.5 W/ft
Efficacy	72 lm/W	68 lm/W	66 lm/W	103 lm/W	97 lm/W	103 lm/W	89 lm/W
Max Run Length (in series)	40 ft	31 ft	22 ft	48 ft	42 ft	33 ft	21 ft
Max Ambient Temperature*	50°C [122°F]		45°C [113°F]	50°C [122°F]			40°C [104°F]

*Max Ambient Temperature to maintain L70 of 50k+ hours. Exceeding Max Ambient Temperature may result in decreased life/output. Consult Technical Support for specific inquiries.

High Color Quality (72)

CCT	Multiplier (reference - 3000K)	TM-30 CRI	R_f	R_g	R_9
1900K	0.55	96	94	97	90
2200K	0.70	96	95	101	89
2400K	0.72	98	97	101	91
2700K	0.74	97	96	101	91
3000K	1.00	97	95	104	97
3500K	1.02	97	94	105	97
4100K	1.07	97	90	99	97

High Efficacy (HE48)

CCT	Multiplier (reference - 3000K)	TM-30 CRI	R_f	R_g	R_9
2200K	0.73	92	91	97	42
2500K	0.81	93	96	96	62
2700K	0.94	92	90	99	58
3000K	1.00	92	89	99	57
3500K	1.02	92	89	99	60
4000K	1.02	92	86	94	71

Ordering Code

MODEL	LENGTH[1]	OUTPUT[5]	CCT	LENS[2]	MOUNTING	FINISH[3]	POSITION TYPE	POWER FEED
MK - Myka	12"–144" 1" increments	72SO - Standard 72HO - High 72VHO - Very High	19K - 1900K 22K - 2200K 24K - 2400K 27K - 2700K 30K - 3000K 35K - 3500K 41K - 4100K	C - Clear HF - Half Frosted F - Frosted MF - Matte Frosted BLV - Black Blade Louver WLV - White Blade Louver	CB - Concealed Bracket MAG - Magnetic A - Adjustable Hinge Mounting	Base SA - Silver Anodized Standard BK - Black BZ - Bronze WH - White	E - End B - Back	1 - 72" wire leads 1X2 72" wire leads at both ends 2 - 72" wire leads at one end and Quick Connect at other 3 - Single Quick Connect 4 - Dual Quick Connect
	12"–144" 2" increments	HE48LO - Low HE48SO - Standard HE48MO - Medium HE48HO - High	22K - 2200K 25K - 2500K 27K - 2700K 30K - 3000K 35K - 3500K 40K - 4000K			Premium MBK - Matte Black WN - Warm Nickel AB - Aged Brass PG - Polished Gold[4] CH - Chrome[4]		

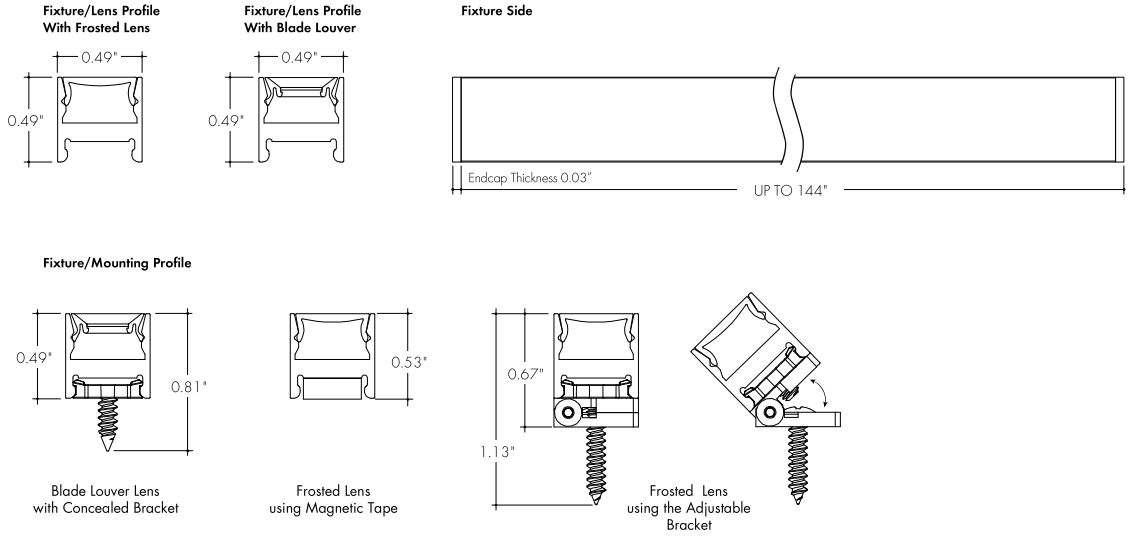
1 - Custom lengths and increments are available, please consult Inside Sales with specific request.
2 - All High Efficacy options can be used to comply with Title 24 JA8. High Color Quality options can be used to comply with Title 24 JA8 depending on Output, CCT, and Lens selections. See multiplier charts to calculate specific efficacies.
3 - Non SA finishes may have extended lead times and price adders. Custom RALs are available, contact Inside Sales with specific request.
4 - Polished Gold, and Chrome finishes have a maximum fixture length of 96".
5 - Closet/Storage Space ratings only available on fixtures with outputs 5.7W/ft or less

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Myka - Static White | Linear Illumination System

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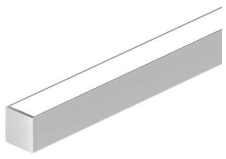
Product Dimensions



Finish Options

- Finish options are available in a wide variety, allowing for complete customization of style and aesthetic.
- Non Silver Anodized finishes may have extended lead times and price adder.
- Polished Gold and Chrome finishes have a maximum fixture length of 96".
- Custom RALs are available, please consult Inside Sales with specific request.

Silver Anodized
Base



Silver Anodized is a soft silver with a clear finish.

Black
Standard



Black is a true deep black with a glossy finish.

Bronze
Standard



Bronze is a rich, dark brown with a satin finish.

White
Standard

White is a polar bright white and field paintable.

Matte Black
Premium



Matte Black is a dark, pitch-black with a soft flat finish.

Warm Nickel
Premium



Warm Nickel is a soft, silvery smoke with warm tones and a satin finish.

Aged Brass
Premium



Aged Brass is a deep brown shade with slightly golden undertones.

Polished Gold
Premium



Polished Gold is bright and radiant for a brilliant finish.

Chrome
Premium



Chrome is a highly reflective silver polish.

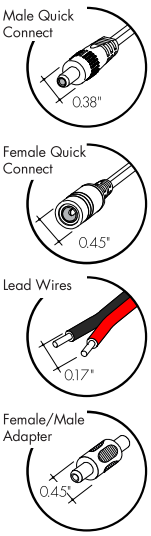
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Powerfeeds and Connectors

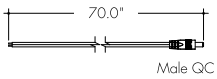
Linking and Extension Cable Options



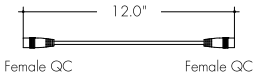
LMC-12
Male quick-connect, 2 pin, 12"



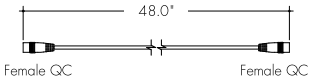
LMC-70
Male quick-connect long, 2 pin, 70"



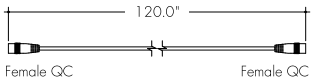
EC-12
Female to Female Extension Cable, 2 pin, 12"



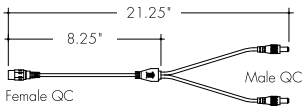
EC-48
Female to Female Extension Cable, 2 pin, 48"



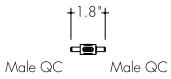
EC-120
Female to Female Extension Cable, 2 pin, 120"



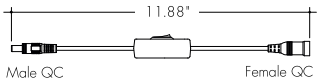
LYC
1 Female to 2 Male Splitter Cable, 2 pin, 12"



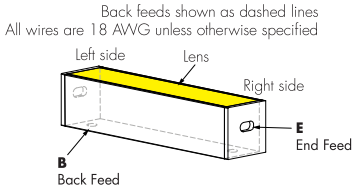
FMA
Female to male adapter



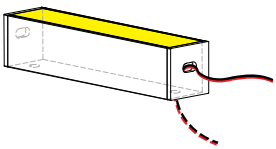
IS-DC
Male to Female Inline DC Switch, 2 pin, 12"



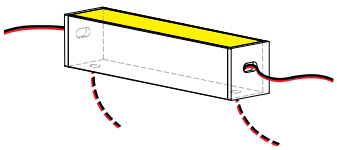
Powerfeeds Position/Type



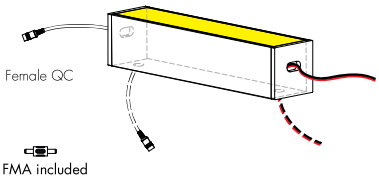
1
72" wire leads



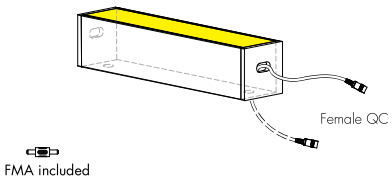
1X2
72" wire leads at both end



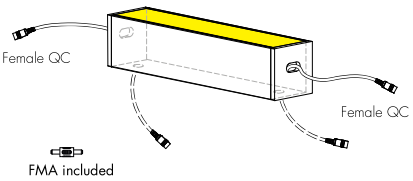
2
72" wire leads at one end and Female Quick Connect at other



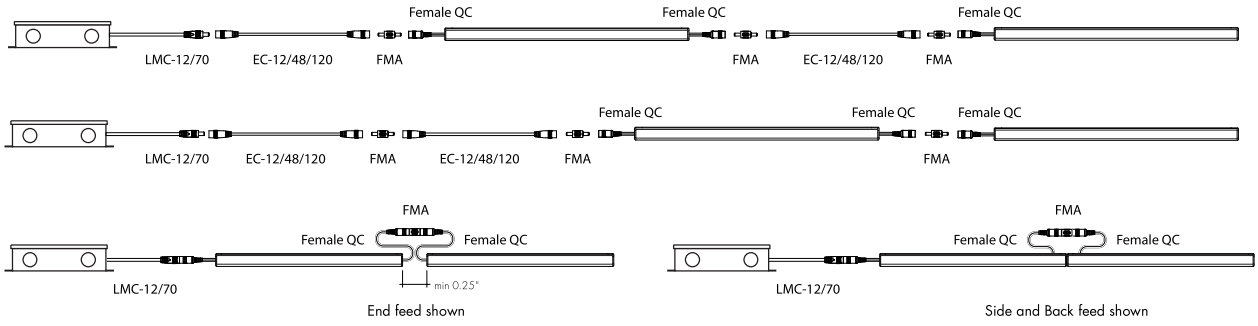
3
Single Female Quick Connect



4
Dual Female Quick Connect



Sample Layout



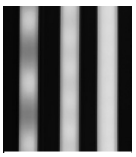
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Light Transmission and Dotting

Output Options	Lens/Accessory					
	Clear Lens	Half Frosted Lens	Matte Frosted Lens	Frosted Lens	White Blade Louver	Black Blade Louver
72SO	CD	SD	ND	ND	ND	ND
72HO	CD	SD	ND	ND	ND	ND
72VHO	CD	SD	ND	ND	ND	ND
HE48LO	CD	CD	SD	SD	SD	SD
HE48SO	CD	CD	SD	SD	SD	SD
HE48MO	CD	CD	SD	SD	SD	SD
HE48HO	CD	CD	SD	SD	SD	SD
Transmission Percentage	100%	84%	79%	62%	50%	34%

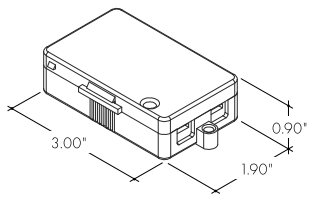


CD SD ND

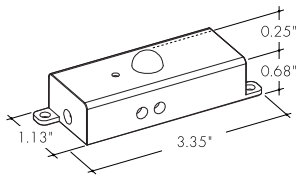
CD - Clear Dotting
SD - Slight Dotting
ND - No Dotting

Accessory Options

LVSP-4T-BK
Low Voltage, 4 Terminal Splice Box, Black

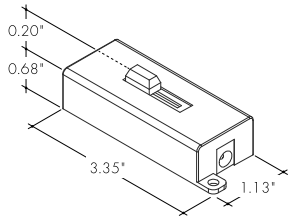


OS-DC-F4-BK
Occupancy Sensor



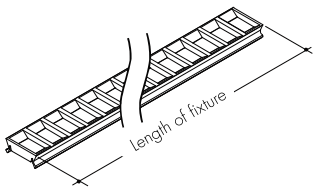
Male Quick Connect, FMA, LMC, LYC, or IS-DC are required for input and output.

DIM-DC-F4-BK
24VDC Low Voltage In-line Dimmer Module



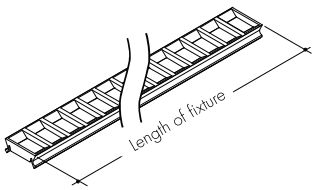
Male Quick Connect, FMA, LMC, LYC, or IS-DC are required for input and output.

LV-BL-MKC-12-BK
Blade Louver reduces glare at high angle in two directions
Also available with complete fixture, use ordering code **-BLV**



This Black louver/lens combo comes in 12" increments and sits in place of a Myka lens, not in addition to.

LV-BL-MKC-12-WH
Blade Louver reduces glare at high angle in two directions
Also available with complete fixture, use ordering code **-WLV**



This White louver/lens combo comes in 12" increments and sits in place of a Myka lens, not in addition to.

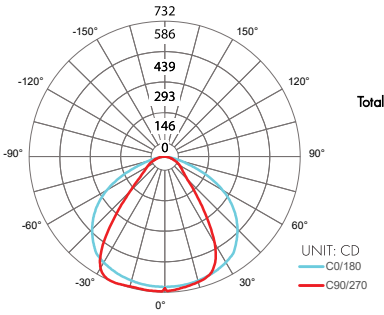
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Photometry

MK-48-30K-72VHO-C

Myka, 4ft, 3000K, 72VHO, Clear Lens



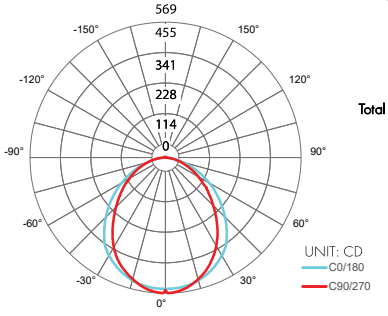
Zonal Lumen Summary 3000K

Zone	Lumen	% Fixture
0-30	551	34.7%
0-40	897	56.6%
0-60	1381	87.2%
0-90	1568	98.9%
Total 0-180	1584	100%

Beam Angle	UGR
77°	15

MK-48-30K-72VHO-HF

Myka, 4ft, 3000K, 72VHO, Half-Frosted Lens



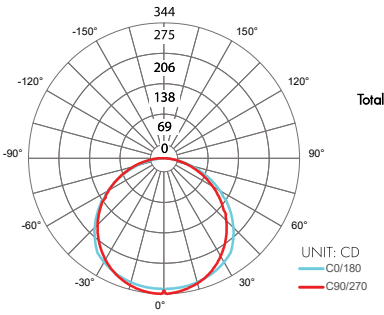
Zonal Lumen Summary 3000K

Zone	Lumen	% Fixture
0-30	397	29.9%
0-40	639	48.1%
0-60	1073	80.7%
0-90	1315	98.9%
Total 0-180	1329	100%

Beam Angle	UGR
91°	15

MK-48-30K-72VHO-F

Myka, 4ft, 3000K, 72VHO, Frosted Lens



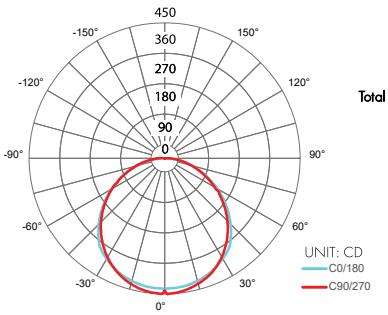
Zonal Lumen Summary 3000K

Zone	Lumen	% Fixture
0-30	252	25.6%
0-40	420	42.5%
0-60	757	76.6%
0-90	976	98.8%
Total 0-180	988	100%

Beam Angle	UGR
112°	15

MK-48-30K-72VHO-MF

Myka, 4ft, 3000K, 72VHO, Matte-Frosted Lens



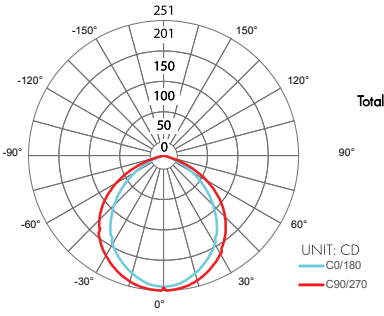
Zonal Lumen Summary 3000K

Zone	Lumen	% Fixture
0-30	322	25.7%
0-40	532	42.4%
0-60	953	76.0%
0-90	1239	98.7%
Total 0-180	1254	100%

Beam Angle	UGR
112°	15

MK-48-30K-72VHO-BLV

Myka, 4ft, 3000K, 72VHO, Black Blade Louver



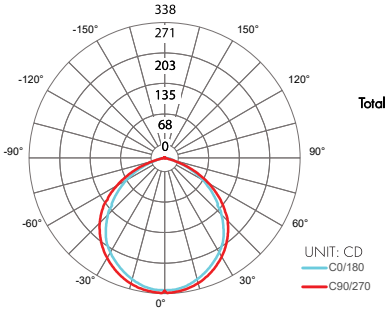
Zonal Lumen Summary 3000K

Zone	Lumen	% Fixture
0-30	175	32.5%
0-40	282	52.3%
0-60	472	87.7%
0-90	533	98.9%
Total 0-180	538	100%

Beam Angle	UGR
109°	15

MK-48-30K-72VHO-WLV

Myka, 4ft, 3000K, 72VHO, White Blade Louver



Zonal Lumen Summary 3000K

Zone	Lumen	% Fixture
0-30	240	30.1%
0-40	391	49.1%
0-60	671	84.3%
0-90	787	98.9%
Total 0-180	796	100%

Beam Angle	UGR
109°	15

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Power Consumption

Tested at Full Power with PDC Series power supplies.

