

SONOMA CLEAN POWER
ADVANCED ENERGY CENTER
TENANT IMPROVEMENTS

PROJECT MANUAL

PROJECT
MANUAL

PROJECT ADDRESS

**741 4th Street
Santa Rosa, CA 95401**

OWNER

**Empire Property Services
P.O. Box 455, Santa Rosa, CA 95404**

ISSUED DATE

06/04/2019

ADVERTISEMENT DATE

06/04/2019

BID DATE

06/26/2019

SECTION 00001

TITLE PAGE

TLCD PROJECT NUMBER

18077.00

SECTION 00010

TABLE OF CONTENTS

PROJECT MANUAL

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

INTRODUCTORY INFORMATION

00001	Title Page
00010	Table of Contents

BIDDING REQUIREMENTS

00100	Advertisement for Bids
00200	Instructions to Bidders
00202	Pre-Bid Site Visit Vicinity Map
00203	Bid Submittal Vicinity Map
00210	Indemnity and Release Agreement
00320	Geotechnical Data and Existing Conditions
00335	Hazardous Material Documentation
00400	Bid Form
00411	Bond Accompanying Bid
00430	Subcontractors List
00450	Statement of Qualifications for Construction Work
00451	Bidder Certifications
00481	Noncollusion Declaration
00482	Iran Contracting Act Certification

CONTRACTING REQUIREMENTS

00505	Notice of Intent to Award for Construction
00510	Notice of Award
00520	Agreement
00550	Notice to Proceed
00611	Construction Performance Bond
00612	Construction Labor and Material Payment Bond
00630	Guarantee
00650	Agreement and Release of Any and All Claims
00660	Substitution Request Form
00670	Escrow Bid Documents
00680	Escrow Agreement for Security Deposits in Lieu of Retention

CONDITIONS OF THE CONTRACT

00700	General Conditions
00800	Supplementary Conditions - Insurance and Indemnification
00803	Supplementary Conditions

**TLCD ARCHITECTURE SONOMA CLEAN POWER (SCP) ADVANCED ENERGY CENTER
741 4TH STREET, SANTA ROSA, CA**

00805	Supplementary Conditions - Hazardous Materials
00810	Supplementary Conditions Work by Others
00815	Supplementary Conditions – Apprenticeship Program
00910	Addenda

DIVISION 01 – GENERAL REQUIREMENTS

01100	Summary
01200	Price and Payment Procedures
01250	Modification Procedure
01255	Construction Cost Reduction Incentive
01312	Cloud-Based Project Management Software
01315	Project Meetings
01320	Progress Schedules and Submittals
01330	Submittals
01410	Regulatory Requirements
01420	References and Definitions
01500	Temporary Facilities and Controls
01501	Field Offices
01510	Storm Water Pollution Prevention Plan
01540	Site Security and Safety
01600	Product Requirements
01735	Selective Demolition, Cutting, and Patching
01737	Openings and Penetrations in Construction
01740	Cleaning
01741	Construction Material Waste Management Plan
01750	Starting and Adjusting
01770	Contract Closeout
01810	Commissioning

DIVISION 02 – EXISTING CONDITIONS

02 41 20 Selective Building Demolition

DIVISION 03 – CONCRETE

03 10 00 Concrete Forming and Accessories
03 20 00 Concrete Reinforcing
03 30 00 Cast-in-Place Concrete
03 35 50 Polished Concrete Flooring

DIVISION 04 – MASONRY

04 01 20 Masonry Restoration and Cleaning

DIVISION 05 – METALS

05 11 00 Structural and Miscellaneous Steel
05 50 00 Metal Fabrications

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

06 10 00 Rough Carpentry
06 40 00 Architectural Woodwork
06 80 00 Acrylic Sign Panels

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

07 01 50 Roofing Repairs
07 21 00 Thermal Insulation
07 28 00 Weather Barrier Underlayment
07 60 00 Flashing and Sheet Metal
07 72 00 Roof Hatches
07 90 00 Joint Sealants

DIVISION 08 – OPENINGS

08 11 20 Interior Aluminum Frames
08 14 00 Wood Doors
08 31 00 Access Doors and Panels
08 35 40 Folding, Sliding Aluminum and Glass Walls
08 41 00 Entrances and Storefronts
08 62 10 Tube Skylights
08 71 00 Door Hardware

DIVISION 09 – FINISHES

09 21 00	Gypsum Board Assemblies
09 24 00	Portland Cement Plaster
09 30 00	Tiling
09 51 00	Acoustical Ceilings
09 65 10	Resilient Base
09 65 20	Resilient Tile Flooring
09 68 10	Tile Carpeting
09 77 10	Acoustic Wall Covering
09 77 30	Fiberglass Wall Panels
09 90 00	Painting and Coating

DIVISION 10 – SPECIALTIES

10 14 00	Signage
10 21 10	Metal Toilet Compartments
10 28 00	Toilet Accessories
10 44 00	Fire Extinguisher Cabinets

DIVISION 11 – EQUIPMENT

11 31 00	Residential Appliances
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DIVISION 12 – FURNISHINGS

Not used.

DIVISION 13 – SPECIAL CONSTRUCTION

Not used.

DIVISION 14 – CONVEYING EQUIPMENT

Not used.

DIVISION 21 – FIRE SUPPRESSION

Under separate cover.

DIVISION 22 – PLUMBING

22 01 00	General Requirements
22 50 00	Basic Material and Methods
22 05 19	Instrumentation
22 05 23	Valves
22 05 29	Supports and Anchors
22 05 48	Noise, Vibration, and Seismic Control
22 07 00	Insulation
22 11 00	Plumbing Pipe and Pipe Fittings
22 30 00	Plumbing Systems

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING

23 01 00	General Requirements
23 05 00	Basic Materials and Methods
23 05 13	Motors and Motor Controllers
23 05 29	Support and Anchors
23 05 48	Noise, Vibration and Seismic Control
23 05 93	Tests and Balancing
23 07 00	Insulation
23 31 00	Ductwork
23 34 00	Fans
23 40 00	Air Filters
23 72 13	Air to Air Energy Core Ventilator for Outdoor and Indoor Installation
23 74 16	Small Capacity Packaged Rooftop Air Conditioning Units
23 81 75	Variable Refrigerant Volume System

DIVISION 25 – INTEGRATED AUTOMATION

25 00 00	Control – General Conditions
25 10 00A	Building Management System (BMS)
25 30 00	Building Management Systems – Field Devices

DIVISION 26 – ELECTRICAL

26 01 00	Electrical General Requirements
26 05 19	Low Voltage Electrical Power Conductors and Cables
26 05 26	Grounding and Bonding for Electrical Systems
26 05 29	Supports and Anchors
26 05 33	Conduit Raceway and Boxes for Electrical Systems
26 05 48	Vibration Isolation and Seismic Restraints
26 09 23	Building Lighting Control System
26 24 16	Panelboards
26 27 26	Wiring Devices
26 28 00	Low Voltage Circuit Protection Devices
26 28 16	Motor and Circuit Disconnects
26 50 00	Luminaires and Accessories

DIVISION 27 – COMMUNICATIONS

27 00 00	Basic Communications Requirements
27 05 26	Communications Bonding
27 05 28	Communications Building Pathways
27 05 33	Communications Building Pathways-Conduits and Boxes
27 08 11	Communications Twisted Pair Testing
27 11 00	Communications Equipment Rooms
27 15 13	Communications Horizontal Twisted Pair Cabling
27 41 16	Integrated Audiovisual Systems

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

28 31 00	Fire Detection and Alarm System
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DIVISION 31-35

Not Used

DIVISION 40-48

Not used

END OF SECTION

SECTION 00100

ADVERTISEMENT FOR BIDS

ARTICLE 1 - INVITATION TO BID

- 1.1 NOTICE INVITING BIDS: OWNER WILL RECEIVE SEALED BIDS AT OWNER'S OFFICE, AS SHOWN ON THE MAP PROVIDED IN SECTION 00203 (BID SUBMITTAL VICINITY MAP), UNTIL 2:00 P.M. ON TUESDAY, JUNE, 25, 2019 FOR THE FOLLOWING PUBLIC WORK:

SONOMA CLEAN POWER AUTHORITY

SONOMA CLEAN POWER ADVANCED ENERGY CENTER

- A. Envelope "A" shall be due by 2:00 p.m. according to the clock in Owner's lobby.
B. Envelope "B" shall be due by 3:00 p.m. according to the clock in Owner's lobby.
C. Owner will open Bids at 3:00 p.m. according to the clock in Owner's lobby.
- 1.2 PROJECT DESCRIPTION: THE WORK CONSISTS OF CONSTRUCTION OF TENANT IMPROVEMENTS LOCATED AT 741 4TH STREET IN THE CITY OF SANTA ROSA THE WORK INCLUDES, BUT IS NOT LIMITED TO, DEMOLITION OF EXISTING TENANT IMPROVEMENT ON THE FIRST AND SECOND FLOOR OF APPROXIMATELY 12, 286 SF, AND THE CONSTRUCTION OF NEW TENANT IMPROVEMENTS OF APPROXIMATELY 9,492 SF INCLUDING MECHANICAL ELECTRICAL AND FIRE SPRINKLERS THROUGHOUT. WORK SHALL BE COMPLETED WITHIN 198 CALENDAR DAYS FROM THE DATE WHEN CONTRACT TIME COMMENCES TO RUN. BIDDING DOCUMENTS CONTAIN THE FULL DESCRIPTION OF THE WORK.
- 1.3 ESTIMATED PROJECT COST RANGE: \$2,500,000.00 TO \$2,900,000.00.
- 1.4 CONTACT INFORMATION:
- | | |
|------------------------------|--|
| Mailing address: | Website address: |
| Sonoma Clean Power Authority | www.sonomacleanpower.org |
| 50 Santa Rosa Avenue | |
| Santa Rosa, CA 95404 | |
- Phone: 707-978-3463
Fax: 707-978-3471
Email: Programs@sonomacleanpower.org
- 1.5 PROCUREMENT OF BIDDING DOCUMENTS: BIDDERS MAY OBTAIN BIDDING DOCUMENTS FROM OWNER UPON REGISTRATION AS A PLANHOLDER THROUGH OWNER'S OFFICE AND PAYMENT OF A NON-REFUNDABLE FEE OF

“SONOMA CLEAN POWER AUTHORITY.” BIDDING DOCUMENTS CONTAIN A REDUCED SET OF DRAWINGS. BIDDERS MAY ARRANGE TO OBTAIN FULL-SIZE DRAWINGS FROM DIGITAL PRINTS & IMAGING, 375 TESCONI CIRCLE, SANTA ROSA, CALIFORNIA, 95401, 707-546-0401, FOR AN ADDITIONAL CHARGE TO BE PAID DIRECTLY TO DIGITAL PRINTS & IMAGING. ELECTRONIC BIDDING DOCUMENTS ARE AVAILABLE ON OWNER’S WEBSITE [HTTPS://SONOMACLEANPOWER.ORG/](https://sonomacleanpower.org/). FOR INFORMATION PERTAINING TO THE BIDDING DOCUMENTS, PLEASE CONTACT OWNER AT (707) 978-3463.

- 1.6 **INSTRUCTIONS: BIDDERS SHALL REFER TO SECTION 00200 (INSTRUCTIONS TO BIDDERS) FOR REQUIRED DOCUMENTS AND ITEMS TO BE SUBMITTED IN SEALED ENVELOPES FOR DEPOSIT INTO THE BID BOX, LOCATED AT OWNER’S OFFICE, NO LATER THAN THE TIME(S) AND DATE SET FORTH IN PARAGRAPH 1 ABOVE.**
- 1.7 **OPTIONAL PRE-BID SITE VISIT: OWNER WILL CONDUCT OPTIONAL PRE-BID SITE VISIT(S) AT 2:00 P.M. ON TUESDAY JUNE 11TH, 2019, AND AT 9:00 A.M. ON WEDNESDAY JUNE 12TH 2019, AT THE SITE. IT IS OPTIONAL FOR BIDDERS TO ATTEND ONE PRE-BID SITE VISIT AND SIGN AN ATTENDANCE ROSTER AS A CONDITION TO BIDDING. A THIRD SITE VISIT, DATE AND TIME, CAN BE CREATED IF REQUESTED TO: Programs@sonomacleanpower.org.**
- 1.8 **BID PREPARATION COST: BIDDERS ARE SOLELY RESPONSIBLE FOR THE COST OF PREPARING THEIR BIDS.**
- 1.9 **RESERVATION OF RIGHTS: OWNER SPECIFICALLY RESERVES THE RIGHT, IN ITS SOLE DISCRETION, TO REJECT ANY OR ALL BIDS, TO RE-BID, OR TO WAIVE INCONSEQUENTIAL DEFECTS IN BIDDING NOT INVOLVING TIME, PRICE, OR QUALITY OF THE WORK. OWNER MAY REJECT ANY AND ALL BIDS AND WAIVE ANY MINOR IRREGULARITIES IN THE BIDS.**

ARTICLE 2 - LEGAL REQUIREMENTS

- 2.1 **REQUIRED CONTRACTOR’S LICENSE(S): A CALIFORNIA “A” CONTRACTOR’S LICENSE IS REQUIRED TO BID THIS CONTRACT. JOINT VENTURES MUST SECURE A JOINT VENTURE LICENSE PRIOR TO AWARD OF THIS CONTRACT.**
- 2.2 **BID ALTERNATES: BID ALTERNATES ARE IDENTIFIED IN SECTION 00400 (BID FORM). THE DETERMINATION OF LOWEST BID SHALL BE BASED UPON:**
 - A. Base contract bid and alternates specifically identified on Section 00400 (Bid Form)
- 2.3 **SUBSTITUTION OF SECURITIES: OWNER WILL PERMIT THE SUCCESSFUL BIDDER TO SUBSTITUTE SECURITIES FOR ANY RETENTION MONIES WITHHELD TO ENSURE PERFORMANCE OF THE CONTRACT, AS SET FORTH IN SECTION 00680 (ESCROW AGREEMENT FOR SECURITY DEPOSITS IN LIEU OF RETENTION) AND INCORPORATED HEREIN IN FULL BY THIS REFERENCE, IN ACCORDANCE WITH SECTION 22300 OF THE CALIFORNIA PUBLIC CONTRACT CODE.**

- 2.4 **PREVAILING WAGE LAWS: THIS PROJECT IS SUBJECT TO COMPLIANCE MONITORING AND ENFORCEMENT BY THE DEPARTMENT OF INDUSTRIAL RELATIONS. THE SUCCESSFUL BIDDER MUST COMPLY WITH ALL PREVAILING WAGE LAWS APPLICABLE TO THE PROJECT, AND RELATED REQUIREMENTS CONTAINED IN THE CONTRACT DOCUMENTS. TO BID ON THIS PROJECT, A CONTRACTOR MUST BE REGISTERED TO PERFORM PUBLIC WORK PURSUANT TO LABOR CODE SECTION 1725.5. COPIES OF THE GENERAL PREVAILING RATES OF PER DIEM WAGES FOR EACH CRAFT, CLASSIFICATION, OR TYPE OF WORKER NEEDED TO EXECUTE THE CONTRACT, AS DETERMINED BY DIRECTOR OF THE STATE OF CALIFORNIA DEPARTMENT OF INDUSTRIAL RELATIONS, ARE ON FILE AT OWNER'S OFFICE AND ARE DEEMED INCLUDED IN THE BIDDING DOCUMENTS. UPON REQUEST, OWNER WILL MAKE AVAILABLE COPIES TO ANY INTERESTED PARTY. ALSO, THE SUCCESSFUL BIDDER SHALL POST THE APPLICABLE PREVAILING WAGE RATES AT THE SITE IN ADDITION TO ALL OTHER JOB SITE NOTICES PRESCRIBED BY REGULATIONS.**

By order of the Sonoma Clean Power Authority's Chief Executive Officer acting on behalf of the Sonoma Clean Power Authority.

END OF SECTION

SECTION 00200

INSTRUCTIONS TO BIDDERS

ARTICLE 1 - PROCEDURES FOR SUBMISSION OF BIDS

1.1 OPTIONAL PRE-BID SITE VISIT:

- A. Owner will conduct Pre-Bid Site Visit(s) at the date(s), time(s), and location(s) indicated in Section 00100 (Advertisement for Bids) It is optional for Bidders to attend one Pre-Bid Site Visit and sign an attendance roster as a condition to bidding.
- B. A map showing the meeting place for the Pre-Bid Site Visit(s) is included in Section 00202 (Pre-Bid Site Visit Vicinity Map).
- C. The Pre-Bid Site Visit(s) is (are) merely a showing of the Site and existing conditions and is (are) not an opportunity for Bidders to ask questions. Bidders are encouraged, however, to submit written questions.
- D. The Site Visit may be the Bidders' only opportunity to investigate conditions at the Site. Other Pre-Bid Site Visits may be scheduled at Owner's sole discretion, depending on staff availability.

1.2 REQUIRED PRE-BID INVESTIGATIONS:

- A. Prior to submission of Bid, Bidder must conduct a careful examination of Bidding Documents and understand the nature, extent, and location of Work to be performed. Refer to Section 00700 (General Conditions) on required pre-bid investigations.
- B. Bidders may examine any available existing conditions information (e.g., record documents, specifications, studies, drawings of previous work), as well as applicable environmental assessment information (if any) regarding the Project, by giving Owner reasonable advanced notice. Owner will make copies available for a fee. Documents may also be available on Owner's website. A Bidder must give five Days advanced notice if copies are desired.

1.3 BIDDER QUESTIONS AND ANSWERS:

- A. Bidders must direct questions about the meaning or intent of Bidding Documents to Owner in writing. Interpretations or clarifications considered necessary by Owner in response to such questions will be issued by written Addenda mailed, faxed, emailed, or delivered to all parties recorded by Owner as having received Bidding Documents. Owner may not answer questions received less than ten Days prior to the date for opening Bids.
- B. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect, and Bidders shall not rely on oral statements.

1.4 ADDENDA:

- A. Addenda may also be issued to modify the Bidding Documents as deemed advisable by Owner. Addenda shall be acknowledged by number in Section 00400 (Bid Form) and shall be part of the Contract Documents. A complete listing of Addenda may be secured from Owner.

ARTICLE 2 - RECEIPT OF BIDS

2.1 DATE AND TIME:

- A. Sealed Bids will be received by the Owner until the date(s) and time(s) indicated in Section 00100 (Advertisement for Bids). All Bid envelopes will be time-stamped to reflect their submittal time. Owner shall reject all Bids received after the specified time and will return such Bids to Bidders unopened. Bidders must submit Bids in accordance with this Section 00200.

2.2 TWO ENVELOPE BID SUBMISSION:

- A. Owner will receive Bids in opaque sealed 10 inch x 13 inch envelope, containing the required items described herein.
- B. Bidders must submit Bids in two envelopes: "Envelope A - Bid Submittals" and "Envelope B - Statement of Qualifications."
- C. Bidders should mark their Bid envelopes with the Bidder's DIR registration number, and the [project?] name, address, identifying information, and contract number indicated in Section 00100 (Advertisement for Bids).

2.3 REQUIRED CONTENTS: OF "ENVELOPE A - BID SUBMITTALS:"

- A. Section 00400 (Bid Form). Bidders must submit Bids on Section 00400 (Bid Form) in accordance with the provisions of Section 00400 (Bid Form). Bidders must complete all Bid items and supply all information required by Bid Documents and specifications.
- B. Section 00411 (Bond Accompanying Bid). Bidders must submit Section 00411 (Bond Accompanying Bid) accompanied by a cashier's check, certified check (certified without qualification and drawn on a solvent bank of the State of California or a National Bank doing business in the State of California) or completed form of Section 00411 (Bond Accompanying Bid) of not less than 10% of the base Bid, payable to Owner and completed in accordance with the provisions of Section 00411 (Bond Accompanying Bid).
- C. Section 00430 (Subcontractors List). Bidders must submit Section 00430 (Subcontractors List) completed in accordance with the provisions of Section 00430 (Subcontractors List). The Subcontractors List must include the names of all subcontractors for those subcontractors who will perform any portion of Work, including labor, rendering of service, or specially fabricating and installing a portion of the Work or improvement according to detailed drawings contained in the plans and specifications, in excess of one half of one percent (0.5%) of the total Bid amount. Any violation of this requirement may result in a Bid being deemed non-responsive and not being considered.
- D. Section 00451 (Bidder Certifications). Bidders must submit Section 00451 (Bidder Certification) completed in accordance with the provisions of Section 00451 (Bidder Certification).
- E. Section 00481 (Noncollusion Declaration). Bidders must submit Section 00481 (Noncollusion Declaration) completed in accordance with the provisions of Section 00481 (Noncollusion Declaration).

2.4 REQUIRED CONTENTS OF "ENVELOPE B - STATEMENT OF QUALIFICATIONS:"

- A. Section 00450 (Statement of Qualifications for Construction Work). Bidders must submit Section 00450 (Statement of Qualifications for Construction Work) in accordance with the provisions of Section 00450 (Statement of Qualifications for Construction Work).

ARTICLE 3 - BID OPENING AND EVALUATION

3.1 DETERMINATION OF APPARENT LOW BIDDER:

- A. Owner will open each Bidder's Envelope at the time and place indicated in Section 00100 (Advertisement for Bids), initially evaluate them for responsiveness, and determine an Apparent Low Bidder as specified herein.
- B. Apparent Low Bid will be determined in accordance with Public Contract Code Section 20128. Apparent Low Bid will be determined solely on the total amount of all Bid items based on terms contained in Section 00100 (Advertisement for Bids) and Section 00400 (Bid Form). All Bidders are required to submit Bids on all Bid items (including any alternates).
- C. If Apparent Low Bidder is determined to be non-responsive, then Owner may proceed to the next Apparent Low Bidder's Bid pursuant to any procedures determined in its reasonable discretion and proceed for all purposes as if this Apparent Low Bidder were the original Apparent Low Bidder.

3.2 EVALUATION OF BIDS:

- A. Bids must be full, complete, clearly written, and use the required forms. To make any change to the Bid, Bidders shall cross out the original entry, then enter and initial the new entry. Bidder's failure to submit all required documents strictly as required entitles Owner to reject the Bid as non-responsive. All Bidders must submit Bids containing each of the fully executed documents supplied in this Project Manual.
- B. Owner will open each Bidder's Envelope "B" and evaluate contents for responsiveness to requirements of Section 00450 (Statement of Qualifications for Construction Work) and evidence of responsibility.
- C. In evaluating Bids, Owner will consider Bidders' qualifications, whether or not the Bids comply with the prescribed requirements, unit prices, and other data, as may be requested in Section 00400 (Bid Form) or by Owner prior to the Notice of Award.
- D. Owner may conduct reasonable investigations and reference checks of Bidder and other persons and organizations as Owner deems necessary to assist in the evaluation of any Bid and to establish Bidder's responsibility, qualifications, financial ability and ability to perform the Work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time. Submission of a Bid constitutes Bidder's consent to the foregoing.
- E. Owner shall have the right to consider information provided by sources other than Bidder. Owner shall also have the right to communicate directly with Bidder's surety regarding Bidder's bonds.
- F. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between written words and figures will be resolved in favor of the words.

- G. Owner will notify Apparent Low Bidder in writing of any irregularities or deficiencies found and will provide Bidder the opportunity to respond in writing with reasonable clarifications.
- H. Bids shall be deemed to include the written responses of the Bidder to any questions or requests for information of Owner made as part of Bid evaluation process after submission of Bid.

3.3 RESERVATION OF RIGHTS:

- A. Owner reserves the right to reject any or all nonconforming, non-responsive, unbalanced, or conditional Bids, and to reject the Bid of any Bidder as non-responsive as a result of any error or omission in the Bid, or if Owner believes that it would not be in the best interest of Project to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by Owner. For purposes of this paragraph, an "unbalanced Bid" is one having nominal prices for some Bid items and enhanced prices for other Bid items.
- B. Owner may retain Bid securities and Bid bonds of other than the Apparent Low Bidder for a period of 90 Days after award or until full execution of the Contract, whichever first occurs.
- C. Owner may reject any or all Bids and waive any informalities or minor irregularities in the Bids. Owner also reserves the right, in its discretion, to reject any or all Bids and to re-Bid the Project.
- D. Owner expressly disclaims responsibility for any assumptions a Bidder might draw from the presence or absence of information provided by Owner in any form. Each Bidder is solely responsible for its costs to prepare and submit a Bid, including Site investigation costs.

ARTICLE 4 - NOTICE OF INTENT TO AWARD FOR CONSTRUCTION

- 4.1 **SECTION 00505 (NOTICE OF INTENT TO AWARD FOR CONSTRUCTION) WILL BE POSTED AT OWNER'S OFFICE. OWNER WILL USE REASONABLE EFFORTS TO DELIVER AN ELECTRONIC COPY OF SECTION 00505 (NOTICE OF INTENT TO AWARD FOR CONSTRUCTION) TO ALL BIDDERS WHO SUBMITTED BIDS NO LATER THAN THE BUSINESS DAY AFTER ISSUANCE, ALTHOUGH ANY DELAY OR FAILURE TO DO SO WILL NOT EXTEND THE BID PROTEST DEADLINE DESCRIBED BELOW.**

ARTICLE 5 - MANDATORY BID PROTEST PROCEDURES

5.1 SUBMISSION OF WRITTEN BID PROTEST:

- A. Any Bid protest in connection with the construction contract or work described in general in Section 00100 (Advertisement for Bids) must be submitted in writing and received by Owner (Attention: Contract Administration), before 3:30 p.m. no later than the THIRD (3rd) business day following bid opening.

- B. The initial protest document must contain a complete statement of the basis for the protest and must include all supporting documentation. Material submitted after 3:30 p.m. on the third business day following bid opening will not be considered.
- C. The protest must include the name, address, email address, and telephone number of the person representing the protesting party.
- D. Only Bidders who the Owner otherwise determines are responsive and responsible and could be awarded the Contract if the bid protest is upheld are eligible to protest a Bid; protests from any other Bidder will not be considered. In order to determine whether a protesting Bidder is responsive and responsible, Owner may evaluate all information contained in any protesting Bidder's Bid, and conduct the same investigation and evaluation as Owner is entitled to take regarding an Apparent Low Bidder.
- E. The protest must refer to the specific portions of all documents that form the basis for the protest.
 - 1. Without limitation to any other basis for protest, an inadvertent error in listing the California contractor's license number on the Designated Subcontractors List shall not be grounds for filing a bid protest or grounds for considering the Bid nonresponsive if the correct contractor's license number is submitted to Owner within 24 hours after the bid opening and the corrected number corresponds with the submitted name and location for that subcontractor.
 - 2. Without limitation to any other basis for protest, an inadvertent error listing an unregistered subcontractor shall not be grounds for filing a bid protest or grounds for considering the Bid nonresponsive provided that any of the following apply:
 - a. The subcontractor is registered prior to the bid opening.
 - b. The subcontractor is registered and has paid the penalty registration fee within 24 hours after the bid opening.
 - c. The subcontractor is replaced by another registered subcontractor pursuant to Public Contract Code section 4107.
- F. The party filing the protest must concurrently transmit a copy of the initial protest document and any attached documentation to all other parties with a direct financial interest that may be adversely affected by the outcome of the protest. Such parties shall include all other Bidders who appear to have a reasonable prospect of receiving an award depending upon the outcome of the protest.

5.2 EXCLUSIVE REMEDY:

- A. The procedure and time limits set forth in this Article 5 are mandatory and are Bidder's sole and exclusive remedy in the event of a Bid protest. Bidder's failure to comply with these procedures shall constitute a waiver of any right to further pursue the Bid protest, including filing a Government Code Claim or initiation of legal proceedings. A Bidder may not rely on a protest submitted by another Bidder, but must timely pursue its own protest.

ARTICLE 6 - AWARD AND EXECUTION OF THE CONTRACT

6.1 NOTICE OF AWARD AND SUBMITTAL OF EXECUTED CONTRACT DOCUMENTS:

- A. If Contract is to be awarded, it will be awarded to the lowest responsible responsive Bidder. Owner will issue Section 00510 (Notice of Award). Such award, if made, will be made within 90 Days after the opening of the Bids.

- B. Successful Bidder must execute and submit to Owner the “Required Contract Documents and Proof of Insurance” set forth below, by 5:00 p.m. of the **SEVENTH (7th)** Day following the Notice of Award, except that additional time may be allowed to submit Section 00680 (Escrow Agreement for Security Deposits in Lieu of Retention).

6.2 REQUIRED CONTRACT DOCUMENTS AND PROOF OF INSURANCE:

- A. Section 00520 (Agreement), fully executed by successful Bidder. Submit four originals, each bearing an original signature.
- B. Section 00611 (Construction Performance Bond), fully executed by successful Bidder and surety, in the amount set forth in Section 00611 (Construction Performance Bond). Submit four originals.
- C. Section 00612 (Construction Labor and Material Payment Bond), fully executed by successful Bidder and surety, in the amount set forth in Section 00612 (Construction Labor and Material Payment Bond). Submit four originals.
- D. Section 00630 (Guarantee), fully executed by successful Bidder. Submit four originals, each bearing an original signature.
- E. Documentary information received or generated by successful Bidder in preparation of Bid prices for its Bid, as set forth in Section 00670 (Escrow Bid Documents): Submit one complete set.
- F. Insurance certificates and endorsements required by Section 00800 (Supplementary Conditions – Insurance and Indemnification): Submit one original set.
- G. If Bidder exercises the option to open an Escrow Account, Owner and Contractor shall, at the time the account is opened, deliver to Escrow Agent a fully executed counterpart of Section 00680 (Escrow Agreement for Security Deposits in Lieu of Retention).

6.3 FAILURE TO EXECUTE AND DELIVER DOCUMENTS:

- A. If Bidder to whom Contract is awarded, within the period described in this Section 00200, fails or neglects to execute and deliver all required Contract Documents and file all required bonds, insurance certificates, and other documents, Owner may, in its sole discretion, rescind the award, recover on Bidder’s surety bond, or deposit Bidder’s cashier’s check or certified check for collection, and retain the proceeds thereof as liquidated damages for Bidder’s failure to enter into the Contract Documents. Bidder agrees that calculating the damages Owner may suffer as a result of Bidder’s failure to execute and deliver all required Contract Documents would be extremely difficult and impractical and that the amount of Bidder’s required Bid security shall be the agreed and presumed amount of Owner’s damages.
- B. Upon such failure to timely deliver all required Contract Documents as set forth herein, Owner may determine the next Apparent Low Bidder and proceed accordingly.

ARTICLE 7 - GENERAL CONDITIONS AND REQUIREMENTS

7.1 MODIFICATION OF COMMENCEMENT OF WORK:

- A. Owner expressly reserves the right to modify the date for the Commencement of Work under the Contract and to independently perform and complete work related to Project.

Owner accepts no responsibility to Contractor for any delays attributed to its need to complete independent work at the Site.

- B. Owner shall have the right to communicate directly with Apparent Low Bidder's proposed construction performance bond surety, to confirm the performance bond. Owner may elect to extend the time to receive performance and payment bonds.

7.2 CONFORMED PROJECT MANUAL:

- A. Following award of Contract, Owner may prepare a conformed Project Manual for convenience, reflecting Addenda issued during bidding.

7.3 CONSTRUCTION PERFORMANCE BOND AND CONSTRUCTION PAYMENT BONDS

- A. Successful Bidder must provide a Construction Performance Bond (equal to 100% of the Contract Amount) on the form provided in the Contract Documents and fully executed as indicated on the form.
- B. If the Project described in Section 00100 (Advertisement for Bids) involves an expenditure in excess of twenty-five thousand dollars (\$25,000), the successful Bidder must give a payment bond on the form provided in the Contract Documents and fully executed as indicated on the form prior to entering upon the performance of the Work, in accordance with Civil Code Section 9550.

7.4 WAGE RATES:

- A. Copies of the general prevailing rates of per diem wages for each craft, classification, or type of worker needed to execute the Contract, as determined by Director of the State of California Department of Industrial Relations, are on file at Owner's office, and are deemed included in the Bidding Documents. State wage rates are also available at www.dir.ca.gov/labor_law.html. Upon request, Owner will make available copies to any interested party. Also, Contractor shall post the applicable prevailing wage rates at the Site in addition to all other job site notices prescribed by regulations.

7.5 WITHDRAWAL OF BIDS:

- A. Bidders may withdraw their Bids at any time prior to the Bid opening time fixed in this Section 00200, only by written request to Owner. Bidder or its duly authorized representative shall execute request to withdraw Bid.

7.6 REGISTRATION PURSUANT TO LABOR CODE SECTION 1725.5 REQUIRED

- A. All Contractors and Subcontractors who will perform any portion of the Work must be currently registered and qualified to perform public work pursuant to Labor Code Section 1725.5. Owner requires proof of current registration by Bidder and all Subcontractors listed on Section 00430 (Subcontractors List) as a condition to Bid on this Project, subject only to the allowances of Labor Code Section 1771.1.

7.7 INELIGIBLE CONTRACTORS AND SUBCONTRACTORS:

- A. Owner shall not accept a Bid from a Bidder who is ineligible to bid or work on, or be awarded, a public works project pursuant to California Labor Code Section 1777.1 or 1777.7. Bidders and the Contractor who is awarded the project contract shall not utilize, or allow work by, any subcontractor who is ineligible to bid or work on, or be awarded, a public

works project pursuant to California Labor Code Section 1777.1 or 1777.7. (See California Public Contract Code Section 6109.) The California Division of Labor Standards Enforcement publishes a list of debarred contractors and subcontractors on the Internet at www.dir.ca.gov/DLSE/debar.html.

7.8 SUBSTITUTIONS:

- A. Bidders must base their Bids on products and systems specified in Contract Documents or listed by name in Addenda. Owner will consider substitution requests only for "or equal items." Bidders wanting to use "or equal" item(s) shall submit Section 00660 (Substitution Request Form) no later than ten Days prior to submitting their Bids. After that date, Owner will not accept "or equal" substitution requests except as provided in Section 01600 (Product Requirements).
- B. Bidders must not base their bids on a requested substitution that Owner has not approved in advance and in writing. To the extent that Bidders base their bids on a requested substitution that Owner has not approved in advance and in writing, Owner is not responsible and/or liable in any way for Bidders' damages and/or claims.

7.9 DEFINITIONS:

- A. All abbreviations and definitions of terms used in this Section 00200 are set forth in Section 00700 (General Conditions) and Section 01420 (References and Definitions).

END OF SECTION

SECTION 00202

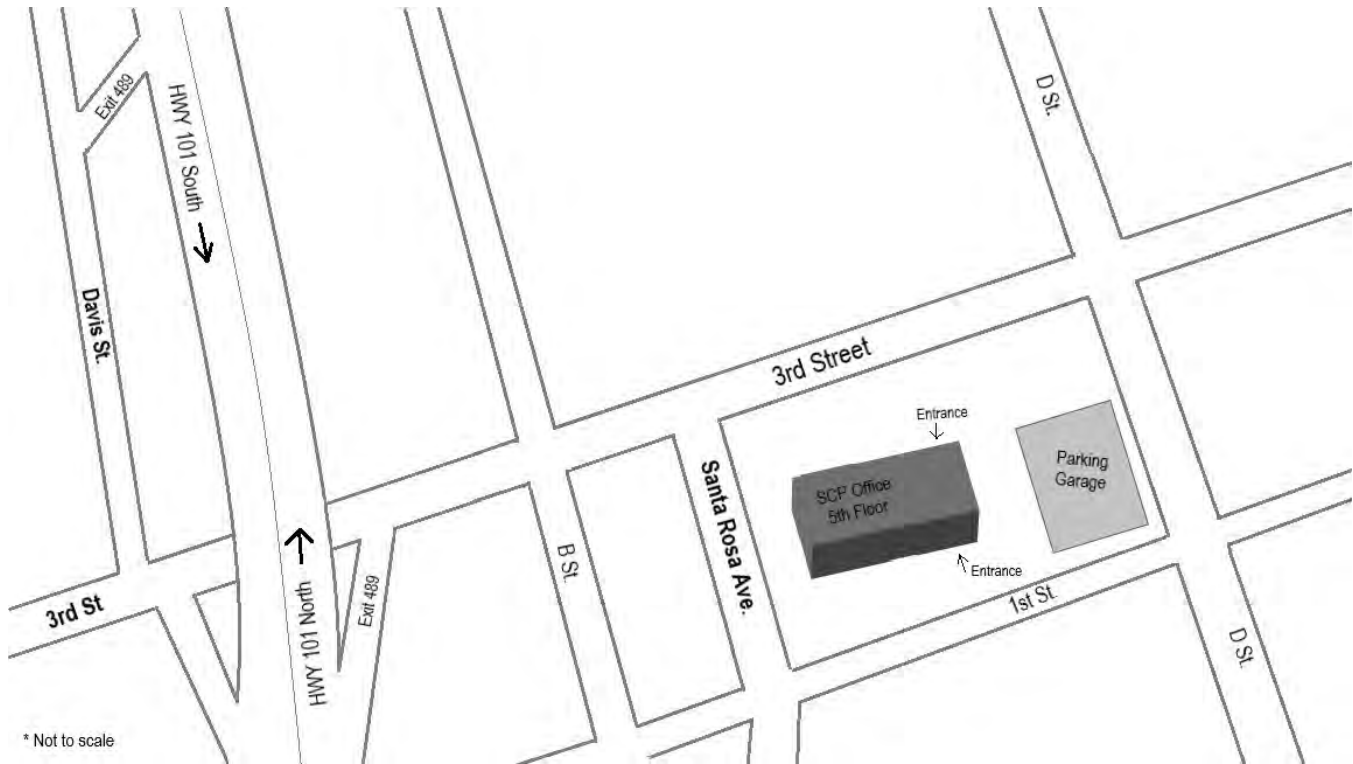
PRE-BID SITE VISIT VICINITY MAP



END OF SECTION

SECTION 00203

BID SUBMITTAL VICINITY MAP



END OF SECTION

SECTION 00320

GEOTECHNICAL DATA AND EXISTING CONDITIONS

ARTICLE 1 - REPORTS AND INFORMATION ON EXISTING CONDITIONS

1.1 INSPECTION OF REPORTS:

- A. Owner, its consultants, and prior contractors may have collected documents providing a general description of the Site and conditions of the Work. These documents may consist of geotechnical reports for and around the Site, contracts, contract specifications, tenant improvement contracts, as-built drawings, utility drawings, information regarding hazardous materials, and information regarding Underground Facilities (collectively, "Existing Conditions Data").
- B. Bidders may inspect Existing Conditions Data. These documents are listed in Section 01100 (Summary) and are available for review as identified therein. Copies may be obtained for the cost of reproduction and handling upon Bidder's payment for the costs.
- C. Existing Conditions Data is for information only and does not describe labor, materials, or equipment furnished by Contractor, but rather, information regarding conditions of the Work. Such Existing Conditions Data is not a Contract Document.

ARTICLE 2 - USE OF EXISTING CONDITIONS DATA

2.1 ABOVEGROUND EXISTING CONDITIONS:

- A. Owner makes no warranty or representation of existing aboveground conditions, as-built conditions, or other aboveground actual conditions verifiable by reasonable independent investigation. These conditions are verifiable by Bidder by the performance of its own independent investigation that Bidder must perform prior to bidding, and Bidder must not rely on the information supplied by Owner regarding existing conditions.
- B. Bidder represents and agrees that in submitting its Bid, it is not relying on any information regarding aboveground existing conditions supplied by Owner.

2.2 UNDERGROUND FACILITIES:

- A. Information supplied regarding existing Underground Facilities at or contiguous to the Site is based on information furnished to Owner by others (e.g., the builders of such Underground Facilities or others).
- B. Owner assumes responsibility for only the general accuracy, completeness, or thoroughness of information regarding Underground Facilities owned by Owner. This express assumption of responsibility applies only if Bidder has conducted the independent investigation required of it under Section 00700 (General Conditions) and discrepancies were not apparent. Bidder is solely responsible for any interpretation or conclusion drawn from this information.
- C. Owner is not responsible for information regarding Underground Facilities owned by others.

2.3 HAZARDOUS MATERIALS SURVEYS:

- A. Bidders may rely on Existing Conditions Data for general accuracy regarding the locations of potentially hazardous materials that may be encountered as part of Work. Owner does not warrant and makes no representation regarding the completeness or thoroughness of any data or information regarding existing conditions or hazardous materials including, but not limited to, quantities, characteristics, volumes, or associated structural features. Bidder represents and agrees that in submitting a Bid it is not relying on any such data, information, or deductions.
- B. Data and information regarding the locations of hazardous materials are not part of Contract Documents.

2.4 GEOTECHNICAL DATA:

- A. Bidder may rely upon the general accuracy of the “technical data” contained in the Existing Conditions Data, but only insofar as it relates to subsurface conditions, provided Bidder has conducted the independent investigation required of it and discrepancies were not apparent.
- B. The term “technical data” shall include actual reported depths, reported quantities, reported soil types, reported soil conditions, and reported material, equipment, or structures that were encountered during subsurface exploration. The term “technical data” does not include, and Bidder may not rely upon, any other data, interpretations, opinions or information shown or indicated in such drawings or reports that otherwise relate to subsurface conditions or described structures. The term “technical data” shall not include the location of Underground Facilities.
- C. Bidder may not rely on the completeness of reports and drawings for the purposes of bidding or construction. Bidder is solely responsible for any interpretation or conclusion drawn from any “technical data” or any other data, interpretations, opinions, or information contained in supplied Existing Conditions Data.
- D. Except as expressly set forth in this Section 00320, Owner does not warrant, and makes no representation regarding, the accuracy or thoroughness of any Existing Conditions Data.
- E. Bidder represents and agrees that in submitting its Bid, it is not relying on any geotechnical data supplied by Owner, except as specifically set forth herein.

ARTICLE 3 - INVESTIGATIONS

3.1 REQUIRED INVESTIGATIONS:

- A. Before submitting a Bid, each Bidder shall be responsible to obtain such additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site or otherwise, which may affect cost, progress, performance, or furnishing of Work or which relate to any aspect of the means, methods, techniques, sequences, or procedures of construction to be employed by Bidder and safety precautions and programs incident thereto or which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of Contract Documents.

- B. Bidders shall advise Owner in writing during the Bid period of any questions, suppositions, inferences, or deductions Bidders may have for Owner's review and response.
- C. Owner has provided time in the period prior to bidding for Bidder to perform these investigations.

3.2 ACCESS TO SITE FOR INVESTIGATIONS:

- A. Except for any areas that are open to the public at large, Bidders may not enter property owned or leased by Owner or the Site without prior written authorization from Owner. Bidders must fill all holes and clean up and restore the Site to its former conditions upon completion of such explorations, investigations, tests, and studies. Such investigations may be performed only under the provisions of Section 00200 (Instructions to Bidders) and Section 00700 (General Conditions) including, but not limited to, proof of insurance and obligation to indemnify against claims arising from such investigation work. Each Bidder shall supply all equipment required to perform any investigations as each Bidder deems necessary. Owner has the right to limit the number of pieces of machinery operating at one time due to safety concerns.

END OF SECTION

SECTION 00400

BID FORM

TO SONOMA CLEAN POWER AUTHORITY

THIS BID IS SUBMITTED BY:

(Firm/Company Name)

Re: Sonoma Clean Power Advanced Energy Center

The undersigned Bidder proposes and agrees:

1. if this Bid is accepted, to enter into an agreement with Sonoma Clean Power Authority in the form included in the Contract Documents, Section 00520 (Agreement), to perform and furnish all Work as specified or indicated in the Contract Documents for the Contract Sum and within the Contract Time indicated in this Bid and in accordance with all other terms and conditions of the Contract Documents.
2. The undersigned declares that Bidder has read and understands the Contract Documents and accepts all of the terms and conditions of the Contract Documents including Section 00100 (Advertisement for Bids), and Section 00200 (Instructions to Bidders) and without limitation, those dealing with the disposition of Bid Security. This Bid will remain subject to acceptance for 90 Days after the day of Bid opening.

and will accept in full payment for that Work the following total lump sum amount, all taxes included:

_____ dollars \$ _____

BASE BID

Bidder acknowledges and agrees that the Base Bid accounts for any and all Allowance(s) and Total Cost for Unit Prices.

Additive/Deductive Alternates:

Alternate #1

_____ dollars \$ _____

Additive/Deductive

Descriptions of alternates are primarily scope definitions and do not necessarily detail the full range of materials and processes needed to complete the construction.

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Additional Detail Regarding Calculation of Base Bid

1. **Unit Prices.** The Bidder's Base Bid includes the following unit prices, which the Bidder must provide and the Owner may, at its discretion, utilize in valuing additive and/or deductive change orders (Unit Prices shall include all labor, materials, services, profit, overhead, insurance, bonds, taxes, and all other incidental costs of Contractor, subcontractors, and suppliers):

SCHEDULE OF UNIT PRICES

<u>Item No.</u>	<u>Description</u>	<u>Unit of Measure</u>	<u>Estimated Quantity</u>	<u>Unit Price</u>	<u>Total Cost = Unit Price x Estimated Quantity (Included in Base Bid)</u>
				\$ _____	\$ _____
				\$ _____	\$ _____

Where scope of Work is decreased, all Work pertaining to the item, whether specifically stated or not, shall be omitted, and where scope of Work is increased, all work pertaining to that item required to render same ready for use on the Project in accordance with intentions of the Drawings and Specifications shall be included in the above agreed-upon price amount.

2. The undersigned has reviewed the Work outlined in the Contract Documents, performed all necessary Pre-Bid investigations and fully understands the scope of Work required in this Proposal, understands the construction and project management function(s) is described in the Contract Documents, and that each Bidder who is awarded a contract shall be in fact a prime contractor, not a subcontractor, to the Owner, and agrees that its Proposal, if accepted by the Owner, will be the basis for the Bidder to enter into a contract with the Owner in accordance with the intent of the Contract Documents.
3. Bidder has visited the Site and performed all tasks, research, investigation, reviews, examinations, and analysis regarding the Project and the Site, as set forth in Article 2 of Section 00700 (General Conditions).
4. The undersigned has notified the Owner in writing of any discrepancies or omissions or of any doubt, questions, or ambiguities about the meaning of any of the Contract Documents and has contacted the Construction Manager before bid date to verify the issuance of any clarifying Addenda.
5. The undersigned Bidder understands that Owner reserves the right to reject this Bid.
6. If written notice of the acceptance of this Bid, hereinafter referred to as Notice of Award, is mailed or delivered to the undersigned Bidder within the time described in Paragraph 2 of this Section 00400 or at any other time thereafter before it is withdrawn, the undersigned Bidder will

execute and deliver the documents required by Section 00200 (Instructions to Bidders) within the times specified therein.

7. Notice of Award or request for additional information may be addressed to the undersigned Bidder at the address set forth below.
8. The undersigned Bidder herewith encloses cash, a cashier's check, or certified check of or on a responsible bank in the United States, or a corporate surety bond furnished by a surety authorized to do a surety business in the State of California, in form specified in Section 00200 (Instructions to Bidders), in the amount of ten percent (10%) of the Bid and made payable to Sonoma Clean Power Authority.
9. The undersigned agrees to commence work under this Contract on the date established in the Contract Documents and to complete all work within the time specified in the Contract Documents. The undersigned Bidder acknowledges that Owner has reserved the right to delay issuance of Section 00550 (Notice to Proceed) by up to 90 Days after the date of Owner's issuance of Notice of Award.
10. The liquidated damages clause of the General Conditions and Agreement is hereby acknowledged.
11. It is understood that the Owner reserves the right to reject this bid and that the bid shall remain open to acceptance and is irrevocable for a period of ninety (90) days.
12. The following documents are attached hereto:
 - Section 00400 (Bid Form)
 - Section 00411 (Bond Accompanying Bid) or other security.
 - Section 00430 (Subcontractors List).
 - Section 00451 (Bidder Certifications).
 - Section 00481 (Noncollusion Declaration).
 - Section 00482 (Iran Contracting Act Certification)
13. Receipt and acceptance of the following Addenda is hereby acknowledged:

No. _____, Dated _____	No. _____, Dated _____
No. _____, Dated _____	No. _____, Dated _____
No. _____, Dated _____	No. _____, Dated _____

14. Bidder acknowledges that the license required for performance of the Work is a _____ license.

15. The undersigned hereby certifies that Bidder is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the Work.
16. Bidder specifically acknowledges and understands that if it is awarded the Contract, that it shall perform the Work of the Project while complying with all requirements of the Department of Industrial Relations.
17. The Bidder represents that it is competent, knowledgeable, and has special skills with respect to the nature, extent, and inherent conditions of the Work to be performed. Bidder further acknowledges that there are certain peculiar and inherent conditions existent in the construction of the Work that may create, during the Work, unusual or peculiar unsafe conditions hazardous to persons and property.
18. Bidder expressly acknowledges that it is aware of such peculiar risks and that it has the skill and experience to foresee and to adopt protective measures to adequately and safely perform the Work with respect to such hazards.
19. Bidder expressly acknowledges that it is aware that if a false claim is knowingly submitted (as the terms "claim" and "knowingly" are defined in the California False Claims Act, Gov. Code, § 12650 et seq.), the Owner will be entitled to civil remedies set forth in the California False Claim Act. It may also be considered fraud and the Contractor may be subject to criminal prosecution.
20. The undersigned Bidder certifies that it is, at the time of bidding, and shall be throughout the period of the Contract, licensed by the State of California to do the type of work required under the terms of the Contract Documents and registered as a public works contractor with the Department of Industrial Relations. Bidder further certifies that it is regularly engaged in the general class and type of work called for in the Contract Documents.

Furthermore, Bidder hereby certifies to the Owner that all representations, certifications, and statements made by Bidder, as set forth in this bid form, are true and correct and are made under penalty of perjury.

Dated this _____ day of _____ 20 _____

Name of Bidder: _____

Name of Principal Contact: _____

TYPE OF BUSINESS: _____ Sole Proprietor _____ Partnership
 _____ Non-Profit 501 C3 _____ Corporation
 _____ other (please explain: _____)

Place of incorporation: _____

Name of Principals: _____

Signed by: _____

Title of Signer: _____

Address of Bidder: _____

Taxpayer Identification No. of Bidder: _____

Telephone Number: _____

Fax Number: _____

E-mail: _____ Web Page: _____

Contractor's License No(s): No.: _____ Class: _____ Expiration Date: _____

No.: _____ Class: _____ Expiration Date: _____

No.: _____ Class: _____ Expiration Date: _____

Public Works Contractor Registration No.: _____

END OF SECTION

SECTION 00411

BOND ACCOMPANYING BID

KNOW ALL BY THESE PRESENTS:

That the undersigned _____ [Name of Contractor] as Principal and the undersigned as Surety are held and firmly bound unto the SONOMA CLEAN POWER AUTHORITY, a public agency ("Owner"), as obligee, in the penal sum of _____

_____ Dollars (\$_____) lawful money of the United States of America being at least ten percent (10%) of the aggregate amount of said Principal _____'s Bid, for the payment of which, well and truly to be made, we bind ourselves, our successors, executors, administrators, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the said Principal is submitting a Bid for Owner's Sonoma Clean Power Advanced Energy Center.

THE CONDITION OF THIS OBLIGATION IS SUCH that if the Bid submitted by the said Principal be accepted and the Contract be awarded to said Principal, then said Principal shall, within the required periods, enter into the Contract so awarded and provide the required Construction Performance Bond, Construction Labor and Material Payment Bond, insurance certificates, Guarantee, and all other endorsements, forms, and documents required under Section 00200 (Instructions to Bidders). If Principal fulfills these obligations, then this obligation shall be void; otherwise it will remain in full force and effect for 90 days following bid opening or until this bond is returned to Bidder, whichever occurs first. Surety waives the provisions of Civil Code sections 2819 and 2845.

IN WITNESS WHEREOF, the above bounden parties have executed this instrument this _____ day of _____, 20____.

(Corporate Seal)

By

Principal

Surety

(Corporate Seal)

By

Attorney in Fact

END OF SECTION

SECTION 00430

SUBCONTRACTORS LIST

Bidder submits the following information as to the subcontractors Bidder intends to employ if awarded the Contract, for any subcontractor who will perform, fabricate, or install work for an amount in excess of one half of one percent of the prime contractor's total bid, as further specified in Public Contract Code section 4104.

Full Name of Subcontractor and Location of Place of Business	Email Address of Subcontractor	Description of Work: Reference to Bid Items	Contractor's License No.	Subcontractor's Registration Number pursuant to Labor Code Section 1725.5

(Bidder to attach additional sheets if necessary)

END OF SECTION

SECTION 00450

STATEMENT OF QUALIFICATIONS FOR CONSTRUCTION WORK

ARTICLE 1 - GENERAL INFORMATION

1.1 MINIMUM BIDDER QUALIFICATIONS:

- A. Bidders must be duly licensed in accordance with the California Business & Professions Code and have a history of work performance sufficient to meet the requirements of a responsible bidder as defined in the California Public Contract Code Section 1103.

--

- B. Bidders must have five years' experience as a continuously operating entity engaged in the performance of similar work.
- C. Bidders must demonstrate successful experience with type of work of this Project, to include, within the past year, completed three projects of a similar nature and complexity with a contract dollar amount of at least \$1,000,000.
- D. Bidder may request changes or additions to these minimum requirements to seek consideration of other combinations of experience, skills, capacity or licensing that provide equivalent or appropriate levels of Bidder responsibility. Requests must be submitted in accordance with the Bidder question procedure described in Section 00200 (Instructions to Bidders). Any changes to the minimum requirements are at the sole discretion of Owner and only changes made by formal written Addenda will be binding.

1.2 MEASUREMENT:

- A. Bidder's compliance with the minimum qualification requirements will be measured by Bidder's experience as an operating entity and also by the experience of the supervisory personnel who will have responsible charge of the various major components of the Work.
- B. If Bidder subcontracts portions of the Work, Owner, in its determination of whether the minimum qualification requirements have been met, may consider the qualifications of the Subcontractor's supervisory personnel.
- C. The qualifications of the Key Personnel are to be submitted with the Statement of Qualifications ("SOQ"), by providing the information described in this Section 00450.









ARTICLE 2 - REQUIRED CONTENTS OF SOQ SUBMISSION

2.1 TRANSMITTAL LETTER:



- A. The Transmittal Letter shall name the proposed prime contractor, its legal structure (i.e., corporation, partnership, limited partnership, joint venture). If a joint venture or partnership is proposed, Bidder shall identify partner and/or member of the joint venture and their roles and responsibilities.

2.2 SUBMITTALS:

-  A. Completed Questionnaire. Include a completed Statement of Qualification Questionnaire in the form attached to this Section 00450 as Attachment A.
-  B. Resumes of Proposed Key Personnel. Provide a resume for each named Key Personnel of Bidder and Subcontractor(s), if applicable, to include as necessary: Current employer, years of experience; education - degrees, schools and years obtained; professional registrations; fluency in English (Yes/No); at least two client references, including contact names, addresses, email addresses, and telephone numbers, and description of projects of a similar nature worked on in the past five years.
-  C. Audited or Reviewed Financial Statements. Include audited or reviewed financial statements for the three most recently completed fiscal years for Bidder and each member of any proposed consortium or joint venture. Also include audited or reviewed financial statements for the three most recently completed fiscal years for any parent companies of Bidder and each member of any proposed consortium or joint venture. Bidder shall fully disclose the nature and extent of any material changes in Bidder's financial condition since the date of its most recent audited or reviewed financial statement(s).
-  D. Surety Letter re: Capability to Provide Required Performance and Payment Bonds. Include a completed "Letter of Assurance Regarding Performance and Payment Bonds" from a surety duly licensed to do business in the State of California, having a financial rating from A.M. Best Company of A-, VII or better, in the form attached to this Section 00450 as Attachment B, indicating that the surety has agreed to provide Bidder with the required performance and payment bonds in accordance with the requirements set forth in Sections 00611 (Construction Performance Bond) and 00612 (Construction Labor and Material Payment Bond), each in the penal sum of the Contractor's bid when submitted. Owner shall have the right to verify with the surety that the surety, based upon the Bid prices, will issue the required bonds under the conditions stated. Bidder shall include a completed "Authorization to Contact Surety" in the form attached to this Section 00450 as Attachment C.
-  E. Insurance. Include certificates of insurance evidencing coverage as specified in Section 00800 (Supplementary Conditions - Insurance and Indemnification). For those coverages that Bidder will acquire only if awarded the Contract, Bidder must provide a letter from an insurance agent, broker, or underwriter stating that such coverages (as specified in Section 00800 [Supplementary Conditions - Insurance and Indemnification]) can be obtained.
-  F. Description of Human and Physical Resources. Identify, describe, and quantify for itself, the following technical information for the construction work: Description and location of manufacturing facilities, naming products and quantifying production capacity and current demand; description of field organization(s), naming skills and equipment; description of safety program quality control procedures and safety experience.
-  G. License. Include evidence of a valid contractor's license and required licenses of all licensees of persons who are Key Personnel necessary to perform the Work.
-  H. Litigation History. Owner reserves the right to require submission of a description of all claims and litigation matters, whether pending or resolved, brought by or against Bidder in the last five years, which description shall include, for each such matter, the names of involved parties, the nature of dispute, and its disposition, including the dollar amount of any judgment or settlement.

2.3 FORMAT:

- A. The SOQ shall be clear and concise to enable Owner to make a thorough evaluation and arrive at a sound determination as to whether the SOQ meets Owner's requirement. To this end, the SOQ must be so specific, detailed, and complete as to demonstrate clearly and fully that the Bidder has a thorough understanding of and has demonstrated knowledge of the requirements to perform the Work (or applicable portion thereof).
- B. Any explanation requested by a Bidder regarding the meaning or interpretation of this Section 00450 must be requested in writing in accordance with Paragraph 1.4 of Section 00200 (Instructions to Bidders). Oral explanations or instructions will not be binding. Any information provided to any prospective Bidder concerning this Section 00450 will be furnished to all prospective Bidders as an Addendum to the Bidding Documents.

END OF SECTION

ATTACHMENT A – Statement of Qualification Questionnaire

Bidders shall complete the entire Statement of Qualification Questionnaire and submit it in accordance with Section 00200 (Instructions to Bidders) and Section 00450 (Statement of Qualifications). Failure to complete the questionnaire or inclusion of any false statement(s) shall be grounds for immediate disqualification.

CONTACT INFORMATION

Company Name: _____

Owner of Company: _____

Contact Person: _____

PART A: GENERAL INFORMATION

1. Does Bidder possess a valid and current California Contractor's license for the work proposed? Yes ___ No ___
2. Does Bidder have the general liability insurance coverage required by Section 00800 (Supplementary Conditions – Insurance and Indemnity)? Yes ___ No ___
3. Has Bidder's License been revoked or suspended at any time in the last five years? Yes ___ No ___
4. Has Bidder been "default terminated" by an Owner (other than for convenience), or has a Surety completed a contract for Bidder within the last five years? Yes ___ No ___
5. Has Bidder been convicted more than twice for failure to pay prevailing wages in the last three years? Yes ___ No ___
6. Has Bidder attached copies of its reviewed or audited financial statements and accompanying notes for the last three years? Yes ___ No ___

Bidder may be disqualified if any answer to questions 1, 2, or 6 is No.

Bidder may be disqualified if any answer to questions 3, 4, or 5 is Yes.

PART B: SAFETY, PREVAILING WAGE, LICENSE, DISPUTES, AND BONDS

(SAFETY)

1. Has Cal/OSHA, Federal OSHA, the EPA or any Air Quality Management Owner cited Bidder in the past five years?

☐ Yes ___ No ___ If yes, attach description of each citation. For each citation, state whether the action by Cal/OSHA resulted in a citation, or a penalty, or both. Describe the activities that led to the action by Cal/OSHA. Provide dates, citation numbers, penalty amounts, and any other relevant information regarding the action by Cal/OSHA. Provide legible descriptions on company letterhead and signed by an officer of the company.

☐ Attach Cal/OSHA 300A log for 2018

2. What were Bidder's Interstate Experience Modification Rates for the last three years?

2016: _____

2017: _____

2018: _____

Average of last three years: _____ (no rounding)



If Bidder was not eligible to obtain a formal rating from the Workers' Compensation Insurance Rating Bureau for any of the years listed above, Bidder shall submit written documentation from its workers' compensation insurance company that establishes what Bidder's equivalent experience modification rate would be.



If average of last three years is greater than 1.1, Bidder shall provide an explanation here or as a separate attachment:

3. Total Recordable Incident Rates (RIR): What were Bidder's Total Recordable Incident Rates (RIR) for each of the last three complete years?

2016: _____

2017: _____

2018: _____

Average of last three years: _____ (no rounding)

4. Total Lost Time Incident Rates (LTIR): What were Bidder's Total Lost Time Incident Rates (LTIR) for each of the last three complete years?

2016: _____

2017: _____

2018: _____

Average of last three years: _____ (no rounding)

(PREVAILING WAGE PROVISIONS)



5. In the past five years, has Bidder been fined, penalized, or otherwise found to have violated any prevailing wage or Labor Code provision? If yes, attach description of each occurrence.


Yes _____ No _____

(LICENSE PROVISIONS)

6. In the past five years, has Bidder changed names or license numbers? If so, please state reason for change and list previous name(s) and any previous license number for any of Bidder's principals.

Yes ____ No ____ Reason: _____

(DISPUTES)

-  7. In the past five years, has Bidder had any claims, litigation (pending or resolved), or disputes resulting in mediation or arbitration, or termination for cause associated with any project? If yes, attach description of each instance including details of total claim amount, judgment amount, or settlement amount, and the adverse party's (or parties') name(s), email address(es), and phone number(s).
Yes ____ No ____

(BONDING)

8. Bonding Capacity – Provide documentation from Bidder's surety identifying the following:

Name of bonding company/surety: _____

Name of Surety Agent: _____

Surety Agent address: _____

Surety Agent phone number: _____

Is surety a California-admitted surety? Yes ____ No ____

Is surety listed in the current edition of the California Department of the Treasury's Listing of approved sureties? Yes ____ No ____

List surety's A.M. Best Rating: _____

What is Bidder's total bonding capacity? _____

What percentage rate does Bidder pay for bonds? _____

PART C: FINANCIAL INFORMATION

1. Has Bidder ever reorganized under the protection of bankruptcy laws?
Yes ____ No ____ If yes, please state when _____
2. If Bidder has had its current general liability carrier for less than five years, please provide additional information below for balance of the last five years:

Agency Name: _____

Contact Name: _____

Phone Number: _____ Email Address: _____

Carrier: _____ Dates: _____ A.M. Best Rating: _____

Carrier: _____ Dates: _____ A.M. Best Rating: _____

Carrier: _____ Dates: _____ A.M. Best Rating: _____

3. Has Bidder ever had insurance terminated by a carrier?
☐ Yes ____ No ____ If yes, explain on a separate signed sheet marked with correlating cross-reference to this paragraph of the questionnaire.
4. Does Bidder have any outstanding or unsatisfied judgments? Yes ____ No ____
☐ If yes, attach for each such judgment an explanation of the steps Bidder has taken to ensure the judgment won't interfere with Bidder's performance of the Work.

PART D: EXPERIENCE OF BIDDER

The nature of this Project requires prior similar experience for the firm and the Key Personnel assigned. Summarize similar project experience below and provide the detailed project information requested.

List projects as required by Paragraph 1.1C of this Section 00450. This listing will be used to assess compliance with the stated minimum qualifications in Paragraph 1.1C of this Section 00450.


	Project 1	Project 2	Project 3
Project Name			
Location			
Client			
Client Contact (name and phone number)			
Architect/Engineer			
Architect/Engineer Contact (name and phone number)			
Construction Manager (name and phone number)			
Description of Project, Scope of Work Performed			
Total Construction Cost			
Completion Date			
[customize for each project, if applicable]			

 List Key Personnel that will be assigned to the Work of the current Project and their experience and training with the projects listed above (attach additional sheets as necessary):

Contractor's Project Manager (must be employee of Bidder): _____

Contractor's Project Superintendent (must be employee of Bidder): _____

Recent Projects.

 Provide information about three of Bidder's most currently completed projects. Names and references must be current and verifiable. This listing will be used to assess compliance with the stated minimum qualifications in Paragraph 1.1B. If a separate sheet is used, it must contain all of the following information:

	Recent Project 1	Recent Project 2	Recent Project 3
Project Name			
Location			
Prime Contractor			
Client			
Client Contact (name and phone number)			
Architect/Engineer			
Architect/Engineer Contact (name and phone number)			
Construction Manager (name and phone number)			
Description of Project, Scope of Work Performed			
Total Construction Cost			
Completion Date			
Total Change Order Amount			
Original Scheduled Date of Completion			
Time Extensions Granted (number of Days)			
Actual Date of Completion			
Number of Stop Notices filed by subcontractors or suppliers			

Bidder hereby declares under penalty of perjury that all the information provided in this questionnaire is true and correct.

SIGNATURE

TITLE

ATTACHMENT B - Letter of Assurance Regarding Performance and Payment Bonds

To Sonoma Clean Power Authority]:

This letter is written by _____ [name of surety], a surety duly licensed to do business in the State of California, having a financial rating from A.M. Best Company of A-, VII or better. The purpose of this letter is to advise the Sonoma Clean Power Authority that this surety has agreed to provide _____ [name of Bidder] with the required performance and payment bonds in accordance with the requirements set forth in Sections 00611 (Construction Performance Bond) and 00612 (Construction Labor and Material Payment Bond) for the [Full Project Name], if the Bid submitted by said Bidder is accepted and the Contract is awarded to said Bidder. These performance and payment bonds shall be in the minimum penal sums provided therein.

Signature of Surety's Authorized Representative

Name and Title

Date

ATTACHMENT C - Authorization to Contact Surety

The Sonoma Clean Power Authority is hereby authorized to verify with the surety identified in Attachment B that the surety will, based upon Bid prices, issue the required bonds under the conditions stated in Attachment B.

Signature of Bidder's Authorized Representative

Name and Title

Date

SECTION 00451

BIDDER CERTIFICATIONS

TO BE EXECUTED BY ALL BIDDERS AND SUBMITTED WITH BID

The undersigned Bidder certifies to Owner as set forth in sections 1 through 8 below.

1. STATEMENT OF CONVICTIONS

By my signature hereunder, I hereby swear, under penalty of perjury, that no more than one final, unappealable finding of contempt of court by a Federal Court has been issued against Bidder within the past two years because of failure to comply with an order of a Federal Court or to comply with an order of the National Labor Relations Board.

2. CERTIFICATION OF WORKERS' COMPENSATION INSURANCE

By my signature hereunder, as the Contractor, I certify that I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that Code, and I will comply with such provisions before commencing the performance of the work of this Contract.

3. CERTIFICATION OF PREVAILING WAGE RATES AND RECORDS

By my signature hereunder, as the Contractor, I certify that I am aware of the provisions of Section 1773 of the California Labor Code, which requires the payment of prevailing wage on public projects. Also, that the Contractor and any subcontractors under the Contractor shall comply with California Labor Code Section 1776, regarding wage records, and with California Labor Code Section 1777.5, regarding the employment and training of apprentices. It is the Contractor's responsibility to ensure compliance by any and all subcontractors performing work under this Contract.

4. CERTIFICATION OF NON-DISCRIMINATION

By my signature hereunder, as the Contractor, I certify that there will be no discrimination in employment with regard to race, color, religion, gender, sexual orientation, age, or national origin; that all federal, state, and local directives and executive orders regarding non-discrimination in employment will be complied with; and that the principal of equal opportunity in employment will be demonstrated positively and aggressively.

5. CERTIFICATION OF NON-DISQUALIFICATION

By my signature hereunder, as the Contractor, I swear, under penalty of perjury, that the below indicated Bidder, any officer of Bidder, or any employee of Bidder who has a proprietary interest in such Bidder, has never been disqualified, removed, or otherwise prevented from bidding on, or completing a Federal, State, or local government project because of a violation of law or safety regulation, except as indicated on the separate sheet attached hereto entitled "Previous Disqualifications." (If a statement of "Previous Disqualifications" is attached, please explain the circumstances.)

6. CERTIFICATION OF COMPLIANCE WITH PUBLIC WORKS CHAPTER OF LABOR CODE

By my signature hereunder, as the Contractor, I certify that I am aware of Sections 1777.1 and 1777.7 of the California Labor Code and Contractor and Subcontractors and am eligible to bid and work on public works projects.

7. CERTIFICATION OF ADEQUACY OF CONTRACT AMOUNT

By my signature hereunder, as the Contractor, pursuant to Labor Code Section 2810(a), I certify that, if awarded the Contract based on the undersigned's Bid, the Contract will include funds sufficient to allow the Contractor to comply with all applicable local, state, and federal laws or regulations governing the labor or services to be provided. I understand that Owner will be relying on this certification if it awards the Contract to the undersigned.

8. CERTIFICATION REGARDING DIR CONTRACTOR / SUBCONTRACTOR REGISTRATION

By my signature hereunder, as the Contractor, I certify that Contractor, and all Subcontractors listed on Section 00430 (Subcontractors List) are the subject of current and active contractor registrations pursuant to Division 2, Part 7, Chapter 1 (commencing with §1720) of the California Labor Code.

BIDDER: _____
Name of Bidder

Date

By: _____
Signature

Print Name

Title

END OF SECTION

SECTION 00481

NONCOLLUSION DECLARATION

PUBLIC CONTRACT CODE SECTION 7106

NONCOLLUSION DECLARATION TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID

The undersigned declares:

I am the _____ of _____, the party making the foregoing bid.
[Office of Declarant] [Name of Bidder]

The bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation. The bid is genuine and not collusive or sham. The bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived or agreed with any bidder or anyone else to put in a sham bid, or to refrain from bidding. The bidder has not in any manner, directly or indirectly, sought by agreement, communication or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit or cost element of the bid price, or of that of any other bidder. All statements contained in the bid are true. The bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof, to effectuate a collusive or sham bid, and has not paid, and will not pay, any person or entity for such purpose.

Any person executing this declaration on behalf of a bidder that is a corporation, partnership, joint venture, limited liability company, limited liability partnership, or any other entity, hereby represents that he or she has full power to execute, and does execute, this declaration on behalf of the bidder.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this declaration is executed on _____ [date], at
_____ [city], _____ [state].

Signature of Principal

END OF SECTION

SECTION 00482

IRAN CONTRACTING ACT CERTIFICATION
(Public Contract Code Sections 2202-2208)

PROJECT between Sonoma Clean Power Authority ("Owner") and _____
_____ ("Contractor" or "Bidder") ("Contract" or "Project").

Prior to bidding on or submitting a proposal for a contract for goods or services of \$1,000,000 or more, the bidder/proposer must submit this certification pursuant to Public Contract Code section 2204.

The bidder/proposer must complete **ONLY ONE** of the following two options. To complete OPTION 1, check the corresponding box **and** complete the certification below. To complete OPTION 2, check the corresponding box, complete the certification below, and attach documentation demonstrating the exemption approval.

- ☐ **OPTION 1.** Bidder/Proposer is not on the current list of persons engaged in investment activities in Iran created by the California Department of General Services ("DGS") pursuant to Public Contract Code section 2203(b), and we are not a financial institution extending twenty million dollars (\$20,000,000) or more in credit to another person, for 45 days or more, if that other person will use the credit to provide goods or services in the energy sector in Iran and is identified on the current list of persons engaged in investment activities in Iran created by DGS.
- ☐ **OPTION 2.** Bidder/Proposer has received a written exemption from the certification requirement pursuant to Public Contract Code sections 2203(c) and (d). *A copy of the written documentation demonstrating the exemption approval is included with our bid/proposal.*

CERTIFICATION:

I, the official named below, CERTIFY UNDER PENALTY OF PERJURY, that I am duly authorized to legally bind the bidder/proposer to the OPTION selected above. This certification is made under the laws of the State of California.

<i>Vendor Name/Financial Institution (Printed)</i>	<i>Federal ID Number (or n/a)</i>
<i>By (Authorized Signature)</i>	
<i>Printed Name and Title of Person Signing</i>	<i>Date Executed</i>

END OF DOCUMENT

SECTION 00505

NOTICE OF INTENT TO AWARD FOR CONSTRUCTION

DATE POSTED: _____

PROJECT TITLE: Sonoma Clean Power Advanced Energy Center

Geof Syphers, Chief Executive Officer of the Sonoma Clean Power Authority, intends to recommend to the Board of Directors of the Sonoma Clean Power Authority the award of the above-referenced Project to _____.
(Name of Contractor)

Owner

By: Geof Syphers, Chief Executive Officer

By: _____

(Print name)

Title: _____

Date: _____

END OF SECTION

SECTION 00510
NOTICE OF AWARD

Dated _____

TO: _____

ADDRESS: _____

CONTRACT FOR:

Sonoma Clean Power Advanced Energy Center

The Contract Sum of your contract is _____

_____ Dollars (\$_____).

1. Five copies of the proposed Contract Documents listed below accompany this Notice of Award.
2. You must comply with the following conditions precedent by 5:00 p.m. of the 7th Day following the date of this Notice of Award, that is, by _____, 20____ [month day, year].
 - a. Deliver to Owner four fully executed counterparts of Section 00520 (Agreement). Each copy of Section 00520 (Agreement) must bear your original signature on the signature page.
 - b. Deliver to Owner four originals of Section 00611 (Construction Performance Bond), executed by you and your surety.
 - c. Deliver to Owner four originals of Section 00612 (Construction Labor and Material Payment Bond), executed by you and your surety.
 - d. Deliver to Owner four original copies of Section 00630 (Guarantee), each executed by you.
 - e. Deliver to Owner original set of the insurance certificates with endorsements required under Section 00800 (Supplementary Conditions – Insurance and Indemnification).
 - f. Deliver to Owner one complete set of the documentary evidence received or generated by you in preparation of Bid prices for this Contract, as set forth in Section 00670 (Escrow Bid Documents).
3. Failure to comply with these conditions within the time specified will entitle Owner to consider your Bid abandoned, to annul this Notice of Award, and to declare your Bid security forfeited.
4. Within 21 Days after you comply with the conditions in Paragraph 2 of this Section 00510, Owner will return to you one fully signed counterpart of Section 00520 (Agreement) with 10 copies of the Project Manual (including Specifications and Drawings) and 5 sets of full-size Drawings.
5. Before you may start any Work at the Site, you must attend a preconstruction conference. The preconstruction conference may be arranged through [_____ (____) ____-____.] Questions

regarding bonds and insurance may be directed to [_____] at the same number. All other inquiries regarding the Project should be directed to [_____]. In accordance with Article 5 of Section 00700 (General Conditions), at the preconstruction conference you must submit your draft initial schedule.

6. Upon commencement of the Work, you and each of your Subcontractors shall certify, maintain, and furnish payroll records as required by the Division of Labor Standards Enforcement, in accordance with California Labor Code Sections 1776 and 1771.4.

SONOMA CLEAN POWER AUTHORITY, Public Agency
of the State of California ("Owner")

BY: _____
Geof Syphers, Chief Executive Officer

END OF SECTION

SECTION 00520

AGREEMENT

THIS AGREEMENT, dated this _____ [date] day of _____ [Month], 20____ [Year], by and between _____ [Name of Contractor] whose place of business is located at _____ [Address of Contractor] ("Contractor"), and Sonoma Clean Power Authority ("Owner"), a public agency of the State of California, acting under and by virtue of the authority vested in Owner by the laws of the State of California.

WHEREAS, Owner, by its Board Action on the _____ [date] day of _____ [Month], 20____ [Year], awarded to Contractor the following Contract:

SONOMA CLEAN POWER ADVANCED ENERGY CENTER
at
741 FOURTH STREET
SANTA ROSA, CA 95404

NOW, THEREFORE, in consideration of the mutual covenants hereinafter set forth, Contractor and Owner agree as follows:

ARTICLE 1 - SCOPE OF WORK OF THE CONTRACT

1.1 WORK OF THE CONTRACT:

- A. Contractor shall complete all Work specified in the Contract Documents, in accordance with the Specifications, Drawings, and all other terms and conditions of the Contract Documents (Work).

1.2 PRICE FOR COMPLETION OF THE WORK:

- A. Owner shall pay Contractor the following Contract Sum (Contract Sum) for completion of Work in accordance with Contract Documents as set forth below: base bid plus the following alternates.

ARTICLE 2 - COMMENCEMENT AND COMPLETION OF WORK

2.1 COMMENCEMENT OF WORK:

- A. Contractor shall commence Work on the date established in the Notice to Proceed (Commencement Date).
- B. Owner reserves the right to modify or alter the Commencement Date after the issuance of Section 00550 (Notice to Proceed).

2.2 COMPLETION OF WORK

- A. Contractor shall achieve Substantial Completion of the entire Work within [] Days from the Commencement Date.
- B. Contractor shall achieve Final Completion of the entire Work [] Days from the Commencement Date.

ARTICLE 3 - PROJECT REPRESENTATIVES

3.1 OWNER'S PROJECT MANAGER:

- A. Owner has designated Cordel Stillman, Director of Programs, as its Project Manager to act as Owner's Representative in all matters relating to the Contract Documents.
- B. Owner's Project Manager shall have final authority over all matters pertaining to the Contract Documents and shall have sole authority to modify the Contract Documents on behalf of Owner, to accept work, and to make decisions or actions binding on Owner, and shall have sole signature authority on behalf of Owner.
- C. Owner's Project Manager and each Owner's Representative are the beneficiary of all Contractor obligations to Owner, including without limitation, all releases and indemnities.

3.2 CONTRACTOR'S PROJECT MANAGER:

- A. Contractor has designated _____ as its Project Manager to act as Contractor's Representative in all matters relating to the Contract Documents.

3.3 CONSTRUCTION MANAGER

- A. **Construction Manager Role and Authority.** Sixth Dimension, LLC is the Construction Manager for this Project. The Construction Manager will assist Owner in the management of the construction of the Project. The Construction Manager may perform services in the areas of supervision and coordination of the work of Contractor and/or other contractors, scheduling the Work, monitoring the progress of the Work, providing Owner with evaluations and recommendations concerning the quality of the Work, recommending the approval of progress payments to Contractor, or other services for the Project in accordance with the Construction Manager's contract with Owner.
 - 1. **Communications.** Contractor must submit all notices and communications relating to the Work directly to the Construction Manager in writing, as follows:
 - 2. **On-Site Management and Communication Procedures.** The Construction Manager will provide and maintain a management team on the Project site to provide contract administration as an agent of Owner, and will establish and implement coordination and communication procedures among Owner, the Architect, Contractor, and others.

3. **Contract Administration Procedures.** The Construction Manager will establish and implement procedures for reviewing and processing requests for clarifications and interpretations of the Contract Documents, Shop Drawings, samples, other submittals, schedule adjustments, Change Order proposals, written proposals for substitutions, payment applications, and maintenance of logs.
4. **Pre-Construction Conference.** Contractor will attend the pre-construction conference, during which the Construction Manager will review the Contract administration procedures and Project requirements.
5. **Contractor's Construction Schedule.** The Construction Manager will review Contractor's construction schedules and will verify that each schedule is prepared in accordance with the requirements of the Contract Documents. **Article 4 - Liquidated Damages for Delay in Completion of Work**

4.1 LIQUIDATED DAMAGE AMOUNTS:

- A. As liquidated damages for delay, Contractor shall pay twenty-five hundred dollars (\$2,500.00) for each Day that expires after the time specified herein for Contractor to achieve Substantial Completion of the entire Work, until achieved.
- B. As liquidated damages for delay, Contractor shall pay Owner twenty-five hundred dollars (\$2,500.00) for each Day that expires after the time specified herein for Contractor to achieve Final Completion of the entire Work, until achieved.

4.2 SCOPE OF LIQUIDATED DAMAGES:

- A. Measures of liquidated damages listed in Paragraphs 4.1A and 4.1B above shall apply cumulatively.
- B. Limitations and stipulations regarding liquidated damages are set forth in Section 00700 (General Conditions).

ARTICLE 5 - CONTRACT DOCUMENTS

- 5.1 **CONTRACT DOCUMENTS CONSIST OF THE FOLLOWING DOCUMENTS, INCLUDING ALL CHANGES, ADDENDA, AND MODIFICATIONS THERETO:**

- 5.2 Contract Documents consist of the following documents, including all changes, Addenda, and Modifications thereto:

	Notice Inviting Bids
	Instruction to Bidders
Section 00510	Notice of Award
Section 00520	Agreement
Section 00550	Notice to Proceed
Section 00611	Construction Performance Bond
Section 00612	Construction Labor and Material Payment Bond
Section 00630	Guarantee
Section 00650	Agreement and Release of Any and All Claims
Section 00660	Substitution Request Form
Section 00670	Escrow Bid Documents
Section 00680	Escrow Agreement for Security Deposits in Lieu of Retention
Section 00700	General Conditions
Section 00800	Supplementary Conditions - Insurance and Indemnification
Section 00803	Supplementary Conditions
Section 00805	Supplemental Conditions - Hazardous Materials
Section 00815	Supplementary Conditions - Apprenticeship Program
Section 00910	Addenda
Specifications	Divisions 1 through 16
Drawings listed in Drawing No. ____ - ____	
Supplementary Photographic Exhibit of Select Existing Conditions.	
Any and all Change Orders or written modifications to the above documents if approved in writing by the Owner.	

- 5.3 There are no Contract Documents other than those listed above. The Contract Documents may only be amended, modified, or supplemented as provided in Section 00700 (General Conditions). The order of precedence for purposes of interpretation of Contract Documents will be as set forth in section ---.

ARTICLE 6 - MISCELLANEOUS

- 6.1 **TERMS AND ABBREVIATIONS USED IN THIS AGREEMENT ARE DEFINED IN SECTION 00700 (GENERAL CONDITIONS) AND SECTION 01420 (REFERENCES AND DEFINITIONS) AND WILL HAVE THE MEANING INDICATED THEREIN.**

- 6.2 IT IS UNDERSTOOD AND AGREED THAT IN NO INSTANCE ARE THE PERSONS SIGNING THIS AGREEMENT FOR OR ON BEHALF OF OWNER OR ACTING AS AN EMPLOYEE, AGENT, OR REPRESENTATIVE OF OWNER, LIABLE ON THIS AGREEMENT OR ANY OF THE CONTRACT DOCUMENTS, OR UPON ANY WARRANTY OF AUTHORITY, OR OTHERWISE, AND IT IS FURTHER UNDERSTOOD AND AGREED THAT LIABILITY OF OWNER IS LIMITED AND CONFINED TO SUCH LIABILITY AS AUTHORIZED OR IMPOSED BY THE CONTRACT DOCUMENTS OR APPLICABLE LAW.
- 6.3 IN ENTERING INTO A PUBLIC WORKS CONTRACT OR A SUBCONTRACT TO SUPPLY GOODS, SERVICES, OR MATERIALS PURSUANT TO A PUBLIC WORKS CONTRACT, CONTRACTOR OR SUBCONTRACTOR OFFERS AND AGREES TO ASSIGN TO THE AWARDING BODY ALL RIGHTS, TITLE, AND INTEREST IN AND TO ALL CAUSES OF ACTION IT MAY HAVE UNDER SECTION 4 OF THE CLAYTON ACT (15 U.S.C. §15) OR UNDER THE CARTWRIGHT ACT (CHAPTER 2 (COMMENCING WITH §16700) OF PART 2 OF DIVISION 7 OF THE BUSINESS AND PROFESSIONS CODE), ARISING FROM PURCHASES OF GOODS, SERVICES, OR MATERIALS PURSUANT TO THE PUBLIC WORKS CONTRACT OR THE SUBCONTRACT. THIS ASSIGNMENT SHALL BE MADE AND BECOME EFFECTIVE AT THE TIME OWNER TENDERS FINAL PAYMENT TO CONTRACTOR, WITHOUT FURTHER ACKNOWLEDGMENT BY THE PARTIES.
- 6.4 COPIES OF THE GENERAL PREVAILING RATES OF PER DIEM WAGES FOR EACH CRAFT, CLASSIFICATION, OR TYPE OF WORKER NEEDED TO EXECUTE THE CONTRACT, AS DETERMINED BY DIRECTOR OF THE STATE OF CALIFORNIA DEPARTMENT OF INDUSTRIAL RELATIONS, ARE DEEMED INCLUDED IN THE CONTRACT DOCUMENTS AND ON FILE AT OWNER'S OFFICE, AND SHALL BE MADE AVAILABLE TO ANY INTERESTED PARTY ON REQUEST. PURSUANT TO CALIFORNIA LABOR CODE SECTIONS 1860 AND 1861, IN ACCORDANCE WITH THE PROVISIONS OF SECTION 3700 OF THE LABOR CODE, EVERY CONTRACTOR WILL BE REQUIRED TO SECURE THE PAYMENT OF COMPENSATION TO THEIR EMPLOYEES. CONTRACTOR REPRESENTS THAT IT IS AWARE OF THE PROVISIONS OF SECTION 3700 OF THE LABOR CODE WHICH REQUIRE EVERY EMPLOYER TO BE INSURED AGAINST LIABILITY FOR WORKERS' COMPENSATION OR TO UNDERTAKE SELF-INSURANCE IN ACCORDANCE WITH THE PROVISIONS OF THAT CODE, AND CONTRACTOR SHALL COMPLY WITH SUCH PROVISIONS BEFORE COMMENCING THE PERFORMANCE OF THE WORK OF THE CONTRACT DOCUMENTS.
- 6.5 OWNER AND ITS AGENTS AND AUTHORIZED REPRESENTATIVES SHALL NOT IN ANY WAY OR MANNER BE ANSWERABLE OR SUFFER LOSS, DAMAGE, EXPENSE, OR LIABILITY FOR ANY LOSS OR DAMAGE THAT MAY HAPPEN TO THE WORK, OR ANY PART THEREOF, OR IN OR ABOUT THE SAME DURING ITS CONSTRUCTION AND BEFORE ACCEPTANCE, AND THE CONTRACTOR SHALL ASSUME ALL LIABILITIES OF EVERY KIND OR NATURE ARISING FROM THE WORK, EITHER BY ACCIDENT, NEGLIGENCE, THEFT, VANDALISM, OR ANY CAUSE WHATSOEVER; AND SHALL HOLD THE OWNER AND ITS AGENTS AND AUTHORIZED REPRESENTATIVES HARMLESS FROM ALL LIABILITY OF EVERY KIND AND NATURE ARISING FROM ACCIDENT, NEGLIGENCE, OR ANY CAUSE WHATSOEVER.