*For Back Feed add 4/16" (1/4") to Actual Length. Standard Nominal Lengths offered provide minimal shadowing. For alternate lengths, please consult Inside Sales with specific request.

High Color Quality (72)

Nominal Length (in)	End Feed Actual Length*	Watts			Nominal Length (in)	End Feed Actual Length*	Watts			Nominal Length (in)	End Feed Actual Length*	Watts			Nominal Length (in)	End Feed Actual Length*	Watts		
		SO	HO	VHO			SO	HO	VHO			SO	HO	VHO			SO	HO	VHO
12	11	2.7	4.4	6.2	**47**	46 14/16	10.5	17.4	23.1	**82**	81 10/16	18.3	29.5	38.4	**117**	116 6/16	25.9	40.8	52.4
13	12 2/16	2.7	4.4	6.2	**48**	–	–	–	–	**83**	82 12/16	18.5	29.8	38.8	**118**	117 8/16	26.1	41.1	52.8
14	13 5/16	2.9	4.8	6.7	**49**	48 1/16	10.7	17.8	23.5	**84**	83 15/16	18.7	30.1	39.2	**119**	118 11/16	26.3	41.4	53.2
15	14 7/16	3.1	5.2	7.3	**50**	49 3/16	11.1	18.6	24.4	**85**	–	–	–	–	**120**	119 13/16	26.5	41.7	53.6
16	15 10/16	3.4	5.6	7.8	**51**	50 6/16	11.4	18.9	24.9	**86**	85 1/16	19.2	30.8	40.0	**121**	121	26.7	42.0	54.0
17	16 12/16	3.6	6.0	8.3	**52**	51 8/16	11.6	19.3	25.3	**87**	86 4/16	19.4	31.1	40.4	**122**	–	–	–	–
18	17 15/16	3.9	6.5	8.9	**53**	52 11/16	11.9	19.7	25.7	**88**	87 6/16	19.6	31.5	40.8	**123**	122 2/16	27.1	42.6	54.7
19	–	–	–	–	**54**	53 13/16	12.1	20.1	26.1	**89**	88 9/16	19.9	31.8	41.1	**124**	123 5/16	27.3	42.9	55.0
20	19 1/16	4.4	7.3	9.9	**55**	55	12.3	20.5	26.6	**90**	89 12/16	20.1	32.2	41.5	**125**	124 7/16	27.5	43.1	55.4
21	20 4/16	4.6	7.7	10.5	**56**	–	–	–	–	**91**	90 14/16	20.4	32.5	41.9	**126**	125 10/16	27.7	43.4	55.7
22	21 6/16	4.8	8.1	11.0	**57**	56 2/16	12.8	21.3	27.4	**92**	–	–	–	–	**127**	126 12/16	27.9	43.7	56.1
23	22 9/16	5.1	8.6	11.5	**58**	57 5/16	13.1	21.6	27.8	**93**	92 1/16	20.6	32.9	42.3	**128**	127 15/16	28.1	43.9	56.4
24	23 12/16	5.3	9.0	12.1	**59**	58 7/16	13.3	22.0	28.3	**94**	93 3/16	21.1	33.6	43.1	**129**	–	–	–	–
25	24 14/16	5.6	9.4	12.6	**60**	59 10/16	13.6	22.4	28.7	**95**	94 6/16	21.3	33.9	43.4	**130**	129 1/16	28.5	44.5	57.1
26	–	–	–	–	**61**	60 12/16	13.8	22.8	29.1	**96**	95 8/16	21.5	34.2	43.8	**131**	130 4/16	28.7	44.7	57.4
27	26 1/16	5.8	9.8	13.1	**62**	61 15/16	14.0	23.1	29.6	**97**	96 11/16	21.8	34.6	44.2	**132**	131 7/16	28.9	45.0	57.8
28	27 3/16	6.2	10.5	14.1	**63**	–	–	–	–	**98**	97 13/16	22.0	34.9	44.6	**133**	132 9/16	29.1	45.3	58.1
29	28 6/16	6.5	10.9	14.5	**64**	63 1/16	14.5	23.8	30.5	**99**	99	22.2	35.2	45.0	**134**	133 12/16	29.3	45.5	58.4
30	29 8/16	6.7	11.2	15.0	**65**	64 4/16	14.7	24.1	31.0	**100**	–	–	–	–	**135**	134 14/16	29.5	45.7	58.7
31	30 11/16	6.9	11.6	15.5	**66**	65 6/16	14.9	24.4	31.4	**101**	100 2/16	22.5	35.9	45.9	**136**	–	–	–	–
32	31 13/16	7.1	12.0	16.0	**67**	66 9/16	15.1	24.7	31.9	**102**	101 5/16	22.7	36.2	46.3	**137**	136 1/16	29.6	45.9	59.1
33	33	7.3	12.3	16.5	**68**	67 12/16	15.3	25.0	32.4	**103**	102 7/16	22.9	36.5	46.7	**138**	137 3/16	30.0	46.3	59.7
34	–	–	–	–	**69**	68 14/16	15.5	25.4	32.8	**104**	103 10/16	23.1	36.8	47.1	**139**	138 6/16	30.2	46.5	60.0
35	34 2/16	7.8	13.1	17.4	**70**	–	–	–	–	**105**	104 12/16	23.3	37.1	47.5	**140**	139 8/16	30.3	46.8	60.3
36	35 5/16	8.0	13.4	17.9	**71**	70 1/16	15.8	25.7	33.3	**106**	105 15/16	23.5	37.4	48.0	**141**	140 11/16	30.5	47.0	60.6
37	36 7/16	8.2	13.8	18.4	**72**	71 3/16	16.2	26.3	34.2	**107**	–	–	–	–	**142**	141 13/16	30.7	47.2	61.0
38	37 10/16	8.4	14.2	18.9	**73**	72 6/16	16.4	26.6	34.7	**108**	107 1/16	23.9	38.1	48.8	**143**	143	30.8	47.4	61.3
39	38 12/16	8.7	14.5	19.3	**74**	73 8/16	16.6	26.9	35.1	**109**	108 4/16	24.1	38.4	49.2	**144**	–	–	–	–
40	39 15/16	8.9	14.9	19.8	**75**	74 11/16	16.8	27.3	35.5	**110**	109 7/16	24.3	38.7	49.6					
41	–	–	–	–	**76**	75 13/16	17.1	27.6	35.9	**111**	110 9/16	24.5	39.0	50.0					
42	41 1/16	9.3	15.6	20.7	**77**	77	17.3	27.9	36.3	**112**	111 12/16	24.8	39.3	50.4					
43	42 4/16	9.6	16.0	21.2	**78**	–	–	–	–	**113**	112 14/16	25.0	39.6	50.8					
44	43 6/16	9.8	16.4	21.7	**79**	78 2/16	17.7	28.5	37.2	**114**	–	–	–	–					
45	44 9/16	10.0	16.7	22.1	**80**	79 5/16	17.9	28.9	37.6	**115**	114 1/16	25.2	39.9	51.2					
46	45 12/16	10.2	17.1	22.6	**81**	80 7/16	18.1	29.2	38.0	**116**	115 3/16	25.6	40.5	52.0					

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Power Consumption

Tested at Full Power with PDC Series power supplies.

*For Back Feed add 4/16" (1/4") to Actual Length. Standard Nominal Lengths offered provide minimal shadowing. For alternate lengths, please consult Inside Sales with specific request.

High Efficacy (HE48)

Nominal Length (in)	End Feed Actual Length*	Watts				Nominal Length (in)	End Feed Actual Length*	Watts				Nominal Length (in)	End Feed Actual Length*	Watts				Nominal Length (in)	End Feed Actual Length*	Watts			
		LO	SO	MO	HO			LO	SO	MO	HO			LO	SO	MO	HO			LO	SO	MO	HO
12	10 9/16	1.7	2.5	3.5	5.7	**47**	46 9/16	6.9	10.7	13.3	24.7	**82**	–	–	–	–	–	**117**	116 9/16	17.3	27.3	33.7	57.9
13	12 9/16	1.7	2.5	3.5	5.7	**48**	–	–	–	–	–	**83**	82 9/16	12.5	19.9	23.9	42.2	**118**	–	–	–	–	–
14	–	–	–	–	–	**49**	48 9/16	7.1	11.2	13.9	25.4	**84**	–	–	–	–	–	**119**	118 9/16	17.5	27.7	34.3	58.7
15	14 9/16	2.0	3.0	4.0	7.2	**50**	–	–	–	–	–	**85**	84 9/16	12.8	20.3	24.5	43.1	**120**	–	–	–	–	–
16	–	–	–	–	–	**51**	50 9/16	7.4	11.7	14.5	26.3	**86**	–	–	–	–	–	**121**	120 9/16	17.8	28.1	34.9	59.6
17	16 9/16	2.4	3.5	4.6	8.7	**52**	–	–	–	–	–	**87**	86 9/16	13.1	20.8	25.1	44.1	**122**	–	–	–	–	–
18	–	–	–	–	–	**53**	52 9/16	7.7	12.3	15.1	27.4	**88**	–	–	–	–	–	**123**	122 9/16	18.1	28.6	35.5	60.5
19	18 9/16	2.7	3.9	5.2	10.2	**54**	–	–	–	–	–	**89**	88 9/16	13.4	21.3	25.7	45.0	**124**	–	–	–	–	–
20	–	–	–	–	–	**55**	54 9/16	8.0	12.9	15.7	28.5	**90**	–	–	–	–	–	**125**	124 9/16	18.3	29.0	36.0	62.1
21	20 9/16	3.0	4.4	5.8	11.7	**56**	–	–	–	–	–	**91**	90 9/16	13.7	21.7	26.3	46.0	**126**	–	–	–	–	–
22	–	–	–	–	–	**57**	56 9/16	8.4	13.5	16.4	29.5	**92**	–	–	–	–	–	**127**	126 9/16	18.4	29.5	36.6	63.8
23	22 9/16	3.4	4.9	6.4	13.2	**58**	–	–	–	–	–	**93**	92 9/16	14.0	22.1	26.9	47.0	**128**	–	–	–	–	–
24	–	–	–	–	–	**59**	58 9/16	8.7	14.0	17.0	30.6	**94**	–	–	–	–	–	**129**	128 9/16	18.6	29.9	37.2	65.4
25	24 9/16	3.7	5.4	7.0	14.7	**60**	–	–	–	–	–	**95**	94 9/16	14.3	22.6	27.5	47.9	**130**	–	–	–	–	–
26	–	–	–	–	–	**61**	60 9/16	9.0	14.6	17.6	31.6	**96**	–	–	–	–	–	**131**	130 9/16	18.8	30.4	37.7	67.0
27	26 9/16	4.1	5.9	7.5	15.8	**62**	–	–	–	–	–	**97**	96 9/16	14.4	22.8	27.8	48.4	**132**	–	–	–	–	–
28	–	–	–	–	–	**63**	62 9/16	9.4	15.2	18.2	32.6	**98**	–	–	–	–	–	**133**	132 9/16	18.9	30.8	38.3	68.6
29	28 9/16	4.4	6.4	8.1	16.8	**64**	–	–	–	–	–	**99**	98 9/16	14.7	23.3	28.5	49.4	**134**	–	–	–	–	–
30	–	–	–	–	–	**65**	64 9/16	9.7	15.6	18.7	33.7	**100**	–	–	–	–	–	**135**	134 9/16	19.1	31.2	38.9	70.2
31	30 9/16	4.8	6.9	8.7	17.9	**66**	–	–	–	–	–	**101**	100 9/16	15.0	23.7	29.0	50.4	**136**	–	–	–	–	–
32	–	–	–	–	–	**67**	66 9/16	10.0	16.1	19.2	34.7	**102**	–	–	–	–	–	**137**	136 9/16	19.3	31.8	39.4	70.7
33	32 9/16	5.0	7.2	9.0	18.5	**68**	–	–	–	–	–	**103**	102 9/16	15.3	24.1	29.6	51.3	**138**	–	–	–	–	–
34	–	–	–	–	–	**69**	68 9/16	10.4	16.5	19.8	35.7	**104**	–	–	–	–	–	**139**	138 9/16	19.5	32.3	40.0	71.2
35	34 9/16	5.4	7.7	9.6	19.5	**70**	–	–	–	–	–	**105**	104 9/16	15.6	24.6	30.2	52.3	**140**	–	–	–	–	–
36	–	–	–	–	–	**71**	70 9/16	10.7	17.0	20.3	36.7	**106**	–	–	–	–	–	**141**	140 9/16	19.8	32.8	40.6	71.8
37	36 9/16	5.7	8.2	10.2	20.6	**72**	–	–	–	–	–	**107**	106 9/16	15.8	25.0	30.7	53.2	**142**	–	–	–	–	–
38	–	–	–	–	–	**73**	72 9/16	11.0	17.4	20.8	37.7	**108**	–	–	–	–	–	**143**	142 9/16	20.0	33.3	41.1	72.3
39	38 9/16	6.0	8.7	10.8	21.5	**74**	–	–	–	–	–	**109**	108 9/16	16.1	25.5	31.3	54.2	**144**	–	–	–	–	–
40	–	–	–	–	–	**75**	74 9/16	11.3	17.9	21.4	38.7	**110**	–	–	–	–	–						
41	40 9/16	6.2	9.2	11.4	22.3	**76**	–	–	–	–	–	**111**	110 9/16	16.4	25.9	31.9	55.2						
42	–	–	–	–	–	**77**	76 9/16	11.6	18.4	22.0	39.6	**112**	–	–	–	–	–						
43	42 9/16	6.4	9.7	12.0	23.1	**78**	–	–	–	–	–	**113**	112 9/16	16.7	26.4	32.5	56.1						
44	–	–	–	–	–	**79**	78 9/16	11.9	18.9	22.7	40.5	**114**	–	–	–	–	–						
45	44 9/16	6.7	10.2	12.6	23.9	**80**	–	–	–	–	–	**115**	114 9/16	17.0	26.8	33.1	57.0						
46	–	–	–	–	–	**81**	80 9/16	12.2	19.4	23.3	41.4	**116**	–	–	–	–	–						

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Voltage Drop Calculator

The below chart assumes nominal voltage of 24 Volts and a Voltage Drop Allowance of 3% through the wire

Wattage [W]	Maximum Wire Length From Power Supply to Start of Run [ft]						
	12 AWG	14 AWG	16 AWG	18 AWG	20 AWG	22 AWG	24 AWG
5	1088.2	684.4	430.3	270.6	170.2	107.1	67.3
10	544.1	342.2	215.1	135.3	85.1	53.5	33.7
15	362.7	228.1	143.4	90.2	56.7	35.7	22.4
20	272.0	171.1	107.6	67.7	42.6	26.8	16.8
25	217.6	136.9	86.1	54.1	34.0	21.4	13.5
30	181.4	114.1	71.7	45.1	28.4	17.8	11.2
35	155.5	97.8	61.5	38.7	24.3	15.3	9.6
40	136.0	85.5	53.8	33.8	21.3	13.4	8.4
45	120.9	76.0	47.8	30.1	18.9	11.9	7.5
50	108.8	68.4	43.0	27.1	17.0	10.7	6.7
55	98.9	62.2	39.1	24.6	15.5	9.7	6.1
60	90.7	57.0	35.9	22.6	14.2	8.9	5.6
65	83.7	52.6	33.1	20.8	13.1	8.2	5.2
70	77.7	48.9	30.7	19.3	12.2	7.6	4.8
75	72.5	45.6	28.7	18.0	11.3	7.1	4.5
80	68.0	42.8	26.9	16.9	10.6	6.7	4.2
85	64.0	40.3	25.3	15.9	10.0	6.3	4.0
90	60.5	38.0	23.9	15.0	9.5	5.9	3.7
96	56.7	35.6	22.4	14.1	8.9	5.6	3.5

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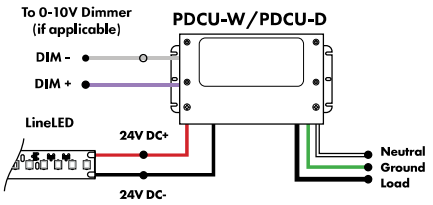
Power Supplies

See Power Supply instructions and spec sheet for wiring information. For a complete list of compatible dimmers, see Compatible Dimming Chart on the Resources page.

Universal Power Supply 1% 120VAC - 277VAC

MODEL	POWER	OUTPUT
PDCU-D - IP20 Dry Series	30 - 30 W 60 - 60 W 96 - 96 W 3X96 - 3X96 W	24 - 24 VDC
PDCU-W - IP66 Wet Series	96 - 96 W 3X96 - 3X96 W	

0-10V dims down to 1%, MLV/ELV/TRIAC dims down to 1%.
For a complete list of compatible dimmers, see Compatible Dimming Chart on the Resources page.

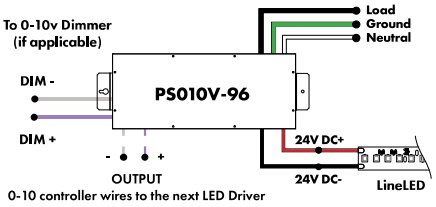


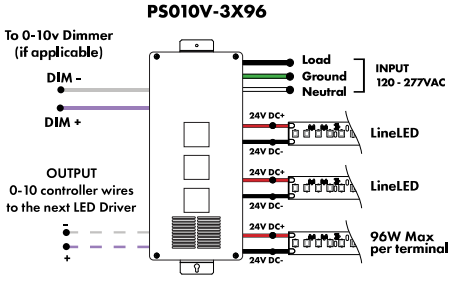
MODELS	PDCU-W 96W	PDCU-W 3X96W	PDCU-D 30W	PDCU-D 60W	PDCU-D 96W	PDCU-D 3X96W
Length	8.66"	11.85"	6.10"	7.93"	8.25"	9.57"
Width	3.73"	4.32"	3.35"	3.35"	4.10"	5.94"
Depth	1.61"	1.81"	1.33	1.32"	1.56"	1.13"

0-10V Dimming Power Supplies 0.1% 120VAC - 277VAC

MODEL	POWER	OUTPUT	DIMMING
PS010V - 0-10V Power Supply dims down to 0.1%	96 - 96 Watt 3X96 - 3 X 96 Watt	24 - 24 VDC	LIN - Linear LOG - Logarithmic

MODELS	96W	3X96
Length	14.40"	15.75"
Width	5.20"	6.62"
Depth	2.60"	4.95"

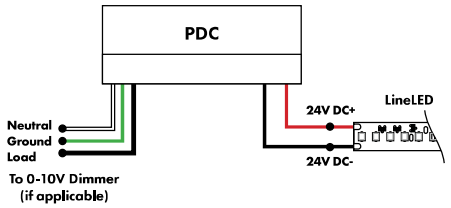




Triac, MLV, & ELV Compatible Dimmers

MODEL	POWER	OUTPUT
PDC - (IP20) Power Supply	96 - 96 Watts	24 - 24 VDC

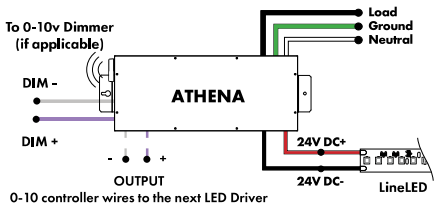
MODELS	96W
Length	8.25"
Width	4.10"
Depth	1.56"



Athena 0-10V LED Driver

MODEL	INPUT CONTROL	ENVIRONMENT	WATTAGE	OUTPUT	FEATURE
PS-Power Supply, 120-277VAC	010V-LIN-0-10V Dimming, Linear 010V-LOG 0-10V Dimming, Logarithmic	D-Dry	96-96 W	24-24 VDC	AWNR-Athena

MODELS	96W
Length	14.40"
Width	5.20"
Depth	2.60"



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Myka - Static White | Linear Illumination System

luminii

Power Supplies

See Power Supply instructions and spec sheet for wiring information. For a complete list of compatible dimmers, see Compatible Dimming Chart on the Resources page.

DMX Dimming Power Supplies 120VAC - 277VAC

MODEL		POWER		OUTPUT
	-		-	

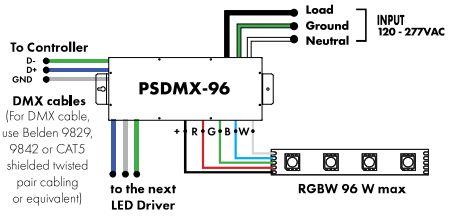
PSDMX - DMX Power Supply dims down to 0%

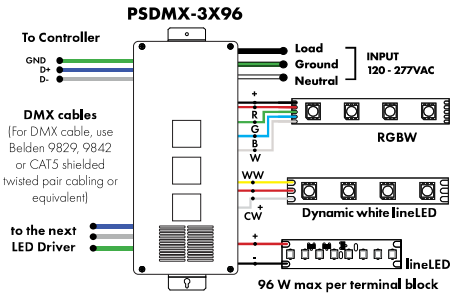
96 - 96 Watt
3X96 - 3 X 96 Watt

24 - 24 VDC

Features eldoLED's LINEARdrive configurable dimmable drivers

MODELS	96W	3X96
Length	14.40"	15.75"
Width	5.20"	6.62"
Depth	2.60"	4.95"





DALI 0% Dimming Power Supplies 120VAC - 277VAC

MODEL		POWER		OUTPUT
	-		-	

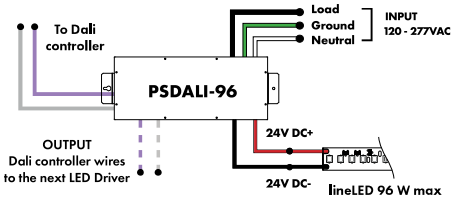
PSDALI - DALI Power Supply dims down to 0%

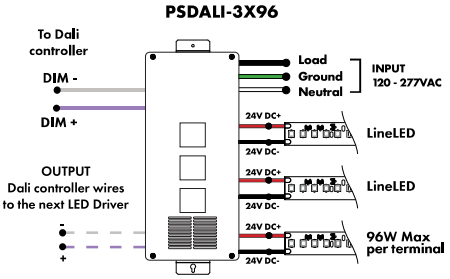
96 - 96 Watt
3X96 - 3 X 96 Watt

24 - 24 VDC

Features eldoLED's LINEARdrive configurable dimmable drivers

Model	96W	3X96
Length	14.40"	15.75"
Width	5.20"	6.62"
Depth	2.60"	4.95"





Enlighted Enabled Dimming Power Supplies 120VAC - 277VAC

MODEL		POWER		OUTPUT		DIMMING		LOCATION
	-		-		-		-	

PSV - PSV Series

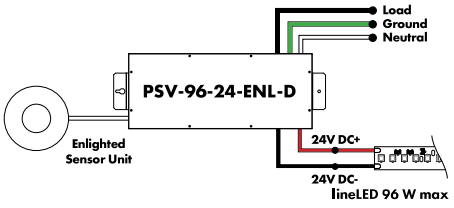
96 - 96 Watt

24 - 24 VDC

ENL - Enlighted Dimming dims down to 0%

D - Damp

Model	96W
Length	14.40"
Width	5.20"
Depth	2.60"



*LUMINII RESERVES THE RIGHTS TO CHANGE SPECIFICATION & INSTRUCTION WITHOUT NOTICE

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Myka - Static White | Linear Illumination System

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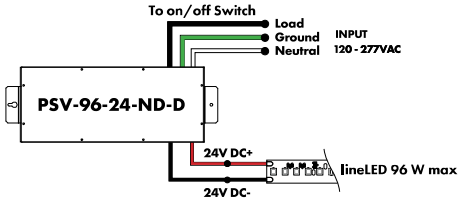
Power Supplies

See Power Supply instructions and spec sheet for wiring information. For a complete list of compatible dimmers, see Compatible Dimming Chart on the Resources page.

Non-Dimming Power Supply 120VAC - 277VAC

MODEL	POWER	OUTPUT	DIMMING	LOCATION
PSV - PSV Series	96 - 96 Watt	24 - 24 VDC	ND - Non Dimming	D - Damp

MODELS	96W
Length	14.40"
Width	5.20"
Depth	2.60"



LUTRON

Luminii is a Lutron OEM Advantage Partner

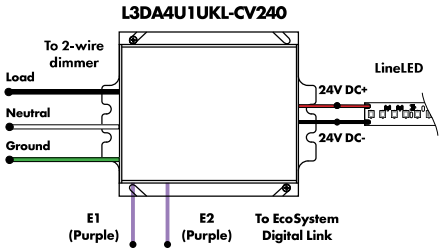
Lutron Power Supplies 1%

MODEL

L3DA4U1UKL-CV240

Hi-lume™ 1% EcoSystem Voltage LED driver
40W max

MODELS	L3DA4U1UKL-CV240
Length	4.98"
Width	4.00"
Depth	2.62"



LUTRON

Luminii is a Lutron OEM Advantage Partner

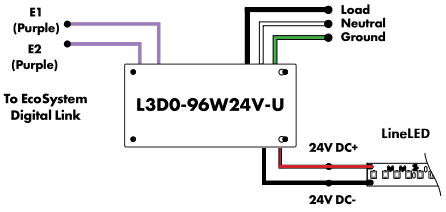
Lutron Power Supplies 0.1%

MODEL

L3D0-96W24V-U

Hi-lume™ 0.1% EcoSystem Voltage LED Driver with Soft-On, Fade-to-Black™
96W max

MODELS	L3D0
Length	10.50"
Width	5.50"
Depth	2.00"

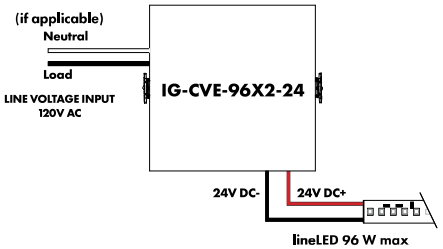


In-Ground Power Supplies

MODEL	POWER	OUTPUT	INPUT
IG - In ground CVE Series	CVE - ELV Dimming	96X2 - 2 X 96 Watt	24 - 24 VDC	Blank - 120 V 277 - 240/277 V

Dims down to 0%

MODELS	Dual Circuit
Length	8.40"
Width	8.30"
Depth	8.10"



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GD2AS

2" Gravity Square LED Adjustable

JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

ELECTRICAL DATA

LED Light Engine	Nominal Delivered Lumens*	System Wattage**
L1	700lm @ 3000K / 82CRI	10 Watts
L2	1000lm @ 3000K / 82CRI	15 Watts
L3	1200lm @ 3000K / 82CRI	20 Watts

* Delivered Lumens will vary depending on CCT, CRI, optic and reflector finish.
** System Wattage includes driver and LED Module consumption.

FEATURES

- Field changeable 16° to 60° Optics
- Integral field changeable accessory holder
- Toolless adjustability with 360° of rotation in 90° increments & 45° of tilt
- In-field adjustable module height accommodates ½" to 1-¼" ceiling thickness

LED LIGHT ENGINE

- 10W, 15W & 20W
- 16° to 60° Optics: 2 SDCM, 82/92CRI in 2700K, 3000K, 3500K & 4000K
- Rated life of >50,000 hours L70 based on LED testing per LM-80-08 and projected values using IESNA TM21-11

OPTICS

- Field changeable 16° Spot, 24° Narrow Flood, 36° Flood, 48° Wide Flood and 60° Very Wide Flood
- Accepts (2) field changeable filter media

ELECTRICAL SYSTEM

- 120V/277V input; Power factor >.9, 50/60Hz
- This product complies with IEEE C62.41 for surge endurance up to 2.5KV. Additional surge protection recommended. Damage from power surge is not covered by warranty.

HOUSING

- Heavy duty black powder coated 18 gauge steel frame
- Accommodates ½" to 1-¼" Ceilings
- Integral driver compartment with below ceiling access

EMERGENCY BACKUP

- Remote test switch included. External Battery operates LED load @ 725 nominal delivered Lumens. Servicing requires above ceiling access.
- Available with IC and AIC housings only.

INSTALLATION

- IC and Non-IC Rated housing types, must specify. (Remodel housings are Non-IC only) Non-IC rated housings must be kept at a minimum of 3" away from insulation
- Remodel housings requres 5-½" of plenum space for installtion and serviceing.
- Adjustable (10-¾" to 25") joist/ grid ceiling bar hangers included (Hanger bars does not allow for height adjustments)

REFLECTOR

- Specification grade 1.0mm spun aluminum reflector
- Shallow cone for maximum flexibility and 45° of adjustability
- Reflector available in black, white or haze finishes (Consult factory for other finishes)
- Architectural, discrete polished self flange (**Note:** Not available with trimless trims)

DIMMING

- Phase dimming, Forward 1% & Reversed 5% (120V only)
- 0-10V 1% Dimming 1%
- EldoLED SOLOdrive 0-10V 0.1%
- EldoLED ECOdrive 0-10V 1%
- Lutron® LDE1 Hi-Lume 1% EcoSystem LED driver with Soft-on, Fade-to-Black dimming technology

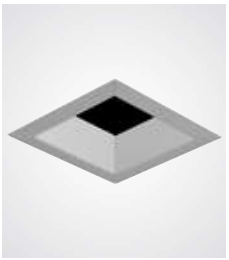
REMOTE BOX

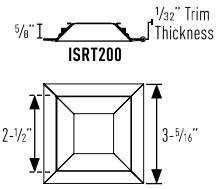
- Remote box included when required by specification (eldoLED or Lutron dimming option). Available with IC and AIC housings only.
- Above ceiling access required for servicing
- Galvanized steel construction with separate line voltage and low voltage wiring compartments
- 50ft remote distance maximum

LISTING / WARRANTY

- 5-Year Intense LED Limited Warranty
- ETL Listed to US and Canadian standards for damp locations
- (-IC / -AIC Only) ETL listed for direct contact w/insulation
- (-AIC Only) Air-Tight Certified ASTM E283.
- (-AIC Only) Can be used to comply with Title 24, Part 6, JA8 high efficacy LED light source requirements

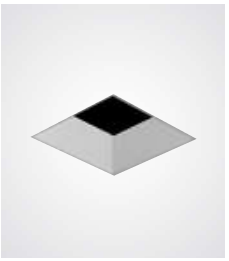
Trimmed Reflectors

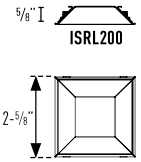




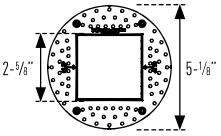
Ceiling Cutout: 2-⅞"

Trimless Reflectors





Ceiling Cutout: 2-⅞"



Trimless Mud Flanged: Perforated collar for seamless and trimless mounting. Must be ordered separately and can only be used in conjunction with trimless trims.

Available Trim Finishes



Housing Part Number: (Example: GD2ASNCL1279DIMSP)

Housing	Installation Type	Wattage	CCT / CRI	Dimming	Voltage	Optic	Options
GD2AS	**NC** (New Cons Non-IC)	**L1** (10W)	**27** (2700K / 82CRI)	**DIM**[2] (Phase Dimming)	blank (120V)	**SP** (16° SP)	**EM**[1,3,5] (7W Emergency Backup IOTA part #ILB-CP07-A)
	NIC[1] (New Cons IC-Rated)	**L2** (15W)	**279** (2700K / 92CRI)	**D101** (0-10V Dimming 1%)	**27** (277V)	**NF** (24° NFL)	
☐	☐ **NAIC**[1] (New Cons Air-Tight IC)	**L3** (20W)	**30** (3000K / 82CRI)	☐ **ED10V1**[1,3] (eldoLED 0-10V 1%)	☐	**FL** ☐ (36° FL)	☐
○	○ **RC** (Remodel Non-IC)	○	**309** (3000K / 92CRI)	○ **ED10V01**[1,3] (eldoLED 0-10V 0.1%)	○	**WF** ○ (48° WFL)	
○	○	○	**35** (3500K / 82CRI)	○ **LUT**[1,3] (Lutron® LDE1		**VF** ○ (60° VFL)	
○	○	○	**359** (3500K / 92CRI)	○ EcoSystem 1%)		○	
		○	**40** (4000K / 82CRI)	○		○	
		○	**409** (4000K / 92CRI)				

Reflector Part Number: (Example: ISRT200W-SF)

Reflector	Reflector Finish	Trim
ISRT200 (5/8" Regress Trim)	**W** (White)	**-SF** (Self Flanged)
ISRL200[5] (5/8" Regress Trimless)	**B**[6] (Black)	blank[5] (Trimless)
	HZ (Haze)	
☐	☐	☐
○	○	○
	○	

Optional Accessory

GD2S-MR[5] Square Trimless Mud Ring

Filter Media

☐ **PFL2-45** Hex Louver
PFL4-45 Soft Focus Film
PFL-LS-45 Linear Spread

Notes:
1. Not available with L3
2. Available in 120V only
3. Remote driver box required for eldoLED, Lutron and EM back up. Compatible with IC and AIC rated housings only.
4. Emergency backup available with IC and AIC housings only
5. Trimless options are for use with mud ring accessory only
6. Consult factory for lead times

GRAVITY LJM-0906-23 P-7

Intense Lighting
3340 E La Palma Ave, Anaheim, CA 92806 | tel 714 630-9877 | fax 714 630-9883

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intense LIGHTING | a LEVITON company

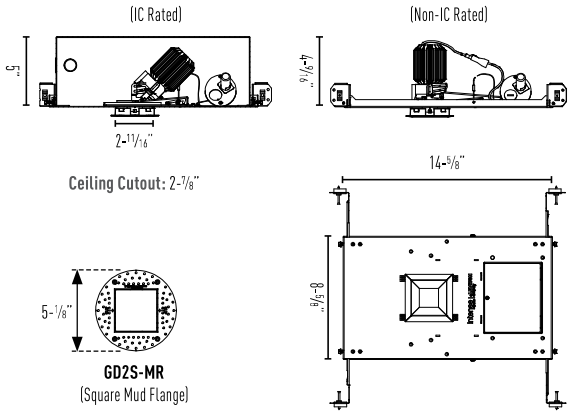
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GD2AS

2" Gravity Square LED Adjustable

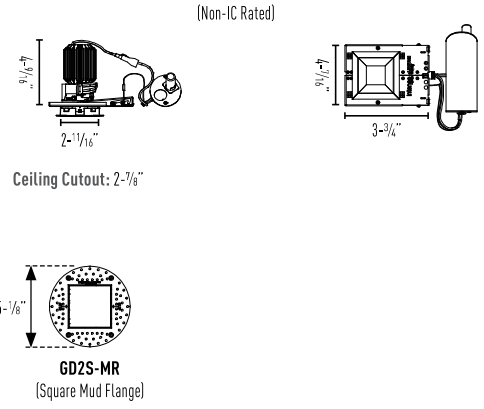
JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

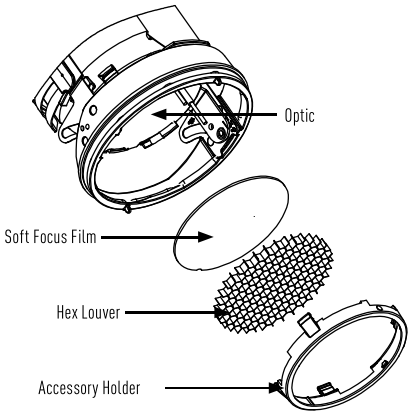
New Construction Dimension (IC & Non-IC):



Remodel Dimension (Non-IC):

Remodel housings requres 5-½" of plenum space for installtion and serviceing.