- 6.7 Prior to issuance of the Notice to Proceed by Owner, Contractor shall provide all required certificates of insurance, insurance endorsements, and payment and performance bonds as evidence thereof in accordance with section -- of --.
- 6.8 If Contractor should neglect to prosecute the Work properly or fail to perform any provisions of this Contract, Owner, may, pursuant to the General Conditions and without prejudice to any other remedy it may have, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor.
- 6.9 **NEITHER THE CONTRACT, NOR ANY PART THEREOF, NOR ANY MONEYS DUE OR TO BECOME DUE THEREUNDER, MAY BE ASSIGNED BY CONTRACTOR WITHOUT THE PRIOR WRITTEN APPROVAL OF OWNER, NOR WITHOUT THE WRITTEN CONSENT OF THE SURETY ON THE CONTRACTOR'S PERFORMANCE BOND (THE "SURETY"), UNLESS THE SURETY HAS WAIVED IN WRITING ITS RIGHT TO NOTICE OF ASSIGNMENT.**
- 6.10 Contractor hereby acknowledges that it currently holds valid Type _____ Contractor's license(s) issued by the State of California, Contractors' State License Board, in accordance with division 3, chapter 9, of the Business and Professions Code and in the classification called for in the Contract Documents.
- 6.11 Contractor and all Subcontractors currently are registered as public works contractors with the Department of Industrial Relations, State of California, in accordance with Labor Code section 1771.1.
- 6.12 **CONTRACTOR AND ALL SUBCONTRACTORS SHALL PAY ALL WORKERS ON ALL WORK PERFORMED PURSUANT TO THIS CONTRACT NOT LESS THAN THE GENERAL PREVAILING RATE OF PER DIEM WAGES AND THE GENERAL PREVAILING RATE FOR HOLIDAY AND OVERTIME WORK AS DETERMINED BY THE DIRECTOR OF THE DEPARTMENT OF INDUSTRIAL RELATIONS, STATE OF CALIFORNIA, FOR THE TYPE OF WORK PERFORMED AND THE LOCALITY IN WHICH THE WORK IS TO BE PERFORMED WITHIN THE BOUNDARIES OF THE OWNER, PURSUANT TO SECTIONS 1770 ET SEQ. OF THE CALIFORNIA LABOR CODE.**
- 6.13 No representations have been made other than as set forth in writing in the Contract Documents, including this Agreement. Each of the Parties to this Agreement warrants that it has carefully read and understood the terms and conditions of this Agreement and all Contract Documents, and that it has not relied upon the representations or advice of any other Party or any attorney not its own.

The Contract Documents, including this Agreement, set forth the entire agreement between the parties hereto and fully supersede any and all prior agreements, understandings, written or oral, between the parties hereto pertaining to the subject matter thereof.

- 6.15 IF ANY TERM, COVENANT, CONDITION, OR PROVISION IN ANY OF THE CONTRACT DOCUMENTS IS HELD BY A COURT OF COMPETENT JURISDICTION TO BE INVALID, VOID OR UNENFORCEABLE, THE REMAINDER OF THE PROVISIONS IN THE CONTRACT DOCUMENTS SHALL REMAIN IN FULL FORCE AND EFFECT AND SHALL IN NO WAY BE AFFECTED, IMPAIRED, OR INVALIDATED THEREBY.**
- 6.16 THIS AGREEMENT AND THE CONTRACT DOCUMENTS SHALL BE DEEMED TO HAVE BEEN ENTERED INTO IN THE COUNTY OF SONOMA, STATE OF CALIFORNIA, AND GOVERNED IN ALL RESPECTS BY CALIFORNIA LAW (EXCLUDING CHOICE OF LAW RULES). THE EXCLUSIVE VENUE FOR ALL DISPUTES OR LITIGATION HEREUNDER SHALL BE IN THE SUPERIOR COURT FOR THE COUNTY OF SONOMA.**

IN WITNESS WHEREOF the parties have executed this Agreement in duplicate the day and year first above written.

Reviewed as to substance by Owner:

Geof Syphers, Chief Executive Officer

Reviewed as to funds by Owner:

Division Manager - Administrative Services

Reviewed as to form by General Counsel:

Jessica Mullan, General Counsel

Certificates of Insurance and Guarantee are on
file with and reviewed as to substance for
Owner by:

Programs Manager Date

CONTRACTOR:

[Contractor's name]

By: _____
[Signature]

[Please print name here]

Title: _____

[If Corporation: Chairman, President, or Vice
President]

By: _____
[Signature]

[Please print name here]

Title: _____

Owner

END OF SECTION

SECTION 00550
NOTICE TO PROCEED

Dated: _____, 20____

To: _____
(Contractor)

Address: _____

CONTRACT FOR: **Sonoma Clean Power Advance Energy Center**

You are notified that the Contract Time under the above Contract will commence to run on _____, 20____ [month day, year]. On that date, you are to start performing your obligations with respect to Work under the Contract Documents. In accordance with Article 2 of Section 00520 (Agreement), the dates of Substantial Completion and Final Completion for the entire Work are _____, 20____ [month day, year], and _____, 20____ [month day, year], respectively.

In accordance with Article 5 of Section 00700 (General Conditions), on _____, 20____ [month day, year], you must submit your Schedule of Values and schedule of submittals.

Before you may start any Work at the Site, you must:

OWNER

By: _____

Its: _____

END OF SECTION

SECTION 00611

PERFORMANCE BOND

THIS PERFORMANCE BOND ("Bond") dated _____, is in the penal sum of

[which is one hundred percent of the Contract Sum], and is entered into by and between the parties listed below to ensure the faithful performance of the Construction Contract listed below, which is fully incorporated, including all of the Contract Documents, herein. This Bond consists of this page and the Bond Terms and Conditions, Paragraphs 1 through 12, attached to this page. Any singular reference to _____ [insert name of Contractor] ("Contractor"), _____ [insert name of Surety] ("Surety"), Sonoma Clean Power Authority, a public agency of the State of California ("Owner") or other party shall be considered plural where applicable.

CONTRACTOR:

Name

Address

City/State/Zip

SURETY:

Name

Principal Place of Business

City/State/Zip

CONSTRUCTION CONTRACT:

SONOMA CLEAN POWER ADVANCED ENERGY CENTER

At 741 Fourth Street, Santa Rosa, Sonoma County, California

Signed _____, 20____ in the Amount of \$ _____ (the "Penal Sum")

CONTRACTOR AS PRINCIPAL
Company: (Corp. Seal)

Signature: _____

Name and Title: _____

SURETY
Company: (Corp. Seal)

Signature: _____

Name and Title: _____

BOND TERMS AND CONDITIONS

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to Owner for the complete and proper performance of the Construction Contract, which is incorporated herein by reference.
2. If Contractor completely and properly performs all of its obligations under the Construction Contract, Surety and Contractor shall have no obligation under this Bond.
3. If there is no Owner Default, Surety's obligation under this Bond shall arise after:
 - 3.1 Owner has declared a Contractor Default under the Construction Contract pursuant to the terms of the Construction Contract; and
 - 3.2 Owner has agreed to pay the Balance of the Contract Sum:
 - 3.2.1 To Surety in accordance with the terms of this Bond and the Construction Contract;
or
 - 3.2.2 To a contractor selected to perform the Construction Contract in accordance with the terms of this Bond and the Construction Contract.
4. When Owner has satisfied the conditions of Paragraph 3, Surety shall promptly (within 30 Days) and at Surety's expense elect to take one of the following actions:
 - 4.1 Arrange for Contractor, with consent of Owner, to perform and complete the Construction Contract (but Owner may withhold consent, entirely within its discretion, in which case the Surety must elect an option described in Paragraphs 4.2, 4.3, or 4.4, below); or
 - 4.2 Undertake to perform and complete the Construction Contract itself, through its agents or through independent contractors; provided that Surety may not select Contractor as its agent or independent contractor without Owner's consent; or
 - 4.3 Undertake to perform and complete the Construction Contract by obtaining bids from qualified contractors acceptable to Owner for a contract for performance and completion of the Construction Contract and, upon determination by Owner of the lowest responsive and responsible Bidder, arrange for a contract to be prepared for execution by Owner and the contractor selected with Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract; and, if Surety's obligations defined in Paragraph 6, below, exceed the Balance of the Contract Sum, then Surety shall pay to Owner the amount of such excess upon Owner's demand; or
 - 4.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances and, after investigation and consultation with Owner, tender the full penal sum of the bond.

5. If Surety does not proceed as provided in Paragraph 4, above, then Surety shall be deemed to be in default on this Bond ten Days after receipt of an additional written notice from Owner to Surety demanding that Surety perform its obligations under this Bond. At all times Owner shall be entitled to enforce any remedy available to Owner at law or under the Construction Contract, including without limitation, and by way of example only, rights to perform work, protect Work, mitigate damages, advance critical Work to mitigate schedule delay, or coordinate Work with other consultants or contractors.
6. Surety's monetary obligation under this Bond is limited by the amount of this Bond identified herein as the Penal Sum. This monetary obligation shall augment the Balance of the Contract Sum. Subject to these limits, Surety's obligations under this Bond are commensurate with the obligations of Contractor under the Construction Contract. Surety's obligations shall include, but are not limited to:
 - 6.1 The responsibilities of Contractor under the Construction Contract for completion of the Construction Contract and correction of Defective Work;
 - 6.2 The responsibilities of Contractor under the Construction Contract to pay liquidated damages, and for damages for which no liquidated damages are specified in the Construction Contract, actual damages caused by non-performance of the Construction Contract including, but not limited to, all valid and proper backcharges, offsets, payments, indemnities, or other damages;
 - 6.3 Additional legal, design professional, and delay costs resulting from Contractor Default or resulting from the actions or failure to act of the Surety under Paragraph 4, above (but excluding attorney's fees incurred to enforce this Bond).
7. No right of action shall accrue on this Bond to any person or entity other than Owner or its successors or assigns.
8. Surety hereby waives notice of any change, alteration or addition, to the Construction Contract or to related subcontracts, purchase orders, and other obligations, including changes of time. Surety consents to all terms of the Construction Contract, including provisions on changes to the Contract. No extension of time, change, alteration, Modification, deletion, or addition to the Contract Documents, or of the Work required thereunder, shall release or exonerate Surety on this Bond or in any way affect the obligations of Surety on this Bond. Surety waives the provisions of Civil Code §§ 2819 and 2845.
9. Any proceeding, legal or equitable, under this Bond shall be instituted in any court of competent jurisdiction where a proceeding is pending between Owner and Contractor regarding the Construction Contract, or in the courts of the County of Sonoma, or in a court of competent jurisdiction in the location in which the Work is located. Communications from Owner to Surety under Paragraph 3.1 of this Bond shall be deemed to include the necessary agreements under Paragraph 3.2 of this Bond unless expressly stated otherwise.
10. All notices to Surety or Contractor shall be mailed or delivered (at the address set forth on the signature page of this Bond), and all notices to Owner shall be mailed or delivered as provided in Section 00520 (Agreement). Actual receipt of notice by Surety, Owner or Contractor,

however accomplished, shall be sufficient compliance as of the date received at the foregoing addresses.

11. Any provision in this Bond conflicting with any statutory or regulatory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein.
12. Definitions.
 - 12.1 Balance of the Contract Sum: The total amount payable by Owner to Contractor pursuant to the terms of the Construction Contract after all proper adjustments have been made under the Construction Contract, for example, deductions for progress payments made, and increases/decreases for approved Modifications to the Construction Contract.
 - 12.2 Construction Contract: The agreement between Owner and Contractor identified on the signature page of this Bond, including all Contract Documents and changes thereto.
 - 12.3 Contractor Default: Material failure of Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Construction Contract including, but not limited to, "default" or any other condition allowing a termination for cause as provided in Section 00700 (General Conditions).
 - 12.4 Owner Default: Material failure of Owner, which has neither been remedied nor waived, to pay Contractor progress payments due under the Construction Contract or to perform other material terms of the Construction Contract, if such failure is the cause of the asserted Contractor Default and is sufficient to justify Contractor termination of the Construction Contract.

END OF SECTION

SECTION 00612

PAYMENT BOND

THIS PAYMENT BOND ("Bond") is dated _____, is in the penal sum of _____

[one hundred percent of the Contract Sum], and is entered into by and between the parties listed below to ensure the payment of claimants under the Construction Contract listed below. This Bond consists of this page and the Bond Terms and Conditions, Paragraphs 1 through 13, attached to this page. Any singular reference to _____ [insert name of Contractor] ("Contractor"), _____ [insert name of Surety] ("Surety"), the Sonoma Clean Power Authority, a public agency of the State of California ("Owner") or other party shall be considered plural where applicable.

CONTRACTOR:

Name

Address

City/State/Zip

SURETY:

Name

Principal Place of Business

City/State/Zip

CONSTRUCTION CONTRACT:

SONOMA CLEAN POWER ADVANCED ENERGY CENTER

At 741 Fourth Street, Santa Rosa, Sonoma County, California

Signed _____, 20____ in the Amount of \$ _____ (the "Penal Sum")

CONTRACTOR AS PRINCIPAL
Company: (Corp. Seal)

Signature: _____

Name and Title: _____

SURETY
Company: (Corp. Seal)

Signature: _____

Name and Title: _____

BOND TERMS AND CONDITIONS

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner and to Claimants, to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference.
2. With respect to Owner, this obligation shall be null and void if Contractor:
 - 2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants; and
 - 2.2 Defends, indemnifies, and holds harmless Owner from all claims, demands, liens, or suits by any person or entity who furnished labor, materials, or equipment for use in the performance of the Construction Contract, provided Owner has promptly notified Contractor and Surety (at the address set forth on the signature page of this Bond) of any claims, demands, liens, or suits and tendered defense of such claims, demands, liens, or suits to Contractor and Surety, and provided there is no Owner Default.
3. With respect to Claimants, this obligation shall be null and void if Contractor promptly makes payment, directly or indirectly through its Subcontractors, for all sums due Claimants. If Contractor or its Subcontractors fail to pay any of the persons named in Section 9100 of the California Civil Code, or amounts due under the Unemployment Insurance Code with respect to Work or labor performed under the Contract, or for any amounts required to be deducted, withheld, and paid over to the Employment Development Department from the wages of employees of Contractor or Subcontractors pursuant to Section 13020 of the Unemployment Insurance Code, with respect to such Work and labor, then Surety shall pay for the same, and also, in case suit is brought upon this Bond, a reasonable attorney's fee, to be fixed by the court.
4. Consistent with the California Mechanic's Lien Law, Civil Code Section 8000, *et seq.*, Surety shall have no obligation to Claimants under this Bond unless the Claimant has satisfied all applicable notice requirements.
5. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by Surety under this Bond.
6. Amounts due Contractor under the Construction Contract shall be applied first to satisfy claims, if any, under any Construction Performance Bond and second, to satisfy obligations of Contractor and Surety under this Bond.
7. Owner shall not be liable for payment of any costs, expenses, or attorney's fees of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.
8. Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations. Surety further hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the Construction Contract, or to the Work to be performed thereunder, or materials or equipment to be furnished thereunder or the Specifications accompanying the same, shall in

any way affect its obligations under this Bond, and it does hereby waive any requirement of notice or any such change, extension of time, alteration or addition to the terms of the Construction Contract or to the Work or to the Specifications or any other changes. Surety waives the provisions of Civil Code §§ 2819 and 2845.

9. Suit against Surety on this Bond may be brought by any Claimant or its assigns at any time after the Claimant has furnished the last of the labor or materials or both, but, per Civil Code Section 9558, must be commenced before the expiration of six months after the period in which stop notices may be filed as provided in Civil Code Section 9356.
10. All notices to Surety or Contractor shall be mailed or delivered (at the address set forth on the signature page of this Bond), and all notices to Owner shall be mailed or delivered as provided in Section 00520 (Agreement). Actual receipt of notice by Surety, Owner, or Contractor, however accomplished, shall be sufficient compliance as of the date received at the foregoing addresses.
11. This Bond has been furnished to comply with the California Law including, but not limited to, Civil Code Sections 9550, 9554, *et seq.* Any provision in this Bond conflicting with said statutory requirements shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirements shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.
12. Upon request by any person or entity appearing to be a potential beneficiary of this Bond, Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.
13. Definitions.
 - 13.1.1 Claimant: An individual or entity having a direct contract with Contractor or with a Subcontractor of Contractor to furnish labor, materials, or equipment for use in the performance of the Contract, as further defined in California Civil Code section 9100. The intent of this Bond shall be to include without limitation in the terms "labor, materials, or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural, and engineering services required for performance of the Work of Contractor and Contractor's Subcontractors, and all other items for which a stop notice might be asserted. The term Claimant shall also include the Unemployment Development Department as referred to in Civil Code section 9554(b).
 - 13.1.2 Construction Contract: The agreement between Owner and Contractor identified on the signature page of this Bond, including all Contract Documents and changes thereto.
 - 13.1.3 Owner Default: Material failure of Owner, which has neither been remedied nor waived, to pay the Contractor as required by the Construction Contract, provided that failure is the cause of the failure of Contractor to pay the Claimants and is sufficient to justify termination of the Construction Contract.

END OF SECTION

SECTION 00630

GUARANTEE

TO: SONOMA CLEAN POWER AUTHORITY("Owner"), for construction of Sonoma Clean Power Advanced Energy Center located 741 Fourth Street, Santa Rosa at Sonoma County , California.

1. The undersigned guarantees all construction performed on this Project and also guarantees all material and equipment incorporated therein.
2. Contractor hereby grants to Owner for a period of two year following the date of Final Acceptance of the Work completed, or such longer period of time as may be prescribed by laws and regulations, or by the terms of the Contract Documents (the "Guarantee Period"), its unconditional warranty of the quality and adequacy of all of the Work including without limitation, all labor, materials, and equipment provided by Contractor and its Subcontractors of all tiers in connection with the Work. Without limiting the generality of the forgoing warranties, if the performance of materials or equipment involves or affects water-tightness (above grade or below grade) or any type of moisture intrusion, Contractor shall act as co-guarantor of such materials and equipment for either the term of the Extended Warranty pursuant to Section 00700 (General Conditions) for such materials or equipment or three years, whichever is shorter.
3. Neither final payment nor use or occupancy of the Work performed by the Contractor shall constitute an acceptance of Work not done in accordance with this Guarantee or relieve Contractor of liability in respect to any express warranties or responsibilities for faulty materials or workmanship. Contractor shall remedy any defects in the Work and pay for any damage resulting therefrom, which shall appear within the Guarantee Period.
4. If within the Guarantee Period any Work is found to be Defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions, correct such Defective Work. Contractor shall remove any Defective Work rejected by Owner and replace it with Work that is not Defective, and satisfactorily correct or remove and replace any damage to other Work or the work of others resulting therefrom. If Contractor fails to promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the Defective Work corrected or the rejected Work removed and replaced. Contractor shall pay for all claims, costs, losses and damages caused by or resulting from such removal and replacement. Where Contractor fails to correct Defective Work, or defects are discovered outside the Guarantee Period, Owner shall have all rights and remedies granted by law including, but not limited to, the right to pursue an action for breach of contract based on a patent or latent deficiency.
5. Inspection of the Work shall not relieve Contractor of any of its obligations under the Contract Documents. Even though equipment, materials, or Work required to be provided under the Contract Documents have been inspected, accepted, and estimated for payment, Contractor shall, at its own expense, replace or repair any such equipment, material, or Work found to be Defective or otherwise not to comply with the requirements of the Contract Documents up to the end of the Guarantee Period.

6. All abbreviations and definitions of terms used in this Agreement shall have the meanings set forth in the Contract Documents, including, without means of limitation, Section 00700 (General Conditions) and Section 01420 (References and Definitions).
7. The foregoing Guarantee is in addition to any other warranties of Contractor contained in the Contract Documents, and not in lieu of, any and all other liability imposed on Contractor under the Contract Documents and at law with respect to Contractor's duties, obligations, and performance under the Contract Documents. In the event of any conflict or inconsistency between the terms of this Guarantee and any warranty or obligation of the Contractor under the Contract Documents or at law, such inconsistency or conflict shall be resolved in favor of the higher level of obligation of the Contractor.

Date: _____, 20____

Contractor's name

By: _____
Signature

Print Name

Title

Street Address

City, State, Zip code

END OF SECTION

SECTION 00650

AGREEMENT AND RELEASE OF ANY AND ALL CLAIMS

THIS AGREEMENT AND RELEASE OF ANY AND ALL CLAIMS ("Agreement and Release"), made and entered into this [date] day of [Month], 20____, by and between Sonoma Clean Power Authority("Owner"), and [Name of Contractor] ("Contractor"), whose place of business is at [Address of Contractor].

RECITALS

- A. Owner and Contractor entered into a Contract for work on the [Full Project Name].
- B. The Work under the Contract has been completed.

AGREEMENT

NOW THEREFORE, it is mutually agreed between Owner and Contractor as follows:

1. Contractor will not be assessed liquidated damages or other withheld items except as detailed below:

Original Contract Sum	\$ _____
Modified Contract Sum	\$ _____
Payment to Date	\$ _____
Liquidated Damages	\$ _____
Other Withheld Items	\$ _____
Payment Due Contractor	\$ _____
2. Subject to the provisions of this Agreement and Release, Owner will forthwith pay to Contractor the sum of [_____ Dollars and _____ Cents (\$_____)] under the Contract, less any amounts withheld under the Contract or represented by any Notice to Withhold Funds on file with Owner as of the date of such payment.
3. Contractor acknowledges and hereby agrees that there are no unresolved or outstanding claims in dispute against Owner arising from the Contract, except for the claims described in Paragraph 4 of this Agreement and Release. It is the intention of the parties in executing this Agreement and Release that this Agreement and Release shall be effective as a full, final and general release of all claims, demands, actions, causes of action, obligations, costs, expenses, damages, losses and liabilities of Contractor against Owner, and all of its agents, employees, consultants, inspectors, representatives, assignees, and transferees, except for the Disputed Claims set forth in Paragraph

4 of this Agreement and Release. Nothing in this Agreement and Release shall limit or modify Contractor's continuing obligations described in Paragraph 6 of this Agreement and Release.

4. The following claims submitted under Section 00700 (General Conditions), Article 12, are disputed (hereinafter, the "Disputed Claims") and are specifically excluded from the operation of this Agreement and Release.

[Insert information in Chart below, affix attachment if necessary]

DATE SUBMIT TED	DESCRIPTION OF CLAIM	AMOUNT OF CLAIM

5. Consistent with California Public Contract Code Section 7100, Contractor hereby agrees that, in consideration of the payment set forth in Paragraph 2 of this Agreement and Release, Contractor hereby releases and forever discharges Owner, and all of its agents, employees, consultants, inspectors, assignees, and transferees from any and all liability, claims, demands, actions, or causes of action of whatever kind or nature arising out of or in any way concerned with the Work under the Contract.
6. Guarantees and warranties for the Work, and any other continuing obligation of Contractor, shall remain in full force and effect as specified in the Contract Documents.
7. To the fullest extent permitted by law, Contractor must indemnify, defend, and hold harmless Owner, its Board and Committees, officers, officials, employees, agents, volunteers, and consultants (individually, an "Indemnatee," and collectively the "Indemnitees") from and against any and all liability, loss, damage, claims, causes of action, demands, charges, fines, costs, and expenses (including, without limitation, attorney fees, expert witness fees, paralegal fees, and fees and costs of litigation or arbitration) (collectively, "Liability") of every nature arising out of or in connection with the acts or omissions of Contractor, its employees, Subcontractors, representatives, or agents, in bidding or performing the Work or in failing to comply with any obligation of Contractor under the Contract, except such Liability caused by the active negligence, sole negligence, or willful misconduct of an Indemnatee and except for the Disputed Claims set forth in paragraph 4 of this release .
8. **Contractor, having had full opportunity to consult with independent counsel regarding this matter, expressly waives all benefits and rights otherwise available under Section 1542 of the California Civil Code, which provides:**

A general release does not extend to claims which the creditor does not know or suspect to exist in his or her favor at the time of executing the release, which if known by him or her, must have materially affected his or her settlement with the debtor.

Contractor has read the foregoing waiver and understands that the releases here granted by Contractor apply to and include all known and unknown and unexpected claims. Contractor intends, by signing this Agreement and Release, to release and assume the risk of unknown claims.

By: _____
Contractor initials

9. The provisions of this Agreement and Release are contractual in nature and not mere recitals and shall be considered independent and severable, and if any such provision or any part thereof shall be at any time held invalid in whole or in part under any federal, state, county, municipal, or other law, ruling, or regulation, then such provision or part thereof shall remain in force and effect only to the extent permitted by law, and the remaining provisions of this Agreement and Release shall also remain in full force and effect, and shall be enforceable.
10. Contractor represents and warrants that it is the true and lawful owner of all claims and other matters released pursuant to this Agreement and Release, and that it has full right, title, and authority to enter into this instrument. Each party represents and warrants that it has been represented by counsel of its own choosing in connection with this Agreement and Release.
11. All rights of Owner shall survive completion of the Work or termination of the Contract, and execution of this Agreement and Release.

*** * * CAUTION: THIS IS A RELEASE - READ BEFORE EXECUTING * * ***

SONOMA CLEAN POWER AUTHORITY

A Public Agency of the State of California

By: _____
Geof Sypher, Chief Executive Officer

[CONTRACTOR]

By: _____

Name: _____

Its: _____
(Title)

REVIEWED AS TO FORM:

General Counsel

_____, 20____

END OF SECTION

SECTION 00660

SUBSTITUTION REQUEST FORM

During Bid Period To: Cordel Stillman, Director of Programs Sonoma Clean Power Authority Fax: 707-978-3471 Email: cstillman@sonomacleanpower.org	After Award of Contract To: Cordel Stillman, Director of Programs Sonoma Clean Power Authority Electronic submittal: Owner's construction management system
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PROJECT: Sonoma Clean Power Advanced Energy Center	Bidder/Contractor:
---	---------------------------

Substitution Request By:	Company Name:
--------------------------	---------------

Transmittal Record	Attn:	Company Name:	Date Sent:	Date Rec'd:	Date Due:
Bidder/Contractor to Owner					
Owner to Consultant (if applicable)					
Consultant to Owner (if applicable)					
Owner to Bidder/Contractor					

We hereby submit for your consideration the following product instead of the specified item for the Project:

Section / Drawing	Paragraph	Specified Item
Proposed Substitution:		

We have (a) attached manufacturer's literature, including complete technical data and laboratory test results, if applicable, (b) attached an explanation of why proposed substitution is a true equivalent to specified item, (c) included complete information on changes to Contract Documents that the proposed substitution will require for its proper installation, and (d) filled in the blanks below:

Bidder/Contractor to complete questions that follow and certifies to the accuracy of all answers:

A.	Does the substitution affect dimensions shown on Drawings? Yes ___ / No ___. If No, please explain proposed mitigation and why substitution is equivalent to originally specified item:
B.	Will the undersigned be responsible for additional Project costs for design and construction resulting from the proposed substitution? Yes ___ / No ___. If No, please state reasons explain why substitution is equivalent to originally specified item:
C.	Will substitution cause change to Project Schedule, or to critical delivery dates? Add? Shorten? If the substitution will add to schedule dates or affect critical activities, please explain why substitution is equivalent to originally specified item:
D.	Please describe differences between proposed substitution and specified item. Please explain and identify any and all differences, and please explain why substitution is equivalent to originally specified item:
E.	What is the Cost Differential to Contractor in original specified item and proposed substitution including all mark-ups? [If substitution requested during Bid period, skip this question.]
F.	Are Manufacturer's warranties for the proposed item the same as for item specified? Yes ____; No _____. If No, please explain why substitution is equivalent to originally specified item. Provide the proposed warranty form with Project-specific references signed by the manufacturers authorized representative:
G.	Does Bidder/Contractor accept full responsibility for delays caused by redesign of other items of the Work necessitated by substitution? Yes ___ / No ___. If No, please state reasons and explain why substitution is equivalent to originally specified item:

H.	Does Bidder/Contractor certify that the function, appearance, and quality are equivalent or superior to the specified item? Yes ___ / No ___. If No, please explain why substitution is equivalent to originally specified item:
I.	Does the substitution meet or exceed performance standards of proposed item? Yes ___ / No ___. If No, explain why why substitution is equivalent to originally specified item:

We certify that the function, appearance, and quality of the proposed substitution are equivalent or superior to those of the specified item, except as we may specifically state otherwise in this request.

Submitted by: _____ Signature: _____

Company Name: _____ Date: _____

Address: _____ Phone/ Fax: _____

Email: _____

Remarks: _____

Owner Response:

- ☐ Accepted
- ☐ Not Accepted
- ☐ Accepted As Noted
- ☐ Received Too Late

Remarks:

By:

Date:

END OF SECTION

SECTION 00670

ESCROW BID DOCUMENTS



1. Requirements for Escrow Bid Documents.
 - a. Within the time period established in Section 00200 (Instructions to Bidders), Contractor shall submit to Owner a set of Escrow Bid Documents as defined in Paragraph 2 below. Escrow Bid Documents will be used only in the manner and for the purposes described in this Section 00670.
 - b. The submission of the Escrow Bid Documents, as with the bonds and insurance documents required under Section 00200 (Instructions to Bidders), is considered an essential part of the Contract award. Should Contractor fail to make the submission within the allowed time specified, Contractor may be deemed to have failed to enter into the Contract, Contractor shall forfeit the amount of its Bid security accompanying Contractor's Bid, and Owner may award the Contract to the next lowest responsive responsible Bidder.
 - c. NO PAYMENTS WILL BE MADE, NOR WILL OWNER ACCEPT CHANGE ORDER REQUESTS UNTIL THE ABOVE-REQUIRED INFORMATION IS SUBMITTED AND APPROVED.
 - d. Contractor shall submit the Escrow Bid Documents, in person by an authorized representative of the Contractor, to:

Cordel Stillman, Director of Programs, Sonoma Clean Power Authority

50 Santa Rosa Ave.
Santa Rosa, California

2. Scope of Escrow Bid Documents.
 - a. Within the time period specified in Section 00200 (Instructions to Bidders), Contractor shall submit one copy of all documentary information received or generated by Contractor in preparation of Bid prices for the Contract Documents, as specified in Paragraphs 5 and 6 of this Section 00670. If Contractor's Bid is based upon subcontracting any part of the Work, each Subcontractor whose total subcontract price exceeds five percent of the total Contract Sum proposed by Contractor, shall provide separate Escrow Documents to be included with those of Contractor. The material described in this Paragraph is referred to in this Section 00670 as the "Escrow Bid Documents." Contractor's Escrow Bid Documents, and those of any Subcontractors submitted pursuant to this Section 00670, will be held in escrow as provided in this Section 00670.
 - b. Contractor represents and agrees, as a condition of award of the Contract, that the Escrow Bid Documents constitute all written information used in the preparation of its Bid, and that no other written Bid preparation information shall be considered in resolving disputes or

claims or may be considered in legal proceedings. Contractor also agrees that nothing in the Escrow Bid Documents shall change or modify the terms or conditions of the Contract Documents. Contractor is advised that the Escrow Bid Documents will only be used as a guide in the resolution of disputes and claims.

3. Ownership of Escrow Bid Documents.

- a. The Escrow Bid Documents are, and shall always remain, the property of Contractor or the Subcontractor as the case may be, subject to joint review by Owner, Contractor, and Subcontractor, as provided in this Section 00670.

b. Owner stipulates and expressly acknowledges that the Escrow Bid Documents constitute trade secrets. This acknowledgement is based on Owner's express understanding that the information contained in the Escrow Bid Documents is not known outside Contractor's or Subcontractor's business, is known only to a limited extent and only by a limited number of Contractor's or Subcontractor's Employees, is safeguarded while in Contractor's and Subcontractor's possession, is extremely valuable to Contractor and Subcontractor and could be extremely valuable to Contractor's and Subcontractor's competitors by virtue of it reflecting Contractor's and Subcontractor's contemplated construction techniques. Owner further acknowledges that the Escrow Bid Documents and the information contained in them are made available to Owner only because such action is an express pre-requisite to award of the Contract. Owner agrees to safeguard the Escrow Bid Documents, and all information contained in them, against disclosure to the fullest extent permitted by law, consistent with Paragraph 4 of this Section 00670.

4. Escrow Bid Documents may be used in the determination of price adjustments and Change Orders and in the settlement of disputes and claims. If used in legal proceedings, Escrow Bid Documents shall be subject to an appropriate protective order limiting their disclosure.

5. Format and Contents of Escrow Bid Documents.

- a. Contractor and Subcontractor(s) subject to the requirements of this Section 00670 may submit Escrow Bid Documents in their usual cost-estimating format; a standard format is not required. Contractor and Subcontractor(s) shall prepare and submit the Escrow Bid Documents in English.
- b. Owner requires Contractor to itemize clearly in the Escrow Bid Documents the estimated costs of performing the Work of each Bid item contained in Contractor's Bid. Contractor shall separate Bid items into sub-items as required to present a detailed cost estimate and allow a detailed cost review. The Escrow Bid Documents shall include all Subcontractor bids or quotes, supplier bids or quotes, quantity take-offs, crews, equipment, calculations of rates of production and progress, copies of quotes from Subcontractors and suppliers, and memoranda, narratives, add/deduct sheets, and all other information used by Contractor to arrive at the prices contained in the Bid. Escrow Bid Documents shall include costs of scheduled maintenance, depreciation, fleet rental expense discounts and incentives, and similar cost adjustments if used by Contractor to calculate its Bid prices. Estimated costs shall be broken down into Contractor's usual estimate categories such as direct labor, repair labor, equipment ownership and operation, expendable materials, permanent materials,

and subcontract costs as appropriate. Plant and equipment and indirect costs should be detailed in Contractor's usual format. Contractor shall identify its allocation of indirect costs, contingencies, markup, and other items to each Bid item. The foregoing requirements also apply to Subcontractor Escrow Bid Documents.

- c. Contractor and Subcontractor shall identify all costs. For Bid items amounting to less than \$10,000, Contractor and Subcontractor may estimate costs without a detailed cost estimate, provided that Contractor and Subcontractor includes applicable labor, equipment, materials, and subcontracts, and allocates applicable indirect costs, contingencies, and markup.
- d. Bid documents provided by Owner should not be included in the Escrow Bid Documents unless needed to comply with these requirements.

6. Submittal of Escrow Bid Documents.

- a. Submit Escrow Bid Documents in a container clearly marked on the outside with Contractor's name, date of submittal, Project name, and the words "Escrow Bid Documents - Open only in the presence of Authorized Representatives of both Owner and Contractor." Owner will review the Escrow Bid Documents for initial compliance. Owner has three Days after receipt of Bidder's Escrow Bid Documents to demand additional information.
- b. By submitting Escrow Bid Documents, Contractor represents that the material in the Escrow Bid Documents constitutes all the documentary information used in preparation of the Bid and that Contractor has personally examined the contents of the Escrow Bid Documents container and has found that the documents in the container are complete. Contractor agrees that it will not introduce or rely on any other documents to prove how it prepared its Bid.
- c. Subcontractor Escrow Bid Documents shall be opened and examined in the same manner and at the same time as the examination described above for Contractor.
- d. If Contractor wishes to subcontract any portion of the Work after award, Owner retains the right to require Contractor to submit Escrow Documents for the Subcontractor before approval of the subcontract.

7. Storage, Examination, and Final Disposition of Escrow Bid Documents.

- a. The Escrow Bid Documents will be stored until Final Completion of Work on the Project in a secure location at Owner's main office unless Contractor requests that the Escrow Bid Documents be placed in escrow at a mutually agreeable institution. If Contractor requests storage by a third party escrow agent, Contractor shall pay the cost of storage for the Escrow Bid Documents. The storage facilities shall be the appropriate size for all the Escrow Bid Documents and located conveniently to both Owner's and, to the extent reasonably possible, Contractor's offices, but in no event outside the County of Sonoma.

- b. Both Owner and Contractor shall examine the Escrow Bid Documents, at any time deemed necessary by either Owner or Contractor, to assist in the negotiation of price adjustments and Change Orders or the settlement of disputes and claims. Examination of the Escrow Bid Documents is subject to the following conditions:
 - i. As trade secrets, the Escrow Bid Documents are proprietary and confidential under Paragraph 3.b. of this Section 00670.
 - ii. Owner and Contractor (and any Subcontractor, to the extent Escrow Bid Documents are required of a Subcontractor) shall each designate in writing to the other party(s) at least seven Days prior to any examination, representatives who are authorized to examine the Escrow Bid Documents. Except as otherwise provided in a court order, no other persons shall have access to the Escrow Documents.
 - iii. Except as otherwise provided in a court order, access to the documents may take place only in the presence of duly designated representatives of Owner and Contractor (and any Subcontractor, to the extent Subcontractor Escrow Bid Documents are to be reviewed). If Contractor or Subcontractor fails to designate a representative or appear for joint examination on seven Days' notice, then Owner's Representative(s) may examine the Escrow Bid Documents upon an additional three Days' notice.
 - iv. Following Final Completion of Work on the Project and achievement of final settlement, Owner shall direct the escrow agent holding the Escrow Bid Documents in writing to return those documents to Contractor or to the Subcontractor, as applicable.

END OF SECTION

SECTION 00680

ESCROW AGREEMENT FOR SECURITY DEPOSIT IN LIEU OF RETENTION

California Public Contract Code Section 22300

THIS ESCROW AGREEMENT ("Escrow Agreement") is made and entered into this ____ day of _____, 20____, by and between Sonoma Clean Power Authority, ("Owner"), whose address is 50 Santa Rosa Avenue, Santa Rosa, CA 95404, _____ **[Name of Contractor]** ("Contractor"), whose place of business is located at _____ **[Contractor's Address]**, and [] Owner, as escrow agent OR [] _____ **[Name of Bank]**, a state or federally chartered bank in the State of California, whose place of business is located at _____ ("Escrow Agent").

For the consideration hereinafter set forth, Owner, Contractor, and Escrow Agent agree as follows:

1. Pursuant to California Public Contract Code Section 22300, Contractor has the option to deposit securities with Escrow Agent as a substitute for retention earnings required to be withheld by Owner pursuant to Contract entered into between Owner and Contractor for Sonoma Clean Power Advanced Energy Center located at _____ in the amount of \$_____ dated _____, 20____ (the "Contract"). Alternatively, on written request of Contractor, Owner shall make payments of the retention earnings directly to Escrow Agent. When Contractor deposits the securities as a substitute for Contract earnings, Escrow Agent shall notify Owner within ten Days of the deposit. The market value of the securities at the time of substitution shall be at least equal to the cash amount then required to be withheld as retention under terms of Contract between Owner and Contractor. Securities shall be held in name of _____, and shall designate Contractor as the beneficial owner.
2. Owner shall make progress payments to Contractor for those funds which otherwise would be withheld from progress payments pursuant to Contract provisions, provided that Escrow Agent holds securities in form and amount specified in Paragraph 1 of this Section 00680.
3. When Owner makes payment(s) of retention earned directly to Escrow Agent, Escrow Agent shall hold said payment(s) for the benefit of Contractor until the time that the escrow created under this Escrow Agreement is terminated. Contractor may direct the investment of the payments into securities. All terms and conditions of this Escrow Agreement and the rights and responsibilities of the parties shall be equally applicable and binding when Owner pays Escrow Agent directly.
4. Contractor shall be responsible for paying all fees for the expenses incurred by Escrow Agent in administering the Escrow Account, and all expenses of Owner. Such expenses and payment terms shall be determined by Owner, Contractor, and Escrow Agent.
5. Interest earned on securities or money market accounts held in escrow and all interest earned on that interest shall be for sole account of Contractor and shall be subject to withdrawal by Contractor at any time and from time to time without notice to Owner.

6. Contractor shall have the right to withdraw all or any part of the principal in the Escrow Account only by written notice to Escrow Agent accompanied by written authorization from Owner to Escrow Agent that Owner consents to withdrawal of amount sought to be withdrawn by Contractor.
7. Owner shall have the right to draw upon the securities in event of default by Contractor. Upon seven Days written notice to Escrow Agent from Owner of the default, Escrow Agent shall immediately convert the securities to cash and shall distribute the cash as instructed by Owner.
8. Upon receipt of written notification from Owner certifying that the Contract is final and complete, and that Contractor has complied with all requirements and procedures applicable to the Contract, Escrow Agent shall release to Contractor all securities and interest on deposit less escrow fees and charges of the Escrow Account. The escrow shall be closed immediately upon disbursement of all monies and securities on deposit and payments of fees and charges.
9. Escrow Agent shall rely on written notifications from Owner and Contractor pursuant to Paragraphs 5 through 8, inclusive, of this Section 00680 and Owner and Contractor shall hold Escrow Agent harmless from Escrow Agent's release and disbursement of securities and interest as set forth.
10. Names of persons who are authorized to give written notice or to receive written notice on behalf of Owner and on behalf of Contractor in connection with the foregoing, and exemplars of their respective signatures are as follows:

ON BEHALF OF OWNER:

Chief Executive Officer

Title

Geof Syphers

Name

Signature

50 Santa Rosa Avenue

Address

Santa Rosa, CA 95404

City/State/Zip

ON BEHALF OF CONTRACTOR:

Title

Name

Signature

Address

City/State/Zip

ON BEHALF OF ESCROW AGENT:

Title

Name

Signature

Address

City/State/Zip

REVIEWED AS TO FORM

General Counsel

Date: _____

At the time the Escrow Account is opened, Owner and Contractor shall deliver to Escrow Agent a fully executed counterpart of this Section 00680.