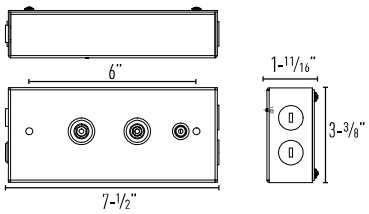


Optics

- ☐ **IP-OP45SP** (16° Spot)
- ☐ **IP-OP45NF** (24° Narrow Flood)
- ☐ **IP-OP45FL** (36° Flood)
- ☐ **IP-OP45WF** (48° Wide Flood
- ☐ **IP-OP45VF** (60° Very Wide Flood)

Accessories

- ☐ **PFL2-45** Hex Louver
- ☐ **PFL4-45** Soft Focus Film
- ☐ **PFL-LS-45** Linear Spread



Remote Mounted Driver

(For use with IC/AIC housings with eldoLED or Lutron dimming option)

- Remote box included when required by specification (eldoLED or Lutron dimming option). Available with IC and AIC housings only.
- Above ceiling access required for servicing
- Galvanized steel construction with separate line voltage and low voltage wiring compartments
- 50ft remote distance maximum

Remote Driver Box For Dimming Options

eldoLED 0-10V 1%
eldoLED 0-10V 0.1%
Lutron® LDE1 EcoSystem 1%
Lutron® LTEA2W 2-Wire 1%

Note: Wires for class 2 LED driver require a minimum of 18 awg wire at a maximum of 50 feet length per local and national electrical regulations.

Intense Lighting
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GD2AS

2" Gravity Square LED Adjustable

JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

ISRT200WL3

Report #: ILL-20190114-1 (16)
ILL-20190114-1 (24)
ILL-20190114-1 (36)
ILL-20190114-1 (48)
ILL-20190114-1 (60)

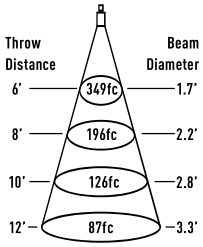
LED PACKAGE MULTIPLIERS:
ISRT200WL1 (x 0.58)
ISRT200WL2 (x 0.82)

ISRT200 (5/8" REGRESS)
Trim Multiplier (x 0.99)

CCT MULTIPLIERS:

	82CRI	92CRI
2700K	(x 0.93)	(x 0.76)
3000K	(x 1.00)	(x 0.87)
3500K	(x 1.00)	(x 0.87)
4000K	(x 1.00)	(x 0.87)

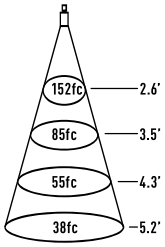
16° Spot



Watts: 20 **LPW:** 67
Lumens: 1346 **CCT:** 3000K

Intensity	
Degree	**CBCP**
0°	12563
5°	10964
15°	1301
25°	133
35°	30
45°	11

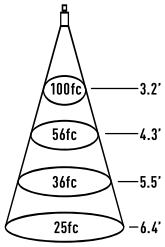
24° Narrow Flood



Watts: 20 **LPW:** 62
Lumens: 1245 **CCT:** 3000K

Intensity	
Degree	**CBCP**
0°	5468
5°	4777
15°	1939
25°	429
35°	82
45°	17

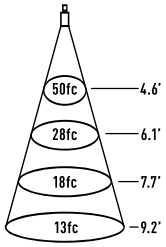
36° Flood



Watts: 20 **LPW:** 59
Lumens: 1190 **CCT:** 3000K

Intensity	
Degree	**CBCP**
0°	3611
5°	3352
15°	1803
25°	556
35°	144
45°	28

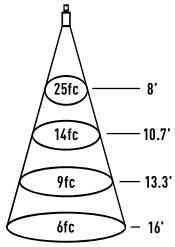
48° Wide Flood



Watts: 20 **LPW:** 54
Lumens: 1080 **CCT:** 3000K

Intensity	
Degree	**CBCP**
0°	1801
5°	1727
15°	1273
25°	658
35°	275
45°	79

60° Very Wide Flood



Watts: 20 **LPW:** 49
Lumens: 993 **CCT:** 3000K

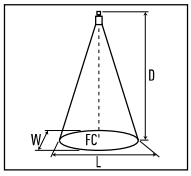
Intensity	
Degree	**CBCP**
0°	908
5°	894
15°	822
25°	643
35°	420
45°	164

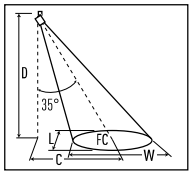
APPLICATION DATA:

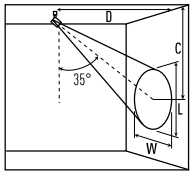
W and **L** are the outer points where the candle power drops to 50% of maximum. **FC** are the initial foot candles at the center of the beam.

W: Beam width
L: Beam length
C: Distance to center of beam
D: Distance
FC: Foot-candles

Illuminated width & length are based upon point at which illuminance falls to 50% of center illuminance. Recommended spacing is based upon uniform illuminance aiming angle is the angle between the lamp axis and the perpendicular to the illuminated plane.







	0° HORIZONTAL				35° HORIZONTAL					35° VERTICAL				
	D	FC	W	L	D	C	FC	W	L	D	C	FC	W	L
ISRT200WL2WL3 3000K 16° Spot	6'	349	1.7	1.7	6'	4.2	192	2.6	2.1	3'	4.3	263	1.5	2.8
	8'	196	2.2	2.2	8'	5.6	108	3.5	2.9	4'	5.7	148	2	3.7
	10'	126	2.8	2.8	10'	7	69	4.4	3.6	5'	7.1	95	2.5	4.6
	12'	87	3.3	3.3	12'	8.4	48	5.3	4.3	6'	8.6	66	3.1	5.5
ISRT200WL2WL3 3000K 24° Narrow Flood	6'	152	2.6	2.6	6'	4.2	83	3.9	3.2	3'	4.3	115	2.3	4.3
	8'	85	3.5	3.5	8'	5.6	47	5.2	4.2	4'	5.7	64	3	5.8
	10'	55	4.3	4.3	10'	7	30	6.5	5.3	5'	7.1	41	3.8	7.2
	12'	38	5.2	5.2	12'	8.4	21	7.8	6.3	6'	8.6	29	4.5	8.6
ISRT200WL2WL3 3000K 36° Flood	6'	100	3.2	3.2	6'	4.2	55	5	4	3'	4.3	75.7	2.8	5.7
	8'	56	4.3	4.3	8'	5.6	31	6.6	5.3	4'	5.7	42.6	3.8	7.6
	10'	36	5.5	5.5	10'	7	20	8.3	6.6	5'	7.1	27.3	4.7	9.5
	12'	25	6.4	6.4	12'	8.4	14	10	7.9	6'	8.6	19	5.6	11.4
ISRT200WL2WL3 3000K 48° Wide Flood	6'	50	4.6	4.6	6'	4.2	28	7.3	5.6	3'	4.3	38	4	9.8
	8'	28	6.1	6.1	8'	5.6	15	9.7	7.5	4'	5.7	21	5.3	13.1
	10'	18	7.7	7.7	10'	7	10	12.2	9.4	5'	7.1	14	6.7	16.3
	12'	13	9.2	9.2	12'	8.4	7	14.6	11.2	6'	8.6	9	8	19.6
ISRT200WL2WL3 3000K 60° Very Wide Flood	6'	25	8	8	6'	4.2	14	15.2	9.8	3'	4.3	19	7	122
	8'	14	10.7	10.7	8'	5.6	8	20.2	13	4'	5.7	10.7	9.3	162
	10'	9	13.3	13.3	10'	7	5	25.3	16.3	5'	7.1	6.9	11.6	203
	12'	6	16	16	12'	8.4	3	30.3	19.5	6'	8.6	4.8	14	244

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GD2AS

2" Gravity Square LED Adjustable

JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

ELECTRICAL DATA

LED Light Engine	Nominal Delivered Lumens*	System Wattage**
L1	700lm @ 3000K / 82CRI	10 Watts
L2	1000lm @ 3000K / 82CRI	15 Watts
L3	1200lm @ 3000K / 82CRI	20 Watts

* Delivered Lumens will vary depending on CCT, CRI, optic and reflector finish.
** System Wattage includes driver and LED Module consumption.

FEATURES
- Field changeable 16° to 60° Optics
- Integral field changeable accessory holder
- Toolless adjustability with 360° of rotation in 90° increments & 45° of tilt
- In-field adjustable module height accommodates ½" to 1-¼" ceiling thickness

LED LIGHT ENGINE
- 10W, 15W & 20W
- 16° to 60° Optics: 2 SDCM, 82/92CRI in 2700K, 3000K, 3500K & 4000K
- Rated life of >50,000 hours L70 based on LED testing per LM-80-08 and projected values using IESNA TM21-11

OPTICS
- Field changeable 16° Spot, 24° Narrow Flood, 36° Flood, 48° Wide Flood and 60° Very Wide Flood
- Accepts (2) field changeable filter media

ELECTRICAL SYSTEM
- 120V/277V input; Power factor >.9, 50/60Hz
- This product complies with IEEE C62.41 for surge endurance up to 2.5KV. Additional surge protection recommended. Damage from power surge is not covered by warranty.

HOUSING
- Heavy duty black powder coated 18 gauge steel frame
- Accommodates ½" to 1-¼" Ceilings
- Integral driver compartment with below ceiling access

EMERGENCY BACKUP
- Remote test switch included. External Battery operates LED load @ 725 nominal delivered Lumens. Servicing requires above ceiling access.
- Available with IC and AIC housings only.

INSTALLATION
- IC and Non-IC Rated housing types, must specify. (Remodel housings are Non-IC only) Non-IC rated housings must be kept at a minimum of 3" away from insulation
- Remodel housings requres 5-½" of plenum space for installtion and serviceing.
- Adjustable (10-¾" to 25") joist/ grid ceiling bar hangers included (Hanger bars does not allow for height adjustments)

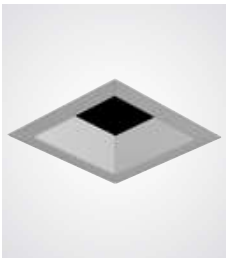
REFLECTOR
- Specification grade 1.0mm spun aluminum reflector
- Shallow cone for maximum flexibility and 45° of adjustability
- Reflector available in black, white or haze finishes (Consult factory for other finishes)
- Architectural, discrete polished self flange (**Note:** Not available with trimless trims)

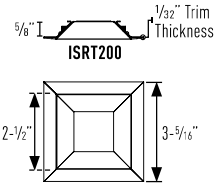
DIMMING
- Phase dimming, Forward 1% & Reversed 5% (120V only)
- 0-10V 1% Dimming 1%
- EldoLED SOLOdrive 0-10V 0.1%
- EldoLED ECOdrive 0-10V 1%
- Lutron® LDE1 Hi-Lume 1% EcoSystem LED driver with Soft-on, Fade-to-Black dimming technology

REMOTE BOX
- Remote box included when required by specification (eldoLED or Lutron dimming option). Available with IC and AIC housings only.
- Above ceiling access required for servicing
- Galvanized steel construction with separate line voltage and low voltage wiring compartments
- 50ft remote distance maximum

LISTING / WARRANTY
- 5-Year Intense LED Limited Warranty
- ETL Listed to US and Canadian standards for damp locations
- (-IC / -AIC Only) ETL listed for direct contact w/insulation
- (-AIC Only) Air-Tight Certified ASTM E283.
- (-AIC Only) Can be used to comply with Title 24, Part 6, JA8 high efficacy LED light source requirements

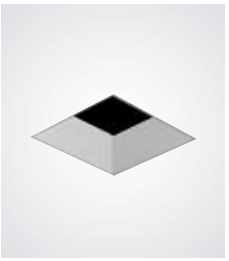
Trimmed Reflectors

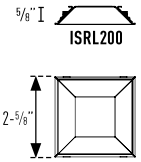




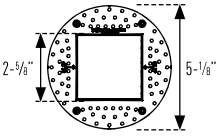
Ceiling Cutout: 2-⅞"

Trimless Reflectors





Ceiling Cutout: 2-⅞"



Trimless Mud Flanged: Perforated collar for seamless and trimless mounting. Must be ordered separately and can only be used in conjunction with trimless trims.

Available Trim Finishes



Housing Part Number: (Example: GD2ASNCL1279DIMSP)

Housing	Installation Type	Wattage	CCT / CRI	Dimming	Voltage	Optic	Options
GD2AS	**NC** (New Cons Non-IC)	**L1** (10W)	**27** (2700K / 82CRI)	**DIM**[2] (Phase Dimming)	blank (120V)	**SP** (16° SP)	**EM**[1,3,5] (7W Emergency Backup IOTA part #ILB-CP07-A)
	NIC[1] (New Cons IC-Rated)	**L2** (15W)	**279** (2700K / 92CRI)	**D101** (0-10V Dimming 1%)	**27** (277V)	**NF** (24° NFL)	
	NAIC[1] (New Cons Air-Tight IC)	**L3** (20W)	**30** (3000K / 82CRI)	**ED10V1**[1,3] (eldoLED 0-10V 1%)		**FL** (36° FL)	
	RC (Remodel Non-IC)		**309** (3000K / 92CRI)	**ED10V01**[1,3] (eldoLED 0-10V 0.1%)		**WF** (48° WFL)	
			35 (3500K / 82CRI)	**LUT**[1,3] (Lutron® LDE1 EcoSystem 1%)		**VF** (60° VFL)	
			359 (3500K / 92CRI)				
			40 (4000K / 82CRI)				
			409 (4000K / 92CRI)				

Reflector Part Number: (Example: ISRT200W-SF)

Reflector	Reflector Finish	Trim
ISRT200 (5/8" Regress Trim)	**W** (White)	**-SF** (Self Flanged)
ISRL200[5] (5/8" Regress Trimless)	**B**[6] (Black)	blank[5] (Trimless)
	HZ (Haze)	

Optional Accessory

GD2S-MR[5] Square Trimless Mud Ring

Filter Media

PFL2-45 Hex Louver
PFL4-45 Soft Focus Film
PFL-LS-45 Linear Spread

Notes:
1. Not available with L3
2. Available in 120V only
3. Remote driver box required for eldoLED, Lutron and EM back up. Compatible with IC and AIC rated housings only.
4. Emergency backup available with IC and AIC housings only
5. Trimless options are for use with mud ring accessory only
6. Consult factory for lead times

GRAVITY LJM-0906-23 P-7

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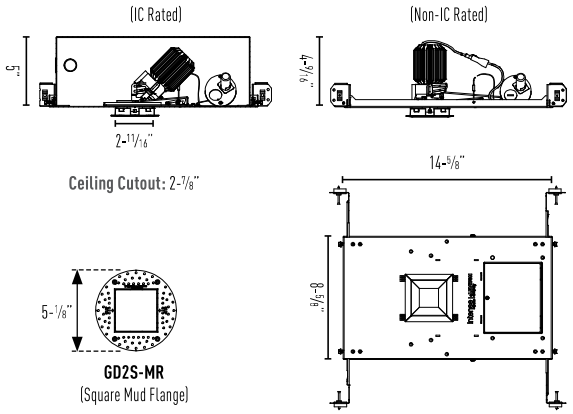
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GD2AS

2" Gravity Square LED Adjustable

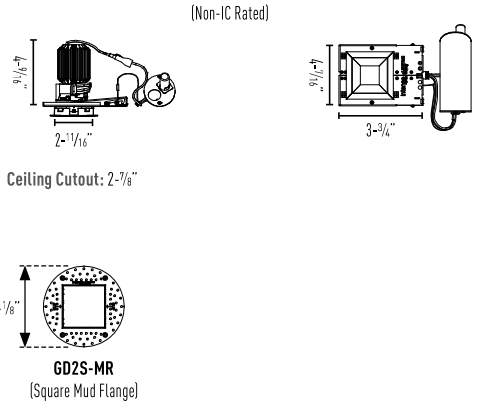
JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

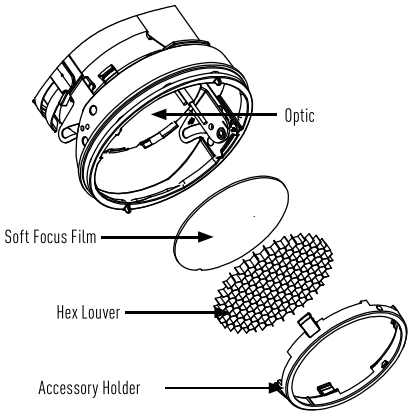
New Construction Dimension (IC & Non-IC):



Remodel Dimension (Non-IC):

Remodel housings requres 5-½" of plenum space for installtion and serviceing.



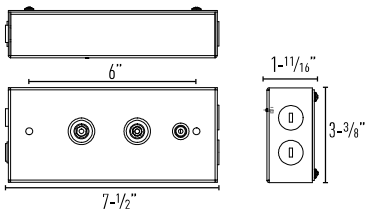


Optics

- ☐ **IP-OP45SP** (16° Spot)
- ☐ **IP-OP45NF** (24° Narrow Flood)
- ☐ **IP-OP45FL** (36° Flood)
- ☐ **IP-OP45WF** (48° Wide Flood
- ☐ **IP-OP45VF** (60° Very Wide Flood)

Accessories

- ☐ **PFL2-45** Hex Louver
- ☐ **PFL4-45** Soft Focus Film
- ☐ **PFL-LS-45** Linear Spread



Remote Mounted Driver

(For use with IC/AIC housings with eldoLED or Lutron dimming option)

- Remote box included when required by specification (eldoLED or Lutron dimming option). Available with IC and AIC housings only.
- Above ceiling access required for servicing
- Galvanized steel construction with separate line voltage and low voltage wiring compartments
- 50ft remote distance maximum

Remote Driver Box For Dimming Options

eldoLED 0-10V 1%
eldoLED 0-10V 0.1%
Lutron® LDE1 EcoSystem 1%
Lutron® LTEA2W 2-Wire 1%

Note: Wires for class 2 LED driver require a minimum of 18 awg wire at a maximum of 50 feet length per local and national electrical regulations.

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GD2AS

2" Gravity Square LED Adjustable

JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

ISRT200WL3

Report #: ILL-20190114-1 (16)
ILL-20190114-1 (24)
ILL-20190114-1 (36)
ILL-20190114-1 (48)
ILL-20190114-1 (60)

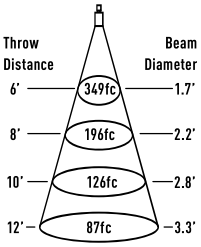
LED PACKAGE MULTIPLIERS:
ISRT200WL1 (x 0.58)
ISRT200WL2 (x 0.82)

ISRT200 (5/8" REGRESS)
Trim Multiplier (x 0.99)

CCT MULTIPLIERS:

	82CRI	92CRI
2700K	(x 0.93)	(x 0.76)
3000K	(x 1.00)	(x 0.87)
3500K	(x 1.00)	(x 0.87)
4000K	(x 1.00)	(x 0.87)

16° Spot

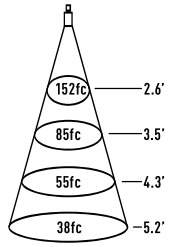


Watts: 20 LPW: 67
Lumens: 1346 CCT: 3000K

Intensity

Degree	CBCP
0°	12563
5°	10964
15°	1301
25°	133
35°	30
45°	11

24° Narrow Flood

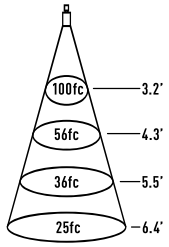


Watts: 20 LPW: 62
Lumens: 1245 CCT: 3000K

Intensity

Degree	CBCP
0°	5468
5°	4777
15°	1939
25°	429
35°	82
45°	17

36° Flood

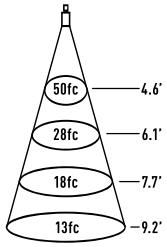


Watts: 20 LPW: 59
Lumens: 1190 CCT: 3000K

Intensity

Degree	CBCP
0°	3611
5°	3352
15°	1803
25°	556
35°	144
45°	28

48° Wide Flood

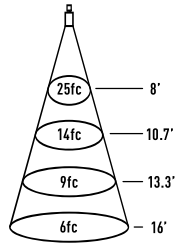


Watts: 20 LPW: 54
Lumens: 1080 CCT: 3000K

Intensity

Degree	CBCP
0°	1801
5°	1727
15°	1273
25°	658
35°	275
45°	79

60° Very Wide Flood



Watts: 20 LPW: 49
Lumens: 993 CCT: 3000K

Intensity

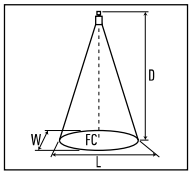
Degree	CBCP
0°	908
5°	894
15°	822
25°	643
35°	420
45°	164

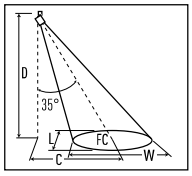
APPLICATION DATA:

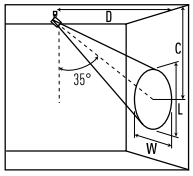
W and **L** are the outer points where the candle power drops to 50% of maximum. **FC** are the initial foot candles at the center of the beam.

W: Beam width
L: Beam length
C: Distance to center of beam
D: Distance
FC: Foot-candles

Illuminated width & length are based upon point at which illuminance falls to 50% of center illuminance. Recommended spacing is based upon uniform illuminance aiming angle is the angle between the lamp axis and the perpendicular to the illuminated plane.







	0° HORIZONTAL				35° HORIZONTAL					35° VERTICAL				
	D	FC	W	L	D	C	FC	W	L	D	C	FC	W	L
ISRT200WL2WL3 3000K 16° Spot	6'	349	1.7	1.7	6'	4.2	192	2.6	2.1	3'	4.3	263	1.5	2.8
	8'	196	2.2	2.2	8'	5.6	108	3.5	2.9	4'	5.7	148	2	3.7
	10'	126	2.8	2.8	10'	7	69	4.4	3.6	5'	7.1	95	2.5	4.6
	12'	87	3.3	3.3	12'	8.4	48	5.3	4.3	6'	8.6	66	3.1	5.5
ISRT200WL2WL3 3000K 24° Narrow Flood	6'	152	2.6	2.6	6'	4.2	83	3.9	3.2	3'	4.3	115	2.3	4.3
	8'	85	3.5	3.5	8'	5.6	47	5.2	4.2	4'	5.7	64	3	5.8
	10'	55	4.3	4.3	10'	7	30	6.5	5.3	5'	7.1	41	3.8	7.2
	12'	38	5.2	5.2	12'	8.4	21	7.8	6.3	6'	8.6	29	4.5	8.6
ISRT200WL2WL3 3000K 36° Flood	6'	100	3.2	3.2	6'	4.2	55	5	4	3'	4.3	75.7	2.8	5.7
	8'	56	4.3	4.3	8'	5.6	31	6.6	5.3	4'	5.7	42.6	3.8	7.6
	10'	36	5.5	5.5	10'	7	20	8.3	6.6	5'	7.1	27.3	4.7	9.5
	12'	25	6.4	6.4	12'	8.4	14	10	7.9	6'	8.6	19	5.6	11.4
ISRT200WL2WL3 3000K 48° Wide Flood	6'	50	4.6	4.6	6'	4.2	28	7.3	5.6	3'	4.3	38	4	9.8
	8'	28	6.1	6.1	8'	5.6	15	9.7	7.5	4'	5.7	21	5.3	13.1
	10'	18	7.7	7.7	10'	7	10	12.2	9.4	5'	7.1	14	6.7	16.3
	12'	13	9.2	9.2	12'	8.4	7	14.6	11.2	6'	8.6	9	8	19.6
ISRT200WL2WL3 3000K 60° Very Wide Flood	6'	25	8	8	6'	4.2	14	15.2	9.8	3'	4.3	19	7	122
	8'	14	10.7	10.7	8'	5.6	8	20.2	13	4'	5.7	10.7	9.3	162
	10'	9	13.3	13.3	10'	7	5	25.3	16.3	5'	7.1	6.9	11.6	203
	12'	6	16	16	12'	8.4	3	30.3	19.5	6'	8.6	4.8	14	244

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GD2DS

2" Gravity Square LED Downlight

JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

ELECTRICAL DATA

LED Light Engine	Nominal Delivered Lumens*	System Wattage**
L1	700lm @ 3000K / 82CRI	10 Watts
L2	1000lm @ 3000K / 82CRI	15 Watts
L3	1200lm @ 3000K / 82CRI	20 Watts

* Delivered Lumens will vary depending on CCT, CRI, optic and reflector finish.
** System Wattage includes driver and LED Module consumption.

FEATURES
- Field changeable 16° to 60° Optics
- Integral field changeable accessory holder
- Toolless adjustability with 360° of rotation in 90° increments & 45° of tilt
- In-field adjustable module height accommodates ½" to 1-¼" ceiling thickness

LED LIGHT ENGINE
- 10W, 15W & 20W
- 16° to 60° Optics: 2 SDCM, 82/92CRI in 2700K, 3000K, 3500K & 4000K
- Rated life of >50,000 hours L70 based on LED testing per LM-80-08 and projected values using IESNA TM21-11

OPTICS
- Field changeable 16° Spot, 24° Narrow Flood, 36° Flood, 48° Wide Flood and 60° Very Wide Flood
- Accepts (2) field changeable filter media

ELECTRICAL SYSTEM
- 120V/277V input; Power factor >.9, 50/60Hz
- This product complies with IEEE C62.41 for surge endurance up to 2.5KV. Additional surge protection recommended. Damage from power surge is not covered by warranty.

HOUSING
- Heavy duty black powder coated 18 gauge steel frame
- Accommodates ½" to 1-¼" Ceilings
- Integral driver compartment with below ceiling access

EMERGENCY BACKUP
- Remote test switch included. External Battery operates LED load @ 725 nominal delivered Lumens. Servicing requires above ceiling access.
- Available with IC and AIC housings only.

INSTALLATION
- IC and Non-IC Rated housing types, must specify. (Remodel housings are Non-IC only) Non-IC rated housings must be kept at a minimum of 3" away from insulation
- Remodel housings requres 5-½" of plenum space for installtion and serviceing.
- Adjustable (10-¾" to 25") joist/ grid ceiling bar hangers included (Hanger bars does not allow for height adjustments)

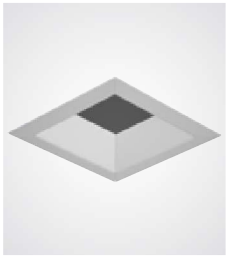
REFLECTOR
- Specification grade 1.0mm spun aluminum reflector
- Reflector available in black, white or haze finishes (Consult factory for other finishes)
- Architectural, discrete polished self flange (**Note:** Not available with trimless trims)

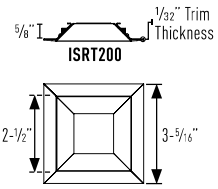
DIMMING
- Phase dimming, Forward 1% & Reversed 5% (120V only)
- 0-10V 1% Dimming 1%
- EldoLED SOLOdrive 0-10V 0.1%
- EldoLED ECOdrive 0-10V 1%
- Lutron® LDE1 Hi-Lume 1% EcoSystem LED driver with Soft-on, Fade-to-Black dimming technology

REMOTE BOX
- Remote box included when required by specification (eldoLED or Lutron dimming option). Available with IC and AIC housings only.
- Above ceiling access required for servicing
- Galvanized steel construction with separate line voltage and low voltage wiring compartments
- 50ft remote distance maximum

LISTING / WARRANTY
- 5-Year Intense LED Limited Warranty
- ETL Listed to US and Canadian standards for damp locations
- (-IC / -AIC Only) ETL listed for direct contact w/insulation
- (-AIC Only) Air-Tight Certified ASTM E283.
- (-AIC Only) Can be used to comply with Title 24, Part 6, JA8 high efficacy LED light source requirements

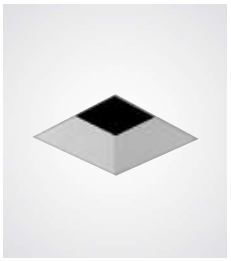
Trimmed Reflectors

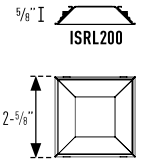




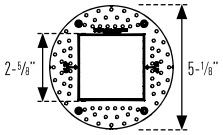
Ceiling Cutout: 2-⅞"

Trimless Reflectors





Ceiling Cutout: 2-⅞"



Trimless Mud Flanged: Perforated collar for seamless and trimless mounting. Must be ordered separately and can only be used in conjunction with trimless trims.

Available Trim Finishes



White Black Haze

Housing Part Number: (Example: GD2DSNCL1279DIMSP)

Housing	Installation Type	Wattage	CCT / CRI	Dimming	Voltage	Optic	Options
GD2DS	NC (New Cons Non-IC)	L1 (10W)	27 (2700K / 82CRI)	DIM[2] (Phase Dimming)	blank (120V)	SP (16° SP)	EM7[1,3,5] (7W Emergency Backup IOTA part #ILB-CP07-A)
	NIC[1] (New Cons IC-Rated)	L2 (15W)	279 (2700K / 92CRI)	D101 (0-10V Dimming 1%)	27 (277V)	NF (24° NFL)	
	NAIC[1] (New Cons Air-Tight IC)	L3 (20W)	30 (3000K / 82CRI)	ED10V1[1,3] (eldoLED 0-10V 1%)		FL (36° FL)	
	RC (Remodel Non-IC)		309 (3000K / 92CRI)	ED10V01[1,3] (eldoLED 0-10V 0.1%)		WF (48° WFL)	
			35 (3500K / 82CRI)	LUT[1,3] (Lutron® LDE1 EcoSystem 1%)		VF (60° VFL)	
			359 (3500K / 92CRI)				
			40 (4000K / 82CRI)				
			409 (4000K / 92CRI)				

Reflector Part Number: (Example: ISRT200W-SF)

Reflector	Reflector Finish	Trim
ISRT200 (5/8" Regress Trim)	W (White)	-SF (Self Flanged)
ISRL200[5] (5/8" Regress Trimless)	B[6] (Black)	blank[5] (Trimless)
	HZ (Haze)	

Optional Accessory

GD2S-MR[5] Square Trimless Mud Ring

Filter Media

- PFL2-45 Hex Louver
- PFL4-45 Soft Focus Film
- PFL-LS-45 Linear Spread

Notes:
1. Not available with L3
2. Available in 120V only
3. Remote driver box required for eldoLED, Lutron and EM back up. Compatible with IC and AIC rated housings only.
4. Emergency backup available with IC and AIC housings only
5. Trimless options are for use with mud ring accessory only
6. Consult factory for lead times

GRAVITY LJM-0906-23-P-7

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intense LIGHTING | a LEVITON company

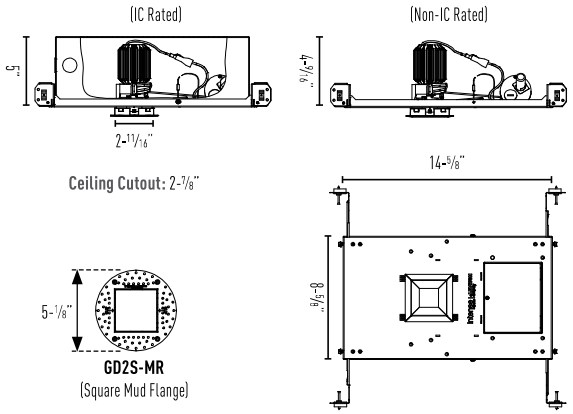
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GD2DS

2" Gravity Square LED Downlight

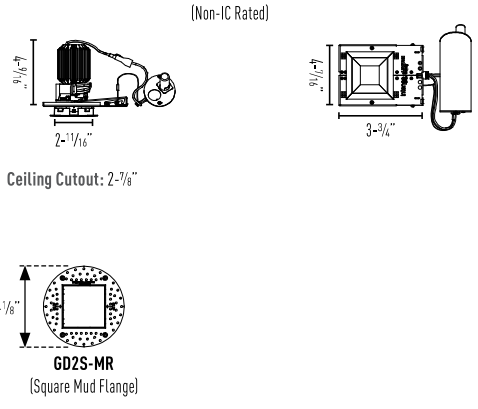
JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

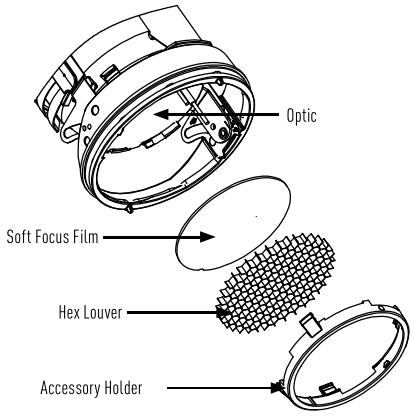
New Construction Dimension (IC & Non-IC):



Remodel Dimension (Non-IC):

Remodel housings requres 5-½" of plenum space for installtion and serviceing.