END OF SECTION

SECTION 00700

GENERAL CONDITIONS

Table of Contents

Article 1 – Interpretation of Contract Documents.....	45
1.1 Interpretation of Contract Documents:	45
1.2 Order Of Precedence Of Documents:	45
Article 2 – Pre-Bid Investigations	46
2.1 Pre-Bid Investigations Required:.....	46
2.2 Limited Reliance Permitted on Owner’s Existing Conditions Data:	47
2.3 Pre-Bid Investigation Requirements for Excavation and Utilities Relocation Projects:	47
Article 3 – Subcontractors.....	48
3.1 Subcontractor Listing Law:	48
3.2 Subcontracts:	48
Article 4 – Drawings and Specifications.....	49
4.1 Intent of Drawings and Specifications:.....	49
4.2 Checking of Drawings and Specifications:	49
4.3 Interpretation of Drawings and Specifications:.....	50
4.4 Use of Drawings and Specifications:	50
Article 5 – Commencement of the Work	50
5.1 Submission of Required Schedules:	50
5.2 Commencement Date of Contract Time:	51
Article 6 – Contractor’s Organization and Equipment	51
6.1 Contractor’s Legal Address:.....	51
6.2 Contractor’s Superintendents or Forepersons:.....	52
6.3 Proficiency in English:	52
6.4 Contractor’s and Subcontractors’ Employees:.....	52
6.5 Contractor’s Use of the Site:	52
6.6 Contractor’s Site Office:	53
Article 7 – Owner’s Administration of Work	53
7.1 Owner’s Representative(s):	53
7.2 Owner’s Observation of the Work:	53
7.3 Construction Manager’s Observation of Work:	53
7.4 Owner’s and Construction Manager’s Exercise of Contract Responsibilities:.....	54
7.5 Owner’s Right of Access to the Work:.....	54

7.6	Owner's Right of Separate Construction:	54
Article 8 – Contractor's Prosecution and Progress of the Work		55
8.1	Contractor to Supervise the Work:	55
8.2	Contractor to Maintain Cost Data:	56
8.3	Contractor to Supply Sufficient Workers and Materials:	56
8.4	Contractor to Maintain Project Record Documents:	57
8.5	Contractor to not Disrupt Owner Operation:	58
8.6	Contractor to Provide Temporary Facilities and Controls:	58
Article 9 – Warranty, Guarantee, and Inspection of Work		58
9.1	Warranty and Guarantee:	59
9.2	Inspection of Work:	60
9.3	Correction of Defective Work:	61
9.4	Acceptance and Correction of Defective Work by Owner:	62
9.5	Rights Upon Inspection, Correction or Acceptance:	63
9.6	Proof of Compliance of Contract Provisions:	63
9.7	Guarantee Period and Project Warranty Period:	63
9.8	No Waiver:	64
Article 10 – Modification of Contract Documents		64
10.1	Owner's Right to Direct Changed Work:	64
10.2	Required Documentation for Changed Work:	65
10.3	Procedures and Pricing of Changed Work:	65
Article 11 – Time Allowances		65
11.1	Time of the Essence:	65
11.2	Excusable Delay and Inexcusable Delay Defined:	65
11.3	Notice of Delay:	66
11.4	Compensable and Non-Compensable Time Extensions:	66
11.5	Adverse Weather:	67
11.6	Liquidated Damages:	68
Article 12 – Claims by Contractor		69
12.1	Obligation to File Claims for Disputed Work:	69
12.2	Form and Contents of Claim:	69
12.3	Administration During/ After Claim Submission:	70
12.4	Compliance:	70
12.5	Mediation:	71
Article 13 – Underground Conditions		72
13.1	Contractor to Locate Underground Facilities:	72
13.2	Contractor to Protect Underground Facilities:	72
13.3	Concealed or Unknown Conditions:	73

13.4	Notice of Hazardous Waste or Materials Conditions:.....	75
Article 14 – Legal and Miscellaneous		76
14.1	Laws and Regulations:.....	76
14.2	Permits and Taxes:.....	76
14.3	Communications and Information Distribution:	77
14.4	Suspension of Work:	77
14.5	Termination of Contract for Cause:	78
14.6	Termination of Contract for Convenience:	78
14.7	Contingent Assignment of Subcontracts:.....	79
14.8	Remedies and Contract Integration:	79
14.9	Interpretation:	80
14.10	Patents:	80
14.11	Substitution for Patented and Specified Articles:	81
14.12	Interest of Public Officers:	81
14.13	Limit of Liability:	81
Article 15 – Working Conditions and Prevailing Wages		82
15.1	Use of Site/Sanitary Rules:	82
15.2	Protection of Work, Persons, and Property:	82
15.3	Responsibility for Safety and Health:	83
15.4	Emergencies:.....	84
15.5	Use of Roadways and Walkways:.....	84
15.6	Nondiscrimination:	84
15.7	Prevailing Wages and Working Hours:.....	84
15.8	Environmental Controls:	86
15.9	Shoring Safety Plan:	86

GENERAL CONDITIONS

ARTICLE 1 - INTERPRETATION OF CONTRACT DOCUMENTS

1.1 INTERPRETATION OF CONTRACT DOCUMENTS:

- A. Contract Documents are complementary; what is called for by one is as binding as if called for by all.
- B. Individual Contract Documents subdivide at first level into Articles, and then into Paragraphs.

1.2 ORDER OF PRECEDENCE OF DOCUMENTS:

- A. . Information included in one Contract Document but not in another will not be considered a conflict or inconsistency. Unless otherwise specified in the Special Conditions, in case of any conflict or inconsistency among the Contract Documents, the following order of precedence will apply, beginning from highest to lowest, with the most recent version taking precedent over an earlier version:
 - 1. Change Orders;
 - 2. Addenda;
 - 3. Contract;
 - 4. Notice to Proceed;
 - 5. Supplementary Conditions;
 - 6. General Conditions;
 - 7. Payment, Performance and Warranty Bonds;
 - 8. Specifications;
 - 9. Plans;
 - 10. Notice of Intent to Award;
 - 11. Advertisement for Bids
 - 12. Instructions to Bidders;
 - 13. Contractor's Bid Proposal and attachments; and
 - 14. Any generic documents prepared by and on behalf of a third party, that were not prepared specifically for this Project, such as the Caltrans Standard Specifications or Caltrans Special Provisions.
- B. Plans and Specifications. The Plans and Specifications included in the Contract Documents are complementary. If Work is shown on one but not on the other, Contractor must perform the Work as though fully described on both, consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results. The Plans and Specifications are deemed to include and require everything necessary and reasonably incidental to completion of the Work, whether or not particularly mentioned or shown. Contractor must perform all Work and services and supply all things reasonably related to and inferable from the Contract Documents. In the event of a conflict between the Plans and Specifications, the Specifications will control, unless the drawing(s) at issue are dated later than the Specification(s) at issue. Detailed drawings take precedence over general drawings, and large-scale drawings take precedence over smaller scale drawings. Any arrangement or division of the Plans and Specifications into sections is for convenience and is not intended to limit the Work required by separate trades. A

conclusion presented in the Plans or Specifications is only a recommendation. Actual locations and depths must be determined by Contractor's field investigation. Contractor may request access to underlying or background information in City's possession that is necessary for Contractor to form its own conclusions.

- C. Figures and Dimensions. Figures control over scaled dimensions.
- D. Technical or Trade Terms. Any terms that have well-known technical or trade meanings will be interpreted in accordance with those meanings, unless otherwise specifically defined in the Contract Documents.
- E. Measurements. Contractor must verify all relevant measurements in the Contract Documents and at the Project site before ordering any material or performing any Work, and will be responsible for the correctness of those measurements or for costs that could have been avoided by independently verifying measurements.
- F. Compliance with Laws. The Contract Documents are intended to comply with Laws and will be interpreted to comply with Laws.
- G.

ARTICLE 2 - PRE-BID INVESTIGATIONS

2.1 PRE-BID INVESTIGATIONS REQUIRED:

- A. Prior to and as a condition of submitting a Bid and executing Section 00520 (Agreement), Contractor shall make reasonable efforts to investigate fully the Work of the Contract. Contractor shall visit the Site, examine thoroughly and understand fully the nature and extent of the Contract Documents, Work, Site, locality, actual conditions, and as-built conditions.
- B. Contractor's investigation shall include, without limitation, requesting and thoroughly examining all reports of exploration and tests of subsurface conditions, as-built drawings, drawings, product specification(s), or reports, made available by Owner for contracting purposes or during Contractor's pre-Bid investigations, of existing above ground and (to the extent applicable) below ground conditions (together, "Existing Conditions Data"), including, as applicable, Underground Facilities, geotechnical data, as-built data, utility surveys, record documents of all types, hazardous materials surveys, or similar materials which may appear or be referenced in the Project Manual or the in the Contract Documents, and all local conditions, and federal, state, and local laws and regulations that in any manner may affect cost, progress, performance, or furnishing of Work or which relate to any aspect of the means, methods, techniques, sequences, or procedures of construction to be employed by Contractor and safety precautions and programs incident thereto.
- C. Contractor's investigations shall consider fully the fact that Existing Conditions Data is in many cases based on information furnished to Owner by others (e.g., the prior owner or builders), and that due to their age or their chain of custody since preparation, may not meet current industry standards for accuracy.

Contractor shall also: (i.) provide Owner with prompt written notice of all conflicts, errors, ambiguities, or discrepancies of any type, that it discovered in or among the Contract Documents and the Existing Conditions Data, and (ii.) subject to Owner's approval, conduct any such additional or supplementary examinations, investigations, explorations, tests, studies, and data compilations, concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site or otherwise, which Contractor may deem necessary in order to perform and furnish the Work in accordance with the terms and conditions of Contract Documents.

- D. During performance of the Contract, Contractor will be charged with knowledge of all information that it should have learned in performing these pre-Bid investigations and other obligations, and shall not be entitled to Change Orders (time or compensation) due to any information, error, inconsistency, omission, or conditions that Contractor should have known as a part of this Work. Contractor shall be responsible for the resultant losses, including without limitation, the cost of correcting Defective Work.

2.2 LIMITED RELIANCE PERMITTED ON OWNER'S EXISTING CONDITIONS DATA:

- A. Regarding aboveground and as-built conditions shown on the Contract Documents or supplied by Owner, such information has been compiled in good faith; however, Owner does not expressly or impliedly warrant or represent that such information is correctly shown or indicated, or otherwise complete for construction purposes. Contractor must independently verify such information as part of its pre-Bid investigations, and where conditions are not reasonably verifiable or discrepancies are identified, bring such matters to Owner's attention through written question issued during the Bid period. In executing Section 00520 (Agreement), Contractor shall rely on the results of its own independent investigation and shall not rely on Owner-supplied information regarding aboveground conditions and as-built conditions, and Contractor shall accept full responsibility for its verification work sufficient to complete the Work as intended.
- B. Regarding subsurface conditions other than Underground Facilities shown on the Contract Documents or otherwise supplied by Owner, Contractor may rely only upon the general accuracy of actual reported depths, actual reported character of materials, actual reported soil types, actual reported water conditions, or actual obstructions shown or indicated in the Contract Documents. Owner is not responsible for the completeness of any subsurface condition information, Contractor's conclusions or opinions drawn from any subsurface condition information, or subsurface conditions that are not specifically shown. (e.g., Owner is not responsible for soil conditions in areas contiguous to areas where a subsurface condition is shown.)

2.3 PRE-BID INVESTIGATION REQUIREMENTS FOR EXCAVATION AND UTILITIES RELOCATION PROJECTS:

- A. As part of its pre-Bid investigations for Projects involving excavation and/or relocation of existing utilities, Contractor shall make reasonable efforts to verify

information regarding Underground Facilities including, but not limited to, requesting additional information or verification of information as necessary.

- B. Because of the nature and location of Owner and the Project, the existence of Underground Facilities is deemed inherent in the Work of the Contract, as is the fact that Underground Facilities are not always accurately shown or completely shown on as-built records, both as to their depth and location. Therefore, Contractor shall take care to note the existence and potential existence of Underground Facilities, in particular, above and below grade structures, drainage lines, storm drains, sewers, water, gas, electrical, chemical, hot water, and other similar items and utilities. Contractor shall carefully consider all supplied information, request additional information Contractor may deem necessary, and visually inspect the Site for above ground indications of Underground Facilities (such as, for example not by way of limitation, the existence of existing service laterals, appurtenances or other types of utilities, indicated by the presence of an underground transmission main or other visible facilities, such as buildings, new asphalt, meters and junction boxes, on or adjacent to the Site). Contractor shall also consider local underground conditions and typical practices for Underground Facilities, either through its own direct knowledge or through its subcontractors, and fully consider this knowledge in assessing the existing information and the reasonableness of its reliance.

ARTICLE 3 - SUBCONTRACTORS

3.1 SUBCONTRACTOR LISTING LAW:

- A. Contractor shall comply with the Subcontractor Listing law, California Public Contract Code Sections 4101 et seq. Contractor shall not substitute any other person or firm in place of any Subcontractor listed in the Bid except as may be allowed by law.
- B. Subcontractors shall not assign or transfer their subcontracts or permit them to be performed by any other contractor without Owner's written approval. At Owner's request, Contractor shall provide Owner with a complete copy of all executed subcontracts or final commercial agreements with Subcontractors and/or suppliers.

3.2 SUBCONTRACTS:

- A. Subcontract agreements shall preserve and protect the rights of Owner under the Contract Documents so that subcontracting will not prejudice such rights. To the extent of the Work to be performed by a Subcontractor, Contractor shall require the Subcontractor's written agreement (1) to be bound to the terms of Contract Documents and (2) to assume vis-à-vis Contractor all the obligations and responsibilities that Contractor assumes toward Owner under the Contract Documents. (These agreements include for example, and not by way of limitation, all warranties, claims procedures and rules governing submittals of all types to which Contractor is subject under the Contract Documents.)
- B. Contractor shall provide for the assignment to Owner of all rights any Subcontractor (of any tier) may have against any manufacturer, supplier, or distributor for breach of warranties and guarantees relating to the Work performed by the Subcontractor under the Contract Documents. Subcontracts

shall provide and acknowledge Owner as an intended third-party beneficiary of each subcontract and supply contract (of any tier).

ARTICLE 4 - DRAWINGS AND SPECIFICATIONS

4.1 INTENT OF DRAWINGS AND SPECIFICATIONS:

- A. Contractor shall interpret words or phrases used to describe Work (including services), materials, or equipment that have well-known technical or construction industry or trade meaning in accordance with that meaning. Drawings' intent specifically includes the intent to depict construction that complies with all applicable laws, codes, and standards.
- B. As part of the "Work," Contractor shall provide all labor, materials, equipment, machinery, tools, facilities, services, employee training and testing, hoisting facilities, Shop Drawings, storage, testing, security, transportation, disposal, the securing of all necessary or required field dimensions, the cutting or patching of existing materials, notices, permits, documents, reports, agreements, and any other items required or necessary to timely and fully complete Work described and the results intended by Contract Documents and, in particular, Drawings and Specifications. Divisions and Specification Sections and the identification on any Drawings shall not control Contractor in dividing Work among Subcontractors or suppliers or delineating the Work to be performed by any specific trade.
- C. Contractor shall perform reasonably implied parts of Work as "incidental work" although absent from Drawings and Specifications. Incidental work includes any work not shown on Drawings or described in Specifications that is necessary or normally or customarily required as a part of the Work shown on Drawings or described in Specifications. Incidental work includes any work necessary or required to make each installation satisfactory, legally operable, functional, and consistent with the intent of Drawings and Specifications or the requirements of Contract Documents. Contractor shall perform incidental work without extra cost to Owner. Incidental work shall be treated as if fully described in Specifications and shown on Drawings, and the expense of incidental work shall be included in price Bid and Contract Sum.

4.2 CHECKING OF DRAWINGS AND SPECIFICATIONS:

- A. Before undertaking each part of Work, Contractor shall carefully study and compare Contract Documents and check and verify pertinent figures shown in the Contract Documents and all applicable field measurements. Contractor shall be responsible for any errors that might have been avoided by such comparison. Figures shown on Drawings shall be followed; Contractor shall not scale measurements. Contractor shall promptly report to Owner, in writing, any conflict, error, ambiguity or discrepancy that Contractor may discover. Contractor shall obtain a written interpretation or clarification from Owner before proceeding with any Work affected thereby. Contractor shall provide Owner with a follow-up correspondence every seven Days until it receives a satisfactory interpretation or clarification.

4.3 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS:

- A. A typical or representative detail on Drawings shall constitute the standard for workmanship and material throughout corresponding parts of Work. Where necessary, and where reasonably inferable from Drawings, Contractor shall adapt such representative detail for application to such corresponding parts of Work. The details of such adaptation shall be subject to prior approval by Owner. Repetitive features shown in outline on Drawings shall be in exact accordance with corresponding features completely shown.
- B. Should any discrepancy appear or any misunderstanding arise as to the import of anything contained in Drawings and Specifications, or should Contractor have any questions or requests relating to Drawings or Specifications, Contractor shall refer the matter to Owner, in writing. Owner will issue with reasonable promptness written responses, clarifications, or interpretations as Owner may determine necessary, which shall be consistent with the intent of, and be reasonably inferable from, Contract Documents. Such written clarifications or interpretations shall be binding upon Contractor. If Contractor believes that a written response, clarification, or interpretation justifies an adjustment in the Contract Sum or Contract Time, Contractor shall give Owner prompt written notice. If the parties are unable to agree to the amount or extent of the adjustment, if any, then Contractor shall perform the Work in conformance with Owner's response, clarification, or interpretation and may make a written claim for the adjustment as provided in Article 12.
- C. The following general specifications shall apply wherever in the Specifications, or in any directions given by Owner in accordance with or supplementing Specifications, it is provided that Contractor shall furnish materials or manufactured articles or shall do Work for which no detailed specifications are shown. Materials or manufactured articles shall be of the best grade, in quality and workmanship, obtainable in the market from firms of established good reputation. If not ordinarily carried in stock, the materials or manufactured articles shall conform to industry standards for first class materials or articles of the kind required, with due consideration of their intended use. Work shall conform to the usual standards or codes, such as those cited herein, for first class work of the kind required. Contractor shall specify in writing to Owner the materials to be used or Work to be performed under this Paragraph ten Business Days prior to furnishing such materials or performing such Work.

4.4 USE OF DRAWINGS AND SPECIFICATIONS:

- A. Drawings, Specifications, and other Contract Documents were prepared for use for Work of Contract Documents only. No part of Contract Documents shall be used for any other construction or for any other purpose except with the written consent of Owner. Any unauthorized use of Contract Documents is prohibited and at the sole liability of the user.

ARTICLE 5 - COMMENCEMENT OF THE WORK

5.1 SUBMISSION OF REQUIRED SCHEDULES:

- A. Contractor shall submit its initial schedule to Owner in draft for review and discussion at the Preconstruction Conference.

- B. Contractor shall submit the following schedules to Owner within 21 Days after issuance of Section 00550 (Notice to Proceed):
 - 1. Schedule of submittals, which shall conform to Section 01330 (Submittals).
 - 2. Schedule of Values, which shall conform to Section 01200 (Price and Payment Procedures).
- C. No progress payment shall be due or owing to Contractor until such schedules are submitted to and acceptable to Owner as meeting the requirements of the Contract Documents. At Owner's sole discretion, Owner may elect to instead withhold a portion of any progress payment for unacceptable compliance with contract requirements for such schedules.
- D. Owner's acceptance of Contractor's schedules will not create any duty of care or impose on Owner any responsibility for the sequencing, scheduling, or progress of Work nor will it interfere with or relieve Contractor from Contractor's full responsibility therefore.

5.2 COMMENCEMENT DATE OF CONTRACT TIME:

Contractor will fully complete the Work for the Project within 198 calendar days from the commencement date given in the Notice to Proceed ("Contract Time"). By signing below, Contractor expressly waives any claim for delayed early completion.

ARTICLE 6 - CONTRACTOR'S ORGANIZATION AND EQUIPMENT

6.1 NOTICE TO CONTRACTOR AND SERVICE THEREOF:

Any notice, billing, or payment required by or pursuant to the Contract Documents must be made in writing, signed, dated and sent to the other party by personal delivery, U.S. Mail, a reliable overnight delivery service, or by email as a PDF file. Notice is deemed effective upon delivery, except that service by U.S. Mail is deemed effective on the second working day after deposit for delivery. Notice for each party must be given as follows:

A. Owner:

<Department or Title>
<Address>
<City/State/Zip>
<Phone (optional)>
Attn: <Name/Title>
<Email address>

Copy to: <Name/Title>
<Email address>

B. Contractor:

Name: _____
Address: _____

City/State/Zip: _____
Phone: _____
Attn: _____
Email: _____
Copy to: _____

C.

6.2 CONTRACTOR'S SUPERINTENDENTS OR FOREPERSONS:

- A. Contractor shall at all times be represented on Site by one or more superintendents or forepersons authorized and competent to receive and carry out any instructions that Owner may give, and shall be liable for faithful observance of instructions delivered to Contractor or to authorized representative or representatives on Site.

6.3 PROFICIENCY IN ENGLISH:

- A. Supervisors, security guards, safety personnel, and employees who have unescorted access to the Site shall possess proficiency in the English language in order to understand, receive, and carry out oral and written communications or instructions relating to their job functions, including safety and security requirements.

6.4 CONTRACTOR'S AND SUBCONTRACTORS' EMPLOYEES:

- A. Contractor shall employ, and shall permit its Subcontractors to employ, only competent and skillful personnel to do Work. If Owner notifies Contractor that any of its employees or any of its Subcontractors' employees on Work is incompetent, unfaithful, disorderly, or profane, or fail to observe customary standards of conduct or refuses to carry out any provision of the Contract Documents, or uses threatening or abusive language to any person on Work representing Owner, or violates sanitary rules, or is otherwise unsatisfactory, and if Owner requests that such person be discharged from Work, then Contractor or its Subcontractor shall immediately discharge such person from Work and the discharged person shall not be re-employed on the Work except with consent of Owner.

6.5 CONTRACTOR'S USE OF THE SITE:

- A. Contractor shall not make any arrangements with any person to permit occupancy or use of any land, structure or building within the limits of the Work, for any purpose whatsoever, either with or without compensation, in conflict with any agreement between Owner and any owner, former owner or tenant of such land, structure or buildings. Contractor may not occupy Owner-owned property outside the limit of the Work as indicated on the Drawings unless it obtains prior approval from Owner.

6.6 CONTRACTOR'S SITE OFFICE:

- A. Unless expressly provided otherwise in the Contract Documents, Contractor shall provide a site office staffed by a resident job superintendent or an employee of comparable status.

ARTICLE 7 - OWNER'S ADMINISTRATION OF WORK

7.1 OWNER'S REPRESENTATIVE(S):

- A. Owner's Representative(s) will have limited authority to act on behalf of Owner as set forth in the Contract Documents.
- B. Except as otherwise provided in these Contract Documents or subsequently identified in writing by Owner, Owner will issue all communications to Contractor through Owner's Representative, and Contractor shall issue all communications to Owner through Owner's Representative in a written document delivered to Owner.
- C. Should any direct communications between Contractor and Owner's consultants occur during field visits or by telephone, Contractor shall immediately confirm them in a written document copied to Owner.

7.2 OWNER'S OBSERVATION OF THE WORK:

- A. Work shall be performed under Owner's general observation and administration. Contractor shall comply with Owner's directions and instructions in accordance with the terms of Contract Documents, but nothing contained in these General Conditions shall be taken to relieve Contractor of any obligations or liabilities under the Contract Documents. Owner's failure to review or, upon review, failure to object to any aspect of Work reviewed, shall not be deemed a waiver or approval of any non-conforming aspect of Work.
- B. Subject to those rights specifically reserved in the Contract Documents, Owner will not supervise, or direct, or have control over, or be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or Contractor's failure to comply with laws and regulations applicable to the furnishing or performance of Work. Owner will not be responsible for Contractor's failure to perform or furnish the Work in accordance with Contract Documents.

7.3 CONSTRUCTION MANAGER'S OBSERVATION OF WORK:

- A. Owner may engage a Construction Manager to assist in administering the Work. If so engaged, Construction Manager will advise and consult with Owner, but will have authority to act on behalf of Owner only to the extent provided in the Contract Documents or as set forth in writing by Owner. Construction Manager will not be responsible for and will not have control or charge of construction means, methods, techniques, sequences, or procedures, or for safety precautions and programs in connection with Work. Construction Manager will not be responsible for or have control over the acts or omissions of Contractor,

Subcontractors or their agents or employees, or any other persons performing Work.

- B. Construction Manager may review Contractor's Submittals, such as Shop Drawings, Product Data, and Samples, but only for conformance with design concept of Work and with information given in the Contract Documents.
- C. Construction Manager may visit the Site at intervals appropriate to stage of construction to become familiar generally with the progress and quality of Work and to determine, in general, if Work is proceeding in accordance with Contract Documents. Based on its observations, Construction Manager may recommend to Owner that it disapproves or rejects Work that Construction Manager believes to be Defective or will not produce a complete Project that conforms to Contract Documents, or will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by Contract Documents. Owner will also have authority to require special inspection or testing of Work, whether or not the Work is fabricated, installed, or completed.
- D. Construction Manager may conduct inspections to recommend to Owner the dates that Contractor has achieved Substantial Completion and Final Acceptance, and will receive and forward to Owner for review written warranties and related documents required by Contract Documents.

7.4 OWNER'S AND CONSTRUCTION MANAGER'S EXERCISE OF CONTRACT RESPONSIBILITIES:

- A. Owner, Owner's Project Manager, Construction Manager, and all Owner's Representatives, in performing their duties and responsibilities under the Contract Documents, accept no duties, responsibilities, or duty of care, nor may the same be implied or inferred, towards Contractor, any Subcontractor, sub-Subcontractor, or supplier, except those set forth expressly in the Contract Documents.

7.5 OWNER'S RIGHT OF ACCESS TO THE WORK:

- A. During performance of Work, Owner and its agents, consultants, and employees may at any time enter upon Work, shops, or studios where any part of the Work may be in preparation, or factories where any materials for use in Work are being or are to be manufactured. Contractor shall provide proper and safe facilities for this purpose and shall make arrangements with manufacturers to facilitate inspection of their processes and products to such extent as Owner's interests may require. Other contractors performing work for Owner may also enter upon Work for all purposes required by their respective contracts. Subject to the rights reserved in the Contract Documents, Contractor shall have sole care, custody, and control of the Site and its Work areas.

7.6 OWNER'S RIGHT OF SEPARATE CONSTRUCTION:

- A. Owner may perform with its own forces, construction or operations related to the Project, or the Site during Contractor's operations. Owner may also award separate contracts in connection with other portions of the Project or other construction or operations, on the Site or areas contiguous to the Site, under conditions similar to these Contract Documents, or may have utility Owners perform other work.

- B. Contractor shall adjust its schedule and fully coordinate with, and shall afford all other contractors, utility districts, and Owner (if Owner is performing work with its own forces), proper and safe access to the Site, and reasonable opportunity for the installation and storage of their materials. Contractor shall ensure that the execution of its Work properly connects and coordinates with others' work, do all cutting, fitting, and patching of the Work that may be required to make its several parts come together properly and integrate with such other work, and shall cooperate with them to facilitate the progress of the Work.
- C. To the extent that any part of Contractor's Work is to interface with work performed or installed by other contractors or utility owners, Contractor shall inspect and measure the in-place work. Contractor shall promptly report to Owner in writing any defect in in-place work that will impede or increase the cost of Contractor's interface unless corrected.

ARTICLE 8 - CONTRACTOR'S PROSECUTION AND PROGRESS OF THE WORK

8.1 CONTRACTOR TO SUPERVISE THE WORK:

- A. Subject to those rights specifically reserved in the Contract Documents, Contractor shall supervise, direct, have control over, and be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, safety precautions, and programs incident thereto, and compliance with laws and regulations applicable to the furnishing or performance of Work.
- B. Contractor shall keep on the Site at all times during Work progress a competent resident Superintendent, who shall not be replaced without Owner's express written consent. The Superintendent shall be Contractor's representative at the Site and shall have complete authority to act on behalf of Contractor. All communications to and from the Superintendent shall be as binding as if given to or by Contractor.
- C. Contractor shall supervise, inspect, and direct Work competently and efficiently, devoting the attention and applying such personal skills and expertise as may be required and necessary to perform Work in accordance with Contract Documents. Contractor shall be solely responsible for and have control and charge of construction means, methods, techniques, sequences and procedures, safety precautions and programs in connection with the Work. Contractor shall be responsible to see that the completed Work complies accurately with Contract Documents.
- D. Contractor is fully responsible for Contractor's own acts and omissions. Contractor is responsible for all acts and omissions of its Subcontractors, suppliers, and other persons and organizations performing or furnishing any of the Work, labor, materials, or equipment under a direct or indirect contract with Contractor.
- E. Contractor shall conduct monthly Contractor Safety Committee meetings and weekly toolbox safety talks.

8.2 CONTRACTOR TO MAINTAIN COST DATA:

- A. Contractor shall maintain full and correct information as to the number of workers employed in connection with each subdivision of Work, the classification and rate of pay of each worker in form of certified payrolls, the cost to Contractor of each class of materials, tools, and appliances used by Contractor in Work, and the amount of each class of materials used in each subdivision of Work. Upon Owner's request, Contractor shall provide Owner with copies of certified payrolls and related documentation. If Contractor maintains or is capable of generating summaries or reports comparing actual Project costs with Bid estimates or budgets, Contractor shall provide Owner with a copy of such report upon Owner's request and whenever it is generated.
- B. Contractor shall maintain daily job reports recording all significant activity on the job, including the number of workers on Site, Work activities, problems encountered, and delays. Contractor shall provide Owner with copies for each Day Contractor works on the Project, to be delivered to Owner either the same Day or the following morning before starting work at the Site. Contractor shall take pre-construction and monthly progress photographs of all areas of the Work. Contractor shall maintain copies of all correspondence with Subcontractors and records of meetings with Subcontractors.
- C. Owner shall have the right to audit and copy Contractor's books and records of any type, nature, or description relating to the Project (including, but not limited to, financial records reflecting in any way costs claimed on the Project), and to inspect the Site, including Contractor's trailer, or other job Site office, and this requirement shall be contained in the subcontracts of Subcontractors working on Site. By way of example, Owner shall have the right to inspect and obtain copies of all Contract Documents, planning and design documents, Bid proposal and negotiation documents (subject to Section 00670 [Escrow Bid Documents]), cost records, and job cost variance reports, design modification proposals, value engineering or other cost reduction proposals, revisions made to the original design, job progress reports, photographs, and as-built drawings maintained by Contractor. Owner and any other applicable governmental entity shall have the right to inspect all information and documents maintained hereunder at any time during the Project and for a period of five years following Final Completion, in accordance with the provisions of Section 8546.7 of the California Government Code. This right of inspection shall not relieve Contractor of its duties and obligations under the Contract Documents. This right of inspection shall be specifically enforceable in a court of law, either independently or in conjunction with enforcement of any other rights in the Contract Documents.

8.3 CONTRACTOR TO SUPPLY SUFFICIENT WORKERS AND MATERIALS:

- A. Unless otherwise required by Owner under the terms of Contract Documents, Contractor shall at all times keep on the Site materials and employ qualified workers sufficient to prosecute Work at a rate and in a sequence and manner necessary to complete Work within the Contract Time. This obligation shall remain in full force and effect notwithstanding disputes or claims of any type.
- B. At any time during progress of Work should Contractor directly or indirectly (through Subcontractors) refuse, neglect, or be unable to supply sufficient materials or employ qualified workers to prosecute the Work as required, then

Owner may require Contractor to accelerate the Work and/or furnish additional qualified workers or materials as Owner may consider necessary, at no cost to Owner. If Contractor does not comply with the notice within three Business Days of date of service thereof, Owner shall have the right (but not a duty) to provide materials and qualified workers to finish the Work or any affected portion of Work, as Owner may elect. Owner may, at its discretion, exclude Contractor from the Site, or portions of the Site or separate work elements during the time period that Owner exercises this right. Owner will deduct from monies due or which may thereafter become due under the Contract Documents, the sums necessary to meet expenses thereby incurred and paid to persons supplying materials and doing Work. Owner will deduct from funds or appropriations set aside for purposes of Contract Documents the amount of such payments and charge them to Contractor as if paid to Contractor. Contractor shall remain liable for resulting delay, including liquidated damages and indemnification of Owner from claims of others.

- C. Exercise by Owner of the rights conferred upon Owner in this subparagraph is entirely discretionary on the part of Owner. Owner shall have no duty or obligation to exercise the rights referred to in this subparagraph, and its failure to exercise such rights shall not be deemed an approval of existing Work progress or a waiver or limitation of Owner's right to exercise such rights in other concurrent or future similar circumstances. (The rights conferred upon Owner under this subparagraph are, like all other such rights, cumulative to Owner's other rights under any provision of the Contract Documents.)

8.4 **CONTRACTOR TO MAINTAIN PROJECT RECORD DOCUMENTS:**

- A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Contract Modifications, Change Orders, Field Directives, Supplemental Instructions, Force Account orders, and written interpretations and clarifications in good order and annotated to show all as-built changes made during construction. These Project Record Documents, together with all approved Samples and a counterpart of all approved Shop Drawings, shall be maintained and available to Owner for reference. Upon completion of the Work, Contractor shall deliver to Owner, the Project Record Documents, Samples, and Shop Drawings, and as-built drawings (full-size).
- B. Throughout Contractor's performance of the Work of the Project, Contractor shall maintain construction records to include: shop drawings; product data/material data sheets; samples; submittal; purchases; materials; equipment; inspections; applicable handbooks; applicable codes and standards; maintenance and operating manuals and instructions; RFI Log; Submittal Log; other related documents and revisions which arise out of the Construction Contracts. Contractor shall maintain records of principal building layout lines, elevations for the bottom of footings, floor levels, and key site elevations (certified by a qualified surveyor or professional engineer). Contractor shall make all records available to Owner. At the completion of the Project, Contractor shall deliver all such records to the Owner to have a complete set of record as-built drawings.

8.5 CONTRACTOR TO NOT DISRUPT OWNER OPERATION:

- A. Contractor shall schedule and execute all Work in a manner that does not interfere with or disrupt Owner operations including, but not limited to, parking, utilities (electricity, gas, water), noise, access by employees and administration, access by vendors, and any other person or entity using Owner facilities or doing business with Owner. Contractor shall produce and supply coordination plans and requests to Owner, following Owner procedures, for all necessary interference of construction with Owner, which Owner will reasonably cooperate with.

8.6 CONTRACTOR TO PROVIDE TEMPORARY FACILITIES AND CONTROLS:

- A. Unless expressly provided otherwise in the Contract Documents, Contractor shall provide all temporary utilities, including without limitation, electricity, water, natural gas, lighting, heating, cooling and ventilating devices, telephone, sanitary facilities, barriers, fences and enclosures, tree and plant protection, fire protection, pollution, erosion, Storm Water Pollution Prevention controls, noise and traffic control, and any other necessary services required for construction, testing, or completion of the Work.

ARTICLE 9 - WARRANTY, GUARANTEE, AND INSPECTION OF WORK

9.1 CONTRACTORS QUALITY CONTROL PLAN

- 1. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- 2. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - a. Project quality-control manager may also serve as Project superintendent.
- 3. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- 4. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - a. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - b. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - c. Owner-performed tests and inspections indicated in the Contract Documents.
- 5. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of

corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

6. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

9.2 WARRANTY AND GUARANTEE:

- A. General Representations and Warranties: Contractor represents and warrants that it is, and will be at all times, fully qualified and capable of performing every Phase of the Work and to complete Work in accordance with the terms of Contract Documents. Contractor warrants that all construction services shall be performed in accordance with generally accepted professional standards of good and sound construction practices and all requirements of Contract Documents. Contractor warrants that Work (including, but not limited to, each item of materials and equipment incorporated therein) shall be new, of suitable grade of its respective kind for its intended use, and free from defects in design, engineering, materials, construction, and workmanship. Contractor warrants that Work shall conform in all respects with all applicable requirements of federal, state, and local laws, applicable construction codes and standards, licenses, and permits, Drawings and Specifications, and all descriptions set forth therein, and all other requirements of Contract Documents. However, Contractor shall not be responsible for the negligence of others in the specification of specific equipment, materials, design parameters, and means or methods of construction where specifically shown and expressly required by Contract Documents.
- B. Extended Guarantees: For any warranty or guarantee provided by the supplier or manufacturer of any equipment or materials used in the Project exceeding the term of Contractor's Guarantee pursuant to Section 00630 (Guarantee) ("Extended Warranty"), Contractor shall assign such warranties and guarantees to Owner and supply Owner with all warranty and guarantee documents relative thereto.
- C. Environmental and Toxics Warranty: The covenants, warranties, and representations contained in this Paragraph are effective continuously during Contractor's Work on the Project and following cessation of labor for any reason including, but not limited to, Project completion. Contractor covenants, warrants, and represents to Owner that:
 1. To Contractor's knowledge after due inquiry, no lead or Asbestos-containing materials were installed or discovered in the Project at any time during Contractor's construction thereof. If any lead or Asbestos-containing materials were discovered, Contractor made immediate written disclosure to Owner.
 2. To Contractor's knowledge after due inquiry, no electrical transformers, light fixtures with ballasts, or other equipment containing PCBs are or were located on the Project at any time during Contractor's construction thereof.
 3. To Contractor's knowledge after due inquiry, no storage tanks for gasoline or any other toxic substance are or were located on the Project at any time during Contractor's construction thereof. If any such materials were discovered, Contractor made immediate written disclosure to Owner.

4. Contractor's operations concerning the Project are and were not in violation of any applicable environmental federal, state, or local statute, law, or regulation dealing with hazardous materials, substances, or toxic substances, and no notice from any governmental body has been served upon Contractor claiming any violation of any such law, ordinance, code, or regulation, or requiring or calling attention to the need for any Work, repairs, construction, alteration, or installation on or in connection with the Project in order to comply with any such laws, ordinances, codes, or regulations, with which Contractor has not complied. If there are any such notices with which Contractor has complied, Contractor shall provide Owner with copies thereof.

9.3 INSPECTION OF WORK:

- A. Work and materials, and manufacture and preparation of materials, from beginning of construction until Final Completion and acceptance of Work, shall be subject to inspection and rejection by Owner, its agents, representatives, or independent contractors retained by Owner to perform inspection services, or governmental agencies with jurisdictional interests. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's Site safety procedures and program so that they may comply therewith as applicable. Upon request or where specified, Owner shall be afforded access for inspection at the source of supply, manufacture or assembly of any item of material or equipment, with reasonable accommodations supplied for making such inspections.
- B. Contractor shall furnish, in such quantities and sizes as may be required for proper examination and tests, Samples or test specimens of all materials to be used or offered for use in connection with Work. Contractor shall prepare Samples or test specimens at its expense and furnish them to Owner. Contractor shall submit all Samples in ample time to enable Owner to make any necessary tests, examinations, or analyses before the time it is desired to incorporate the material into the Work.
- C. Contractor shall give Owner timely notice of readiness of Work for all required inspections, tests, or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- D. If applicable laws or regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, and furnish Owner with the required certificates of inspection or approval. Owner will pay the cost of initial testing and Contractor shall pay all costs in connection with any follow-up or additional testing. Contractor shall also be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for the acceptance of materials or equipment to be incorporated in the Work, or of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.
- E. If Contractor covers any Work, or the work of others, prior to any required inspection, test or approval without written approval of Owner, Contractor shall uncover the Work at Owner's request. Contractor shall bear the expense of

uncovering Work and replacing Work. In any case where Contractor covers Work contrary to Owner's request, Contractor shall uncover Work for Owner's observation or inspection at Owner's request. Contractor shall bear the cost of uncovering Work.

- F. Whenever required by Owner, Contractor shall furnish tools, labor and materials necessary to make examination of Work that may be completed or in progress, even to extent of uncovering or taking down portions of finished Work. Should Work be found unsatisfactory, cost of making examination and of reconstruction shall be borne by Contractor. If Work is found to be satisfactory, Owner, in manner herein prescribed for paying for alterations, Modifications, and extra Work, except as otherwise herein specified, will pay for examination.
- G. Inspection of the Work by or on behalf of Owner, or Owner's failure to do so, shall not under any circumstances be deemed a waiver or approval of any non-conforming aspect of the Work. Contractor shall have an absolute duty, in the absence of a written Change Order signed by Owner, to perform Work in conformance with the Contract Documents and to immediately correct Defective Work immediately upon Contractor's knowledge.
- H. Any inspection, evaluation, or test performed by or on behalf of Owner relating to the Work is solely for the benefit of Owner, and shall not be relied upon by Contractor. Contractor shall not be relieved of the obligation to perform Work in accordance with the Contract Documents, nor relieved of any guarantee, warranty, or other obligation, as a result of any inspections, evaluations, or tests performed by Owner, whether or not such inspections, evaluations, or tests are permitted or required under the Contract Documents. Contractor shall be solely responsible for testing and inspecting Work already performed to determine whether such Work is in proper condition to receive later Work.

9.4 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

9.5 CORRECTION OF DEFECTIVE WORK:

- A. Owner may direct Contractor to correct any Defective Work or remove it from the Site and replace it with Work that is not Defective and satisfactorily correct, or remove and replace any damage to other Work or the work of others resulting from the correction or removal. Contractor shall be responsible for any and all claims, costs, losses, and damages caused by or resulting from such correction or removal. A Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work and the Contract Sum. If the parties are unable to agree to the amount of an appropriate decrease in the Contract Sum, Owner may decide the proper amount or, in its discretion may elect to leave the Contract Sum unchanged and deduct from monies due Contractor, all such claims, costs, losses and damages caused by or resulting from

the correction or removal. If Contractor disagrees with Owner's calculations, it may make a claim as provided in Article 12 of this Section 00700. Owner's rights under this Paragraph shall be in addition to any other rights it may have under the Contract Documents or by law.

- B. If Contractor fails to supply sufficient skilled workers, suitable materials, or equipment, or to furnish or perform the Work in such a way that the completed Work will conform to Contract Documents, Owner may order Contractor to replace any such Defective Work, or stop any portion of Work to permit Owner (at Contractor's expense) to replace such Defective Work. These Owner rights are entirely discretionary on the part of Owner, and shall not give rise to any duty on the part of Owner to exercise the rights for the benefit of Contractor or any other party.

9.6 ACCEPTANCE AND CORRECTION OF DEFECTIVE WORK BY OWNER:

- A. Owner may in its sole discretion elect to accept Defective Work. Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such Defective Work. If Owner accepts any Defective Work prior to final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work and the Contract Sum. If the parties are unable to agree to the amount of an appropriate decrease in the Contract Sum, Owner may deduct from monies due Contractor, all claims, costs, losses, damages, expenses and liabilities attributable to the Defective Work. If Contractor disagrees with Owner's calculations, Contractor may make a claim as provided in Article 12 of this Section 00700. If Owner accepts any Defective Work after final payment, Contractor shall pay to Owner, an appropriate amount as determined by Owner.
- B. Owner may correct and remedy deficiency if, after FORTY-EIGHT (48) hours written notice to Contractor, Contractor fails to correct Defective Work or to remove and replace rejected Work; or provide a plan for correction of Defective Work acceptable to Owner; or perform Work in accordance with Contract Documents. In connection with such corrective and remedial action, Owner may exclude Contractor from all or part of the Site; take possession of all or part of Work and suspend Contractor's Work related thereto; take possession of all or part of Contractor's tools, appliances, construction equipment and machinery at the Site; and incorporate in Work any materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, its representatives, agents, employees, and other contractors and Owner's Project Manager's consultants' access to the Site to enable Owner to exercise the rights and remedies under this Paragraph. Contractor shall be responsible for all claims, costs, losses, damages, expenses, and liabilities incurred or sustained by Owner in exercising such rights and remedies. A Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to Work and the Contract Sum. If the parties are unable to agree to the amount of an appropriate decrease in the Contract Sum, Owner may deduct from monies due Contractor, all claims, costs, losses, and damages caused by or resulting from the correction or removal. If Contractor disagrees with Owner's calculations, Contractor may make a claim as provided in Article 12.

9.7 RIGHTS UPON INSPECTION, CORRECTION OR ACCEPTANCE:

- A. Contractor shall not be allowed an extension of Contract Time because of any delay in the performance of Work attributable to the exercise by Owner of its rights and remedies under this Article. Where Owner exercises its rights under this Article, it retains and may still exercise all other rights it has by law or under the Contract Documents including, but not limited to, the right to terminate Contractor's right to proceed with the Work under the Contract Documents for cause and/or make a claim or back charge where a Change Order cannot be agreed upon.
- B. Inspection by Owner or its authorized agents or representatives shall not relieve Contractor of its obligation to have furnished material and workmanship in accordance with Contract Documents. Payment for Work completed through periodic progress payments, final payment, or otherwise shall not operate to waive Owner's right to require full compliance with Contract Documents and shall in no way be deemed as acceptance of any defective Work paid therefor. Contractor's obligation to complete the Work in accordance with Contract Documents shall be absolute, unless Owner agrees otherwise in writing.

9.8 PROOF OF COMPLIANCE OF CONTRACT PROVISIONS:

- A. In order that Owner may determine whether Contractor has complied or is complying with requirements of Contract Documents not readily enforceable through inspection and tests of Work and materials, Contractor shall at any time, when requested, submit to Owner properly authenticated documents or other satisfactory proof of compliance with all applicable requirements.
- B. Before commencing any portion of Work, Contractor shall inform Owner in writing as to time and place at which Contractor wishes to commence Work, and nature of Work to be done, in order that proper provision for inspection of Work may occur, and to assure measurements necessary for record and payment. Information shall be given to Owner a reasonable time in advance of time at which Contractor proposes to begin Work, so that Owner may complete necessary preliminary work without inconvenience or delay to Contractor.

9.9 GUARANTEE PERIOD AND PROJECT WARRANTY PERIOD:

- A. If within the Guarantee Period, as defined by Section 00630 (Guarantee), any Work (completed or incomplete) is found to be Defective, Contractor shall promptly without cost to Owner and in accordance with Owner's written instructions, correct such Defective Work. Contractor shall remove any Defective Work rejected by Owner and replace it with Work that is not Defective, and satisfactorily correct or remove and replace any damage to other Work or the work of others resulting therefrom. If Contractor fails to promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the Defective Work corrected or the rejected Work removed and replaced. Contractor shall pay for all claims, costs, losses, and damages caused by or resulting from such removal and replacement. Where Contractor fails to correct Defective Work, or defects are discovered outside the Guarantee Period, Owner shall have all rights and remedies granted by law.

- B. In special circumstances where a part of the Work is occupied or a particular item of equipment is placed in continuous service before Final Acceptance of all the Work, the Guarantee Period for that part of Work or that item may start to run from an earlier date if specifically provided by Change Order.
- C. Where Defective Work or rejected Work (and damage to other Work resulting therefrom) has been corrected, removed, or replaced under this provision after the commencement of the Guarantee Period, the Guarantee Period hereunder with respect to such Work shall be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

9.10 NO WAIVER:

- A. Neither recordation of Final Acceptance nor final payment nor provision of the Contract nor partial or entire use or occupancy of premises by Owner shall constitute acceptance of Work not done in accordance with Contract Documents nor relieve Contractor of liability in respect to express warranties or responsibility for faulty materials or workmanship.
- B. If, after installation, operation or use of materials or equipment provided under the Contract Documents proves to be unsatisfactory to Owner, Owner shall have right to operate and use materials or equipment until said materials and equipment can, without damage to Owner, be taken out of service for correction or replacement. Any period of use of Defective materials or equipment pending correction or replacement shall in no way decrease the Guarantee Period applicable to acceptable corrected or replaced items of materials or equipment.
- C. Nothing in the Contract Documents shall be construed to limit, relieve, or release Contractor's, Subcontractors', and equipment suppliers' liability to Owner for damages sustained as result of latent defects in materials or equipment caused by negligence of Contractor, its agents, suppliers, employees, or Subcontractors.

ARTICLE 10 - MODIFICATION OF CONTRACT DOCUMENTS

10.1 OWNER'S RIGHT TO DIRECT CHANGED WORK:

- A. Owner may, without notice to the sureties and without invalidating the Contract, make changes in the Work ("Changed Work"), including without limitation: alterations, deviations, additions to, or deletions from Contract Documents; increase or decrease the quantity of any item or portion of the Work; expand, reduce or otherwise change the Contract Time; delete any item or portion of the Work; and require extra Work. Contractor shall perform such Work under applicable provisions of the Contract Documents, unless specifically provided otherwise at the time the change is ordered. In the case of any ordered extra Work, Owner reserves the right to furnish all or portions of associated labor, material, and equipment, which Contractor shall accept and use without payment for costs, markup, profit, or otherwise for such Owner-furnished labor, materials, and equipment.
- B. If Changed Work is of such a nature as to increase or decrease the time or cost of any part of Work, price fixed in Contract shall be increased or decreased by amount as the Contractor and Owner may agree upon as reasonable and proper allowance for increase or decrease in cost of Work using the cost guidelines set

forth in this Article, and absent such agreement, then as Owner may direct (with Contractor retaining its rights under Article 12 herein).

10.2 REQUIRED DOCUMENTATION FOR CHANGED WORK:

- A. Changes affecting the Contract Time or Contract Sum of the Work shall be set forth in a written Change Order or Field Directive that shall specify:
 - 1. The Work performed in connection with the change to be made;
 - 2. The amount of the adjustment of the Contract Sum, if any, and the basis for compensation for the Work ordered; and
 - 3. The extent of the adjustment in the Contract Time, if any.
- B. A Change Order or Field Directive will become effective when signed by Owner, notwithstanding that Contractor has not signed it. A Change Order will become effective without Contractor's signature, provided Owner indicates same thereon (by indicating it as a "unilateral change order").
- C. All changes in any plans and specifications approved by any authority with jurisdiction may also require addenda or change orders approved by that authority.
- D. Where Owner requests, a performance bond rider covering the changed Work must be executed and delivered to Owner before proceeding with the changed Work or shortly in time thereafter.

10.3 PROCEDURES AND PRICING OF CHANGED WORK:

- A. Procedures for changed work and pricing of changed work, claims and all forms of extra compensation, are set forth in Section 01250 (Modification Procedures).

ARTICLE 11 - TIME ALLOWANCES

11.1 TIME OF THE ESSENCE:

- A. Time is of the essence. Contract Time may only be changed by Change Order, and all time limits stated in the Contract Documents are to mean that time is of the essence.

11.2 EXCUSABLE DELAY AND INEXCUSABLE DELAY DEFINED:

- A. Excusable Delay. Subject to the provisions on Notice of Delay below, Contract Time may be adjusted in an amount equal to the number of Work Days lost due to excusable delays, as defined by this Paragraph 11.2. An "excusable delay" is a delay that meets each and every of the following conditions: (a) The delay was beyond the control of Contractor and its subcontractors and material suppliers; (b) the delay was caused by events of which Contractor was not advised at or before the time of bidding; (c) the delay impacted and delayed (i) the controlling items of Work (i.e., the as-built critical path, as determined from the as-planned schedule and the actual progress of the Work), or (ii) the completion of the whole Work within the Contract Time; (d) the delay was not caused by Contractor or its subcontractors or suppliers, including but not limited to their breaches of contract or the standard of care; (e) the delay was not associated with loss of time resulting from the necessity of submittals to Owner for approval, or from necessary Owner

surveys, measurements, inspections and testing; (f) the delay was not caused by usual or common weather for the time of year, as defined by the parameters set forth in Paragraph 11.5 (Adverse Weather) of this Section 00700; and (g) the delay could not have been prevented by the exercise of care, prudence, foresight, and diligence by Contractor. Excusable delays may include fires, floods, epidemics, abnormal weather conditions beyond the parameters otherwise set forth in this Article, earthquakes, civil or labor disturbances, or acts of God (together, "force majeure events"), provided damages resulting therefrom are not the result of Contractor's failure to protect the Work as required by Contract Documents ("Force Majeure"). Owner shall take into consideration other relevant factors such as concurrent delays. Contractor has the burden of proving that any delay was excusable, including but not limited to an analysis that establishes no concurrency.

- B. Inexcusable Delay. Contract Time shall not be extended for any period of time where Contractor (and/or any Subcontractor) is delayed or prevented from completing any part of the Work for any reason that fails to qualify as "excusable delay" pursuant to Paragraph 11.2A, above.
- C. Float. Float shall be treated as a Project resource. Contractor shall not be entitled to a time extension for impacts that consume float but do not impact the critical path.

11.3 NOTICE OF DELAY:

- A. Within ten Days of the beginning of any delay (excepting adverse weather delays), Contractor shall notify Owner in writing, by submitting a notice of delay that shall describe the anticipated delays resulting from the delay event in question. If Contractor requests an extension of time, Contractor shall submit a TIE within ten Days of the notice of delay. Owner will determine all claims and adjustments in the Contract Time. No claim for an adjustment in the Contract Time will be valid and such claim will be waived if not submitted in accordance with the requirements of this subparagraph. In cases of substantial compliance with the seven-Day notice requirement here (but not to exceed twenty-one Days from the beginning of the delay event), Owner may in its sole discretion recognize a claim for delay accompanied with the proper TIE, provided Contractor also shows good faith and a manifest lack of prejudice to Owner from the late notice.

11.4 COMPENSABLE AND NON-COMPENSABLE TIME EXTENSIONS:

- A. Compensable delays are those excusable delays (see Paragraph 11.2A above) for which Contractor is also entitled to monetary compensation. To be compensable, an excusable delay must be one for which the Owner is responsible, where the delay was unreasonable under the circumstances involved, and where the delay was not within the contemplation of the parties; however, Contractor shall not be entitled to monetary compensation when:
 - 1. Contractor could have reasonably anticipated the delay and avoided or minimized the cost impacts of it;
 - 2. There was a concurrent delay which does not qualify for monetary compensation under this paragraph;
 - 3. The delay was caused by factors beyond the Owner's control; or
 - 4. Any other defense available to Owner under law or equity applies.

- B. Contractor has the burden of proving that any delay was excusable and compensable, including but not limited to an analysis that establishes non-concurrency. Subject to any defenses available to Owner under law, equity, or the Contract Documents, Contractor may be entitled to compensable delay for acts or omissions of the Owner, changes in the Work ordered by the Owner, impact on the Work caused by the Owner, or concealed or unknown conditions.

11.5 ADVERSE WEATHER:

- A. Adverse weather delays may be allowed only if the number of weather-affected Work Days during the month exceeds the monthly parameters listed immediately below. Adverse weather days are defined as follows: (i.) daily rainfall exceeding 0.10 inch, and/or (ii.) daily snowfall exceeding 1.0 inch or more, at the National Oceanic & Atmospheric Administration (NOAA) station located closest to the Project site, as measured and reported by NOAA. Adverse weather delays may only be allowed when Contractor proves that adverse weather actually caused delays to Work on the critical path. Contractor shall give written notice of intent to claim an adverse weather day within one Work Day of the adverse weather day occurrence.
 - 1. Rain parameters are as follows, and shall be pro-rated in the individual month Contractor starts and finishes Work:
Rain Days: January, [9]; February, [8]; March, [7]; April, [4]; May, [2]; June, [1]; July, [0]; August, [0]; September, [1]; October, [3]; November, [6]; and December, [8].
- B. Claims for extension of time for rain delay will not be granted unless the number of days work is prevented by rain exceeds 110% of the average number of rain days expected for the period of the Contract Time, based on the records of the National Oceanic & Atmospheric Administration (NOAA) weather station closest to the Project Site, as measured and reported by NOAA. (For example, for California, Oregon, and Washington, these figures are contained in the ">=0.10 inch" column at the applicable weather station's "General Climate Summary Table" for "Precipitation" at <http://www.wrcc.dri.edu/Climsum.html>), pro-rated in the individual month Contractor starts and finishes Work. Delays due to adverse weather conditions will not be allowed for weather conditions that fall within these parameters.
- C. Notwithstanding these allowances, Contractor shall at all times employ all available mitigation measures to enable Work to continue, Contractor shall take reasonable steps to mitigate potential weather delays, such as dewatering the Site, lime treatment, and covering Work and material that could be affected adversely by weather. Failure to do so shall be cause for Owner to not grant a time extension due to adverse weather, where Contractor could have avoided or mitigated the potential delay by exercising reasonable care.
- D. Contractor shall include the foregoing precipitation parameters as a monthly activity in its progress schedule. As Work on the critical path is affected by precipitation, Contractor shall notify Owner and request that the Days be moved to the affected activities. Any adverse weather Days remaining shall be considered Project float available to either Owner or Contractor.

- E. Adverse weather delay for precipitation shall be recognized for the actual period of time Contractor proves it was delayed by precipitation exceeding the specified parameters. For example, and not by way of limitation, if precipitation exceeding the specified parameters does not in fact delay Contractor's progress on the critical path, then no time extension shall be recognized; and conversely, if Contractor proves to Owner's satisfaction that precipitation exceeding the specified parameters causes delay to Contractor for a period longer than the number of precipitation Days incurred (e.g., if it rains or snows during grading work), then Contractor shall be entitled to a time extension equal to the actual period of such delay as long as the delay otherwise qualifies as an excusable delay pursuant to Paragraph 11.2A.
- F. During unfavorable weather, wet ground, or other unsuitable construction conditions, Contractor shall employ best practices to protect the Work, manage the construction site and rainwater during inclement weather. Persons performing the Work shall examine surfaces to receive their Work and shall report in writing to Contractor, with copy to Owner's Representative conditions detrimental to the Work. Failure to examine and report discrepancies makes the Contractor responsible, at no increase in Contract Sum, for corrections Owner may require. Commencement of Work constitutes acceptance of construction conditions.

11.6 LIQUIDATED DAMAGES:

- A. Time is of the essence. Execution of Contract Documents by Contractor shall constitute its acknowledgement that Owner will actually sustain damages in the form of Contract administration expenses (such as Project management and consultant expenses) in the amount fixed in the Contract Documents for each and every Day during which completion of Work required is delayed beyond expiration of time fixed for completion plus extensions of time allowed pursuant to provisions hereof.
- B. Contractor and Owner agree that because of the nature of the Project, it would be impractical or extremely difficult to fix the amount of such actual damages incurred by Owner because of a delay in completion of all or any part of the Work. Contractor and Owner agree that specified measures of liquidated damages shall be presumed to be the amount of such damages actually sustained by Owner, and that because of the nature of the Project, it would be impracticable or extremely difficult to fix the actual damages.
- C. Liquidated damages for delay shall cover administrative, overhead, interest on bonds, and general loss of public use damages suffered by Owner as a result of delay. Liquidated damages shall not cover the cost of completion of the Work, damages resulting from Defective Work, lost revenues or costs of substitute facilities, or damages suffered by others who then seek to recover their damages from Owner (e.g., delay claims of other contractors, subcontractors, tenants, or other third-parties), and defense costs thereof. Owner may deduct from any money due or to become due to Contractor subsequent to time for completion of entire Work and extensions of time allowed pursuant to provisions hereof, a sum representing then-accrued liquidated damages.

ARTICLE 12 - CLAIMS BY CONTRACTOR

12.1 OBLIGATION TO FILE CLAIMS FOR DISPUTED WORK:

- A. Should it appear to Contractor that the Work to be performed or any of the matters relative to the Contract Documents are not satisfactorily detailed or explained therein, or should any questions arise as to the meaning or intent of the Contract Documents, or should any dispute arise regarding the true value of any work performed, work omitted, extra work that the Contractor may be required to perform, time extensions, payment to the Contractor during performance of this Contract, performance of the Contract, and/or compliance with Contract procedures, or should Contractor otherwise seek extra time or compensation FOR ANY REASON WHATSOEVER, then Contractor shall first follow procedures set forth in the Contract (including, but not limited to, other Articles of this Section 00700 and Section 01250 [Modification Procedures].) If a dispute remains, then Contractor shall give written notice to Owner that expressly invokes this Article 12, unless a written notice with respect to the same dispute has already been tendered to Owner pursuant the procedures set forth in the Contract and Owner has issued a written decision with respect to the dispute, in which case Contractor may proceed to file a claim pursuant to the procedures of this Article 12 without further written notice to Owner. With respect to any written notice required by this Paragraph 12.1, Contractor shall issue such notice to Owner no later than seven (7) days after Contractor knows or should have known about the existence of an unresolved dispute. Such notice shall provide all information that may be relevant to the dispute and, within three Days of Owner's request, Contractor shall supplement the notice as may be reasonably requested by Owner for the purposes of evaluating the matters presented. Owner shall issue a written decision regarding the matters presented in Contractor's written notice within 15 Days; and Owner's written decision shall be final and conclusive. If Contractor disagrees with Owner's decision, or if Contractor contends that Owner failed to provide a decision timely, then Contractor's SOLE AND EXCLUSIVE REMEDY is to promptly file a written Claim setting forth Contractor's position as required herein.

12.2 FORM AND CONTENTS OF CLAIM:

- A. Contractor's written claim must identify itself as a "Claim" under this Article 12 and must include the following: (1) a narrative of pertinent events; (2) citation to contract provisions; (3) theory of entitlement; (4) complete pricing of all cost impacts; (5) a time impact analysis of all time delays that shows actual time impact on the critical path; (6) documentation supporting items 1 through 5; and (7) a verification under penalty of perjury of the claim's accuracy. The Claim shall be submitted to Owner within thirty (30) calendar Days of receiving Owner's written decision, or the date Contractor contends such decision was due, and shall be priced like a change order according to Section 01250 (Modification Procedures), and must be updated monthly as to cost and entitlement if a continuing claim. Routine contract administrative materials, for example, correspondence, RFI, Change Order requests, or payment requests shall not constitute a claim. Contractor shall bear all costs incurred in the preparation and submission of a claim.

12.3 ADMINISTRATION DURING/AFTER CLAIM SUBMISSION:

- A. Owner may render a final determination based on the Claim or may, in its discretion, conduct an administrative hearing on Contractor's claim, in which case Contractor shall appear, participate, answer questions and inquiries, and present any further evidence or analysis requested by Owner prior to rendering a final determination. Should Owner take no action on the Claim within 45 Days of submission, or such longer period as may be allowed pursuant to Section 9204 of the Public Contract Code, it shall be deemed denied. Consistent with Public Contract Code Section 9204, if Owner takes any action on the Claim, it will provide Contractor a written statement identifying what portion of the Claim is disputed and what portion is undisputed.
- B. Owner shall tender any payment due to Contractor on any undisputed portion of a Claim within 60 Days after Owner issues its written statement.
- C. If Contractor disputes Owner's written response, or if Owner fails to respond to a Claim tendered pursuant to this Section 00700 within the time prescribed, Contractor may demand in writing an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, Owner will schedule a meet and confer conference within 30 days for settlement of the dispute. Within 10 business days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, Owner will provide Contractor with a written statement identifying the portion of the Claim that remains in dispute and the portion that is undisputed. Any payment due on an undisputed portion of the claim will be tendered within 60 days after Owner issues its written statement. Any disputed portion of the Claim, as identified by Contractor in writing, shall be submitted to nonbinding mediation, with the Owner and the Contractor sharing the associated costs equally. The Owner and Contractor shall mutually agree to a mediator within 10 business days after the disputed portion of the Claim has been identified in writing. If the parties cannot agree upon a mediator, each party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the Claim. Each party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator. If mediation is unsuccessful, the parts of the Claim remaining in dispute shall be subject to the remaining procedures of this Article 12.
- D. Notwithstanding and pending the resolution of any claim or dispute, Contractor shall diligently prosecute the disputed work to final completion in accordance with Owner's determination.
- E. After their submission, claims less than \$375,000 shall also be subject to the Local Agency Disputes Act (Public Contract Code §§ 20104 *et seq.*), which provides further requirements to meet and confer, mediate and arbitrate before proceeding with a Government Code Claim in accordance with the procedures specified in this Article 12.

12.4 COMPLIANCE:

- A. The provisions of this Article 12 constitute a non-judicial claim settlement procedure that, pursuant to Section 930.2 of the California Government Code, shall constitute a condition precedent to submission of a valid Government Code

Claim under the California Government Code. Contractor shall bear all costs incurred in the preparation, submission, and administration of a claim. Any claims presented in accordance with the Government Code must affirmatively indicate Contractor's prior compliance with the claims procedure herein and the previous dispositions under Paragraph 12.3 above of the claims asserted. No suit may be brought against Owner arising out of or in connection with the Project unless and until Contractor presents to Owner a statutory Government Code Claim, in accordance with Government Code Sections 910, et seq. The above contractual procedures do not act as a substitute for the Government Code Claim process, and the two sets of procedures shall be sequential with the contractual procedures coming first. Failure to timely file a Government Code Claim shall act as complete waiver of Contractor's rights to (a) recover money or time on the issues for which a Government Code Claim was required, and (b) initiate any action, proceeding or litigation for such money or time, as Contractor will not have satisfied a condition precedent or exhausted administrative remedies. Pursuant to Government Code Section 930.2, the one-year period in Government Code Section 911.2 shall be reduced to 150 Days from either accrual of the cause of action, substantial completion or termination of the contract, whichever occurs first; in all other respects, the Government Code shall apply unchanged.

- B. Failure to submit and administer claims as required in Article 12 shall waive Contractor's right to claim on any specific issues not included in a timely submitted claim. Claim(s) or issue(s) not raised in a timely protest and timely claim submitted under this Article 12 may not be asserted in any subsequent litigation, Government Code Claim, or legal action.
- C. Owner shall not be deemed to waive any provision under this Article 12, if at Owner's sole discretion, a claim is administered in a manner not in accord with this Article 12. Waivers or modifications of this Article 12 may only be made a signed change order approved as to form by legal counsel for both Owner and Contractor; oral or implied modifications shall be ineffective.

12.5 MEDIATION:

- A. All Contractor claims not otherwise subject to Public Contract Code Sections 20104 *et seq* shall, as a condition precedent to litigation thereon, first be mediated. Mediation shall be confidential and non-binding and utilize the services of a mediator mutually acceptable to the parties. .
- B. All statutes of limitation shall be tolled from the date of the demand for mediation until a date two weeks following the mediation's conclusion. All unresolved Contractor claims shall be submitted to the same mediator. The cost of mediation shall be equally shared by all parties to the mediation. The parties shall, prior to the commencement of a mediation pursuant to this Paragraph, upon notice of the other party, exchange relevant, non-privileged project documents in compliance with Code of Civil Procedure Sections 2031.010 et seq. Additionally, the parties may agree mutually to engage in additional discovery prior to mediation. Should the parties proceed with additional discovery, they shall, unless mutually agreed otherwise, comply with Code of Civil Procedure Sections 2019, et. seq. The Mediator will undertake to resolve any discovery disputes relating to the Mediation.

ARTICLE 13 - UNDERGROUND CONDITIONS

13.1 CONTRACTOR TO LOCATE UNDERGROUND FACILITIES:

- A. During construction, Contractor shall comply with Government Code Sections 4216 to 4216.9, and in particular Section 4216.2 which provides, in part: "Except in an emergency, every person planning to conduct any excavation shall contact the appropriate regional notification center at least two Business Days, but no more than 14 calendar Days, prior to commencing that excavation, if the excavation will be conducted in an area which is known, or reasonably should be known, to contain subsurface installations other than the underground facilities owned or operated by the excavator, and, if practical, the excavator shall delineate with white paint or other suitable markings the area to be excavated. The regional notification center shall provide an inquiry identification number to the person who contacts the center and shall notify any member, if known, who has a subsurface installation in the area of the proposed excavation."
- B. Contractor shall contact Common Ground Alliance, and schedule the Work to allow ample time for the center to notify its members and, if necessary, for any member to field locate and mark its facilities. Contractor is charged with knowledge of all subsurface conditions reflected in Common Ground Alliance records. Prior to commencing excavation or trenching work, Contractor shall provide Owner with copies of all Common Ground Alliance records secured by Contractor. Contractor shall advise Owner of any conflict between information provided in Section 00320 (Geotechnical Data and Existing Conditions), the Drawings and that provided by Common Ground Alliance records. Contractor's excavation shall be subject to and comply with the Contract Documents.
- C. Contractor shall also investigate the existence of existing service laterals, appurtenances, or other types of utilities, indicated by the presence of an underground transmission main or other visible facilities, such as buildings, new asphalt, meters, and junction boxes, on or adjacent to the Site, even if not shown or indicated in Section 00320 (Geotechnical Data and Existing Conditions), the Drawings or that provided by Common Ground Alliance records. Contractor shall immediately secure all such available information and notify Owner and the utility owner, in writing, of its discovery.

13.2 CONTRACTOR TO PROTECT UNDERGROUND FACILITIES:

- A. At all times during construction, all operating Underground Facilities shall remain in operation, unless the Contract Documents expressly indicate otherwise. Contractor shall maintain such Underground Facilities in service where appropriate; shall repair any damage to them caused by the Work; and shall incorporate them into the Work, including reasonable adjustments to the design location (including minor relocations) of the existing or new installations. Contractor shall take immediate action to restore any in service installations damaged by Contractor's operations.
- B. Prior to performing Work at the Site, Contractor shall lay out the locations of Underground Facilities that are to remain in service and other significant known underground installations indicated by the Underground Facilities Data. Contractor shall further locate, by carefully excavating with small equipment, potholing, and principally by hand, all such utilities or installations that are to

remain and that are subject to damage. If additional utilities whose locations are unknown are discovered, Contractor shall immediately report to Owner for disposition of the same. Additional compensation or extension of time on account of utilities not shown or otherwise brought to Contractor's attention, including reasonable action taken to protect or repair damage, shall be determined as provided in this Section 00700.

- C. If during construction, an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated in the materials supplied by Owner for Bidding or in information on file at Common Ground Alliance or otherwise reasonably available to Contractor, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby (and in no event later than seven Days), and prior to performing any Work in connection therewith (except in an emergency), identify the owner of such Underground Facility and give written notice to that owner and to Owner. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. The cost of all of the following will be included in the Contract Sum and Contractor shall have full responsibility for (a) reviewing and checking all available information and data including, but not limited to, information made available for Bidding and information on file at Common Ground Alliance; (b) locating all Underground Facilities shown or indicated in the Contract Documents, available information, or indicated by visual observation including, but not limited to, and by way of example only, engaging qualified locating services and all necessary backhoeing and potholing; (c) coordination of the Work with the owners of such Underground Facilities during construction; and (d) the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.
- E. Consistent with California Government Code Section 4215, as between Owner and Contractor, Owner will be responsible for the timely removal, relocation, or protection of existing main or trunk line utility facilities located on the Site only if such utilities are not identified in the Contract Documents or information made available for Bidding. Owner will compensate for the cost of locating and repairing damage not due to Contractor's failure to exercise reasonable care, removing and relocating such main or trunk line utility facilities not indicated in the Contract Documents or information made available for Bidding with reasonable accuracy, and equipment on the Project necessarily idled during such Work. Contractor shall not be assessed liquidated damages for delay in completion of the Project, when such delay was caused by the failure of Owner or the utility to provide for removal or relocation of such utility facilities.

13.3 CONCEALED OR UNKNOWN CONDITIONS:

- A. If either of the following conditions is encountered at Site when digging trenches or other excavations that extend deeper than four feet below the surface, Contractor shall give a written Notice of Differing Site Conditions to Owner promptly before conditions are disturbed, except in an emergency as set forth in this Section 00700, and in no event later than seven Days after first observance of:
 - 1. Subsurface or Latent physical conditions which differ materially from those indicated in the Contract Documents; or

2. Unknown physical conditions of an unusual nature or which differ materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents.
- B. In response to Contractor's Notice of Differing Site Conditions under this Paragraph, Owner will investigate the identified conditions, and if they differ materially and cause increase or decrease in Contractor's cost of, or time required for, performance of any part of the Work, Owner will negotiate the appropriate change order following the procedures set forth in the Contract Documents. If Owner determines that physical conditions at the Site are not Latent or are not materially different from those indicated in Contract Documents or that no change in terms of the Contract Documents is justified, Owner will so notify Contractor in writing, stating reasons (with Contractor retaining its rights under Article 12 of this Section 00700.)
- C. Contractor shall not be entitled to any adjustment in the Contract Sum or Contract Time regarding claimed Latent or materially different Site conditions (whether above or below grade) if Contractor knew or should have known of the existence of such conditions at the time Contractor submitted its Bid, failed to give proper notice, or relied upon information, conclusions, opinions or deductions of the kind that the Contract Documents preclude reliance upon.
- D. Regarding Underground Facilities, Contractor shall be allowed an increase in the Contract Sum or an extension of the Contract Time, or both, to the extent that they are attributable to the existence of any Underground Facility that is owned and was built by Owner only where the Underground Facility:
 1. Was not shown or indicated in the Contract Documents or in the information supplied for Bidding purposes or in information on file at Common Ground Alliance; and
 2. Contractor did not know of it; and
 3. Contractor could not reasonably have been expected to be aware of it or to have anticipated it from the information available. (e.g., if surface conditions such as pavement repairs, valve covers, or other markings, indicate the presence of an Underground Facility, then an increase in the Contract Sum or an extension of the Contract Time will not be due, even if the Underground Facility was not indicated in the Contract Documents, in the information supplied to Contractor for Bidding purposes, in information on file at Common Ground Alliance, or otherwise reasonably available to Contractor.)
- E. Contractor shall bear the risk that Underground Facilities not owned or built by Owner may differ in nature or locations shown in information made available by Owner for Bidding purposes, in information on file at Common Ground Alliance, or otherwise reasonably available to Contractor. Underground Facilities are inherent in construction involving digging of trenches or other excavations on Owner's Project, and Contractor is to apply its skill and industry to verify the information available.
- F. Contractor's compensation for claimed Latent or materially different Site conditions shall be limited to the actual, reasonable, incremental increase in cost of that portion of the Work, resulting from the claimed Latent or materially different Site conditions. Such calculation shall take into account the estimated value of that portion of the Work and the actual value of that portion of the Work, using for guidance Contractor's or its subcontractor's Bid amount and actual

amounts expended for that portion of the Work and the reasonable expectation (if any) of differing or difficult site conditions in the Work area based on the available records and locale of the Work.

13.4 NOTICE OF HAZARDOUS WASTE OR MATERIALS CONDITIONS:

- A. Contractor shall give a written Notice of Hazardous Materials Condition to Owner promptly, before any of the following conditions are disturbed (except in an emergency as set forth in this Section 00700), and in no event later than 24 hours after first observance of any:
 - 1. Material that Contractor believes may be hazardous waste or hazardous material, as defined in Section 25117 of the Health and Safety Code (including without limitation, Asbestos, lead, PCBs, petroleum and related hydrocarbons, and radioactive material) that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with provisions of existing law ("hazardous material"); or
 - 2. Other material that may present an imminent substantial danger to persons or property exposed thereto in connection with Work at the Site ("other materials").
- B. Except as otherwise provided in the Contract Documents or as provided by applicable law, Contractor shall not be required to give any notice for the disturbance or observation of any such hazardous materials or other materials where such matter is disturbed or observed as part of the scope of Work under the Contract Documents (such as hazardous waste or hazardous material investigation, remediation, or disposal activities which are identified as the subject of Work under the Contract Documents), where Contractor complies with all requirements in the Contract Documents and applicable law respecting such materials.
- C. Contractor's Notice of Hazardous Materials Condition shall indicate whether the hazardous materials or other materials were shown or indicated in the Contract Documents to be within the scope of Work, and whether the hazardous materials or other materials were brought to the Site by Contractor, its Subcontractors, suppliers, or anyone else for whom Contractor is responsible.
- D. Contractor shall not be entitled to any adjustment in the Contract Sum or Contract Time regarding claimed hazardous waste or materials if:
 - 1. Contractor knew of the existence of such hazardous materials or other materials at the time Contractor submitted its Bid; or
 - 2. Contractor should have known of the existence of such hazardous material or other materials as a result of its having the responsibility to obtain additional or supplementary examinations, investigation, explorations, tests, studies, and data concerning the conditions at or contiguous to the Site prior to submitting its Bid; or
 - 3. Contractor failed to give the written notice within the required timeframe set forth below.
- E. If Owner determines that conditions involve hazardous materials or other materials and that a change in Contract Document terms is justified, Owner will issue either a Request for Proposal or Field Directive under the procedures described in the Contract Documents. If Owner determines that conditions do not involve hazardous materials or other materials or that no change in Contract

Document terms is justified, Owner will notify Contractor in writing, stating the reasons for its determination.

- F. In addition to the parties' other rights under this Section 00700, if Contractor does not agree to resume Work based on a reasonable belief that it is unsafe, or does not agree to resume Work under special conditions, Owner may order the disputed portion of Work deleted from the Work, or performed by others, or Owner may invoke its right to terminate Contractor's right to proceed under the Contract Documents in whole or in part, for convenience or for cause as the facts may warrant.
- G. If Contractor does not agree with any Owner determination of any adjustment in the Contract Sum or Contract Time under this Article, Contractor may make a claim as provided in Article 12 of this Section 00700.

ARTICLE 14 - LEGAL AND MISCELLANEOUS

14.1 LAWS AND REGULATIONS:

- A. Contractor shall keep fully informed of and shall comply with all laws, ordinances, regulations, and orders of any properly constituted authority affecting the Contract Documents, Work, and persons connected with Work, and shall protect and indemnify Owner and its officers, employees, consultants, and agents against any claim or liability, including attorney's fees, arising from or based on violation of law, ordinance, regulation, or order, whether by Contractor or by Subcontractors, employees, or agents. Authorized persons may at any time enter upon any part of Work to ascertain compliance of all applicable laws, ordinances, regulations, and orders.

14.2 PERMITS AND APPROVALS:

- A. Taxes: Contractor shall pay all sales and/or use taxes levied on materials, supplies, or equipment purchased and used on or incorporated into Work, and all other taxes properly assessed against equipment or other property used in connection with Work, without any increase in the Contract Sum.
 - B. Permits: Contractor shall make necessary arrangements with proper authorities having jurisdiction over roads, streets, pipelines, navigable waterways, railroads, and other works in advance of operations, even where Owner may have already obtained permits for the Work. Contractor shall secure and pay for all permits, licenses, and certificates necessary for prosecution of Work before the date of the commencement of the Work or before the permits, licenses, and certificates are legally required to continue the Work without interruption. The Contractor shall obtain and pay, only when legally required, for all licenses, permits, inspections, and inspection certificates required to be obtained from or issued by any authority having jurisdiction over any part of the Work included in the Contract. All final permits, licenses, and certificates shall be delivered to Owner before demand is made for final payment.
1. Owner will procure the Building Permit for the project. Contractor is responsible for procurement, coordination and payment for all other permits including but not limited to encroachment, street closure, bay area air quality management, and any other permits required for the performance of the work.

2. Contractor is responsible for coordination of all inspections and final acceptance by authorities having jurisdiction.
- C.

14.3 COMMUNICATIONS AND INFORMATION DISTRIBUTION:

- A. All communications recognized under the Contract Documents shall be in writing, in the form of a serialized document, by type of communication. For example, RFI's shall be serialized beginning with RFI No. 1; payment applications shall be serialized beginning with Payment Application No. 1; submittals shall be serialized per Specification Section and transmitted with transmittal sheets with submittal number; and correspondence shall be serialized beginning with letter No. 1. Contractor may propose other record management and identification systems or protocols, intended to facilitate orderly transmittal of project information, storage and retrieval of such information, which Owner will review consistent with these stated objectives, and accept or reject in its sole discretion.
- B. Documents Requiring Signatures. All documents requiring signatures for approval prior to implementing action, as stipulated in other portions of Contract Documents, shall require a manually signed, serialized letter delivered to the other party at its address for notice otherwise specified in the Contract Documents, either personally or by mail.
- C. Electronic data transfer of such correspondence will serve to expedite preliminary concurrence of information, only. Receipt of "hard copy" signature on forms is required prior to implementing action or work as the conditions may require. For example, change orders and authorizations for extra cost, require signatures. A party may acknowledge receipt of PDF copies of required correspondence by e-mail, but in the absence of such acknowledgment, mail or personal delivery is required.
- D. All emails shall be copied to Owner's Project Manager, Owner's Representative(s) as identified by Owner's Project Manager, and Contractor's Project Manager. Owner reserves the right to preclude e-mail communication, in whole or in part, as Project needs may require. Communication between Owner and Contractor shall not be via Twitter, Facebook, or other types of instant text message systems. Any such communications shall be inadmissible for any purpose related to this Contract.

14.4 SUSPENSION OF WORK:

- A. Owner may, without cause, order Contractor in writing to suspend, delay, or interrupt Work in whole or in part for such period of time as Owner may determine. An adjustment shall be made for increases in cost of performance of Work of the Contract Documents caused by any such suspension, delay, or interruption, calculated using the measures set forth in Section 01250 (Modification Procedures). No adjustment shall be made to extent that performance is, was, or would have been so suspended, delayed, or interrupted by another cause for which Contractor is responsible.

14.5 TERMINATION OF CONTRACT FOR CAUSE:

- A. The Contractor shall be in default of the Contract Documents and Owner may terminate the Contractor's right to proceed under the Contract Documents, for cause, in whole or in part, should the Contractor commit a material breach of the Contract Documents and not cure such breach within ten calendar Days of the date of notice from Owner to the Contractor demanding such cure; or, if such breach is curable but not curable within such ten Day period, within such period of time as is reasonably necessary to accomplish such cure. (In order for the Contractor to avail itself of a time period in excess of ten calendar Days, the Contractor must provide Owner within the ten Day period with a written plan acceptable to Owner that demonstrates actual resources, personnel, and a schedule to promptly to cure said breach, and then diligently commence and continue such cure according to the written plan).
- B. In the event of termination by Owner for cause as provided herein, the Contractor shall deliver to Owner possession of the Work in its then condition including but not limited to, all designs, engineering, Project records, cost data of all types, plans and specifications, contracts with vendors and subcontractors, all other documentation associated with the Project, and all construction supplies and aids dedicated solely to performing the Work which, in the normal course of construction, would be consumed or only have salvage value at the end of the construction period. The Contractor shall remain fully liable for the failure of any Work completed and materials and equipment provided through the date of such termination to comply with the provisions of the Contract Documents. The provisions of this Section shall not be interpreted to diminish any right which Owner may have to claim and recover damages for any breach of the Contract Documents or otherwise, but rather, the Contractor shall compensate Owner for all loss, cost, damage, expense, and/or liability suffered by Owner as a result of such termination and/or failure to comply with the Contract Documents.
- C. In the event a termination for cause is later determined to have been made wrongfully or without cause, then the termination shall be treated as a termination for convenience, and the Contractor shall have no greater rights than it would have had following a termination for convenience. Any Contractor claim arising out of a termination for cause shall be made in accord with Article 12 herein. No other loss, cost, damage, expense, or liability may be claimed, requested or recovered by the Contractor.

14.6 TERMINATION OF CONTRACT FOR CONVENIENCE:

- A. Owner may terminate performance of the Work under the Contract Documents in accordance with this clause in whole, or from time to time in part, whenever Owner shall determine that termination is in Owner's best interest. Termination shall be effected by Owner delivering to the Contractor notice of termination specifying the extent to which performance of the Work under the Contract Documents is terminated, and the effective date of the termination.
- B. Contractor shall comply strictly with Owner's direction regarding the effective date of the termination, the extent of the termination, and shall stop work on the date and to the extent specified.
- C. Contractor shall be entitled to a total payment on account of the Contract Work so terminated measured by (i.) the actual cost to Contractor of Work actually

performed, up to the date of the termination, with profit and overhead limited to twelve percent (12%) of actual cost of work performed, up to but not exceeding the actual contract value of the work completed as measured by the Schedule of Values and Progress Schedule, (ii.) offset by payments made and other contract credits. In connection with any such calculation, however, Owner shall retain all rights under the Contract Documents including, but not limited to, claims, indemnities, or setoffs.