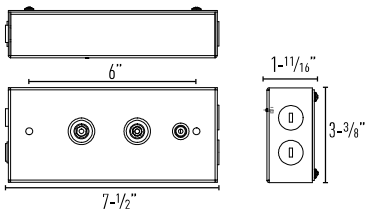


Optics

- ☐ **IP-OP45SP** (16° Spot)
- ☐ **IP-OP45NF** (24° Narrow Flood)
- ☐ **IP-OP45FL** (36° Flood)
- ☐ **IP-OP45WF** (48° Wide Flood
- ☐ **IP-OP45VF** (60° Very Wide Flood)

Accessories

- ☐ **PFL2-45** Hex Louver
- ☐ **PFL4-45** Soft Focus Film
- ☐ **PFL-LS-45** Linear Spread



Remote Mounted Driver

(For use with IC/AIC housings with eldoLED or Lutron dimming option)

- Remote box included when required by specification (eldoLED or Lutron dimming option). Available with IC and AIC housings only.
- Above ceiling access required for servicing
- Galvanized steel construction with separate line voltage and low voltage wiring compartments
- 50ft remote distance maximum

Remote Driver Box For Dimming Options

eldoLED 0-10V 1%
eldoLED 0-10V 0.1%
Lutron® LDE1 EcoSystem 1%
Lutron® LTEA2W 2-Wire 1%

Note: Wires for class 2 LED driver require a minimum of 18 awg wire at a maximum of 50 feet length per local and national electrical regulations.

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GD2DS

2" Gravity Square LED Downlight

JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

ISRT200WL3

Report #: ILL-20190114-1 (16)
ILL-20190114-1 (24)
ILL-20190114-1 (36)
ILL-20190114-1 (48)
ILL-20190114-1 (60)

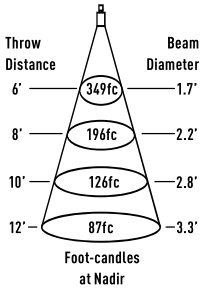
LED PACKAGE MULTIPLIERS:
ISRT200WL1 (x 0.58)
ISRT200WL2 (x 0.82)

ISRT200 (5/8" REGRESS)
Trim Multiplier (x 0.99)

CCT MULTIPLIERS:

	82CRI	92CRI
2700K	(x 0.93)	(x 0.76)
3000K	(x 1.00)	(x 0.87)
3500K	(x 1.00)	(x 0.87)
4000K	(x 1.00)	(x 0.87)

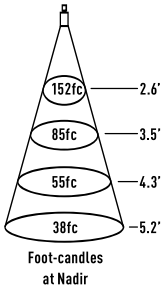
16° Spot



Watts: 20 **LPW:** 67
Lumens: 1346 **CCT:** 3000K

Intensity	
Degree	**CBCP**
0°	12563
5°	10964
15°	1301
25°	133
35°	30
45°	11

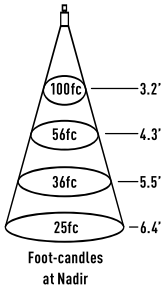
24° Narrow Flood



Watts: 20 **LPW:** 62
Lumens: 1245 **CCT:** 3000K

Intensity	
Degree	**CBCP**
0°	5468
5°	4777
15°	1939
25°	429
35°	82
45°	17

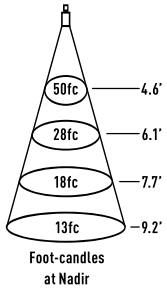
36° Flood



Watts: 20 **LPW:** 59
Lumens: 1190 **CCT:** 3000K

Intensity	
Degree	**CBCP**
0°	3611
5°	3352
15°	1803
25°	556
35°	144
45°	28

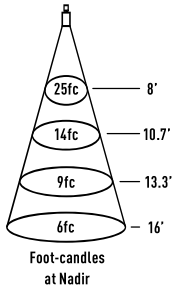
48° Wide Flood



Watts: 20 **LPW:** 54
Lumens: 1080 **CCT:** 3000K

Intensity	
Degree	**CBCP**
0°	1801
5°	1727
15°	1273
25°	658
35°	275
45°	79

60° Very Wide Flood



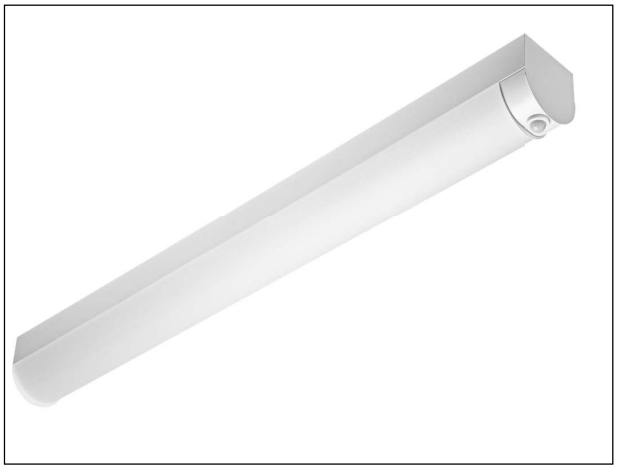
Watts: 20 **LPW:** 49
Lumens: 993 **CCT:** 3000K

Intensity	
Degree	**CBCP**
0°	908
5°	894
15°	822
25°	643
35°	420
45°	164

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LW14STR SERIES

Lumasence Bi-Level LED Lighting System

Fixture Type:

Job Information:

SPECIFICATIONS:

LED MODULES:
- High performance linear configured LED module boards.
- Each board consists of multiple mid-power, high efficacy LEDs in a precise layout eliminating the need for supplemental heat sinking.
- The boards produce an even and diffuse light which maximizes optical efficiency.
- Color temperatures available: 3000K, 3500K and 4000K.
- Upon request: 5000K.

LED DRIVERS:
- Factory programmable constant current LED power supply.
- Multiple standard drive current outputs (factory set by Mercury) are cataloged with their corresponding lumen package offerings. Upon request, custom drive current outputs and lumen packages are available.
- Universal voltage input, 120V-277V, 50HZ-60HZ.

LED LUMEN PACKAGES:
- Cataloged standard lumen packages. See attached chart for full details.
- Custom lumen packages pre-set are optional with programmable drivers only. Contact factory for details.

HOUSING:
- Fabricated from 20GA. cold rolled steel with 18GA. housing ends welded into place.
- White polyester powder coating finish for long lasting durability.
- Sufficient electrical knockouts are provided on the housing back and ends.

DIFFUSER:
- Larger-scale rounded profile design.
- Extruded from custom formulated high transmission impact-resistant acrylic material.
- Linear ribbing for high LED performance.

STANDBY LIGHTING OPTION:
- Self contained module, 7W, 10W or 12W as specified. Battery backup upon loss of power. Available 4Ft. modules only.

OCCUPANCY SENSOR:
- Leviton ZLS05-ILW Sensor.
- Infrared bi-level sensor.
- Daylight harvesting capability.
- Maximum mounting height 10ft.
- Detection angle 120 degrees.
- Eight dip switches allow for field control.
- Task level: 100% default. Optional; 70%, 80%, 90%.
- Occupied Time Out Level: Default 10S. Optional 30S, 5MIN, 10MIN, or 15MIN.
- Standby Light Level(Dim Mode): 20% Default. Optional: 50%.
- Other settings available. Consult factory.

INSTALLATIONS:
- Surface mounts individually, ceiling or wall orientation.
- Maximum mounting height off floor is 10ft for proper sensor operation. Obstructions such as exit signs can possibly impede proper sensor operation.
- End knockouts for surface conduit entry.

CERTIFICATE OF SAFETY COMPLIANCE AND LISTINGS:
- Luminaire: UL and CUL listed 1598 and bears their label. Suitable for damp locations.

WARRANTY:
- 5-year limited warranty is standard. Special 10-year warranty available on a job-to-job basis. Complete LED warranty terms available at www.mercltg.com.
- Actual performance may differ as a result of end-user environment and application.
- Most LED luminaires are suitable to operate in ambient temperatures from -20C (-4F) to 25C (77F).
- The following exclusions apply: Luminaires with optional standby lighting option. Consult factory.
- LM-79 testing was measured under a controlled 25C (77F) ambient operating temperature.

FEATURES:
- Motion sensing bi-level stairwell and passageway LED lighting system.
- Multiple standby and time delay settings.
- Field adjustable sensitivity.
- Multiple power and 100% lumen output packages are factory set and cataloged to meet design and energy needs per application.
- Custom factory set levels available on request.
- Impact-resistant acrylic diffuser suitable for public spaces.
- CRI greater than 80.
- Lumen maintenance; Reported L70 (hours) & L80 (hours) > 60,000.
- Fixture lumens per watt ratios up to 142.
- American Made.

APPLICATIONS:
- Stairwells and similar low traffic public areas require 24-hour lighting for safety and security. In reality, occupancy in these areas can be near zero.
- Optional standby lighting battery backup modules further enhances the requirements for emergency egress from buildings.

DELIVERING UP TO 142 LUMENS PER WATT

MERCURY LIGHTING PRODUCTS CO. INC.

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www.mercltg.com

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LW14STR SERIES

Example: LW14STR-4-3800-35K-HTA20-1%-20-UNI-EM7

LW14STR - - - - - - - UNI -

SERIES	NOMINAL LENGTH (FT)	NOMINAL LUMENS	COLOR TEMP	DIFFUSER	DRIVER	STANDBY POWER %	VOLTAGE	OPTIONS
LW14STR	**2** 24" Length **4** 48" Length	**24"L** **2100** **2300** **2500** **2700** **48"L** **2100** **3800** **4500** **5000** **5700** **8400** **10,900** **XXXX** Custom Lumen Package. Contact Factory.	**30K** **35K** **40K** **50K** Upon Request	**HTA20** High Transmission Impact-Resistant Acrylic	**1%** 0-10V 1% Dimming ____ As Specified	**20** Default **50** Optional	**UNI**	**Standby Modules** **EM7** **EM10** **EM12** Available 4ft. Modules Only

LUMEN PACKAGE

Series	Nominal Length (FT)	Nominal Lumen Package	Color	Fixture Power (W)	Delivered Lumens	Fixture LPW
LW14STR	2					
		2100	3000K	17	2038	120
		2100	3500K	17	2106	124
		2100	4000K	17	2125	125
		2100	5000K	17	2125	125
		2300	3000K	18	2151	120
		2300	3500K	18	2222	123
		2300	4000K	18	2302	128
		2300	5000K	18	2302	128
		2500	3000K	19	2318	122
		2500	3500K	19	2394	126
		2500	4000K	19	2502	132
		2500	5000K	19	2502	132
		2700	3000K	22	2592	118
		2700	3500K	22	2679	122
		2700	4000K	22	2703	123
		2700	5000K	22	2703	123

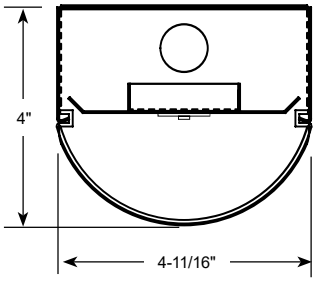
Series	Nominal Length (FT)	Nominal Lumen Package	Color	Fixture Power (W)	Delivered Lumens	Fixture LPW
LW14STR	4					
		2100	3000K	15	2040	136
		2100	3500K	15	2108	141
		2100	4000K	15	2127	142
		2100	5000K	15	2127	142
		3800	3000K	29	3679	127
		3800	3500K	29	3802	131
		3800	4000K	29	3836	132
		3800	5000K	29	3836	132
		4500	3000K	34	4329	127
		4500	3500K	34	4472	132
		4500	4000K	34	4514	133
		4500	5000K	34	4514	133
		5000	3000K	39	4801	123
		5000	3500K	39	4961	127
		5000	4000K	39	5006	128
		5000	5000K	39	5006	128
		5700	3000K	45	5485	122
		5700	3500K	45	5667	126
		5700	4000K	45	5719	127
		5700	5000K	45	5719	127
		8400	3000K	64	8220	128
		8400	3500K	64	8431	132
		8400	4000K	64	8431	132
		8400	5000K	64	8756	137
		10,900	3000K	84	10,481	125
		10,900	3500K	84	10,828	129
		10,900	4000K	84	10,928	130
		10,900	5000K	84	10,928	130

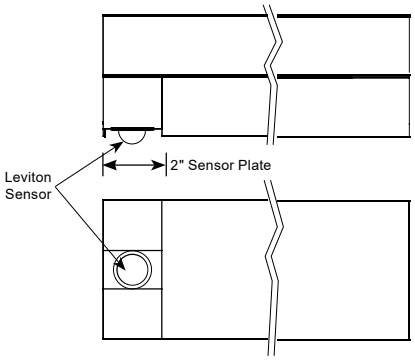
Actual wattage may differ by +/- 5% when operating between 120V-277V +/- 10%.

PHOTOMETRICS:

All photometric reports are available at www.mercltg.com.

CROSS SECTIONS:







Detail

MERCURY LIGHTING PRODUCTS CO. INC.

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Fax: 973.244.9522 • www.mercltg.com

SPECIFICATIONS SUBJECT TO CHANGE, CONSULT FACTORY WHEN CRITICAL.

03/23



LR5 SERIES

Architectural Recessed 2X2 LED Volume Luminaire

Fixture Type: _____

Job Information: _____

_____

_____

SPECIFICATIONS:

LED MODULES:

- High performance linear configured LED module boards.
- Each board consists of multiple mid-power, high efficacy LEDs in a precise layout eliminating the need for supplemental heat sinking.
- The boards produce an even and diffuse light which maximizes optical efficiency.
- Compatible with the dimming performance of the LED driver.
- Color temperatures available: 3000K, 3500K and 4000K.
- Upon request: 5000K.

LED DRIVERS:

- Factory programmable constant current LED power supply.
- Multiple standard drive current outputs (factory set by Mercury) are cataloged with their corresponding lumen package offerings. Upon request, custom drive current outputs and lumen packages are available.
- Note: Certain cataloged lumen packages may be provided with a non-programmable constant current LED power supply at Mercury's discretion. Contact factory if critical.
- Universal voltage input, 120V-277V, 50HZ-60HZ.
- Specification grade dimming down to 1% on 0-10V dimming controls.

LED LUMEN PACKAGES:

- Cataloged standard lumen packages. See attached chart for full details.
- Custom lumen packages pre-set are optional with programmable drivers only. Contact factory for details.

HOUSINGS:

- All metal parts are fabricated in a computer-controlled operation from heavy gauge code grade cold rolled steel.
- Rivets hold all parts together for strength and unity.
- A custom formulated non-glare white powder coating is applied to the housing after fabrication providing a reflectivity of at least 90%.

DIFFUSER:

- Architecturally squared-shape profile design.
- Extruded from custom formulated high transmission acrylic material.
- Linear ribbing for high LED performance.

STANDBY LIGHTING OPTION:

- Self contained module, 5W, 7W, 10W or 12W as specified. Battery backup upon loss of power.
- May not be available with some higher lumen packages. See Lumen package matrix.

INSTALLATIONS:

- Designed for installation into NEMA Type G lay-in acoustical grid ceiling systems, 1" grid or 9/16" fine-line grid.
- For NEMA Type F dry wall applications an additional flange kit must be used with Type G housing.
- Four pry-out style grid support clips are located on the housing sides.
- Four auxiliary suspension points are also provided for securing to building structure.
- A quick wiring access plate is located on back of the housing. Additional knockouts provided.
- Factory installed power whips as specified.

CERTIFICATE OF SAFETY COMPLIANCE AND LISTINGS:

- Luminaire: UL and CUL listed 1598 and bears their label. Suitable for damp locations.
- IC rated. (Some higher lumen packages may not qualify. See Lumen Package matrix).

WARRANTY:

- 5-year limited warranty is standard. Special 10-year warranty available on a job-to-job basis. Complete LED warranty terms available at www.mercltg.com.
- Actual performance may differ as a result of end-user environment and application.
- Most LED luminaires are suitable to operate in ambient temperatures from -20C (-4F) to 25C (77F).
- The following exclusions apply: Luminaires with optional standby lighting option, integral lighting controls options, or wireless control options. Consult factory.
- LM-79 testing was measured under a controlled 25C (77F) ambient operating temperature.

FEATURES:

- Shallow recessed 2X2 ambient LED luminaire featuring a single linear high transmission acrylic diffuser.
- Architecturally-squared shape diffuser envelopes the LED light source allowing maximum light transmission while eliminating pixilations and hot spots.
- Delivers a balanced amount of horizontal and vertical illumination.
- Digital LED technology provides high efficacy and energy efficiency.
- Multiple power and light levels are offered as standard to allow meeting design and energy needs per application. Custom factory set levels available on request.
- Lumen maintenance; Reported L70 (hours) & L80 (hours) > 60,000.
- CRI greater than 80.
- Fixture lumens per watt ratios up to 119.
- American Made.
- Matching surface luminaire: LW5 Series.

DELIVERING UP TO 119 LUMENS PER WATT

MERCURY LIGHTING PRODUCTS CO. INC.