- D. Under no circumstances may Contractor recover legal costs of any nature, nor may Contractor recover costs incurred after the date of the termination.

14.7 CONTINGENT ASSIGNMENT OF SUBCONTRACTS:

- A. Contractor hereby assigns to Owner each Subcontract for a portion of the Work, provided that:
1. The assignment is effective only after Owner's termination of Contractor's right to proceed under the Contract Documents (or portion thereof relating to that Subcontract) as set forth herein;
 2. The assignment is effective only for the Subcontracts which Owner expressly accepts by notifying the Subcontractor in writing;
 3. The assignment is subject to the prior rights, if any, of the Surety, obligated by Section 00611 (Construction Performance Bond) provided under the Contract Documents, where the Surety exercises its rights to complete the Contract;
 4. After the effectiveness of an assignment, Contractor shall, at its sole cost and expense (except as otherwise provided in this Section 00700), sign all instruments and take all actions reasonably requested by Owner to evidence and confirm the effectiveness of the assignment in Owner; and
 5. Nothing in this Paragraph shall modify or limit any of Contractor's obligations to Owner arising from acts or omissions occurring before the effectiveness of any Subcontract assignment including, but not limited to, all defense, indemnity, and hold-harmless obligations arising from or related to the assigned Subcontract.

14.8 REMEDIES AND CONTRACT INTEGRATION:

- A. Subject to Contract Documents provisions regarding Contractor claims, claim review, and claim resolution, and subject to the limitations therein, the exclusive jurisdiction and venue for resolving all claims, counter claims, disputes, and other matters in question between Owner and Contractor arising out of or relating to Contract Documents, any breach thereof, or the Project shall be the applicable court of competent jurisdiction located in the State and County where the Project is located. All Owner remedies provided in the Contract Documents shall be taken and construed as cumulative and not exclusive; that is, in addition to each and every other remedy herein provided and in all instances, Owner shall have any and all other equitable and legal rights and remedies which it would have according to law.
- B. The Contract Documents, any Contract Modifications and Change Orders, shall represent the entire and integrated agreement between Owner and Contractor regarding the subject matters hereof and thereof and shall constitute the exclusive statement of the terms of the parties' agreement. The Contract Documents, and any Contract Modifications and Change Orders, shall supersede any and all prior

negotiations, representations, or agreements, written or oral, express or implied, that relate in any way to the subject matter of the Contract Documents or written Modifications. Owner and Contractor represent and agree that, except as otherwise expressly provided in the Contract Documents, they are entering into the Contract Documents and any subsequent written Modification in sole reliance upon the information set forth or referenced in the Contract Documents or Contract Modifications; the parties are not and will not rely on any other information, which shall be inadmissible in any proceeding to enforce these documents.

- C. Either party's waiver of any breach or failure to enforce any of the terms, covenants, conditions, or other provisions of the Contract Documents at any time shall not in any way affect, limit, modify, or waive that party's right thereafter to enforce or compel strict compliance with every term, covenant, condition, or other provision hereof, any course of dealing or custom of the trade or oral representations notwithstanding.
- D. Neither acceptance of the whole or any part of Work by Owner, nor any verbal statements on behalf of Owner or its authorized agents or representatives shall operate as a waiver or modification of any provision of the Contract Documents, or of any power reserved to Owner herein nor any right to damages provided in the Contract Documents.

14.9 INTERPRETATION:

- A. Should any part, term, or provision of this Agreement or any of the Contract Documents, or any document required herein or therein to be executed or delivered, be declared invalid, void or unenforceable, all remaining parts, terms, and provisions shall remain in full force and effect and shall in no way be invalidated, impaired, or affected thereby. If the provisions of any law causing such invalidity, illegality, or unenforceability may be waived, they are hereby waived to the end that this Agreement and the Contract Documents may be deemed valid and binding agreements, enforceable in accordance with their terms to the greatest extent permitted by applicable law. In the event any provision not otherwise included in the Contract Documents is required to be included by any applicable law, that provision is deemed included herein by this reference (or, if such provision is required to be included in any particular portion of the Contract Documents, that provision is deemed included in that portion).
- B. Contract Documents shall not be construed to create a contractual relationship of any kind between (1) Owner's Project Manager or any Owner's Representative and Contractor; (2) Owner and/or its Representatives and a Subcontractor, sub-Subcontractor, or supplier of any Project labor, materials, or equipment; or (3) between any persons or entities other than Owner and Contractor.

14.10 PATENTS:

- A. Fees or claims for any patented invention, article, or arrangement that may be used upon or in any manner connected with performance of the Work or any part thereof shall be included in the Bid price for doing the Work. Contractor shall defend, indemnify, and hold harmless Owner and each of its officers, employees, consultants, and agents including, but not limited to, the Board, Owner's Project Manager, and each Owner's Representative, from all damages, claims for

damages, costs, or expenses in law or equity, including attorneys' fees, arising from or relating to any claim that any article supplied or to be supplied under the Contract Documents infringes on the patent rights, copyright, trade name, trademark, service mark, trade secret or other intellectual property right of any person or persons or that the person or entity supplying the article does not have a lawful right to sell the same. Such costs or expenses for which Contractor agrees to indemnify and hold harmless the above indemnities include, but are not limited to, any and all license fees, whether such fees are agreed by any indemnitee or ordered by a court or administrative body of any competent jurisdiction.

14.11 SUBSTITUTION FOR PATENTED AND SPECIFIED ARTICLES:

- A. Except as noted specifically in Section 00200 (Instructions to Bidders) or in Contract Documents, whenever material or process is designated in Specifications by patent or proprietary name or by name of manufacturer, such designation shall be deemed to be used for purpose of facilitating description of material and process desired, and shall be deemed to be followed by the words "or Approved Equal" and Contractor may offer any substitute material or process that Contractor considers "equal" in every respect to that so designated and if material or process offered by Contractor is, in opinion of Owner, Equal in every respect to that so designated, its use will be approved. However, Contractor may utilize this right only by timely submitting Section 00660 (Substitution Request Form) as provided in Section 00200 (Instructions to Bidders). A substitution will be approved only if it is a true "or equal" item in every aspect of its design and quality including, but not limited to, its dimensions, weights, service requirements, durability, functioning, impact on contiguous construction elements, overall schedule, and design.

14.12 INTEREST OF PUBLIC OFFICERS:

- A. No representative, officer, or employee of Owner, no member of the governing body of the locality in which the Project is situated, no member of the locality in which Owner, was activated, and no other public official of such locality or localities who exercises any functions or responsibilities with respect to the Project, during the tenure of the official or for one year thereafter, shall, as principal, agent, attorney, or otherwise, be directly or indirectly interested in the Contract Documents or the proceeds thereof.

14.13 LIMIT OF LIABILITY:

- A. OWNER, AND EACH OF ITS OFFICERS, BOARD MEMBERS, EMPLOYEES, CONSULTANTS, AND AGENTS INCLUDING, BUT NOT LIMITED TO, OWNER'S PROJECT MANAGER, AND EACH OTHER OWNER REPRESENTATIVE, SHALL HAVE NO LIABILITY TO CONTRACTOR FOR SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES, EXCEPT TO THE LIMITED EXTENT THAT THESE CONTRACT DOCUMENTS OR APPLICABLE PUBLIC CONTRACTING STATUTES MAY SPECIFY THEIR RECOVERY.

ARTICLE 15 - WORKING CONDITIONS AND PREVAILING WAGES

15.1 USE OF SITE/SANITARY RULES:

- A. All portions of the Work shall be maintained at all times in neat, clean, and sanitary condition. Contractor shall furnish toilets for use of Contractor's and Subcontractors' employees on the Site where needed, and their use shall be strictly enforced. All toilets shall be properly secluded from public observation, and shall be located, constructed, and maintained subject to Owner's approval.
- B. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and land areas identified in and permitted by Contract Documents and other land and areas permitted by applicable laws and regulations, rights of way, permits and easements, or as designated by Owner, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, any improvement located thereon, or to Owner or occupant thereof resulting from the performance of Work.
- C. During the progress of the Work, Contractor shall keep the Site and the Project free from accumulations of waste materials, rubbish, and other debris resulting from the Work. At the completion of the Work, Contractor shall clean the site, remove all waste materials, rubbish, and debris from and about the Site as well as all tools, appliances, construction equipment, and machinery and surplus materials. Contractor shall leave the premises clean and ready for occupancy by Owner at Substantial Completion of Work. Contractor shall restore to original condition all property not designated for alteration by Contract Documents.
- D. Contractor shall not load nor permit any part of any structure or pavement to be loaded in any manner that will endanger the structure or pavement, nor shall Contractor subject any part of Work or adjacent property to stresses or pressures that will endanger it. Contractor shall conduct all necessary existing conditions investigation regarding structural, mechanical, electrical, or any other system existing, shall perform Work consistent with such existing conditions, and shall have full responsibility for insufficiencies or damage resulting from insufficiencies of existing systems, equipment, or structures to accommodate performing the Work.

15.2 PROTECTION OF WORK, PERSONS, AND PROPERTY:

- A. Contractor shall be responsible for initiating, maintaining, and supervising all safety and site security precautions and programs in connection with Work, and shall develop and implement a site security and safety plan throughout construction. Contractor shall comply with all safety requirements specified in any safety program established by Owner, or required by state, federal, or local laws and ordinances. Contractor shall be responsible for all theft or damage to Work, property, or structures, and all injuries to persons, either on the Site or constituting the Work (e.g., materials in transit), arising from the performance of Work of the Contract Documents from a cause.
- B. Contractor shall comply with all applicable laws and regulations of any public body having jurisdiction for safety of persons or property or to protect them from damage, injury, or loss; and shall erect and maintain all necessary safeguards for

such safety and protection. Contractor shall notify Owners of adjacent property and of Underground Facilities and utility Owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

- C. Contractor shall remedy all damage, injury, or loss to any property referred to above in this Article, caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, supplier, or any other person or organization directly or indirectly employed by any of them to perform or furnish any Work or anyone for whose acts any of them may be liable. Contractor's duties and responsibility for safety and for protection of Work shall continue until such time as all the Work is completed and Final Acceptance of the Work. Owner and its agents do not assume any responsibility for collecting any indemnity from any person or persons causing damage to Contractor's Work.
- D. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.
- E. Owner may, at its option, retain such monies due under the Contract Documents as Owner deems necessary until any and all suits or claims against Contractor for injury to persons or property shall be settled and Owner receives satisfactory evidence to that effect.
- F. Work within the right-of-way lines of the city and/or Owner and/or State shall be done in accordance with the standards and specifications of the controlling agency. Permit for such work shall be obtained and paid for by the Contractor before executing the work within such right-of-ways.

15.3 RESPONSIBILITY FOR SAFETY AND HEALTH:

- A. Contractor shall ensure that its and each tier of Subcontractors' employees, agents, and invitees comply with applicable health and safety laws while at the Site. These laws include the Occupational Safety and Health Act of 1970 and rules and regulations issued pursuant thereto, and Owner's safety regulations as amended from time to time. Contractor shall comply with all Owner directions regarding protective clothing and gear.
- B. Contractor shall be fully responsible for the safety of its and its Subcontractors' employees, agents, and invitees on the Site. Contractor shall notify Owner, in writing, of the existence of hazardous conditions, property, or equipment at the Site that are not under Contractor's control. Contractor shall be responsible for taking all necessary precautions against injury to persons or damage to the property of Contractor, Subcontractors or persons from recognized hazards until the responsible party corrects the hazard.
- C. Contractor shall confine all persons acting on its or its Subcontractors' behalf to that portion of the Site where Work under the Contract Documents is to be performed, Owner-designated routes for ingress and egress thereto, and any other Owner-designated area. Except those routes for ingress and egress over which Contractor has no right of control, within such areas, Contractor shall provide safe means of access to all places at which persons may at any time have occasion to be present.

15.4 EMERGENCIES:

- A. In emergencies affecting the safety or protection of persons or Work or property at the Site or adjacent thereto, Contractor, without special instruction or authorization from Owner, is obligated to act to prevent threat and damage, injury, or loss, until directed otherwise by Owner. Contractor shall give Owner prompt written notice if Contractor believes that any significant changes in Work or variations from Contract Documents have been caused thereby. If Owner determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Change Order or Field Directive will be issued to document the consequences of such action.

15.5 USE OF ROADWAYS AND WALKWAYS:

- A. Contractor shall not unnecessarily interfere with use of any roadway, walkway, or other facility for vehicular or pedestrian traffic. Before beginning any interference and only with Owner's prior concurrence, Contractor may provide detour or temporary bridge for traffic to pass around or over the interference, which Contractor shall maintain in satisfactory condition as long as interference continues. Unless otherwise provided in the Contract Documents, Contractor shall bear the cost of these temporary facilities.

15.6 NONDISCRIMINATION:

- A. No person or entity shall discriminate in the employment of persons upon public works because of race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, marital status, sexual preference, or gender of such persons, except as provided in Section 12940 of the California Government Code. Every contractor for public works violating the provisions of Section 1735 of the California Labor Code is subject to all the penalties imposed for a violation of Chapter 1, Part 7, Division 2 of the California Labor Code.

15.7 PREVAILING WAGES AND WORKING HOURS:

- A. Contractor shall pay to persons performing labor in and about Work provided for in the Contract Documents an amount equal to or more than the general prevailing rate of per diem wages for (1) work of a similar character in the locality in which the Work is performed and (2) legal holiday and overtime work in said locality. The per diem wages shall be an amount equal to or more than the stipulated rates contained in a schedule that has been ascertained and determined by the Director of the State Department of Industrial Relations and Owner to be the general prevailing rate of per diem wages for each craft or type of workman or mechanic needed to execute this Contract. Contractor shall also cause a copy of this determination of the prevailing rate of per diem wages to be posted at each Site, in addition to all other job site notices prescribed by regulation.
- B. Contractor shall forfeit, as a penalty to Owner, Two Hundred Dollars (\$200.00) for each laborer, workman, or mechanic employed in performing labor in and about the Work provided for in the Contract Documents for each Day, or portion thereof, that such laborer, workman, or mechanic is paid less than the said stipulated rates for any Work done under the Contract Documents by him or her or by any Subcontractor under him or her, in violation of Articles 1 and 2 of Chapter 1 of Part 7 of Division II of the California Labor Code. The sums and

amounts which shall be forfeited pursuant to this Paragraph and the terms of the California Labor Code shall be withheld and retained from payments due to Contractor under the Contract Documents, pursuant to this Section 00700 and the California Labor Code, but no sum shall be so withheld, retained, or forfeited except from the final payment without a full investigation by either the State Department of Industrial Relations or by Owner. The Labor Commissioner pursuant to California Labor Code Section 1775 shall determine the final amount of forfeiture.

- C. Contractor shall insert in every subcontract or other arrangement which Contractor may make for performance of Work or labor on Work provided for in the Contract, provision that Subcontractor shall pay persons performing labor or rendering service under subcontract or other arrangement not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the Work is performed, and not less than the general prevailing rate of per diem wages for holiday and overtime work fixed in the California Labor Code.
- D. Contractor stipulates that it shall comply with all applicable wage and hour laws, including without limitation, California Labor Code Sections 1725.5, 1776, and 1811. Failure to so comply shall constitute a default under this Contract.
- E. Contractor and its Subcontractors shall be responsible for compliance with Labor Code Sections 1810-1815.
 - 1. Eight hours of labor performed in execution of the Contract constitutes a legal day's work. The time of service of any workman employed on the Project is limited and restricted to 8 hours during any one Day, and 40 hours during any one calendar week.
 - 2. Contractor and its Subcontractors shall keep an accurate record showing the name of and actual hours worked each Day and each calendar week by each worker employed by him or her in connection with the Project. The record shall be kept open at all reasonable hours to the inspection Owner and to the Division of Labor Standards Enforcement.
 - 3. Contractor or its Subcontractors shall, as a penalty to Owner, forfeit twenty-five dollars (\$25) for each worker employed in the execution of the Contract Documents by the respective Contractor or Subcontractor for each Day during which the worker is required or permitted to work more than 8 hours in any one Day and 40 hours in any one calendar week in violation of the provisions of Labor Code Sections 1810-1815.
 - 4. Work performed on the Project by employees of Contractor or its Subcontractors in excess of 8 hours per Day, and 40 hours during any one week, shall be permitted upon compensation for all hours worked in excess of 8 hours per Day at not less than 1 1/2 times the basic rate of pay.
- F. This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations. Contractor shall furnish and shall require all subcontractors to furnish the records specified in Labor Code Section 1776 (e.g. electronic certified payroll records) directly to the Labor Commissioner in a format prescribed by the Labor Commissioner at least monthly.

- G. Contractor and all Subcontractors shall be registered and qualified to perform public work pursuant to Labor Code Section 1725.5 as a condition to engage in the performance of any Work hereunder.
- H. Contractor and its Subcontractors shall be responsible for compliance with Labor Code Section 1776.
 - 1. Contractor and Subcontractors must keep accurate payroll records, showing the name, address, social security number, work classification, straight time and overtime hours worked each Day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed by him or her in connection with the Work of the Contract Documents. Each payroll record shall contain or be verified by a written declaration as required by Labor Code Section 1776.
 - 2. The payroll records enumerated above must be certified and shall be available for inspection at all reasonable hours at the principal office of the Contractor as required by Labor Code Section 1776.
 - a. Contractor shall inform Owner of the location of records enumerated above, including the street address, city, and county, and shall, within five working Days, provide a notice of a change of location and address.
 - b. Contractor or Subcontractor has ten Days in which to comply subsequent to receipt of a written notice requesting the records enumerated above. In the event that the Contractor or Subcontractor fails to comply with the ten-Day period, he or she shall, as a penalty to Owner on whose behalf the contract is made or awarded, forfeit \$25.00 for each Day, or portion thereof, for each worker, until strict compliance is effectuated. Upon the request of the Division of Apprenticeship Standards or the Division of Labor Standards Enforcement, these penalties shall be withheld from progress payments then due. Contractor is not subject to a penalty assessment pursuant to this Paragraph due to the failure of a Subcontractor to comply with this Paragraph.
- I. If requested by Owner, Contractor shall also deliver certified payrolls and any related labor compliance documentation to Owner within ten Days of Owner's request.

15.8 ENVIRONMENTAL CONTROLS:

- A. Contractor shall comply with all rules, regulations, ordinances, and statutes that apply to any Work performed under the Contract Documents including, without limitation, any toxic, water, stormwater management and soil pollution controls and air pollution controls specified in California Government Code Section 11017. Contractor shall be responsible for insuring that Contractor's Employees, Subcontractors, and the public are protected from exposure to airborne hazards or contaminated water, soil, or other toxic materials used during or generated by activities on the Site or associated with the Project.

15.9 SHORING SAFETY PLAN:

- A. Any conflict between this Paragraph and Division 2 of the Specifications shall be resolved in favor of the most stringent requirement.
- B. At least five Days in advance of any excavation five feet or more in depth, Contractor shall submit to Owner a detailed plan showing the shoring, bracing

and sloping design (including calculations) and other provisions to be made for worker protection from the hazard of caving ground during the excavation, as required by California Labor Code Section 6705. A civil or structural engineer registered in California shall prepare and sign any plan that varies from the shoring system standards established by the State Construction Safety Orders.

- C. During the course of Work, Contractor shall be responsible for determining where sloping, shoring, and/or bracing is necessary and the adequacy of the design, installation, and maintenance of all shoring and bracing for all excavation, including any excavation less than five feet in depth. Contractor will be solely responsible for any damage or injuries that may result from excavating or trenching. Owner's acceptance of any drawings showing the shoring or bracing design or Work schedule shall not relieve Contractor of its responsibilities under this Paragraph.
- D. Appoint a qualified supervisory employee who shall be responsible to determine the sloping or shoring system to be used depending on local soil type, water table, stratification, depth, etc.

END OF SECTION

SECTION 00800

SUPPLEMENTARY CONDITIONS - INSURANCE AND INDEMNIFICATION

1.1 SUMMARY

- A. This document includes requirements that supplement Section 00700 (General Conditions).

1.2 SUPPLEMENTS

- A. Insert the following as Article 16:

ARTICLE 16 - INSURANCE

16.1 GENERAL:

- A. Contractor shall maintain and shall require all of its subcontractors and other agents to maintain the insurance listed below. Contractor shall not commence Work, nor allow its employees, subcontractors or anyone to commence Work until the required insurance has been submitted and approved by Owner and a Notice to Proceed has been issued. Any requirement for insurance to be maintained after completion of the Work shall survive this Contract.
- B. Owner reserves the right to review any and all of the required insurance policies and/or endorsements, but has no obligation to do so. Failure to demand evidence of full compliance with the insurance requirements set forth in this Contract or failure to identify any insurance deficiency shall not relieve Contractor from, nor be construed or deemed a waiver of, its obligation to maintain the required insurance at all times during the performance of this Contract.

16.2 CONTRACTOR - REQUIRED INSURANCE:

- A. At or before the date specified in Section 00510 (Notice of Award), Contractor shall furnish to Owner satisfactory proof that Contractor has obtained the following insurance as specified below:

1. Workers Compensation Insurance & Employers Liability Insurance.

- a. Workers Compensation insurance with statutory limits as required by the Labor Code of the State of California.
- b. Employers Liability with minimum limits of \$1,000,000 per Accident; \$1,000,000 Disease per employee; \$1,000,000 Disease per policy.
- c. The policy shall be endorsed to include a written waiver of the insurer's right to subrogate against Owner.
- d. Required Evidence of Insurance:
 - 1) Subrogation waiver endorsement, and
 - 2) Certificate of Insurance.
- e. If injury occurs to any employee of Contractor, Subcontractor, or sub-subcontractor for which the employee, or the employee's

dependents in the event of employee's death, is entitled to compensation from Owner under provisions of the Workers Compensation Insurance and Safety Act (Act), as amended, or for which compensation is claimed from Owner, Owner may retain out of sums due Contractor under Contract Documents, amount sufficient to cover such compensation, as fixed by the Act, as amended, until such compensation is paid, or until it is determined that no compensation is due. If Owner is compelled to pay compensation, Owner may, in its discretion, either deduct and retain from the Contract Sum the amount so paid, or require Contractor to reimburse Owner.

2. General Liability Insurance.

- a. Commercial General Liability Insurance on a standard occurrence form, no less broad than ISO form CG 00 01.
- b. Minimum Limits. The required limits may be provided by a combination of General Liability Insurance and Commercial Excess or Commercial Umbrella Liability Insurance. If Contractor maintains higher limits than the specified minimum limits, Owner requires and shall be entitled to coverage for the higher limits maintained by Contractor.
 - 1) Projects under \$1,000,000: \$1,000,000 per Occurrence; \$2,000,000 General Aggregate; \$2,000,000 Products/Completed Operations Aggregate. The General Aggregate shall apply separately to each Project.
 - 2) Projects from \$1,000,000 - \$4,999,999: \$2,000,000 per Occurrence; \$4,000,000 General Aggregate; \$4,000,000 Products/Completed Operations Aggregate. The General Aggregate shall apply separately to each Project.
 - 3) Projects from \$5,000,000 - \$9,999,999: \$5,000,000 per Occurrence; \$5,000,000 General Aggregate; \$5,000,000 Products/Completed Operations Aggregate. The General Aggregate shall apply separately to each Project.
 - 4) Projects \$10,000,000 and Over: Minimum Limits: \$10,000,000 per Occurrence; \$10,000,000 General Aggregate; \$10,000,000 Products/Completed Operations Aggregate. The General Aggregate shall apply separately to each Project.
- c. Any deductible or self-insured retention shall be shown on the Certificate of Insurance. If the deductible or self-insured retention exceeds \$25,000 it must be approved in advance by Owner. Contractor is responsible for any deductible or self-insured retention and shall fund it upon Owner's written request, regardless of whether Contractor has a claim against the insurance or is named as a party in any action involving Owner.
- d. Insurance shall be maintained for the entire period of the Work and for the duration of Contractor's Guarantee Period specified in Section 00630 (Guarantee). Completed operations insurance shall be maintained beyond the Guarantee Period as specified below:
 - 1) Projects under \$1,000,000: One (1) year after end of Guarantee Period.

- 2) Projects from \$1,000,000 - \$4,999,999: Two (2) years after end of Guarantee Period.
 - 3) Projects from \$5,000,000 - \$9,999,999: Three (3) years after end of Guarantee Period.
 - 4) Projects \$10,000,000 and Over: Five (5) years after end of Guarantee Period.
- e. Owner, its Board of Directors, and its employees, representatives, consultants, and agents; shall be endorsed as additional insureds for liability arising out of ongoing and completed operations by or on behalf of the Contractor in the performance of the Contract Documents. Additional insureds status shall continue for the period(s) specified in paragraph 16.2A.2.d above.
 - f. The additional insured endorsement for completed operations shall not be restricted to work performed during the current policy period.
 - g. TLCD Architecture shall be endorsed as additional insureds for liability arising out of Contractor's ongoing operations (ISO endorsement CG 20 32, Additional Insured – Engineers, Architects, Construction Managers, or Surveyors Not Engaged by the Named Insured, or equivalent).
 - h. The policy definition of "insured contract" shall include assumptions of liability arising out of both ongoing operations and the products-completed operations hazard (broad form contractual liability coverage including the "f" definition of insured contract in ISO form CG 00 01, or equivalent).
 - i. The insurance provided to the additional insureds shall be primary to, and non-contributory with, any insurance or self-insurance program maintained by them.
 - j. The policy shall not exclude injury or damage caused by, or resulting from, explosion, collapse and/or underground hazards.
 - k. The policy shall not contain a Contractors' Warranty or other similar language which eliminates or restricts insurance because of a Subcontractor's failure to carry specific insurance or to supply evidence of such insurance.
 - l. The policy shall be endorsed to include a written waiver of the insurer's right to subrogate against all persons or entities that are, or are required to be, additional insureds.
 - m. The policy shall cover inter-insured suits between Contractor and the additional insureds and shall include a "separation of insureds" or "severability" clause which treats each insured separately.
 - n. Required Evidence of Insurance:
 - 1) Additional insured endorsements or policy language granting additional insured status;
 - 2) Endorsement or policy language indicating that insurance is primary and non-contributory;
 - 3) Subrogation waiver endorsement; and
 - 4) Certificate of Insurance.

3. Automobile Liability Insurance.

- a. Minimum Limit:
 - 1) Projects under \$1,000,000: \$1,000,000 combined single limit per accident.
 - 2) Projects \$1,000,000 and Over: \$2,000,000 combined single limit per accident.
- b. The required limit may be provided by a combination of Automobile Liability Insurance and Commercial Excess or Commercial Umbrella Liability Insurance.
- c. Insurance shall cover all owned, hired, and non-owned vehicles.
- d. Owner, its Board of Directors, and its employees, representatives, consultants, and agents shall be defined as insureds under the policy or shall be endorsed as additional insureds.
- e. Insurance shall be maintained for the entire term of this Contract, including any Guarantee Period.
- f. Required Evidence of Insurance:
 - 1) Endorsement or policy language documenting paragraph 16.2A.3.d; and
 - 2) Certificate of Insurance.

4. Contractors Pollution Liability Insurance.

- a. Minimum Limits:
 - 1) Projects under \$5,000,000: \$1,000,000 per pollution Incident; \$1,000,000 Aggregate; and
 - 2) Projects \$5,000,000 and Over: \$2,000,000 per pollution Incident; \$2,000,000 Aggregate.
- b. The insurance shall cover:
 - 1) bodily injury, sickness, disease, sustained by any person, including death;
 - 2) property damage, including physical injury to or destruction of tangible property including the resulting loss of use thereof;
 - 3) cleanup costs, and the loss of use of tangible property that has not been physically injured or destroyed including diminution of value and natural resources damages;
 - 4) loss arising from pollutants including, but not limited to, fungus, bacteria, asbestos, lead, silica, and contaminated drywall;
 - 5) contractual liability coverage for liability assumed by Contractor under a written contract or agreement;
 - 6) claims arising from owned and non-owned disposal sites utilized in the performance of this Contract; and
 - 7) defense costs, including costs, charges, and expenses incurred in the investigation, adjustment, or defense of claims.
- c. Any deductible or self-insured retention shall be shown on the Certificate of Insurance. If the deductible or self-insured retention exceeds \$25,000 it must be approved in advance by Owner. Contractor is responsible for any deductible or self-

insured retention and shall fund it upon Owner's written request, regardless of whether Contractor has a claim against the insurance or is named as a party in any action involving Owner.

- d. If the insurance is on a Claims-Made basis, the retroactive date shall be no later than the commencement of Work.
- e. Insurance shall be maintained for the entire period of the Work and for the duration of Contractor's Guarantee Period specified in Section 00630 (Guarantee), plus the additional periods as specified below:
 - 1) Projects under \$1,000,000: One (1) year after end of Guarantee Period.
 - 2) Projects from \$1,000,000 - \$4,999,999: Two (2) years after end of Guarantee Period.
 - 3) Projects from \$5,000,000 - \$9,999,999: Three (3) years after end of Guarantee Period.
 - 4) Projects \$10,000,000 and Over: Five (5) years after end of Guarantee Period.
- f. If the insurance is on a Claims-Made basis, the continuation coverage may be provided by: (a) renewal of the existing policy; (b) an extended reporting period endorsement; or (c) replacement insurance with a retroactive date no later than the commencement of the Work.
- g. Owner, its Board of Directors,, its employees, representatives, consultants, and agents; shall be endorsed as additional insureds for liability arising out of ongoing and completed operations by or on behalf of the Contractor in the performance of the Contract Documents.
- h. The insurance provided to the additional insureds shall apply on a primary and non-contributory basis with respect to any insurance or self-insurance program maintained by them.
- i. The policy shall be endorsed to include a written waiver of the insurer's right to subrogate against all persons or entities that are, or are required to be, additional insureds.
- j. The policy shall cover inter-insured suits between the Contractor and the additional insureds and include a "separation of insureds" or "severability" clause which treats each insured separately.
- k. Required Evidence of Insurance:
 - 1) Additional insured endorsement or policy language granting additional insured status;
 - 2) Endorsement or policy language indicating that coverage is primary and non-contributory;
 - 3) Subrogation waiver endorsement; and
 - 4) Certificate of Insurance, including an indication of the coverage basis: occurrence or claims-made. If claims-made, the Certificate shall show the policy retroactive date.

5. Professional Liability/Errors & Omissions Insurance.

- a. Required if the Contractor or its employees engage in design or professional activities (architecture, engineering or surveying) that are not subcontracted out.

- b. Minimum Limit: \$1,000,000 per claim or per occurrence.
 - c. Any deductible or self-insured retention shall be shown on the Certificate of Insurance. If the deductible or self-insured retention exceeds \$25,000 it must be approved in advance by Owner.
 - d. If the insurance is on a Claims-Made basis, the retroactive date shall be no later than the commencement of the Work.
 - e. Insurance applicable to the Work performed under the Contract shall be continued for two (2) years after completion of the Work. Such continuation insurance may be provided by one of the following: (a) renewal of the existing policy; (b) an extended reporting period endorsement; or (c) replacement insurance with a retroactive date no later than the commencement of the Work.
 - f. Required Evidence of Insurance:
 - 1) Certificate of Insurance.
- B. Increase of Minimum Limits.
 - 1. Required minimum amounts of insurance may be increased should conditions of Work, in opinion of Owner, warrant such increase. Contractor shall increase required insurance amounts upon direction by Owner.
- C. Standards for Insurance Companies.
 - 1. Insurers, other than the California State Compensation Insurance Fund, shall have an A.M. Best's rating of at least A:VII.
- D. Documentation.
 - 1. The Certificate of Insurance shall include the following reference: [00-0-7 #_].
 - 2. Contractor agrees to maintain current Evidence of Insurance on file with Owner for the periods specified above in Paragraphs 16.2A.1 through 16.2A.5. Any requirement to maintain insurance after Final Completion of the Work, including providing Certificates evidencing required insurance, shall survive the Contract.
 - a. Required Evidence of Insurance shall be submitted to Sonoma Clean Power Authority, 50 Santa Rosa Avenue, Santa Rosa, CA 95404.
 - b. Required Evidence of Insurance shall be submitted for any renewal or replacement of a policy that already exists, at least ten (10) days before expiration or other termination of the existing policy.
 - c. Contractor shall provide immediate written notice if: (a) any of the required insurance policies are terminated; (b) the limits of any of the required policies are reduced; or (c) the deductible or self-insured retention is increased.
 - d. Upon written request, certified copies of required insurance policies must be provided within thirty (30) days.
- E. Policy Obligations.
 - 1. Contractor's indemnity and other obligations shall not be limited by the foregoing insurance requirements.

F. Material Breach.

1. If Contractor fails to maintain Insurance which is required pursuant to the Contract Documents, it shall be deemed a material breach. Owner, at its sole option, may terminate the Contract for default and obtain damages from Contractor resulting from said breach. Alternatively, Owner may purchase the required Insurance, and without further notice to Contractor, Owner may deduct from sums due to Contractor any premium costs advanced by Owner for such insurance. These remedies shall be in addition to any other remedies available to Owner under the Contract Documents or Law.

16.3 **SUBCONTRACTORS - REQUIRED INSURANCE:**

- A. With respect to their portion of the Work, Subcontractors of all tiers shall maintain the same insurance required to be maintained by Contractor with limits as follows:
 1. Minimum General Liability Limits for Framing, Mechanical, and Electrical Subcontractors.
 - a. Projects under \$1,000,000: \$1,000,000 per Occurrence; \$2,000,000 General Aggregate; \$2,000,000 Products/Completed Operations Aggregate. The General Aggregate shall apply separately to each Project.
 - b. Projects \$1,000,000 and Over: \$2,000,000 per Occurrence; \$4,000,000 General Aggregate; \$4,000,000 Products/Completed Operations Aggregate. The General Aggregate shall apply separately to each Project.
 2. Minimum General Liability Limits for all Subcontractors other than Framing, Mechanical, and Electrical Subcontractors.
 - a. \$1,000,000 per Occurrence; \$2,000,000 General Aggregate; \$2,000,000 Products/Completed Operations Aggregate. The General Aggregate shall apply separately to each Project.
 3. Minimum Automobile Liability Limits.
 - a. \$1,000,000 combined single limit per accident.
 4. Minimum Employers Liability Limits.
 - a. \$1,000,000 per Accident; \$1,000,000 Disease per employee; \$1,000,000 Disease per policy.
 5. Professional Liability/Errors & Omissions Insurance.
 - a. Required for any architect, engineer, surveyor, or other licensed professional engaged by Contractor to perform portions of the Work.
 - b. Minimum Limit: \$1,000,000 per claim or per occurrence.
 - c. Any deductible or self-insured retention shall be shown on the Certificate of Insurance. If the deductible or self-insured retention exceeds \$25,000 it must be approved in advance by Owner.
 - d. If the insurance is on a Claims-Made basis, the retroactive date shall be no later than the commencement of the Work.
 - e. Coverage applicable to the Work performed under the Contract shall be continued for two (2) years after completion of the Work. Such continuation coverage may be provided by one of the following: (a) renewal of the existing policy; (b) an

extended reporting period endorsement; or (c) replacement insurance with a retroactive date no later than the commencement of the Work.

f. Required Evidence of Insurance:

1) Certificate of Insurance.

16.4 BUILDERS RISK:

B. Builder's Risk Insurance: The builder's risk insurance policy must be issued on an occurrence basis, for all-risk or "all perils" coverage on a 100% completed value basis on the insurable portion of the Project for the benefit of Owner.

C. Insert the following as Article 17:

ARTICLE 17 - RESPONSIBILITY OF CONTRACTOR AND INDEMNIFICATION

17.1 OWNER AND EACH OF ITS OFFICERS, EMPLOYEES, CONSULTANTS, AND AGENTS INCLUDING, BUT NOT LIMITED TO, THE BOARD, OWNER'S PROJECT MANAGER, AND EACH OWNER'S REPRESENTATIVE, SHALL NOT BE LIABLE OR ACCOUNTABLE IN ANY MANNER FOR LOSS OR DAMAGE THAT MAY HAPPEN TO ANY PART OF THE WORK; LOSS OR DAMAGE TO MATERIALS OR OTHER THINGS USED OR EMPLOYED IN PERFORMING THE WORK; INJURY, SICKNESS, DISEASE, OR DEATH OF ANY PERSON; OR DAMAGE TO PROPERTY RESULTING FROM ANY CAUSE WHATSOEVER EXCEPT THEIR SOLE NEGLIGENCE, WILLFUL MISCONDUCT OR ACTIVE NEGLIGENCE, ATTRIBUTABLE TO PERFORMANCE OR CHARACTER OF THE WORK, AND CONTRACTOR RELEASES ALL OF THE FOREGOING PERSONS AND ENTITIES FROM ANY AND ALL SUCH CLAIMS.

17.2 TO THE FURTHEST EXTENT PERMITTED BY LAW (INCLUDING WITHOUT LIMITATION CALIFORNIA CIVIL CODE §2782), CONTRACTOR SHALL ASSUME DEFENSE OF, AND INDEMNIFY AND HOLD HARMLESS, OWNER AND EACH OF ITS OFFICERS, EMPLOYEES, CONSULTANTS, AND AGENTS INCLUDING, BUT NOT LIMITED TO, THE BOARD, OWNER'S PROJECT MANAGER AND EACH OWNER'S REPRESENTATIVE, FROM CLAIMS, SUITS, ACTIONS, LOSSES, AND LIABILITY OF EVERY KIND, NATURE AND DESCRIPTION, INCLUDING BUT NOT LIMITED TO CLAIMS AND FINES OF REGULATORY AGENCIES AND ATTORNEY'S FEES AND CONSULTANT'S FEES, DIRECTLY OR INDIRECTLY ARISING OUT OF, CONNECTED WITH OR RESULTING FROM PERFORMANCE OF THE WORK, FAILURE TO PERFORM THE WORK, OR CONDITION OF THE WORK WHICH IS CAUSED IN WHOLE OR PART BY ANY ACT OR OMISSION OF CONTRACTOR, SUBCONTRACTORS, ANYONE DIRECTLY OR INDIRECTLY EMPLOYED BY ANY OF THEM OR ANYONE FOR WHOSE ACTS ANY OF THEM MAY BE LIABLE, RESULTING FROM ANY CAUSE WHATSOEVER EXCEPT THEIR SOLE NEGLIGENCE, WILLFUL MISCONDUCT, OR ACTIVE NEGLIGENCE.

- 17.3 WITH RESPECT TO THIRD-PARTY CLAIMS AGAINST CONTRACTOR, CONTRACTOR WAIVES ANY AND ALL RIGHTS TO ANY TYPE OF EXPRESS OR IMPLIED INDEMNITY AGAINST OWNER AND EACH OF ITS OFFICERS, EMPLOYEES, CONSULTANTS, AND AGENTS INCLUDING, BUT NOT LIMITED TO, OWNER, THE BOARD, OWNER'S PROJECT MANAGER AND EACH OWNER'S REPRESENTATIVE. OWNER SHALL PROVIDE TIMELY NOTICE TO CONTRACTOR OF ANY THIRD-PARTY CLAIM RELATING TO THE CONTRACT DOCUMENTS, IN ACCORDANCE WITH SECTION 9201 OF THE CALIFORNIA PUBLIC CONTRACT CODE.
- 17.4 APPROVAL OR PURCHASE OF ANY INSURANCE CONTRACTS OR POLICIES SHALL IN NO WAY RELIEVE FROM LIABILITY NOR LIMIT THE LIABILITY OF CONTRACTOR, ITS SUBCONTRACTORS OF ANY TIER, OR THE OFFICERS OR AGENTS OF ANY OF THEM.
- 17.5 TO THE FURTHEST EXTENT PERMITTED BY LAW (INCLUDING, WITHOUT LIMITATION, CIVIL CODE §2782), THE INDEMNITIES, RELEASES OF LIABILITY AND LIMITATIONS OF LIABILITY, CLAIMS PROCEDURES, AND LIMITATIONS OF REMEDY EXPRESSED THROUGHOUT CONTRACT DOCUMENTS SHALL APPLY EVEN IN THE EVENT OF BREACH OF CONTRACT, NEGLIGENCE (ACTIVE OR PASSIVE), FAULT OR STRICT LIABILITY OF THE PARTY(IES) INDEMNIFIED, RELEASED, OR LIMITED IN LIABILITY, AND SHALL SURVIVE THE TERMINATION, RESCISSION, BREACH, ABANDONMENT, OR COMPLETION OF THE WORK OR THE TERMS OF THE CONTRACT DOCUMENTS. IF CONTRACTOR FAILS TO PERFORM ANY OF THESE DEFENSE OR INDEMNITY OBLIGATIONS, OWNER MAY IN ITS DISCRETION BACK CHARGE CONTRACTOR FOR OWNER'S COSTS AND DAMAGES RESULTING THEREFROM AND WITHHOLD SUCH SUMS FROM PROGRESS PAYMENTS OR OTHER CONTRACT MONIES WHICH MAY BECOME DUE.
- 17.6 THE INDEMNITIES IN THE CONTRACT DOCUMENTS SHALL NOT APPLY TO ANY INDEMNIFIED PARTY TO THE EXTENT OF ITS SOLE NEGLIGENCE OR WILLFUL MISCONDUCT; NOR SHALL THEY APPLY TO OWNER OR OTHER INDEMNIFIED PARTY TO THE EXTENT OF ITS ACTIVE NEGLIGENCE.

END OF SECTION

SECTION 00803

SUPPLEMENTARY CONDITIONS

ARTICLE 1 - SUMMARY

- 1.1 This document includes requirements that supplement Section 00700 (General Conditions).

ARTICLE 2 - SUPPLEMENTS

- 2.1 Supplement to Article 11 - Time Allowances:
A. Supplement to Paragraph 11.6.A.1, modify rain parameters as follows:

END OF SECTION

2.2 LEASE AGREEMENT at 741 4th Street (EXHIBIT C-WORK LETTER)

Exhibit C- Work Letter

1. Overview of the Work

- This Work Letter shall set forth the terms and conditions by and between Lessor and Lessee relating to the construction of the Lessee improvements at the Premises (the "Improvements"). Lessor and Lessee are at times individually referred to herein as "Party" and collectively referred to herein as "Parties." This Work Letter is effective as of the Commencement Date of the Lease.

2. Designation of Representatives.

- For Purposes of work completed in connection with this Work Letter, the Parties agree to designate the following representatives. Following selection of a design team, architect, engineer or contractor(s) to assist with work completed in connection with this Work Letter, the Parties agree to identify the selected consultant and/or contractor for the other party via letter, and such letter shall be incorporated automatically as an attachment to this Exhibit C.

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a. **For Lessor:** Bill Hillendahl

- EMPIRE PROPERTY SERVICES
- Managing Agent for
- Kushins & Langendorf
- 707-538-0331
- eps@sonic.net

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b. **For Lessee:** Chad Asay

- SONOMA CLEAN POWER AUTHORITY
- Program Manager (Lead Locally)
- 707-791-1346
- casay@sonomacleanpower.org

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3. Pre-existing Building Issues & Responsibilities.

- a. Lessor acknowledges and agrees to address, at Lessor's sole cost and expense, the issues at the Premises described more fully below:

i. **Roof and Other Areas Identified in Section 7.2 of the Lease.**

Lessor acknowledges the existing roof leaks/damage ("Roof Damage") as follows:

- (A) Roof leak and ledger damage in northwest corner of building;
- (B) Roof leak at brace frame adjacent to west wall near middle of building; and
- (C) Roof leak along south east wall near front of building.

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- ii. **North Wall Damage.** Lessor acknowledges the existing water intrusion damage to north west corridor wall due to roof leak above ("North Wall Damage"). Lessor agrees to repair such North Wall Damage at Lessor's sole cost and expense.

- iii. **Scope and Timing for Repair.** Lessor agrees to repair Roof Damage and North Wall Damage to a condition reasonably acceptable to Lessee. Lessor agrees to complete such repairs in accordance with a schedule mutually agreed upon by Lessor and Lessee; provided, however, that such repairs must be complete before Lessee's receipt of a certificate of occupancy and any further extension must be consented to by Lessee.

- iv. Issues associated with the Roof, Exterior Areas identified in section 7.2 of the Lease, including specifically such Roof Damage and North Wall Damage, will be repaired by Lessor at Lessor's sole cost and expense; provided, however, that should it be necessary for Lessee to puncture the Roof structure, Lessee shall be responsible for maintenance associated with any such work.

- b. Lessor agrees to perform the following special work at the Premises and to coordinate with Lessee on such work:

i. **Heating, Ventilation and Air Conditioning (“HVAC”) Repair.**

Lessor acknowledges that the existing HVAC system requires replacement. Lessor agrees to replace the HVAC with a standard unit and provide Lessee with any warranties available in connection with such replacement; however, to the extent Lessee desires to replace the HVAC unit with a unit of equal or greater quality than a standard unit, Lessor agrees to reimburse Lessee for the estimated cost of a standard unit and the labor and materials for its installation. As per paragraph 2 of the Lease, Lessor agrees to warrant the performance and operation the new, building standard HVAC units. Non-building standard HVAC units installed at the request of Lessee shall not be warranted by Lessor under paragraph 2.

ii. **Waste Line Repair.** Lessor acknowledges that main sewer waste line (“Main Line”) requires replacement. Lessor agrees at its sole cost and expense, to replace the Main Line in the same or similar position as original and to retain those lateral connections that are necessary for Lessee’s plans for its plumbing fixtures. Lessor agrees to complete this work in coordination with Lessee, including waiting to complete the Main Line repair work until Lessee has prepared plans for the Improvements that reflect the likely location of waste line lateral connections.

iii. **Alarm Systems and Security.** Lessor has an existing security and smoke sensing alarm, with monitoring, in place and operating. Lessee may take over the existing alarm system and monitoring service from Lessor, or, at Lessee's expense, remove the existing system, and install an alarm system of Lessee's choosing. If the existing alarm system is removed, Lessee will save the components, and offer them to Lessor to store.

4. Points of Consultation Among Parties; Lessor Approvals.

a. Subject to Requirements set forth in the Lease Addendum, including sections 52 (Signs), 53 (Permits), 55 (Tenant Improvements, Licensed Contractors), 62 (Tenant Improvements, Reimbursement for Lessor Cost) and 63(Issues Related to Lessee’s Public Entity Status), Lessee agrees to construct the Improvements at the Premises at Lessee’s sole expense consistent with plans developed by design professionals retained by Lessee and to secure the necessary permits and approvals for construction of the Improvements.

- b. **Review and Approval Milestones.** Lessee agrees to provide Lessor an opportunity to provide review, comments and approvals with respect to the Improvements at the following milestones:
 - i. Prior to final completion of constructions drawings, plans and specifications;
 - ii. Prior to Permit Submittal;
 - iii. At each required city construction progress inspection;
 - iv. Final Building Inspections; and
 - v. Other reviews or inspections that the Parties mutually agree.
- c. **Schedule for Review and Approval of Lessee Improvements.** Lessee agrees to notify Lessor of opportunity to review Improvements upon reaching one of the milestones identified above. Upon receipt of notice from Lessee, Lessor agrees to review and provide approvals to Lessee for such work within ten (10) business days, or such alternative time frame mutually agreed upon by the Parties. To the extent Lessor fails to provide its approval to Lessee in accordance with such time frame, or Lessee shall be deemed to have Lessor's approval to proceed.
- d. **Notice of City Inspections.** Lessee agrees to advise Lessor of scheduled City inspections. To the extent Lessee receives advance notice of such inspections, Lessee will update Lessor concerning the scheduled time for such inspections.
- e. **Additional Adjustments Following Final Plans.** Should Lessor request further changes or modifications to Lessee Improvements after providing an approval in connection with this section, Lessor agrees to be responsible for costs associated with such changes and/or any delays caused by such request.
- f. **Change Orders.** Lessee agrees to notify and secure approval (which shall not be unreasonably withheld) from Lessor of any change orders during construction that materially change the work previously approved by Lessor. The timeline for review and approval set forth in section 4(c) above shall apply, or as the same may be reasonably shortened by Lessee to avoid delays.

5. Cost Responsibility for Work.

- a. **Improvements Constructed at Lessee Cost.** Except as set forth elsewhere in this Work Letter, Lessee agrees to design and construct the Improvements at Lessee's cost.

b. Reimbursement of Lessor Costs. Where Lessor elects to engage design or contractor experts to review Lessee Improvements at the Points of Consultation identified in section 4 of this Work Letter, including specifically, the Review and Approval Milestones set forth in section 4(b), Lessee agrees to reimburse Lessor for any actual costs incurred by Lessor in an amount not-to-exceed twenty-five thousand dollars (\$25,000). Reimbursement shall be made promptly, but in not more than forty-five days from billing.

- Lessee agrees to compensation professionals engaged under this section at the rates set forth below:
 - i. Empire Property Services - \$250.00 per hour, portal to portal, plus materials
 - ii. Solv Architecture Studios - \$145.00 per hour, portal to portal, plus materials
 - iii. MKM & Associates, Structural Engineers - \$155.00 per hour, portal to portal, plus materials
 - iv. Comet Construction - \$110.00 per hour, portal to portal, plus materials
 - v. Other consultants as Lessor reasonably deems necessary.
- The above rates are subject to change. Lessor shall provide written notice of rate changes, however any change in billing rates or consultants shall not change or otherwise increase the not-to-exceed total reimbursement cost obligations to Lessee as provided for in paragraph 5b of this Work Letter.
- The not-to-exceed amount set forth in paragraph 5b of this Work Letter shall also apply to any time spent at individual inspections, described in sections 4(b)(iii) and 4(d).

- **6. Access to Premises.** The anticipated work by both Lessor and Lessee may will necessarily be conducted simultaneously, therefore with advance notice to Lessee, Lessee grants Lessor, and Lessor's agents, consultants, vendors, contractors, access to the Premises during normal business hours up until a mutually agreeable date between the Parties that is no later than issuance of the Certificate of Occupancy to Lessee. Lessee shall provide Lessor with any necessary keys and access codes to accommodate entry.
- **7. Completion of Lessee's Work.** Lessee shall provide Lessor with the following within thirty (30) days following opening:
 - a. A Certificate of Occupancy ("C of O"); provided, however if final C of O is not available, Lessee shall provide a Temporary Certificate of Occupancy

- (Temporary C of O). Lessee shall provide Lessor with a final C of O as soon as the same becomes available.
- b. Lessee shall furnish a copy of its license to do business to Lessor.
 - c. As-Built copies of Lessee's final plans and specifications for all permanent Lessee Work performed, and final signed-off building permit shall be provided to Lessor in paper and electronic form.

2.3 CEC T&Cs (Exhibit C of the EPIC Grant 17-041)

EXHIBIT C

CEC grant terms and conditions (CEC's Electric Program Investment Charge (EPIC) Standard Grant Terms and Conditions.)

EXHIBIT C (from the CEC Grant Contract)
ELECTRIC PROGRAM INVESTMENT CHARGE (EPIC) STANDARD
GRANT TERMS AND CONDITIONS

(i)

(ii) TERMS AND CONDITIONS

Introduction

This grant agreement (Agreement) between the California Energy Commission (Energy Commission, or Commission) and the Recipient is funded by the Electric Program Investment Charge (EPIC), an electricity ratepayer surcharge authorized by the California Public Utilities Commission (CPUC).

Flow-Down Provisions

Subcontracts funded in whole or in part by this Agreement must include language conforming to the provisions below, unless the subcontracts are entered into by the University of California (UC) or the U.S. Department of Energy (DOE) national laboratories. UC may use the terms and conditions negotiated by the Energy Commission with UC for its subcontracts. DOE national laboratories may use the terms and conditions negotiated with DOE (please contact the Commission Grants Officer for these terms).

- Standard of Performance (Section 3)
- Legal Statements on Products (included in Section 5, “Products”)
- Travel and Per Diem (Section 9)
- Prevailing Wage (Section 10)
- Recordkeeping, Cost Accounting, and Auditing (Section 11)
- Equipment (Section 14)
- Disputes (Section 15)
- Indemnification (Section 18)
- Confidentiality (Section 19)
- Pre-Existing and Independently Funded Intellectual Property (Section 20)
- Intellectual Property (Section 21)
- Royalty Payments to the Commission (Section 22)
- Access to Sites and Records (included in Section 23, “General Provisions”)
- Nondiscrimination (included in Section 24, “Certifications and Compliance”)
- Survival of the following sections:
 - Equipment (Section 14)
 - Recordkeeping, Cost Accounting, and Auditing (Section 11)
 - Pre-Existing and Independently Funded Intellectual Property (Section 20)
 - Intellectual Property (Section 21)
 - Royalty Payments to the Commission (Section 22)
 - Access to Sites and Records (included in Section 23, “General Provisions”)

Subcontracts funded in whole or in part by this Agreement must also include the following:

- A clear and accurate description of the material, products, or services to be procured.
- A detailed budget and timeline.
- Provisions that allow for administrative, contractual, or legal remedies in instances where subcontractors breach contract terms, in addition to sanctions and penalties as may be appropriate.

- Provisions for termination by the Recipient, including termination procedures and the basis for settlement.
- A statement that further assignments will not be made to any third or subsequent tier subcontractor without additional advance written consent of the Commission.

3 AUDITS

- 4 ALL SUBCONTRACTS ENTERED INTO FOR THE PERFORMANCE OF THIS AGREEMENT ARE SUBJECT TO EXAMINATION AND AUDIT BY THE ENERGY COMMISSION AND/OR BUREAU OF STATE AUDITS FOR A PERIOD OF THREE (3) YEARS AFTER PAYMENT OF THE RECIPIENT'S FINAL INVOICE UNDER THIS AGREEMENT. THE ENERGY COMMISSION MAY AUDIT SUBCONTRACTS THAT ARE RELEVANT TO THE RECIPIENT'S ROYALTY PAYMENT OBLIGATIONS (SEE SECTION 22) FOR A PERIOD OF TEN (10) YEARS AFTER THE AGREEMENT'S END DATE.**

5 COPIES OF SUBCONTRACTS

- 6 THE RECIPIENT MUST PROVIDE A COPY OF ITS SUBCONTRACTS UPON REQUEST BY THE ENERGY COMMISSION.**

7 CONFLICTING SUBCONTRACT TERMS

Prior to the execution of this Agreement, the Recipient will notify the Commission Agreement Manager of any known or reasonably foreseeable conflicts between this Agreement and its agreements with any subcontractors (e.g., conflicting intellectual property or payment terms). If the Recipient discovers any such conflicts after the execution of this Agreement, it will notify the Commission Agreement Manager of the conflict within fifteen (15) days of discovery. The Energy Commission may terminate this Agreement if any conflict impairs or diminishes its value.

8 PENALTIES FOR NONCOMPLIANCE

Without limiting the Commission's other remedies, failure to comply with the above requirements may result in the termination of this Agreement.

Payment of Funds

a. Definitions

For purposes of this Section 8, the following terms have the following meaning:

- "Advance Payment" means the Energy Commission pays Recipient prior to the Recipient Incurring or Paying the expense.
- "Incurred Cost" means an expense for which the Recipient has become liable (legally obligated) to pay. Here are examples of incurred costs:
 - The Recipient's staff has completed work during the month but has not been paid by the Recipient. These labor and associated costs (e.g., fringe benefits) are considered Incurred Costs.
 - The Recipient has purchased a piece of equipment **and** received an invoice, bill, or receipt. The Recipient has not yet paid the invoice. The invoice shows the amount to be paid and confirmation of the sale. This is an Incurred Costs.

Incurred costs for equipment DO NOT include purchase orders unless accompanied by an invoice, bill, or receipt that shows the payment amount due to the seller for the equipment.

- “Paid Cost” means an expense for which the Recipient has already made payment.

b. Advance Payments

Recipients can receive Advance Payments only for subcontractors with the U.S. Department of Energy laboratories. Otherwise, Advance Payments are NOT allowed under this Agreement. The Energy Commission in its sole discretion, and not the Recipient, decides if the Commission will make an Advance Payment.

c. Reimbursable Cost Requirements

In addition to any other requirements in this Agreement, the Energy Commission is only obligated to reimburse the Recipient for Incurred and Paid Costs that are (1) incurred during the Agreement Term; (2) invoiced within the required timeframes of this Agreement; (3) made in accordance with the Agreement’s Budget; and (4) actual and allowable expenses under this Agreement.

ALL of the items in the Budget, including without limitation labor rates, fringe and indirect and individually listed items are caps (i.e., maximums), and the Recipient can only bill its ACTUAL amount up to capped amounts listed in the Budget. For example, if the Budget includes an employee’s hourly rate of \$50/hour but the employee is only paid \$40/hour, the Recipient can only bill for \$40/hour. Under the same example, if the employee earned \$70/hour but the Budget only lists \$50/hour, the Recipient can only bill for \$50. Another example is if the maximum fringe rate listed in the budget is 20% but the Recipient’s actual fringe rate is only 15%, the Recipient can only bill at 15%.

d. Recipient’s 14-Day Payment Requirement for Incurred Costs

The Recipient shall pay ALL Incurred Costs for which it has invoiced the Energy Commission within 14 calendar days of receiving payment under this Agreement for the Incurred Costs. For example, if the Recipient invoices and then receives payment from the Commission on September 15 for an Incurred Cost of \$10,000, the Recipient shall pay the entire \$10,000 by September 29. This requirement is needed to prevent Recipients from creating long lead times for Incurred Costs (e.g., invoicing and receiving payment from the Commission but not paying for the Incurred Costs for weeks or months).

The Recipient shall only invoice the Commission for Incurred Expenses the Recipient shall pay with 14 calendar days of receiving payment from the Commission. For example, assume the Recipient has an Incurred Cost for a piece of equipment that costs \$300,000 and will pay in three installments of \$100,000 each over three months. The Recipient shall only invoice the Commission for \$100,000 each month. The Recipient shall not invoice for the entire \$300,000 and retain the balance over the three months.

For any Incurred Costs for which the Recipient has received funds from the Energy Commission and does not pay within 14 calendar days, the Recipient shall on the very next business day after the 14 calendar days submit repayment of the unpaid amount back to the Energy Commission. Repaid funds will be placed back into the agreement and will be available to reimburse allowable costs in accordance with this agreement. When making a repayment under this provision, the Recipient shall specify “Repayment of Unspent Funds under Agreement [EPC-17-008].” Recipient shall remit the repayment to:

California Energy Commission
Accounting Office
1516 Ninth Street, MS-2
Sacramento, CA 95814

This repayment requirement of the Recipient is in addition to any other rights the Energy Commission can enforce relative to this Agreement. Recipient agrees and acknowledges that time is of the essence in paying Incurred Costs and submitting repayments and the Energy Commission can treat the Recipient's breach of either requirement as a material breach. Recipient can contact the Commission Agreement Manager for any questions about the logistics of making repayments.

e. Payment Requests

The Recipient may request payment from the Energy Commission at any time during the term of this Agreement but no more frequently than monthly. It is preferred that payment requests be submitted with the progress reports. The final payment request, including retention, MUST be received by the Energy Commission no later than the agreement end date.

Recipient agrees and acknowledges that time is of the essence in submitting the final payment request. The Commission has a limited period of time, set by law, in which it can reimburse funds under this Agreement. Without prejudice to the Commission's other rights, the Recipient risks not receiving any funds, and relieves the Commission of any duty and liability whatsoever to pay, for any payment requests received after the end of the Agreement.

No reimbursement for food or beverages shall be made other than allowable per diem charges.

All Recipient expenditures, reimbursable and match, must occur within the approved term of this Agreement.

f. Invoice Approval and Disputes:

-
- Each request for payment is subject to the Commission Agreement Manager's approval. Payments will be made to the Recipient for undisputed invoices. An undisputed invoice is an invoice submitted by the Recipient for work performed, for which project expenditures and products meet all Agreement conditions, and for which additional evidence is not required to determine its validity.
- The invoice will be disputed if all products due for the billing period have not been received and approved, if the invoice is inaccurate, or if it does not comply with the terms of this Agreement. If the invoice is disputed, the Recipient will be notified via a Dispute Notification Form within fifteen (15) working days of receipt of the Commission Agreement Manager's invoice.

g. Recipient's headquarters:

- For purposes of payment, the Recipient's headquarters is the location of the Recipient's office where the majority of its employees assigned responsibilities for this Agreement are permanently assigned.
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h. Multiple Non-Energy Commission Funding Sources:

- No payment will be made for costs identified in recipient invoices that have been or will be reimbursed by another source, including but not limited to an agreement with another government entity.

- “Government Entity” means: (1) a state governmental agency; (2) a state college or university; (3) a local government entity or agency, including those created as a Joint Powers Authority; (4) an auxiliary organization of the California State University or a California community college; (5) the federal government; (6) a foundation organized to support the Board of Governors of the California Community Colleges; and (7) an auxiliary organization of the Student Aid Commission established under California Education Code Section 69522.
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- i. Reduced funding:
 - If the Energy Commission does not receive sufficient funds under the Budget Act or from the investor-owned utility administrators of the EPIC program to fully fund the work identified in Exhibit A (Scope of Work), the following will occur:
 - a) If the Energy Commission has received a reduced amount of funds for the work, it may: (1) offer an Agreement amendment to the Recipient to reflect the reduced amount; or (2) cancel this Agreement (with no liability occurring to the State).
 - b) If the Energy Commission has received no funds for the work identified in Exhibit A: (1) this Agreement will be of no force and effect; (2) the State will have no obligation to pay any funds to the Recipient; and (3) the Recipient will have no obligation to perform any work under this Agreement.
- j. Allowability of Costs
 - a) Allowable Costs

The costs for which the Recipient will be reimbursed under this Agreement include all costs, direct and indirect, incurred in the performance of the work identified in the Scope of Work. Costs must be incurred within the Agreement term. Factors to be considered in determining whether an individual item of cost is allowable include: (i) reasonableness of the item, including necessity of the item for the work; (ii) applicable federal cost principles or acquisition regulations incorporated by reference in Section 2 of this Agreement; and (iii) the terms and conditions of this Agreement.
 - b) Unallowable Costs

Below are examples of unallowable costs. Details concerning the allowability of costs are available from the Energy Commission’s Accounting Office.

 - a) Profit of the Recipient or fees (this restriction does not apply to subcontractors);
 - b) Contingency costs;
 - c) Imputed costs (e.g., cost of money);
 - d) Fines and penalties;
 - e) Losses;
 - f) Excess profit taxes; and
 - g) Unapproved, increased rates and fees for this Agreement
 - c) Except as provided for in this Agreement or applicable California law or regulations, the Recipient will use the federal cost principles and/or acquisition regulations incorporated by reference in Section 2 of this Agreement when determining allowable and unallowable costs. In the event of a conflict, this Agreement takes precedence over the federal cost principles and/or acquisition regulations.
- k. Payment Request Format

Each request for payment will consist of, but not be limited to, the following:

- 1) An invoice that includes a list of Incurred and Paid Costs. Backup documentation is required at the time of invoice submittal, such as time cards, vendor invoices, and proof of payment (e.g., cancelled checks). Unless otherwise specified in Exhibit B or the invoice template, the invoice must include the following:
 - a) Agreement number;
 - b) Date prepared;
 - c) Recipient's Federal tax ID number;
 - d) Billing period;
 - e) Recipient's actual labor expenditures, including hourly unloaded labor rates by individual name and classification, hours worked, and benefits (fully loaded rates may only be used if they are included in the grant budget);
 - f) Non-labor expenses, including fringe benefits, indirect overhead, and general/administrative expenses;
 - g) Operating expenses, including travel, equipment, materials, and other;
 - h) By budget line item (cost component) category, the budgeted amount, amount billed to date, currently billed amount, and balance of funds;
 - i) Match fund expenditures (if applicable);
 - j) Receipts for travel (including departure and return times), equipment, materials, and miscellaneous; and
 - k) Subcontractor invoices that include all items above, for correspondence with the budget (e.g., if the budget lists hourly labor rates, the subcontractor's invoice should include hourly labor rates).
- 2) A progress report that documents evidence of progress, as described in the Scope of Work.
- 3) Products prepared by the Recipient during the invoicing period, as described in the Scope of Work.

The Commission will accept computer-generated or electronically transmitted invoices without backup documentation provided that the Recipient mails a hard copy the same day.

The Recipient must submit all invoices to the following address:

California Energy Commission
Accounting Office
1516 Ninth Street, MS-2
Sacramento, CA 95814

If the Recipient has not otherwise provided to the Commission documentation showing the Recipient's payment of Incurred Costs, the Recipient shall provide such documentation as soon as possible and not later than three working days from a request from Commission personnel.

I. Certification

The following certification will be included on each payment request form and signed by the Recipient's authorized officer:

The documents included in this request for payment are true and correct to the best of my knowledge and I, as an agent of [Company Name] have authority to submit this request. I certify that reimbursement for these costs has not and will not be received from any other sources, including but not limited to a government entity contract, subcontract, or other procurement method. For projects considered to be a public work, prevailing wages were paid to eligible

workers who provided labor for the work covered by this invoice; the Recipient and all subcontractors have complied with prevailing wage laws.

m. Fringe Benefit, Indirect Overhead, General and Administrative (G&A), and Facilities and Administration (F&A) Rates

Indirect cost rates must be developed in accordance with generally accepted accounting principles and the applicable federal cost principles or acquisition regulations (see the provisions incorporated by reference in Section 2). If the Recipient has an approved fringe benefits or indirect cost rate (indirect overhead, G&A, or F&A) from its cognizant federal agency, the Recipient may bill at the federal rate up to the budget rate caps if the following conditions are met:

- The Recipient may bill at the federal provisional rate but must adjust annually to reflect its actual final rates for the year in accordance with the Labor, Fringe, and Indirect Invoicing Instructions contained in the budget (Exhibit B).
- The cost pools used to develop the federal rates must be allocable to the Agreement, and the rates must be representative of the portion of costs benefiting the Agreement. For example, if the federal rate is for manufacturing overhead at the Recipient's manufacturing facility and the Agreement is for research and development at the Recipient's research facility, the federal indirect overhead rate would not be applicable to the Agreement.
- The federal rate must be adjusted to exclude any costs that are specifically prohibited in the Agreement.
- The Recipient may only bill up to the Agreement budget rate caps, unless and until an amendment to the budget is approved.

n. Retention

The Energy Commission shall retain 10 percent of any payment request or 10 percent of the total Energy Commission award at the end of the project. The Energy Commission has the sole discretion to decide which of these methods of retention will be used in this Agreement. The Recipient must submit a completed payment request requesting release of the retention within the required timeframe (see part e "Payment Requests" above in this term). The CAM will review the project file and, when satisfied that the terms of the funding Agreement have been fulfilled, will authorize release of the retention.

Retention may be released upon completion of tasks that are considered separate and distinct (i.e., the task is a stand-alone piece of work and could be completed without the other tasks). Tasks for administration or management of the Agreement and/or subcontractors are not considered separate and distinct tasks. The tasks for which retention may be released prior to the end of the Agreement must be identified in Exhibit B (budget).

When the Commission withholds 10% retention from each invoice, the Recipient can choose to flow down the retention requirement to its subcontractors subject to the following restrictions and any other requirements in this Agreement:

- The Recipient shall not flow down retention requirements to U.S. Department of Energy national laboratory subcontractors.
- The retention flowed down to subcontractors can only be up to a total of 10% of the amount of Commission funds the subcontractor is to receive. The Recipient is responsible for carrying the retention for its funded portion of the entire Agreement and cannot pass its share of retention to subcontractors. Here are three examples:

- i. A subcontractor submits an invoice for \$100,000 to the Recipient, and the Recipient in turn submits it to the Commission. The Commission will only pay \$90,000 of the invoice and the Recipient can elect to pay only \$90,000 to the subcontractor.
- ii. The subcontractor is the U.S. Department of Energy national laboratory and it submits an advance request for \$100,000 to the Recipient, including any other documents required in the Energy Commission's U.S. Department of Energy Terms and Conditions. The Recipient in turn submits the advance requests to the Commission for payment. The Commission will pay the full amount of the advance requests to the Recipient and the Recipient must pay the full amount to the U.S. Department of Energy.
- iii. The Recipient's submits an invoice for its own staff in the amount of \$20,000. The Commission will only pay \$18,000 to the Recipient, and the Recipient cannot withhold the \$2,000 difference from subcontractor reimbursements.

These requirements apply to all levels of subcontractors (e.g., a subcontractor to a subcontractor).

Travel and Per Diem

- 1 TRAVEL NOT LISTED IN THE BUDGET REQUIRES PRIOR WRITTEN AUTHORIZATION FROM THE COMMISSION AGREEMENT MANAGER.
- 2 NO REIMBURSEMENT FOR FOOD OR BEVERAGES WILL BE MADE OTHER THAN FOR ALLOWABLE PER DIEM CHARGES.
- 3 THE RECIPIENT WILL BE REIMBURSED FOR AUTHORIZED TRAVEL AND PER DIEM UP TO, BUT NOT TO EXCEED, THE RATES ALLOWED NONREPRESENTED STATE EMPLOYEES. CURRENT ALLOWABLE TRAVEL REIMBURSEMENT RATES CAN BE OBTAINED FROM THE COMMISSION'S WEB SITE AT [HTTP://WWW.ENERGY.CA.GOV/CONTRACTS/TRAVEL PER DIEM.PDF](http://www.energy.ca.gov/contracts/travel_per_diem.pdf).
- 4 TRAVEL EXPENSE CLAIMS MUST DETAIL EXPENSES USING THE ALLOWABLE RATES, AND THE
- 5 RECIPIENT MUST SIGN AND DATE EACH TRAVEL EXPENSE CLAIM BEFORE SUBMITTING IT TO THE COMMISSION FOR PAYMENT. EXPENSES MUST BE LISTED BY TRIP, INCLUDING DATES AND TIMES OF DEPARTURE AND RETURN. TRAVEL EXPENSE CLAIMS SUPPORTING RECEIPTS AND EXPENSE DOCUMENTATION MUST BE ATTACHED TO THE RECIPIENT'S PAYMENT REQUEST. A VEHICLE LICENSE NUMBER IS REQUIRED WHEN CLAIMING MILEAGE, PARKING, OR TOLL CHARGES. QUESTIONS REGARDING ALLOWABLE TRAVEL EXPENSES OR PER DIEM SHOULD BE ADDRESSED TO THE COMMISSION AGREEMENT MANAGER.

Prevailing Wage

- a. Requirement

Projects funded by the Energy Commission often involve construction, alteration, demolition, installation, repair, or maintenance work over \$1,000. Such projects might be considered "public works" under the California Labor Code (See California Labor Code Section 1720 et seq. and Title 8 California Code of Regulations, Section 16000 et seq.). Public works projects require the payment of prevailing wages. Prevailing wage rates can be significantly higher than non-prevailing wage rates.
- b. Determination of Project's Status

Only the California Department of Industrial Relations (DIR) and courts of competent jurisdiction may issue legally binding determinations that a particular project is or is not a public work. If the Recipient is unsure whether the project funded by the Agreement is a “public work” as defined in the California Labor Code, it may wish to seek a timely determination from DIR or an appropriate court. As such processes can be time consuming, it may not be possible to obtain a timely determination before the date for performance of the Agreement.

By accepting this grant, the Recipient is fully responsible for complying with all California public works requirements, including but not limited to payment of prevailing wage. As a material term of this grant, the Recipient must either:

- 1) Timely obtain a legally binding determination from DIR or a court of competent jurisdiction before work begins on the project that the proposed project is not a public work; or
- 2) Assume that the project is a public work and ensure that:
 - Prevailing wages are paid unless and until DIR or a court of competent jurisdiction determines that the project is not a public work;
 - The project budget for labor reflects these prevailing wage requirements; and
 - The project complies with all other requirements of prevailing wage law, including but not limited to keeping accurate payroll records and complying with all working hour requirements and apprenticeship obligations.

California Prevailing Wage law provides for substantial damages and financial penalties for failure to pay prevailing wages when such payment is required.

3 SUBCONTRACTORS AND FLOW-DOWN REQUIREMENTS

- The Recipient will ensure that its subcontractors also comply with the public works/prevailing wage requirements above. The Recipient will ensure that all agreements with its subcontractors to perform work related to this Project contain the above terms regarding payment of prevailing wages on public works projects. The Recipient is responsible for any failure of its subcontractors to comply with California prevailing wage and public works laws.

a. Indemnification and Breach

Any failure of the Recipient or its subcontractors to comply with the above requirements will constitute breach of this Agreement which excuses the Commission’s performance of this Agreement at the Commission’s option, and will be at the Recipient’s sole risk. In such a case, the Commission will refuse payment to the Recipient of any amount under this award and the Commission will be released, at its option, from any further performance of this Agreement or any portion thereof. The Recipient will indemnify the Energy Commission and hold it harmless for any and all financial consequences arising out of or resulting from the failure of the Recipient and/or any of its subcontractors to pay prevailing wages or to otherwise comply with the requirements of prevailing wage law.

b. Budget

The Recipient’s budget on public works projects must indicate which job classifications are subject to prevailing wage. For detailed information about prevailing wage and the process to determine if the proposed project is a public work, the Recipient may wish to contact DIR or a qualified labor attorney for guidance.

c. Covered Trades

For public works projects, the Recipient may contact DIR for a list of covered trades and the applicable prevailing wage.

d. Questions

If the Recipient has any questions about this contractual requirement or the wage, record keeping, apprenticeship, or other significant requirements of California prevailing wage law, the Recipient should consult DIR and/or a qualified labor attorney before entering into this Agreement.

e. Certification

- The Recipient will certify to the Energy Commission on each payment request form either that: (a) prevailing wages were paid to eligible workers who provided labor for work covered by the payment request and the Recipient and all contractors and subcontractors otherwise complied with all California prevailing wage laws; or (b) the project is not a public work requiring the payment of prevailing wages. In the latter case, the Recipient will provide competent proof of a DIR or court determination that the project is not a public work requiring the payment of prevailing wages.

Prior to the release of any retained funds under this Agreement, the Recipient will submit to the Energy Commission the above-described certificate signed by the Recipient and all contractors and subcontractors performing public works activities on the project. Absent this certificate, the Recipient will have no right to any funds under this Agreement, and Commission will be relieved of any obligation to pay any funds.

Recordkeeping, Cost Accounting, and Auditing

1 COST ACCOUNTING

The Recipient will keep separate, complete, and correct accounting of the costs involved in completing the project and any match-funded portion of the project. The Commission or its agent will have the right to examine the Recipient's books of accounts at all reasonable times, to the extent necessary to verify the accuracy of the Recipient's reports.

2 ACCOUNTING PROCEDURES

- a. The Recipient's costs will be determined on the basis of its accounting system procedures and practices employed as of the effective date of this Agreement, provided that the Recipient uses generally accepted accounting principles and cost reimbursement practices. The Recipient's cost accounting practices used in accumulating and reporting costs during the performance of this Agreement will be consistent with the practices used in estimating costs for any proposal to which this Agreement relates; provided that such practices are consistent with the other terms of this Agreement and that such costs may be accumulated and reported in greater detail during performance of this Agreement.
- b. The Recipient's accounting system will distinguish between direct and indirect costs. All costs incurred for the same purpose, in like circumstances, are either direct costs only or indirect costs only with respect to costs incurred under this Agreement.
- c. Audit Rights

The Recipient will maintain books, records, documents, and other evidence, based on the procedures set forth above, sufficient to reflect properly all costs claimed to have been incurred in the performance of this Agreement. The Energy Commission, another state agency, and/or a public accounting firm designated by the Energy Commission may audit the Recipient's accounting records at all reasonable times, with prior notice by the Energy Commission.

It is the intent of the parties that the audits will ordinarily be performed not more frequently than once every twelve (12) months during the performance of the work and once at any time within three (3) years after payment by the Energy Commission of the Recipient's final invoice. However, performance of any such interim audits by the Energy Commission does not preclude further audit. The Energy Commission may audit books, records, documents, and other evidence relevant to the Recipient's royalty payment obligations (see Section 22) for a period of ten (10) years after payment of the Recipient's final invoice.

The Recipient will allow the auditor(s) to access such records during normal business hours, and will allow interviews of any employees who might reasonably have information related to such records. The Recipient will include a similar right of the state to audit records and interview staff in any subcontract related to the performance of this Agreement.

d. Refund to the Energy Commission

If the Energy Commission determines that any invoiced and paid amounts exceed the actual allowable incurred costs, the Recipient will repay the amounts to the Energy Commission within thirty (30) days of request or as otherwise agreed by the Energy Commission and the Recipient. If the Energy Commission does not receive such repayments, it will be entitled to take actions such as withholding further payments to the Recipient and seeking repayment from the Recipient.

e. Audit Cost

The Recipient will bear its cost of participating in any audit (e.g., mailing or travel expenses). The Energy Commission will bear the cost of conducting the audit unless the audit reveals an error detrimental to the Energy Commission that exceeds more than ten percent (10%) or \$5,000 (whichever is greater) of: (1) the amount audited; or (2) if a royalty audit, the total royalties due in the period audited. The Recipient will pay the refund as specified in subsection (d), and will reimburse the Energy Commission for reasonable costs and expenses incurred by the Commission in conducting the audit.

f. Match or Cost Share

If the budget includes a match share requirement, the Recipient's commitment of resources, as described in this Agreement, is a required expenditure for receipt of Energy Commission funds. The funds will be released only if the required match percentages are expended. The Recipient must maintain accounting records detailing the expenditure of the match (actual cash and in-kind, non-cash services), and report on match share expenditures on its request for payment.

Workers' Compensation Insurance

- a. The Recipient warrants that it carries Worker's Compensation Insurance for all of its employees who will be engaged in the performance of this Agreement, and agrees to furnish to the Commission Agreement Manager satisfactory evidence of this insurance upon the Commission Agreement Manager's request.
- b. If the Recipient is self-insured for worker's compensation, it warrants that the self-insurance is permissible under the laws of the State of California and agrees to furnish to the Commission Agreement Manager satisfactory evidence of the insurance upon the Commission Agreement Manager's request.

Permits and Clearances

The Recipient is responsible for ensuring that all necessary permits and environmental documents are prepared and that clearances are obtained from the appropriate agencies.

Equipment

Title to equipment acquired by the Recipient with grant funds will vest in the Recipient. The Recipient may use the equipment in the project or program for which it was acquired as long as needed, regardless of whether the project or program continues to be supported by grant funds. However, the Recipient may not sell, lease, or encumber the property (i.e., place a legal burden on the property such as a lien) during the Agreement term without the Commission Agreement Manager's prior written approval.

The Recipient may refer to the applicable federal regulations incorporated by reference in this Agreement for guidance regarding additional equipment requirements.

Disputes

In the event of an Agreement dispute or grievance between the Recipient and the Energy Commission, both parties may follow the procedure detailed below. The Recipient will continue with its responsibilities under this Agreement during any dispute.

- a. Commission Agreement Manager/Commission Agreement Officer
 - The Recipient must first discuss the problem informally with the Commission Agreement Manager.
 - If the problem cannot be resolved at this stage, the Recipient must submit a Contractor Dispute Statement, along with any evidence, to the Commission Agreement Officer. The statement must include: (1) a summary of the issues in dispute; (2) the legal authority or other basis for the Recipient's position; and (3) the remedy sought.
- b. Commission Agreement Officer/ Program Office Manager
 - The Commission Agreement Officer and the Program Office Manager must make a determination on the problem within ten (10) working days of receipt of the Recipient's Dispute Statement.
 - The Commission Agreement Officer will submit a Dispute Finding to the Recipient that includes: (1) a decision; and (2) an explanation of the decision.
 - The Recipient may appeal to the Commission's Executive Director if it disagrees with the Commission Agreement Officer's decision.
- c. Executive Director
 - The Recipient must submit an Appeal to the Commission's Executive Director within ten (10) working days of receipt of the Commission Agreement Officer's Dispute Finding. The Appeal must explain why the Commission Agreement Officer's decision is unacceptable. The Recipient must include the following as attachments to the Appeal: (1) the Recipient Dispute Statement; (2) any supporting documents; and (3) the Dispute Finding.
 - The Executive Director or his/her designee will meet with the Recipient to review the issues raised.
 - A written decision signed by the Executive Director or his/her designee will be sent to the Recipient within twenty (20) working days of receipt of the Appeal. The Executive Director may exercise the option of presenting the decision to the Commission at a business meeting.
 - If the Recipient disagrees with the Executive Director's decision, it may appeal to the Commission at a regularly scheduled business meeting. The Commission Agreement Officer will inform the Recipient of the procedure for placing the appeal on a Commission Business Meeting Agenda.

Stop Work

The Commission Agreement Officer may, at any time by written notice to the Recipient, require the Recipient to stop all or any part of the work tasks in this Agreement. Stop work orders may be issued for reasons such as a project exceeding budget, noncompliance with the standard of performance, out of scope work, project delays, and misrepresentations.

- 1 COMPLIANCE. UPON RECEIPT OF A STOP WORK ORDER, THE RECIPIENT MUST IMMEDIATELY TAKE ALL NECESSARY STEPS TO COMPLY WITH THE ORDER AND TO MINIMIZE THE INCURRENCE OF COSTS ALLOCABLE TO THE WORK STOPPED.**
- 2 EQUITABLE ADJUSTMENT. THE ENERGY COMMISSION WILL MAKE AN EQUITABLE ADJUSTMENT BASED UPON A WRITTEN REQUEST FROM THE RECIPIENT. THE RECIPIENT MUST MAKE THE ADJUSTMENT REQUEST WITHIN THIRTY (30) DAYS FROM THE DATE OF THE STOP WORK ORDER.**
- 3 CANCELING A STOP WORK ORDER. THE RECIPIENT MAY RESUME THE WORK ONLY UPON RECEIPT OF WRITTEN INSTRUCTIONS FROM THE COMMISSION AGREEMENT OFFICER.**

Termination

1 PURPOSE

Because the Energy Commission is a state entity and provides funding on behalf of all California ratepayers, it must be able to terminate the Agreement upon the default of the Recipient and to proceed with the work required under the Agreement in any manner it deems proper. The Recipient agrees that upon any of the events triggering the termination of the Agreement by the Energy Commission, the Energy Commission has the right to terminate the Agreement, and it would constitute bad faith of the Recipient to interfere with the immediate termination of the Agreement by the Energy Commission.

2 BREACH

The Energy Commission will provide the Recipient written notice of intent to terminate due to the Recipient's breach. The Recipient will have fifteen (15) calendar days to fully perform or cure the breach. If the Recipient does not cure the breach within fifteen (15) days, the Energy Commission may, without prejudice to any of its other remedies, terminate this Agreement upon five (5) calendar days written notice to the Recipient. In this event, the Energy Commission will pay the Recipient only the reasonable value of the services performed satisfactorily by the Recipient before the notice of termination, as may be agreed upon by the parties or determined by a court of law, but not to exceed the maximum payable Agreement amount.

3 FOR CAUSE

The Energy Commission may, for cause, terminate this Agreement upon giving thirty (30) calendar days advance written notice to the Recipient. In this event, the Recipient will use all reasonable efforts to mitigate its expenses and obligations. The Energy Commission will pay the Recipient for any services rendered and expenses incurred within thirty (30) days after notice of termination that the Recipient could not have avoided by reasonable efforts, in an amount not to exceed the maximum payable Agreement amount. The Recipient will relinquish possession of equipment purchased for this Agreement with Energy Commission funds to the Commission, or the Recipient may purchase the equipment as provided by the terms of this Agreement, with approval of the Energy Commission.

The term "for cause" includes but is not limited to the following:

- Partial or complete loss of match funds;

- Reorganization to a business entity unsatisfactory to the Energy Commission;
- Retention or hiring of subcontractors, or replacement or addition of personnel, that fail to perform to the standards and requirements of this Agreement;
- The Recipient's inability to pay its debts as they become due and/or the Recipient's default of an obligation that impacts its ability to perform under this Agreement; or
- Significant change in state or Energy Commission policy such that the work or product being funded would not be supported by the Commission.

4 WITHOUT CAUSE

The Energy Commission may terminate this Agreement without cause in whole or in part, upon giving thirty (30) days advance written notice to the Recipient. In this event, the Recipient will use all reasonable efforts to mitigate its expenses and obligations. Also, the Energy Commission will pay the Recipient for all satisfactory services rendered and expenses incurred within thirty (30) calendar days after notice of termination that the Recipient could not avoid by reasonable efforts, in an amount not to exceed the maximum payable under this Agreement.

Indemnification

To the extent allowed under California law, the Recipient will indemnify, defend, and hold harmless the state (including the Energy Commission) and state officers, agents, and employees from any and all claims and losses in connection with the performance of this Agreement.