20 Audrey Place • Fairfield, NJ 07004 • Tel: 800.637.2584 • Fax: 973.244.9522
www.mercltg.com

LR5 SERIES

Fixture Type: _____ **Job Information:** _____

LR5	22G				UNI		

Example: LR5-22G-3400-35K-1%-UNI-EM7

SERIES	MODULE SIZE/CEILING	NOMINAL LUMENS	COLOR TEMP	DRIVER	VOLTAGE	STANDBY LIGHTING OPTIONS	OPTIONS
LR5	22G 2X2 Module/ Nema Type G/Lay-In Grid,1" or 9/16" Fine Line.	2300 2600 3000 3400 3800 4300 4700 XXXX Custom Lumen Package. Contact Factory.	30K 35K 40K 50K Upon Request	1% 0-10V 1% Dimming —— As Specified	UNI	EM5 EM7 EM10 EM12	FLX 6Ft. Single Circuit Power Flex (Specify Voltage) FLX2 6Ft. 2-Circuit Power Flex (Specify Voltage)

LUMEN PACKAGE

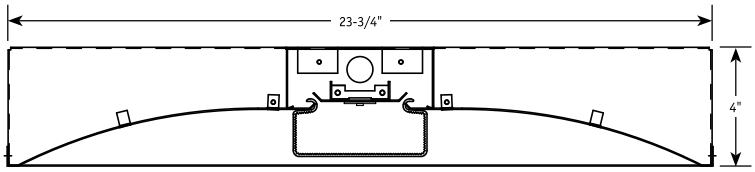
SERIES	MODULE SIZE	Nominal Lumen Package	Color	Fixture Power (W)	Delivered Lumens	Fixture LPW	IC Rated	Standby Lighting Option
LR5	2X2							
		2300	3000K	20	2201	110	✔	✔
		2300	3500K	20	2236	112	✔	✔
		2300	4000K	20	2305	116	✔	✔
		2300	5000K	20	2374	119	✔	✔
		2600	3000K	23	2488	107	✔	✔
		2600	3500K	23	2527	109	✔	✔
		2600	4000K	23	2605	112	✔	✔
		2600	5000K	23	2683	116	✔	✔
		3000	3000K	26	2892	110	✔	✔
		3000	3500K	26	2937	112	✔	✔
		3000	4000K	26	3028	115	✔	✔
		3000	5000K	26	3119	119	✔	✔
		3400	3000K	31	3286	106	✔	✔
		3400	3500K	31	3338	108	✔	✔
		3400	4000K	31	3441	111	✔	✔
		3400	5000K	31	3544	115	✔	✔
		3800	3000K	35	3664	103	✔	✔
		3800	3500K	35	3721	105	✔	✔
		3800	4000K	35	3836	108	✔	✔
		3800	5000K	35	3951	111	✔	✔
		4300	3000K	40	4166	104	–	✔
		4300	3500K	40	4232	106	–	✔
		4300	4000K	40	4363	109	–	✔
		4300	5000K	40	4494	112	–	✔
		4700	3000K	45	4521	100	–	✔
		4700	3500K	45	4592	102	–	✔
		4700	4000K	45	4734	105	–	✔
		4700	5000K	45	4876	108	–	✔

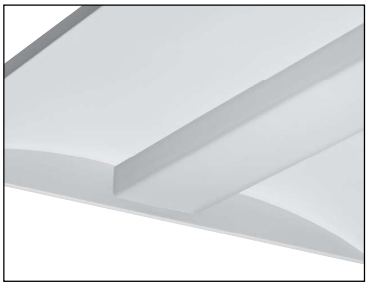
Actual wattage may differ by +/- 5% when operating between 120V-277V +/- 10%.

PHOTOMETRICS:

All photometric reports are available at www.mercltg.com.

CROSS SECTIONS:





Detail

MERCURY LIGHTING PRODUCTS CO. INC.

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www.mercltg.com

SPECIFICATIONS SUBJECT TO CHANGE, **05/18**
CONSULT FACTORY WHEN CRITICAL.

Docusign Envelope ID: 37D6996E-9788-4CCD-AC87-6F1095B8D128

Linear wall luminaire · Opal glass

BEGA

Type:
BEGA Product:
Project:
Modified:

Application
Wall luminaires for a host of applications – arranged individually or in groups. The luminaires can be installed in a horizontal or vertical position.

Materials
Hand-blown three-ply opal glass
Aluminum housing

NRTL listed to North American Standards, for interior use only

Weight: 4.9 lbs.

Electrical

Operating voltage	120-277V AC
Minimum start temperature	-30° C
LED module wattage	13.6 W
System wattage	20.0 W
Controllability	0-10V dimmable
Color rendering index	Ra > 90
Luminaire lumens	1210 lm
LED service life (L70)	60000 hrs

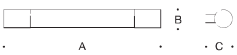
LED color temperature
- ☐ 4000K (K4)
- ○ 3500K (K35)
- ○ 3000K (K3)
- ○ 2700K (K27)

BEGA can supply you with suitable LED replacement modules for up to 20 years after the purchase of LED luminaires - see website for details

Finish
Select the desired material finish by using appropriate code number as suffix.

Available colors
- ☐ White (.1)
- ○ Chrome (.3)
- ○ Stainless steel (.2)

Included (available for pre-shipment)
- ☐ B19537 Narrow opening wiring box





Linear wall luminaire · Opal glass

	LED	A	B	C
B23256	13.6 W	27 1/2	2 3/4	4 1/8

BEGA 1000 BEGA Way, Carpinteria, CA 93013 (805) 684-0533 info@bega-us.com

Due to the dynamic nature of lighting products and the associated technologies, luminaire data on this sheet is subject to change at the discretion of BEGA North America. For the most current technical data, please refer to bega-us.com
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Updated 01/24/24

Docusign Envelope ID: 37D6996E-9788-4CCD-AC87-6F1095B8D128

GD2AS

2" Gravity Square LED Adjustable

JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

ELECTRICAL DATA

LED Light Engine	Nominal Delivered Lumens*	System Wattage**
L1	700lm @ 3000K / 82CRI	10 Watts
L2	1000lm @ 3000K / 82CRI	15 Watts
L3	1200lm @ 3000K / 82CRI	20 Watts

* Delivered Lumens will vary depending on CCT, CRI, optic and reflector finish.
** System Wattage includes driver and LED Module consumption.

FEATURES

- Field changeable 16° to 60° Optics
- Integral field changeable accessory holder
- Toolless adjustability with 360° of rotation in 90° increments & 45° of tilt
- In-field adjustable module height accommodates ½" to 1-¼" ceiling thickness

LED LIGHT ENGINE

- 10W, 15W & 20W
- 16° to 60° Optics: 2 SDCM, 82/92CRI in 2700K, 3000K, 3500K & 4000K
- Rated life of >50,000 hours L70 based on LED testing per LM-80-08 and projected values using IESNA TM21-11

OPTICS

- Field changeable 16° Spot, 24° Narrow Flood, 36° Flood, 48° Wide Flood and 60° Very Wide Flood
- Accepts (2) field changeable filter media

ELECTRICAL SYSTEM

- 120V/277V input; Power factor >.9, 50/60Hz
- This product complies with IEEE C62.41 for surge endurance up to 2.5KV. Additional surge protection recommended. Damage from power surge is not covered by warranty.

HOUSING

- Heavy duty black powder coated 18 gauge steel frame
- Accommodates ½" to 1-¼" Ceilings
- Integral driver compartment with below ceiling access

EMERGENCY BACKUP

- Remote test switch included. External Battery operates LED load @ 725 nominal delivered Lumens. Servicing requires above ceiling access.
- Available with IC and AIC housings only.

INSTALLATION

- IC and Non-IC Rated housing types, must specify. (Remodel housings are Non-IC only) Non-IC rated housings must be kept at a minimum of 3" away from insulation
- Remodel housings requres 5-½" of plenum space for installtion and serviceing.
- Adjustable (10-¾" to 25") joist/ grid ceiling bar hangers included (Hanger bars does not allow for height adjustments)

REFLECTOR

- Specification grade 1.0mm spun aluminum reflector
- Shallow cone for maximum flexibility and 45° of adjustability
- Reflector available in black, white or haze finishes (Consult factory for other finishes)
- Architectural, discrete polished self flange (**Note:** Not available with trimless trims)

DIMMING

- Phase dimming, Forward 1% & Reversed 5% (120V only)
- 0-10V 1% Dimming 1%
- EldoLED SOLOdrive 0-10V 0.1%
- EldoLED ECOdrive 0-10V 1%
- Lutron® LDE1 Hi-Lume 1% EcoSystem LED driver with Soft-on, Fade-to-Black dimming technology

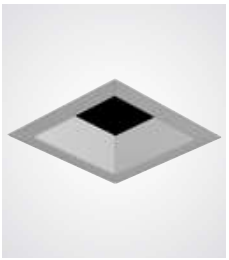
REMOTE BOX

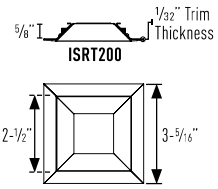
- Remote box included when required by specification (eldoLED or Lutron dimming option). Available with IC and AIC housings only.
- Above ceiling access required for servicing
- Galvanized steel construction with separate line voltage and low voltage wiring compartments
- 50ft remote distance maximum

LISTING / WARRANTY

- 5-Year Intense LED Limited Warranty
- ETL Listed to US and Canadian standards for damp locations
- (-IC / -AIC Only) ETL listed for direct contact w/insulation
- (-AIC Only) Air-Tight Certified ASTM E283.
- (-AIC Only) Can be used to comply with Title 24, Part 6, JA8 high efficacy LED light source requirements

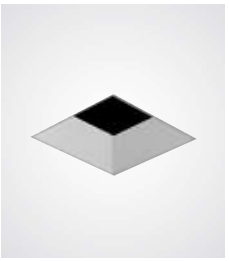
Trimmed Reflectors

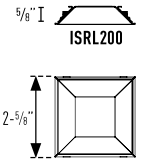




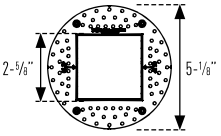
Ceiling Cutout: 2-⅞"

Trimless Reflectors





Ceiling Cutout: 2-⅞"



Trimless Mud Flanged: Perforated collar for seamless and trimless mounting. Must be ordered separately and can only be used in conjunction with trimless trims.

Available Trim Finishes



Housing Part Number: (Example: GD2ASNCL1279DIMSP)

Housing	Installation Type	Wattage	CCT / CRI	Dimming	Voltage	Optic	Options
GD2AS	**NC** (New Cons Non-IC)	**L1** (10W)	**27** (2700K / 82CRI)	**DIM**[2] (Phase Dimming)	blank (120V)	**SP** (16° SP)	**EM**[1,3,5] (7W Emergency Backup IOTA part #ILB-CP07-A)
	NIC[1] (New Cons IC-Rated)	**L2** (15W)	**279** (2700K / 92CRI)	**D101** (0-10V Dimming 1%)	**27** (277V)	**NF** (24° NFL)	
	NAIC[1] (New Cons Air-Tight IC)	**L3** (20W)	**30** (3000K / 82CRI)	**ED10V1**[1,3] (eldoLED 0-10V 1%)		**FL** (36° FL)	
	RC (Remodel Non-IC)		**309** (3000K / 92CRI)	**ED10V01**[1,3] (eldoLED 0-10V 0.1%)		**WF** (48° WFL)	
			35 (3500K / 82CRI)	**LUT**[1,3] (Lutron® LDE1 EcoSystem 1%)		**VF** (60° VFL)	
			359 (3500K / 92CRI)				
			40 (4000K / 82CRI)				
			409 (4000K / 92CRI)				

Reflector Part Number: (Example: ISRT200W-SF)

Reflector	Reflector Finish	Trim
ISRT200 (5/8" Regress Trim)	**W** (White)	**-SF** (Self Flanged)
ISRL200[5] (5/8" Regress Trimless)	**B**[6] (Black)	blank[5] (Trimless)
	HZ (Haze)	

Optional Accessory

GD2S-MR[5] Square Trimless Mud Ring

Filter Media

PFL2-45 Hex Louver
PFL4-45 Soft Focus Film
PFL-LS-45 Linear Spread

Notes:
1. Not available with L3
2. Available in 120V only
3. Remote driver box required for eldoLED, Lutron and EM back up. Compatible with IC and AIC rated housings only.
4. Emergency backup available with IC and AIC housings only
5. Trimless options are for use with mud ring accessory only
6. Consult factory for lead times

GRAVITY LJM-0906-23 P-7

Intense Lighting
3340 E La Palma Ave, Anaheim, CA 92806 | tel 714 630-9877 | fax 714 630-9883
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intense LIGHTING | a LEVITON company

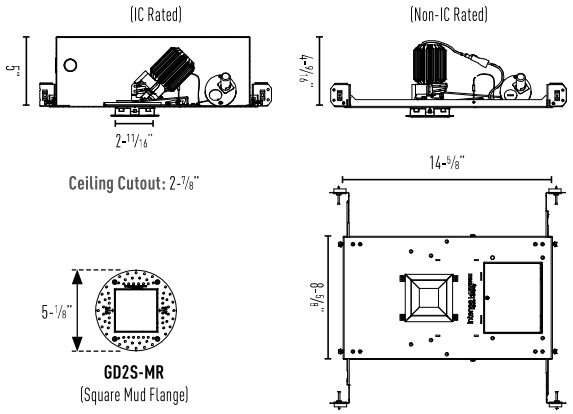
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GD2AS

2" Gravity Square LED Adjustable

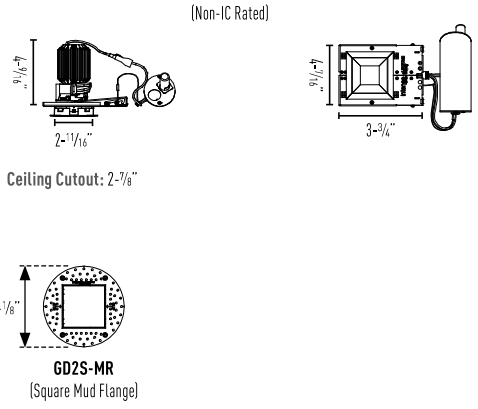
JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

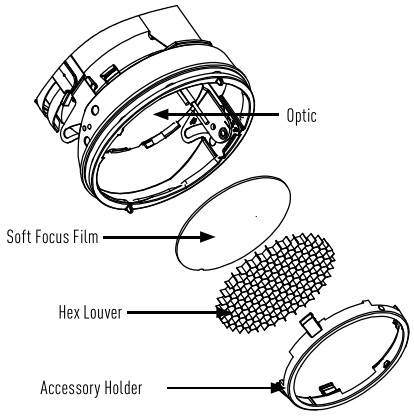
New Construction Dimension (IC & Non-IC):



Remodel Dimension (Non-IC):

Remodel housings requres 5-½" of plenum space for installtion and serviceing.



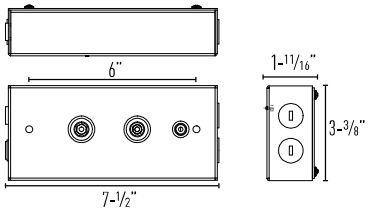


Optics

- ☐ **IP-OP45SP** (16° Spot)
- ☐ **IP-OP45NF** (24° Narrow Flood)
- ☐ **IP-OP45FL** (36° Flood)
- ☐ **IP-OP45WF** (48° Wide Flood
- ☐ **IP-OP45VF** (60° Very Wide Flood)

Accessories

- ☐ **PFL2-45** Hex Louver
- ☐ **PFL4-45** Soft Focus Film
- ☐ **PFL-LS-45** Linear Spread



Remote Mounted Driver

(For use with IC/AIC housings with eldoLED or Lutron dimming option)

- Remote box included when required by specification (eldoLED or Lutron dimming option). Available with IC and AIC housings only.
- Above ceiling access required for servicing
- Galvanized steel construction with separate line voltage and low voltage wiring compartments
- 50ft remote distance maximum

Remote Driver Box For Dimming Options

eldoLED 0-10V 1%
eldoLED 0-10V 0.1%
Lutron® LDE1 EcoSystem 1%
Lutron® LTEA2W 2-Wire 1%

Note: Wires for class 2 LED driver require a minimum of 18 awg wire at a maximum of 50 feet length per local and national electrical regulations.

Intense Lighting
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GD2AS

2" Gravity Square LED Adjustable

JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

ISRT200WL3

Report #: ILL-20190114-1 (16)
ILL-20190114-1 (24)
ILL-20190114-1 (36)
ILL-20190114-1 (48)
ILL-20190114-1 (60)

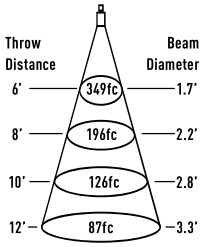
LED PACKAGE MULTIPLIERS:
ISRT200WL1 (x 0.58)
ISRT200WL2 (x 0.82)

ISRT200 (5/8" REGRESS)
Trim Multiplier (x 0.99)

CCT MULTIPLIERS:

	82CRI	92CRI
2700K	(x 0.93)	(x 0.76)
3000K	(x 1.00)	(x 0.87)
3500K	(x 1.00)	(x 0.87)
4000K	(x 1.00)	(x 0.87)

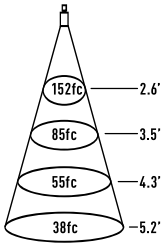
16° Spot



Watts: 20 **LPW:** 67
Lumens: 1346 **CCT:** 3000K

Intensity	
Degree	**CBCP**
0°	12563
5°	10964
15°	1301
25°	133
35°	30
45°	11

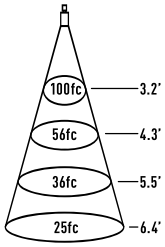
24° Narrow Flood



Watts: 20 **LPW:** 62
Lumens: 1245 **CCT:** 3000K

Intensity	
Degree	**CBCP**
0°	5468
5°	4777
15°	1939
25°	429
35°	82
45°	17

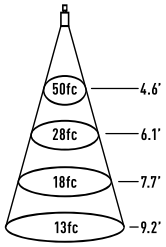
36° Flood



Watts: 20 **LPW:** 59
Lumens: 1190 **CCT:** 3000K

Intensity	
Degree	**CBCP**
0°	3611
5°	3352
15°	1803
25°	556
35°	144
45°	28

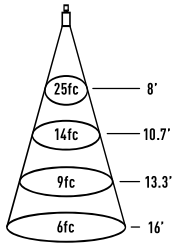
48° Wide Flood



Watts: 20 **LPW:** 54
Lumens: 1080 **CCT:** 3000K

Intensity	
Degree	**CBCP**
0°	1801
5°	1727
15°	1273
25°	658
35°	275
45°	79

60° Very Wide Flood



Watts: 20 **LPW:** 49
Lumens: 993 **CCT:** 3000K

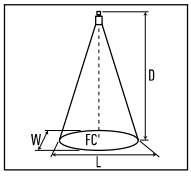
Intensity	
Degree	**CBCP**
0°	908
5°	894
15°	822
25°	643
35°	420
45°	164

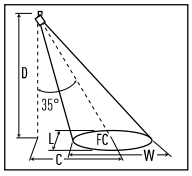
APPLICATION DATA:

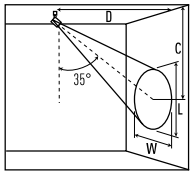
W and **L** are the outer points where the candle power drops to 50% of maximum. **FC** are the initial foot candles at the center of the beam.

W: Beam width
L: Beam length
C: Distance to center of beam
D: Distance
FC: Foot-candles

Illuminated width & length are based upon point at which illuminance falls to 50% of center illuminance. Recommended spacing is based upon uniform illuminance aiming angle is the angle between the lamp axis and the perpendicular to the illuminated plane.







	0° HORIZONTAL				35° HORIZONTAL					35° VERTICAL				
	D	FC	W	L	D	C	FC	W	L	D	C	FC	W	L
ISRT200WL2WL3 3000K 16° Spot	6'	349	1.7	1.7	6'	4.2	192	2.6	2.1	3'	4.3	263	1.5	2.8
	8'	196	2.2	2.2	8'	5.6	108	3.5	2.9	4'	5.7	148	2	3.7
	10'	126	2.8	2.8	10'	7	69	4.4	3.6	5'	7.1	95	2.5	4.6
	12'	87	3.3	3.3	12'	8.4	48	5.3	4.3	6'	8.6	66	3.1	5.5
ISRT200WL2WL3 3000K 24° Narrow Flood	6'	152	2.6	2.6	6'	4.2	83	3.9	3.2	3'	4.3	115	2.3	4.3
	8'	85	3.5	3.5	8'	5.6	47	5.2	4.2	4'	5.7	64	3	5.8
	10'	55	4.3	4.3	10'	7	30	6.5	5.3	5'	7.1	41	3.8	7.2
	12'	38	5.2	5.2	12'	8.4	21	7.8	6.3	6'	8.6	29	4.5	8.6
ISRT200WL2WL3 3000K 36° Flood	6'	100	3.2	3.2	6'	4.2	55	5	4	3'	4.3	75.7	2.8	5.7
	8'	56	4.3	4.3	8'	5.6	31	6.6	5.3	4'	5.7	42.6	3.8	7.6
	10'	36	5.5	5.5	10'	7	20	8.3	6.6	5'	7.1	27.3	4.7	9.5
	12'	25	6.4	6.4	12'	8.4	14	10	7.9	6'	8.6	19	5.6	11.4
ISRT200WL2WL3 3000K 48° Wide Flood	6'	50	4.6	4.6	6'	4.2	28	7.3	5.6	3'	4.3	38	4	9.8
	8'	28	6.1	6.1	8'	5.6	15	9.7	7.5	4'	5.7	21	5.3	13.1
	10'	18	7.7	7.7	10'	7	10	12.2	9.4	5'	7.1	14	6.7	16.3
	12'	13	9.2	9.2	12'	8.4	7	14.6	11.2	6'	8.6	9	8	19.6
ISRT200WL2WL3 3000K 60° Very Wide Flood	6'	25	8	8	6'	4.2	14	15.2	9.8	3'	4.3	19	7	122
	8'	14	10.7	10.7	8'	5.6	8	20.2	13	4'	5.7	10.7	9.3	162
	10'	9	13.3	13.3	10'	7	5	25.3	16.3	5'	7.1	6.9	11.6	203
	12'	6	16	16	12'	8.4	3	30.3	19.5	6'	8.6	4.8	14	244

Intense Lighting
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LITHONIA LIGHTING®

Catalog Number	~~"x" - finish per Architect~~
Notes	~~EXIT SIGN~~
Type	

Signature®

Edge-Lit Exits

LRP

LED LAMPS



FEATURES & SPECIFICATIONS

INTENDED USE — Suitable for architectural applications where aesthetics and superior performance are required.

CONSTRUCTION — High-polish, injection-molded virgin acrylic panel, ultrasonically welded to eliminate visible hardware. Graduated depth of molded letters provides uniform light distribution on graphics. Standard housing finish is brushed aluminum.

Precision-molded, textured letters – 6" high with 3/4" stroke, with 100 ft viewing distance rating, based upon UL924 standard. Chevron indicator direction must be specified.

Recessed rough-in section constructed of 20-gauge, die-formed galvanized steel. Extruded aluminum housing trim mounts flush onto wall or ceiling.

Mounting canopy for top mount is constructed of extruded aluminum housing to match housing finish.

OPTICS — LEDs mounted on printed circuit board. The typical life of the exit LED lamp is 5 years, based on 24/7 operation.

Low energy consumption – EL N operation: only 2.3W for 120V single-face red sign; 1.7W for 120V single-face green sign. Non-emergency operation: only 1.5W for 120V single-face red sign; 1.2W for 120V single-face green sign.

ELECTRICAL — Dual voltage input capability (120/277V).

Sealed, maintenance-free nickel cadmium battery delivers 90 minutes capacity to lamp. Constant-current series charger, 24-hour recharge after 90-minute discharge.

Polarized battery connector simplifies installation and maintenance; prevents charger damage due to improper connection.

INSTALLATION — Recessed mount – rough-in section for back, ceiling or end mounting. Fits into minimum wall or ceiling opening 13-5/8" L x 4-1/2" W x 3-1/8" D.

Adjustable T-bar hangers adapt mounting tray for mounting in suspended ceilings or variable-size framed openings. Trim ring has 3/4" variable depth adjustment to ensure flush fit against surface of wall or ceiling.

Plug-in wire connections and self-captive mounting screws for mounting panel/trim to rough-in section.

Top Mount (TM) – low-profile mounting canopy attaches exit to J-box. No rough-in section required.

LISTINGS — UL listed. Non-IC recessed mounting. Meets UL 924, NFPA 101 (current Life Safety Code), NEC, FCC Title 47, Part 15, Subpart B and OSHA illumination standards, and State of Minnesota requirements for less than 20W energy consumption.

WARRANTY — 5-year limited warranty, including lamp (Battery is pro-rated). This is the only warranty provided and no other statements in this specification sheet create any warranty of any kind. All other express and implied warranties are disclaimed. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

NOTE: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

ORDERING INFORMATION

For shortest lead times, configure products using **bolded options.**

Example: LRP 1 RMR LA 120/277 EL N

LRP											
Family	**Housing color**		**Number of faces**		**Letters/background**		**Directional indicators**[2]		**Input voltage**	
LRP	LED	**(blank)**	Brushed aluminum	**1**	Single face	RW	Red on white	**(blank)**	None	**120/277**	Dual voltage
		W	White	**2**	Double face	**RC**	Red on clear (single face only)	**LA**	Left[3]		
		B	Black			**RMR**	Red on mirror (simulates mirrored background for double-face exits)	**RA**	Right[3]		
		BZ	Bronze			GW	Green on white	**LRA**	Left and right		
		BS	Polished Brass[1]			**GC**	Green on clear (single face only)	**DA**	Double face[4]		
		U	Unfinished			**GMR**	Green on mirror (simulates mirrored background for double-face exits)				

Emergency operation		**Mounting**		**Item type**		**Options**[7]	
(blank)	AC only	**(blank)**	Ceiling or back mount	**(blank)**	Complete exit panel and rough-in section[7]	FI	Fire alarm interface[8]
EL N	Nickel cadmium battery	EM	Recessed end mount	**PNL**	Panel assembly only	F	Flashing emergency operation (one flash/second)[8,9]
X2	Lamp boards wired on two separate circuits (specify 120V or 277V)[5]	TM	Top mount[6]				

Accessories: *Order as separate items.*

ELA R LRIS 120/277 EL N	Single-face, red LED emergency rough-in section [7,10]
ELA G LRIS 120/277 EL N	Single-face, green LED emergency rough-in section [7,10]
ELA R 2LRIS 120/277 EL N	Double-face, red LED emergency rough-in section [7,10]
ELA G 2LRIS 120/277 EL N	Double-face, green LED emergency rough-in section [7,10]
ELA LCRIS	LED rough-in section (supplied standard with recessed exit unless PNL suffix is specified; order ELA LCRIS only if needed for early installation). Available AC only with no options. [10]
ELA LRIS 277 X2	LED rough-in section (supplied standard with recessed exit unless PNL suffix is specified; order ELA LRIS 277 X2 only if needed for early installation). [7,10]
ELA LRIS 120 X2	LED rough-in section (supplied standard with recessed exit unless PNL suffix is specified; order ELA LRIS 120 X2 only if needed for early installation). [7,10]
ELA US12	12" pendant-mount kit (Top mount exits only). Mounting canopy is brushed aluminum. To order white or black canopy, add W or B to catalog number. Example: ELA W US12. To order 24" or 36" lengths, add 24 or 36 to catalog number. Example: ELA US24. See spec sheet ELA-StemKits.

Notes

1 Not available with EM option.
2 See chart on back for more information.
3 Only available with single face.
4 Only available with double face.
5 Not available with top mount exits (TM) or EL N operation.
6 No Rough-In section required. Attaches directly to J-box. Only available with AC operation.
7 When ordering recessed rough-in separately, all options must be included with rough-in nomenclature. Example: ELA LRIS 277 X2 F.
8 Choice of F or FI, not available with both. Not available with top mount exits.
9 Must select EL N option.
10 Rough-in supplied standard with exit unless PNL suffix is specified. Order separately only if needed for early installation.

Docusign Envelope ID: 37D6996E-9788-4CCD-AC87-6F1095B8D128

LRP Signature® LED Exit Signs

SPECIFICATIONS

ELECTRICAL EMERGENCY

Primary Circuit

Type	Typical LED life[1]	Supply voltage	Number of faces	Input watts	Max. amps
Red	>5 years	120	1	2.3	.093
		277	1	2.7	.095
Red	>5 years	120	2	3.2	.084
		277	2	3.9	.094
Green	>5 years	120	1	1.7	.07
		277	1	1.9	.07
Green	>5 years	120	2	3.7	.14
		277	2	3.8	.14

ELECTRICAL AC ONLY

Primary Circuit

Type	Typical LED life[1]	Supply voltage	Number of faces	Input watts	Max. amps
Red	>5 years	120	1	1.5	.087
		277	1	1.8	.089
		347	1	2.2	.107
Red	>5 years	120	2	3.1	.178
		277	2	3.4	.180
		347	2	4.1	.220
Green	>5 years	120	1	1.2	.064
		277	1	1.3	.062
Green	>5 years	120	2	2.0	.06
		277	2	2.3	.06

BATTERY

Sealed Nickel-Cadmium (4.8V)

Typical shelf life [2]	Typical life [2]	Maintenance[3]	Temperature range [4]
3 yrs.	6-8 yrs.	none	32°–100°F (0°-38°C)

Notes

1 Based on 24/7 operation. The typical life of the exit LED lamp is 5 years.

2 At 77°F (25°C).

3 All life safety equipment, including emergency lighting for path of egress must be maintained, serviced, and tested in accordance with all National Fire Protection Association (NFPA) and local codes. Failure to perform the required maintenance, service, or testing could jeopardize the safety of occupants and will void all warranties.

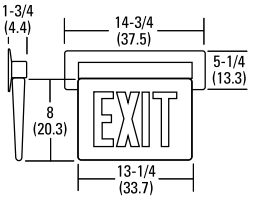
4 Temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity.

MOUNTING

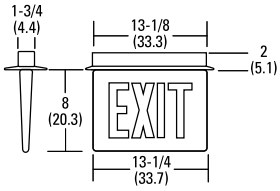
All dimensions are in inches (centimeters).

Shipping weight for panel: 5 lbs. (2.3 kgs.)

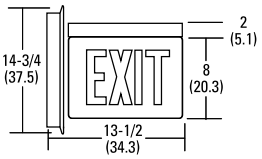
Shipping weight for rough-in section: 5.8 lbs. (2.6 kgs.)



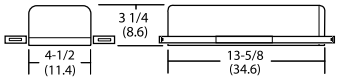
Back Mount (recessed)



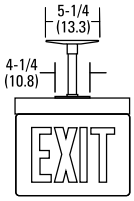
Ceiling Mount (recessed)



End Mount (recessed)



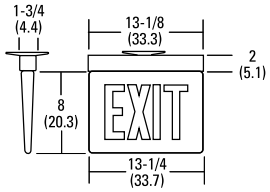
Rough -In Section



With Pendant Mounting kit (TM mounting only)

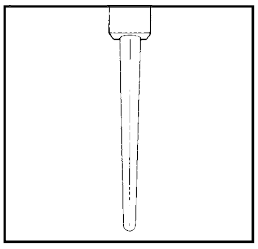
Directional Indicators

Specification (add to catalog number)	Graphics Back	Graphics Front
LA		
RA		
LRA (single face)		
DA		
LRA (double face)		

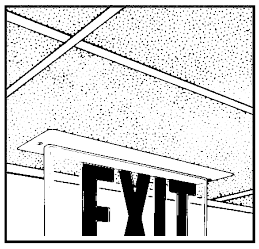


Top Mount (AC only operation)

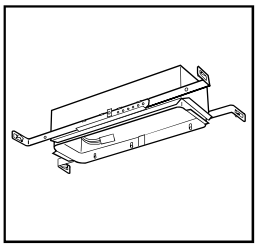
KEY FEATURES



Unique wedge-shaped panel design concentrates light for uniform letter illumination.



Trim fits flush against wall or ceiling for clean, attractive appearance.



Small rough-in section.

Emergency operation: contains battery and charger board.

Non-emergency: rough-in section is empty.

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Certificate Of Completion

Envelope Id: 37D6996E-9788-4CCD-AC87-6F1095B8D128
Status: Completed
Subject: Complete with Docusign: (SBAY) HOJ Court Tenant Improvements Project Agreement
Source Envelope:
Document Pages: 1189
Signatures: 1
Envelope Originator:
Certificate Pages: 4
Initials: 0
Roxanne Maquinana
AutoNav: Enabled
rmaquinana@smcgov.org
EnvelopeId Stamping: Enabled
IP Address: 136.226.78.203
Time Zone: (UTC-08:00) Pacific Time (US & Canada)

Record Tracking

Status: Original
2/10/2026 8:45:10 AM
Holder: Roxanne Maquinana
rmaquinana@smcgov.org
Location: DocuSign
Security Appliance Status: Connected
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Signer Events	Signature	Timestamp
Al Matin ALMATIN@sbayconstruction.com Presidnt Security Level: Email, Account Authentication (None)	DocuSigned by: Al Matin F56200C4AF5144D... Signature Adoption: Pre-selected Style Using IP Address: 173.13.150.165	Sent: 2/10/2026 8:46:55 AM Resent: 2/12/2026 8:29:05 AM Viewed: 2/13/2026 9:44:04 AM Signed: 2/13/2026 11:11:46 AM

Electronic Record and Signature Disclosure:
Accepted: 2/13/2026 9:44:04 AM
ID: 56987ee4-4c64-4583-ace6-1e3fbcc089ee

In Person Signer Events	Signature	Timestamp

Editor Delivery Events	Status	Timestamp

Agent Delivery Events	Status	Timestamp

Intermediary Delivery Events	Status	Timestamp

Certified Delivery Events	Status	Timestamp

Carbon Copy Events	Status	Timestamp

Witness Events	Signature	Timestamp

Notary Events	Signature	Timestamp

Envelope Summary Events	Status	Timestamps
Envelope Sent	Hashed/Encrypted	2/10/2026 8:46:55 AM
Certified Delivered	Security Checked	2/13/2026 9:44:04 AM
Signing Complete	Security Checked	2/13/2026 11:11:46 AM
Completed	Security Checked	2/13/2026 11:11:46 AM

Payment Events	Status	Timestamps

Electronic Record and Signature Disclosure

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