Confidentiality

a. Identification of Confidential Information

- 1) Prior to the effective date of this Agreement, the Recipient will identify all products (or information contained within products) that it considers to be confidential, in addition to the legal basis for confidentiality, in Attachment 1 to this Exhibit. If the Energy Commission agrees that the information is confidential, it will not disclose it except as provided in subsection (b).
- c. 2) During the Agreement, if the Recipient develops additional products (or information contained within products) not originally anticipated as confidential, it will follow the procedures for a request for designation of confidential information specified in Title 20 California Code of Regulations (CCR) Section 2505.
- d. The Energy Commission's Executive Director will make the confidentiality determination. Following this determination, the confidential information may be added to Attachment 1 through a Letter of Agreement (see the "Amendments" section). The Energy Commission will not disclose information subject to an application for confidential designation except as provided in subsection (b).
- e. 3) When submitting products containing confidential information, the Recipient will mark each page of any document containing confidential information as "confidential", and present it in a sealed package to the Contracts, Grants, and Loans Office.
- f. The Commission Agreement Manager may require the Recipient to submit a non-confidential version of the product, if it is feasible to separate the confidential information from the non-confidential information. The Recipient is not required to submit such products in a sealed package.

b. Disclosure of Confidential Information

The Energy Commission will only disclose confidential information under the circumstances specified in Title 20 CCR Sections 2506, 2507, and 2508. All confidential information that is legally disclosed by the Recipient or any other entity will become a public record and will no longer be subject to the Energy Commission's confidentiality designation.

c. Waiver of Consequential Damages

In no event will the Energy Commission, the California Public Utilities Commission, or the state of California be liable for any special, incidental, or consequential damages based on breach of warranty, breach of contract, negligence, strict tort, or any other legal theory for the disclosure of the Recipient's confidential information, even if the Commission has been advised of the possibility of such damages.

Damages that the Energy Commission, the California Public Utilities Commission, and the state of California will not be responsible for include but are not limited to: lost profit; lost savings or revenue; lost goodwill; lost use of the product or any associated equipment; cost of capital; cost of any substitute equipment, facilities, or services; downtime; the claims of third parties including customers; and injury to property.

d. Limitations on the Recipient's Disclosure of Products

- 1) During the Agreement, the Recipient must receive approval from the Commission Agreement Manager prior to disclosing the contents of any draft product to a third party. However, if the Energy Commission makes a public statement about the content of any product provided by the Recipient and the Recipient believes the statement is incorrect, the Recipient may state publicly what it believes is correct.
- 2) After any document submitted has become a part of the public records of the state, the Recipient may publish or use it at its own expense.
- 3) Except as provided in Title 20 CCR Sections 2506, 2507, and 2508, the Recipient may not disclose any information provided to it by the Energy Commission for the performance of this Agreement if the information has been designated as confidential or is the subject of a pending application for confidential designation. At the election of the Commission Agreement Manager, the Recipient, its employees, and its subcontractors must execute a confidentiality agreement provided by the Commission Agreement Manager.
- 4) The Recipient will ensure that each of its officers, employees, and subcontractors who are involved in the performance of this Agreement are informed about these disclosure limitations and will abide by them.

Pre-Existing and Independently Funded Intellectual Property

a. Ownership

The Energy Commission makes no ownership, license, or royalty claims to pre-existing intellectual property, independently funded intellectual property, or project-relevant pre-existing or independently funded intellectual property. **"Ownership"** means exclusive possession and control of all rights to property, including the right to use and transfer property. Intellectual property licenses and royalties are discussed in Sections 21 and 22.

- 1) **“Pre-existing intellectual property”** means: (a) inventions, technologies, designs, drawings, data, software, formulas, compositions, processes, techniques, works of authorship, trademarks, service marks, and logos that the Recipient or a third party owned or possessed prior to the effective date of this Agreement and that have not been developed, altered, or reduced to practice with Energy Commission or match funds; and (b) associated proprietary rights to these items that are obtained without Energy Commission or match funds, such as patent and copyright.
- 2) **“Independently funded intellectual property”** means: (a) inventions, technologies, designs, drawings, data, software, formulas, compositions, processes, techniques, works of authorship, trademarks, service marks, and logos that are created, conceived, discovered, made, developed, altered, or reduced to practice by the Recipient or a third party during or after the Agreement term without Energy Commission or match funds; and (b) associated proprietary rights to these items that are obtained without Energy Commission or match funds, such as patent and copyright.

“Works of authorship” does not include written products created for Agreement reporting and management purposes, such as reports, summaries, lists, letters, agendas, schedules, and invoices. The Commission owns such products regardless of their funding source.

- 3) **“Project-relevant pre-existing intellectual property”** and **“project-relevant independently funded intellectual property”** mean pre-existing and independently funded intellectual property used to support a premise, postulate, or conclusion referred to or expressed in any product under this Agreement.

b. Project-Relevant Pre-Existing and Independently Funded Intellectual Property

- 1) Identification of Property
 - a) The Recipient will identify all project-relevant pre-existing intellectual property in Attachment 1 to this Exhibit prior to the effective date of the Agreement, or within sixty (60) days of becoming aware that the property has been or will be used to support a premise, postulate, or conclusion referred to or expressed in any product under this Agreement. Attachment 1 may be amended by a Letter of Agreement (see the “Amendments” section).
 - b) The Recipient will identify all project-relevant independently funded intellectual property and the source of funding for the property in Attachment 1 to this Exhibit within sixty (60) days of becoming aware that the property has been or will be used to support a premise, postulate, or conclusion referred to or expressed in any product under this Agreement.
 - c) Failure to identify project-relevant pre-existing or independently funded intellectual property in Attachment 1 to this Exhibit may result in the property’s designation as “intellectual property” that is subject to licenses and royalties, as described in Sections 21 and 22.

2) Access to Property

The extent of Energy Commission and California Public Utilities Commission access to project-relevant pre-existing and independently funded intellectual property is limited to that reasonably necessary to: (a) demonstrate the validity of any premise, postulate, or conclusion referred to or expressed in any product; or (b) establish a baseline for repayment purposes.

Upon the Commission Agreement Manager's request, the Recipient will provide the Commission Agreement Manager and any reviewers designated by the Energy Commission or the California Public Utilities Commission with access to review the Recipient's project-relevant pre-existing and independently funded intellectual property. If the property has been designated as confidential as specified in Section 19, the Energy Commission will only disclose it under the circumstances specified in Title 20 CCR Sections 2506, 2507, and 2508.

3) Preservation of Property

The Recipient will preserve any project-relevant pre-existing or independently funded intellectual property at its own expense for at least ten (10) years from the Agreement's end date, unless the Recipient agrees to a longer retention period.

The Energy Commission and the California Public Utilities Commission will have reasonable access to the project-relevant pre-existing or independently funded property throughout the retention period.

Intellectual Property

a. Ownership

- 1) The Recipient owns all intellectual property, subject to the licenses described in subsection b.

"Intellectual property" means: (a) inventions, technologies, designs, drawings, data, software, formulas, compositions, processes, techniques, works of authorship, trademarks, service marks, and logos that are created, conceived, discovered, made, developed, altered, or reduced to practice with Agreement or match funds during or after the Agreement term; (b) any associated proprietary rights to these items, such as patent and copyright; and (c) any upgrades or revisions to these items.

"Works of authorship" does not include written products created for Agreement reporting and management purposes, such as reports, summaries, lists, letters, agendas, schedules, and invoices.

- 2) The Energy Commission owns all products identified in the Scope of Work, with the exception of products that fall within the definition of "intellectual property."

"Product" means any tangible item specified for delivery to the Energy Commission in the Scope of Work.

b. Intellectual Property Licenses

- 1) Both the Energy Commission and the California Public Utilities Commission have a no-cost, non-exclusive, transferable, irrevocable, royalty-free, worldwide, perpetual license to use, publish, translate, modify, and reproduce intellectual property for governmental purposes. The licenses are transferable only to load-serving entities for the purpose described below.

- 2) Both the Energy Commission and the California Public Utilities Commission may grant load-serving entities a no-cost, non-exclusive, transferable, irrevocable, royalty-free, worldwide, perpetual license to use, publish, translate, modify, and reproduce intellectual property to enhance the entities' service to EPIC ratepayers. **"Load-serving entity"** means a company or other organization that provides electricity to EPIC ratepayers.
 - The licenses are transferable to third parties only for the purpose of facilitating the load-serving entity's enhancement of service to EPIC ratepayers. Load-serving entities must obtain prior written approval from the Energy Commission or California Public Utilities Commission (whichever agency granted the load-serving entity the license) in order to transfer the license to a third party.
- 3) The Recipient has a non-exclusive, non-transferable, irrevocable, worldwide, perpetual license to use, publish, translate, modify, and reproduce written products created for Agreement reporting and management purposes, such as reports and summaries.
- d) If any intellectual property that is subject to the licenses above has been designated as confidential as specified in Section 19, all license holders will only disclose the intellectual property under the circumstances specified in Title 20 CCR Sections 2506, 2507, and 2508.

All license holders will ensure that their officers, employees, and subcontractors who have access to the intellectual property are informed of and abide by the disclosure limitations in Section 19.

c. **ENERGY COMMISSION'S RIGHTS TO INVENTIONS**

"Invention" means intellectual property that is patentable.

1) **March-In Rights**

At the Energy Commission's request, the Recipient will forfeit and assign to the Energy Commission all rights to any invention (with the exception of U.S. Department of Energy reserved rights) if the Recipient or assignee has not taken, or is not expected to take within a reasonable time, effective steps to achieve practical application of the invention. The Energy Commission will have the unfettered right to use and/or dispose of the rights in whatever manner it deems most suitable to help transfer the invention into the marketplace, including but not limited to seeking patent protection or licensing the invention.

2) **Notice of Patent**

If any patent is issued for an invention, the Recipient will send the Commission Agreement Manager written notice of the issuance within three (3) months of the issuance date. The notice must include the patent title, issuance number, and a general description of the invention.

3) **Legal Notice**

The Recipient and all persons and/or entities obtaining an ownership interest in patentable intellectual property must include the following statement within the specification of any United States patent application, and any subsequently issued patent for the invention:

"This invention was made with State of California support under California Energy Commission grant number EPC-17-020. The Energy Commission has certain rights to this invention."

d. Access to and Preservation of Intellectual Property

1) Access to Intellectual Property

Upon the Commission Agreement Manager's request, the Recipient will provide the Commission Agreement Manager and any individuals designated by the Energy Commission or the California Public Utilities Commission with access to the Recipient's intellectual property in order to exercise the license and march-in rights described above, and to determine any royalty payments due under the Agreement.

2) Preservation of Intellectual Property

The Recipient will preserve intellectual property at its own expense for at least ten (10) years from the Agreement's end date, unless the Recipient agrees to a longer retention period.

e. Intellectual Property Indemnity

The Recipient may not, in supplying work under this Agreement, knowingly infringe or misappropriate any intellectual property right of a third party, and will take reasonable actions to avoid infringement.

The Recipient will defend and indemnify the Energy Commission and the California Public Utilities Commission from and against any claim, lawsuit, or other proceeding, loss, cost, liability, or expense (including court costs and reasonable fees of attorneys and other professionals) to the extent arising out of: (i) any third party claim that a product infringes any patent, copyright, trade secret, or other intellectual property right of any third party; or (ii) any third party claim arising out of the negligent or other tortious acts or omissions by the Recipient or its employees, subcontractors, or agents in connection with or related to the products or the Recipient's performance under this Agreement.

Royalty Payments to the Commission

"Sale," "sales," and "sold" mean the sale, license, lease, or other transfer of intellectual property. ***"Sales Price"*** means the price at which intellectual property is sold, excluding sales tax.

- g. The Recipient will pay the Energy Commission a royalty of one and one-half percent (1.5%) of the sales price of all sales for which the Recipient receives a payment, beginning on the Agreement's effective date and extending for ten (10) years from the Agreement's end date.
- h. The Recipient will make payments in annual installments due on the first day of March in the calendar year immediately following the year during which the Recipient received any payment for sales.
- i. The Recipient is not required to make a royalty payment for any calendar year in which payments for sales are less than \$1000. Total royalty payments will be limited to three (3) times the amount of funds paid by the Energy Commission under the Agreement.
- j. If intellectual property was developed in part with match funds during the Agreement term, the royalty payment will be reduced in accordance with the percentage of intellectual property development activities that were funded with match funds. For example, if 10% of the development activities were funded with match funds during the Agreement and payments for sales totaled \$100,000 in one year, the Recipient would owe the Energy Commission \$1350 for the year ($1.5\% \text{ of } \$100,000 = \1500 ; $10\% \text{ of } \$1500 = \150 ; $\$1500 - \$150 = \$1350$).

- If the Energy Commission is providing funds to the Recipient under this Agreement as a project match partner and Energy Commission funds are used in part to develop intellectual property, the royalty payments will be reduced in accordance with the percentage of intellectual property development activities that were funded with non-Energy Commission funds during the Agreement term. For example, if 80% of the development activities were funded with Recipient and/or third party funds during the Agreement and payments for sales totaled \$100,000 in one year, the Recipient would owe the Energy Commission \$300 for the year (1.5% of \$100,000 = \$1500; 80% of \$1500 = \$1200; $\$1500 - \$1200 = \$300$).
- k. The Recipient may make an early buyout payment to the Energy Commission without a pre-payment penalty, as an alternative to making annual royalty payments for ten (10) years following the Agreement's end date. The payment must be in a lump sum amount equal to one and a half (1.5) times the amount of funds paid by the Energy Commission under the Agreement and made within five (5) years of the Agreement's end date. The payment amount due under the early buyout option will not be reduced by the percentage of match funds as described above.
 - l. The Recipient may not make any sale of intellectual property for consideration other than fair market value. Such activity constitutes breach of this Agreement, and will obligate the Recipient to repay within sixty (60) days the early buyout amount due. In the event of breach, the Energy Commission may exercise all rights and remedies available to it under law and at equity.
 - m. Royalty payments not made within fifteen (15) days of the due date will constitute breach of this Agreement. The payments will become debt obligations of the Recipient to the Energy Commission, due upon demand and bearing interest at the maximum interest rate allowed by law.
 - n. The Recipient will maintain separate accounts within its financial and other records for the purpose of tracking components of sales and royalties due to the Energy Commission under this Agreement.
 - o. Payments to the Energy Commission are subject to audit as provided for under the Recordkeeping, Cost Accounting, and Auditing section.
 - p. The Recipient will include these royalty provisions in its agreements with all subcontractors who develop or assist with the development of intellectual property.

General Provisions

a. Governing Law

This Agreement is governed by the laws of the State of California as to interpretation and performance.

b. Independent Capacity

- 1 **IN THE PERFORMANCE OF THIS AGREEMENT, THE RECIPIENT AND ITS AGENTS, SUBCONTRACTORS, AND EMPLOYEES WILL ACT IN AN INDEPENDENT CAPACITY AND NOT AS OFFICERS, EMPLOYEES, OR AGENTS OF THE STATE OF CALIFORNIA.**

c. Assignment

- 2 **THIS AGREEMENT IS NOT ASSIGNABLE OR TRANSFERABLE BY THE RECIPIENT EITHER IN WHOLE OR IN PART WITHOUT THE CONSENT OF THE ENERGY COMMISSION IN THE FORM OF AN AMENDMENT.**

d. Timeliness

- 3 **TIME IS OF THE ESSENCE IN THIS AGREEMENT.**

e. Severability

If any provision of this Agreement is unenforceable or held to be unenforceable, all other provisions of this Agreement will remain in full force and effect.

f. Waiver

No waiver of any breach of this Agreement constitutes waiver of any other breach. All remedies in this Agreement will be taken and construed as cumulative, meaning in addition to every other remedy provided in the Agreement or by law.

g. Assurances

The Commission reserves the right to seek further written assurances from the Recipient and its team that the work under this Agreement will be performed in accordance with the terms of the Agreement.

h. Change in Business

- 1) The Recipient will promptly notify the Energy Commission of the occurrence of any of the following:
 - a) A change of address.
 - b) A change in business name or ownership.
 - c) The existence of any litigation or other legal proceeding affecting the project or Agreement.
 - d) The occurrence of any casualty or other loss to project personnel, equipment, or third parties.
 - e) Receipt of notice of any claim or potential claim against the Recipient for patent, copyright, trademark, service mark, and/or trade secret infringement that could affect the Energy Commission's rights.
- 2) The Recipient must provide the Commission Agreement Manager with written notice of a planned change or reorganization of the type of business entity under which it does business. A change of business entity or name change requires an amendment assigning or novating the Agreement to the changed entity. If the Energy Commission does not seek to amend this Agreement or enter into a new agreement with the changed or new entity for any reason (including that the Commission is not satisfied that the new entity can perform in the same manner as the Recipient), it may terminate this Agreement as provided in the "Termination" section.

i. Access to Sites and Records

Energy Commission and California Public Utilities Commission staff and representatives will have reasonable access to all project sites and to all records related to this Agreement.

j. Prior Dealings, Custom, or Trade Usage

These terms and conditions may not be modified or supplemented by prior dealings, custom, or trade usage.

k. Survival of Terms

Certain provisions will survive the completion or termination date of this Agreement for any reason. The provisions include but are not limited to:

- Legal Statements on Products (included in Section 5, "Products")
- Payment of Funds (Section 8)
- Recordkeeping, Cost Accounting, and Auditing (Section 11)
- Equipment (Section 14)
- Disputes (Section 15)
- Termination (Section 17)
- Indemnification (Section 18)
- Pre-Existing and Independently Funded Intellectual Property (Section 20)
- Intellectual Property (Section 21)
- Royalty Payments to the Commission (Section 22)
- Change in Business (see this section)
- Access to Sites and Records (see this section)

Certifications and Compliance

a. Federal, State, and Local Laws

The Recipient will comply with all applicable federal, state and local laws, rules and regulations.

b. Nondiscrimination Statement of Compliance

During the performance of this Agreement, the Recipient and its subcontractors will not unlawfully discriminate, harass, or allow harassment against any employee or applicant for employment because of sex, sexual orientation, race, color, ancestry, religious creed, national origin, physical disability (including HIV and AIDS), mental disability, medical condition, age, marital status, or denial of family care leave. The Recipient and its subcontractors will ensure that the evaluation and treatment of their employees and applicants for employment are free from such discrimination and harassment.

The Recipient and its subcontractors will comply with the provisions of the Fair Employment and Housing Act (Government Code Sections 12990 et seq.) and the applicable regulations promulgated thereunder (California Code of Regulations, Title 2, Section 7285 et seq.). The applicable regulations of the Fair Employment and Housing Commission implementing Government Code Section 12990 (a-f), set forth in Chapter 5 of Division 4 of Title 2 of the California Code of Regulations, are incorporated into this Agreement by reference and made a part of it as if set forth in full. The Recipient and its subcontractors will give written notice of their obligations under this section to labor organizations with which they have a collective bargaining or other Agreement.

The Recipient will include the nondiscrimination and compliance provisions of this section in all subcontracts to perform work under this Agreement.

c. Drug-Free Workplace Certification

By signing this Agreement, the Recipient certifies under penalty of perjury under the laws of the State of California that it will comply with the requirements of the Drug-Free Workplace Act of 1990 (Government Code Section 8350 et seq.) and will provide a drug-free workplace by taking the following actions:

- 1) Publish a statement notifying employees that unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance is prohibited, and specifying actions to be taken against employees for violations as required by Government Code Section 8355(a).
- 2) Establish a Drug-Free Awareness Program as required by Government Code Section 8355(b) to inform employees about all of the following:
 - The dangers of drug abuse in the workplace;
 - The person's or organization's policy of maintaining a drug-free workplace;
 - Any available counseling, rehabilitation, and employee assistance programs; and
 - Penalties that may be imposed upon employees for drug abuse violations.
- 3) Provide, as required by Government Code Section 8355(c), that every employee who works on the proposed project:
 - Will receive a copy of the company's drug-free policy statement; and
 - Will agree to abide by the terms of the company's statement as a condition of employment on the project.

Failure to comply with these requirements may result in suspension of payments under the Agreement or termination of the Agreement or both, and the Recipient may be ineligible for any future state awards if the Commission determines that any of the following has occurred: (1) the Recipient has made false certification, or (2) violates the certification by failing to carry out the requirements as noted above.

d. National Labor Relations Board Certification (Not applicable to public entities)

The Recipient, by signing this Agreement, swears under penalty of perjury that no more than one final unappealable finding of contempt of court by a federal court has been issued against the Recipient within the immediately preceding two year period because of the Recipient's failure to comply with an order of a federal court that orders the Recipient to comply with an order of the National Labor Relations Board.

e. Child Support Compliance Act (Applicable to California Employers)

For any agreement in excess of \$100,000, the Recipient acknowledges that:

- 1) It recognizes the importance of child and family support obligations and will fully comply with all applicable state and federal laws relating to child and family support enforcement, including but not limited to disclosure of information and compliance with earnings assignment orders, as provided in Chapter 8 (commencing with section 5200) of Part 5 of Division 9 of the Family Code; and
 - 2) To the best of its knowledge is fully complying with the earnings assignment orders of all employees and is providing the names of all new employees to the New Hire Registry maintained by the California Employment Development Department.
- f. Air or Water Pollution Violation
- Under state laws, the Recipient will not be:
- 1) In violation of any order or resolution not subject to review promulgated by the State Air Resources Board or an air pollution control district;
 - 2) Subject to a cease and desist order not subject to review issued pursuant to Section 13301 of the Water Code for violation of waste discharge requirements or discharge prohibitions; or
 - 3) Finally determined to be in violation of provisions of federal law relating to air or water pollution.
- g. Americans With Disabilities Act
- q. By signing this Agreement, the Recipient assures the State that it complies with the Americans with Disabilities Act (ADA) of 1990 (42 U.S.C. Section 12101, et seq.), which prohibits discrimination on the basis of disability, as well as applicable regulations and guidelines issued pursuant to the ADA.

Definitions

- **Agreement Term** means the length of this Agreement, as specified on the Agreement signature page (form CEC-146).
- **Budget Reallocation** means the movement of funds between tasks identified in the budget (Exhibit B).
- **Confidential Information** means information that the Recipient has satisfactorily identified as confidential in Attachment 1 to this Exhibit and that the Energy Commission has agreed to designate as confidential under Title 20 California Code of Regulations Section 2505.
- **Data** means any recorded information that relates to the project funded by the Agreement, whether created or collected before or after the Agreement's effective date.
- **Effective Date** means the date on which this Agreement is signed by the last party required to sign, provided that signature occurs after the Agreement has been approved by the Energy Commission at a business meeting or by the Executive Director or his/her designee.
- **EPIC** means the Electric Program Investment Charge, an electricity ratepayer-funded surcharge authorized by the California Public Utilities Commission in December 2011.

- **Equipment** means products, objects, machinery, apparatus, implements, or tools that are purchased or constructed with Energy Commission funds for the project, and that have a useful life of at least one year and an acquisition unit cost of at least \$5,000. "Equipment" includes products, objects, machinery, apparatus, implements, or tools that are composed by over thirty percent (30%) of materials purchased for the project. For purposes of determining depreciated value of equipment used in the Agreement, the project will terminate at the end of the normal useful life of the equipment purchased and/or developed with Energy Commission funds. The Energy Commission may determine the normal useful life of the equipment.
- **Independently Funded Intellectual Property** means: (a) inventions, technologies, designs, drawings, data, software, formulas, compositions, processes, techniques, works of authorship, trademarks, service marks, and logos that are created, conceived, discovered, made, developed, altered, or reduced to practice by the Recipient or a third party during or after the Agreement term without Energy Commission or match funds; and (b) associated proprietary rights to these items that are obtained without Energy Commission or match funds, such as patent and copyright.

"Works of authorship" does not include written products created for Agreement reporting and management purposes, such as reports, summaries, lists, letters, agendas, schedules, and invoices. The Commission owns such products regardless of their funding source.

- **Intellectual Property** means: (a) inventions, technologies, designs, drawings, data, software, formulas, compositions, processes, techniques, works of authorship, trademarks, service marks, and logos that are created, conceived, discovered, made, developed, altered, or reduced to practice with Agreement or match funds during or after the Agreement term; (b) any associated proprietary rights to these items, such as patent and copyright; and (c) any upgrades or revisions to these items.

"Works of authorship" does not include written products created for Agreement reporting and management purposes, such as reports, summaries, lists, letters, agendas, schedules, and invoices.

- **Invention** means intellectual property that is patentable.
- **Load-serving entity** means a company or other organization that provides electricity to EPIC ratepayers.
- **Match Funds** means cash or in-kind (i.e., non-cash) contributions provided by the Recipient or a third party for a project funded by the Energy Commission. If this Agreement resulted from a solicitation, refer to the solicitation's discussion of match funding for guidelines specific to the project.
- **Materials** means the substances used to construct a finished object, commodity, device, article, or product, such as equipment.
- **Ownership** means exclusive possession of all rights to property, including the right to use and transfer property.
- **Pre-existing intellectual property** means: (a) inventions, technologies, designs, drawings, data, software, formulas, compositions, processes, techniques, works of authorship, trademarks, service marks, and logos that the Recipient or a third party owned or possessed prior to the effective date of this Agreement and that have not been developed, altered, or reduced to practice with Energy Commission or match funds; and (b) associated proprietary rights to these items that are obtained without Energy Commission or match funds, such as patent and copyright.

- **Product** means any tangible item specified for delivery to the Energy Commission in the Scope of Work.
- **Project** means the entire effort undertaken and planned by the Recipient and consisting of the work funded by the Energy Commission. The project may coincide with or extend beyond the Agreement term.
- **Project-relevant pre-existing intellectual property and project-relevant independently funded intellectual property** mean pre-existing and independently funded intellectual property used to support a premise, postulate, or conclusion referred to or expressed in any product under this Agreement.
- **Sale, Sales,** and **Sold** mean the sale, license, lease, or other transfer of intellectual property.
- **Sales Price** means the price at which intellectual property is sold, excluding normal returns and allowances such as sales tax.
- **State** means the state of California and all California state agencies within it, including but not limited to commissions, boards, offices, and departments.

End of Exhibit C

END OF SECTION

SECTION 00805

SUPPLEMENTARY CONDITIONS - HAZARDOUS MATERIALS

1.1 SUMMARY

- A. This Section 00805 includes requirements that supplement the paragraphs of Section 00700 (General Conditions) as they apply to location, removal, remediation, disposal, and abatement of hazardous materials and hazardous waste.

1.2 SUPPLEMENTS

- A. Supplement to Article 1, Interpretation of Contract Documents:
 - 1. Add a new paragraph to the end of paragraph 1.2, Order Of Precedence Of Documents, that reads:
 - E. Should any provision or requirement of any Contract Document conflict with another provision or requirement in the Contract Documents on subject matters of hazardous waste abatement, clean up, disposal, or required safety standards or methods, then the most stringent provision or requirement shall control.
- B. Supplement to Article 7, Owner's Administration of Work:
 - 1. Add a new paragraph to the end of paragraph 7.2, Owner's Observation of the Work, that reads:
 - C. Nothing contained in these Contract Documents or inferable therefrom shall be deemed or construed to:
 - 1. Make Contractor the agent, servant, or employee of Owner; or
 - 2. Create any partnership, joint venture, or other association between Owner and Contractor.
- C. Supplement to Article 8, Contractor's Prosecution and Progress of the Work:
 - 1. Add new paragraphs to the end of paragraph 8.1, Contractor to Supervise the Work, that read:
 - F. Owner shall exercise administration on Contract Documents. If Owner employs a HazMat Consultant, Owner reserves the right to assign or delegate to this consultant, or any other consultant, any or all HazMat Consultant's responsibilities under Contract Documents or alternatively to act as Owner's Representative. Contractor will be notified in writing of any such delegation.
 - G. Cooperate with HazMat Consultant as directed by Owner. HazMat Consultant's duties may include observing Contractor's health and safety program and practices, observing the abatement construction activities, observing the extent of material removed from each job Site, reviewing payment requests, reviewing reports required by governmental or quasi-governmental agencies or Contract Documents, and providing clearance tests after abatement is completed. No action, omission to act, approval, or failure to advise Contractor as to any matter by HazMat Consultant shall in any way relieve Contractor from its responsibility for the performance of Work in accordance with Contract Documents and applicable law. Unless directed otherwise in writing by Owner, do not communicate directly with HazMat Consultant and direct all communications to Owner.

2. Add new paragraph to the end of paragraph 8.2, Contractor to Maintain Cost Data, that reads:

D. Contractor shall obtain and maintain and furnish to Owner on completion of Work or at any other time requested by Owner, all necessary permits, licenses, approvals, authorizations, notifications, training certificates, respirator certificates, reports, correspondence, tests results, air monitoring certificates, forms, medical records, medical certificates, notes and photographs of Work conditions, approved shipping and disposal facility receipts, manifests, and all other documentation required by Contract Documents or applicable Law, or both. Contractor shall further provide Owner with copies of each such document as it is generated and, as a condition to final payment, provide Owner with a complete set of such documents (bound, organized, and indexed) at the conclusion of Work. Keep and maintain in retrievable files true and correct copies of all such documents for a period of not less than 30 years after Final Completion of the Work. Owner shall have the right to inspect or photocopy these records and, if Contractor should cease business operations, then it shall furnish these records to Owner.

D. Supplement to Article 9, Warranty, Guarantee, and Inspection of Work:

1. Add to the end of paragraph 9.1, Warranty and Guarantee, the following additional representations and warranties:

D. Additional Warranties and Representations:

2. Contractor represents and warrants that it, its employees and its Subcontractors and their employees, shall at all times have the required levels of familiarity with the Site and the Work, training and ability to comply fully with all applicable law and Contract Documents requirements for safe and expeditious performance of the Work, including whatever training is or may be required regarding the activities to be performed (including, but not limited to, all training required to adequately address the actual or potential dangers of Contract performance).
3. Contractor represents and warrants that it, its employees and its subcontractors and their employees, shall at all times have and maintain in good standing any and all certifications and licenses required by applicable federal, state, and other governmental and quasi-governmental requirements applicable to the Work.
4. Contractor represents and warrants that it has studied carefully all requirements of the Contract Documents regarding procedures for demolition, hazardous waste abatement, or safety practices, specified in the Contract Documents, and prior to submitting its Bid, has either:
 - a. Verified to its satisfaction that the specified procedures are adequate and sufficient to achieve the results intended by Contract Documents; or
 - b. By way of approved "or equal" request or request for clarification and written Addenda, secured changes to the specified procedures sufficient to achieve the results intended by Contract Documents.
5. Contractor accepts the risk that any specified procedure will result in a completed Project in full compliance with all Contract Documents requirements.
6. Add to the end of Article 9 a new paragraph 9.9 that reads:

9.9 Monitoring

A. Owner reserves the right, in its sole discretion, to conduct air monitoring, earth monitoring, Work monitoring, and any other tests (in addition to testing required under Section 00520 [Agreement] or applicable Law), to monitor Contract requirements of safe and statutory compliant work methods and (where

applicable) safe re-entry level air standards under state and federal Law upon completion of the Work, and compliance of the Work with periodic and final inspection of public and quasi-public entities having jurisdiction.

1. Contractor acknowledges that Owner also has the right to perform, or cause to be performed, various activities and tests including, but not limited to, pre-abatement, during abatement and post-abatement air monitoring, provided that Owner shall have no obligation to perform said activities and tests, and that a portion of said activities and tests may take place prior to the completion of Work by Contractor. In the event Owner elects to perform these activities and tests, afford Owner ample access to the Site and all areas of the Work as may be necessary for the performance of these activities and tests. Include the potential impact of these activities for tests by Owner in the Contract Sum and the scheduled completion date.
2. Notwithstanding Owner's rights granted by this paragraph 9, Contractor may be required to retain its own industrial hygiene consultant and shall have primary responsibility for collecting samples and performing all applicable, relevant, or appropriate activities and tests including, but not limited to, pre-abatement, during abatement, and post-abatement air monitoring, required by Contract Documents, applicable Law, or both, and Owner reserves the right to request documentation of all such activities and tests performed by Contractor relating to Work.

E. Supplement to Article 14, Legal and Miscellaneous:

1. Add new paragraphs to the end of paragraph 14.1, Laws and Regulations, that read:
 - B. Compliance with Laws. Contractor represents that it is familiar with and shall comply with all Laws applicable to the Work or completed Work including, but not limited to all Laws relating to:
 1. Protection of the public health, welfare, and environment;
 2. Generation, processing, treatment, handling, storage, transport, disposal, destruction, or other management of Asbestos, PCB, lead, petroleum-based products, or other hazardous materials of any kind; or
 3. Protection of environmentally sensitive areas such as wetlands.
 - C. Disposal. Contractor has the sole responsibility for determining current waste storage, handling, and transportation and disposal regulations for the Site and for each waste disposal facility. Contractor shall comply fully at Contractor's sole cost and expense with these regulations and any applicable Law. Owner may, but is not obligated to, require submittals with this information for it to review consistent with Contract Documents.
 - D. Tracking. Contractor shall develop and implement a system acceptable to Owner to track hazardous waste from the Site to disposal, including appropriate "Hazardous Waste Manifests" on the applicable EPA form, so that Owner may track the volume of waste Contractor puts in each landfill and receive from each landfill a certificate of receipt.
 - E. Facilities. Contractor shall provide Owner with the name and address of each waste disposal facility prior to any disposal, and Owner shall have the express right to reject any proposed disposal facility. Contractor may not use any disposal facility to which Owner has objected. Contractor shall document actual disposal or destruction of waste at a designated facility by completing a disposal certificate or

certificate of destruction and forwarding the original to the Contractor (with a copy to Owner).

4. Add new paragraphs to the end of 14.2, Permits and Approvals, that read:
 - B. Before performing any of the Work, and at such other times as may be required by applicable Law, deliver all requisite notices and obtain the approval of all governmental and quasi-governmental authorities having jurisdiction over the Work. Submit evidence satisfactory to Owner that Contractor and any disposal facility (a) have obtained all required permits, approvals and the like in a timely manner both prior to commencement of the Work and thereafter as and when required by applicable Law, and (b) are in compliance with all such permits, approvals and the like. For example, before commencing any work in connection with the Work involving Asbestos-containing materials or PCB subject to regulation, Contractor shall provide the required notice of intent to renovate or demolish to the appropriate state or federal agency having jurisdiction, by certified mail, return receipt required, or by some other method of transmittal for which a return receipt is obtained, and to send a copy of that notice to Owner. Contractor shall not conduct any Work involving Asbestos-containing materials or PCB unless Contractor has first confirmed that the appropriate agency having jurisdiction is in receipt of the required notification. All permits, licenses, and bonds required by governmental or quasi-governmental authorities, fees, deposits, tap fees, Off Site easements, and Asbestos and PCB disposal facilities necessary for the prosecution of the Work shall be procured and paid for by Contractor. Contractor shall give all notices and comply with the Law bearing on the conduct of the Work as drawn and specified. If Contractor observes or reasonably should have observed that Drawings and Specifications and other Contract Documents are at variance therewith, it shall be responsible for promptly notifying Owner in writing of such fact. If Contractor performs any Work contrary to Law without such notice to Owner, Contractor shall bear all costs arising therefrom.
 - C. In the case of any permits or notices held in Owner's name or of necessity to be made in Owner's name, Owner will cooperate with Contractor in securing the permit or giving the notice, but Contractor shall prepare for Owner's review and execution upon approval, all necessary applications, notices, and other materials.
5. Add a new paragraph at the end of paragraph 14.5, Termination of Contract for Cause, that reads:
 - D. Notwithstanding anything in paragraph 14.5 to the contrary, Owner shall have an absolute right to terminate for default immediately without notice and without an opportunity to cure should Contractor knowingly or recklessly commit a material breach of the terms of the Contract Documents or the Law on any matter involving the exposure of persons or property to hazardous waste. If the breach exposing persons or property to hazardous waste is due solely to an ordinary, unintentional and non-reckless failure to exercise reasonable care, then the procedures in paragraph 13.7 for termination for default shall apply without modification.
- F. Supplement to Article 15, Working Conditions and Prevailing Wages:
 1. Add a new paragraph to the end of 15.2, Protection of Work, Persons, and Property, that reads:
 - G. Contractor shall perform safe, expeditious, and orderly work in accordance with the best practices and the highest standards in the hazardous waste abatement, removal, and disposal industry, the Law (as herein defined), and the Contract Documents

including, but not limited to, all responsibilities relating to the preparation and return of waste shipment records, all requirements of the Law, delivering of all requisite notices, and obtaining all necessary governmental and quasi-governmental approvals.

G. Supplement to Article 17, Responsibility of Contractor and Indemnification:

1. Add a new paragraph to the end of Article 17 that reads:

17.7 To the greatest extent permitted by Law, the indemnities and limitation of liability expressed throughout the Contract Documents apply with equal force and effect to any claims or liabilities imposed or existing by virtue of the removal, abatement, and disposal of hazardous waste. This includes liabilities connected to the selection and use of a waste disposal facility, personal injury, property damage, loss of use of property, damage to the environment or natural resources, or “disposal” and “release” of materials associated with the Work (as defined in 42 U.S.C. Section 9601 *et seq*).

END OF SECTION

SECTION 00810

WORK UNDER OTHER CONTRACTS

1.1 SUMMARY

- A. This Section 00810 includes requirements that supplement the paragraphs of Section 01100 (SUMMARY) as they apply to coordination of the Contractor and coordination with other work.

1.2 SUPPLEMENTS

- A. Supplement to Article 1.7, Coordination of Contractor and Coordination with Other Work:

- 1. WORK UNDER OTHER CONTRACTS

- a. Installation of New Sewer Main

- 1) The replacement of the existing sewer line from the cleanout on the exterior of the building, in the public sidewalk to a new two-way cleanout located approximately 50 +/- linear feet inside the building will be performed under a separate contract and performed by Owner Utility Contractor. This work is more specifically described on drawings C-002.
 - 2) The work to be performed by the Owner Utility Contractor includes trenching, removal, replacement and disposal of existing sewer lines as described herein. The associated excavation will be backfilled and compacted and with temporary asphalt patches (asphalt patches at building exterior only) by the Owner Utility Contractor.
 - 3) Work under this Contract includes removal of temporary patches and installation of new concrete after Owner Utility Contractor Work is Complete.

- b. Installation of New Fire Sprinkler System

- 1) The installation of a new fire suppression system will be performed under a separate contract and performed by Owner Fire Suppression Contractor. Prior to Contractor interior demolition, the Owner Fire Suppression Contractor will provide a riser, to be stubbed, within the building from the water supply, from the sidewalk, north of the building. Proceeding demolition, the Owner Fire Suppression Contractor requires 14 (fourteen) calendar days for installation of the fire sprinkler piping within the building. Contractor to allow 7 (seven) calendar days after installation of ceilings for Owner Fire Suppression Contractor to adjust sprinkler piping elevations and install sprinkler heads and associated trim.

- B. WORK SEQUENCE

- 1. The Contractor shall construct the Work in stages and at times to accommodate Work under Other Contracts during the construction period and shall coordinate with and include the schedules of Work Under Other Contracts into the Contractor's Schedules.

- C. COOPERATION OF CONTRACTOR AND COORDINATION WITH OTHER WORK.

- 1. Should construction work, or work of any other nature, be underway by other forces or by other contractors within or adjacent to the limits of the Work at the time of executing

- the Contract, or should work be performed under the contracts listed in paragraph A above, the Contractor shall cooperate with all such other contractors or forces to the end that any delay or hindrance to their work will be avoided. The cost of such cooperation will be considered as included in the contract price and no additional payment will be made therefor. Contractor shall coordinate with such other contractors and forces as required by Document 00700 (General Conditions).
2. Owner reserves the right to perform other or additional work, within or adjacent to the limits of the Work specified, at any time by the use of other forces. Contractor shall coordinate with Owner and any of Owner's forces, or other forces engaged by Owner, as required by Document 00700 (General Conditions).
 3. Contractor shall limit use of the Site for the Work and for construction operations to allow for:
 - a. Owner's operations
 - b. Work by other contractors and tenants
 4. Contractor shall coordinate use of and access to the Site with other contractors, utilities, and Owner's forces, as required by Document 00700 (General Conditions). Owner has final authority over coordination, use of premises, and access to the Site.
 5. Contractor shall cooperate with Owner and others who may occupy or begin work on Site and inside building prior to completion of Work of this Contract.
 6. Contractor shall cooperate with contractors for other work, not included in Contract, but which may take place during construction period.

END OF SECTION

SECTION 00815

SUPPLEMENTARY CONDITIONS - APPRENTICESHIP PROGRAM

ARTICLE 1 - COMPLIANCE REQUIRED

- 1.1 CONTRACTOR AND SUBCONTRACTORS SHALL COMPLY WITH THE REQUIREMENTS OF CALIFORNIA LABOR CODE SECTIONS 1776, 1777.5, AND 1777.6 CONCERNING THE EMPLOYMENT OF APPRENTICES BY CONTRACTOR OR SUBCONTRACTORS. WILLFUL FAILURE TO COMPLY MAY RESULT IN PENALTIES, INCLUDING LOSS OF THE RIGHT TO BID ON OR RECEIVE PUBLIC WORKS CONTRACTS.**

ARTICLE 2 - CERTIFICATION OF APPROVAL

- 2.1 CALIFORNIA LABOR CODE SECTION 1777.5, AS AMENDED, REQUIRES A CONTRACTOR OR SUBCONTRACTOR EMPLOYING TRADESPERSONS IN ANY APPRENTICEABLE OCCUPATION TO APPLY TO THE JOINT APPRENTICESHIP COMMITTEE NEAREST THE SITE OF A PUBLIC WORKS PROJECT AND WHICH ADMINISTERS THE APPRENTICESHIP PROGRAM IN THAT TRADE FOR A CERTIFICATION OF APPROVAL. THE CERTIFICATE SHALL ALSO FIX THE RATIO OF APPRENTICES TO JOURNEYPERSONS THAT WILL BE USED IN PERFORMANCE OF THE CONTRACT. THE RATIO OF WORK PERFORMED BY APPRENTICES TO JOURNEYPERSONS IN SUCH CASES SHALL NOT BE LESS THAN ONE *HOUR* OF APPRENTICES WORK FOR EVERY FIVE *HOURS* OF LABOR PERFORMED BY JOURNEYPERSONS (THE MINIMUM RATIO FOR THE LAND SURVEYOR CLASSIFICATION SHALL NOT BE LESS THAN ONE APPRENTICE FOR EACH FIVE JOURNEYPERSONS), EXCEPT:**
- A. When unemployment for the previous three month period in the area exceeds an average of 15 percent;**
 - B. When the number of apprentices in training in the area exceeds a ratio of one to five;**
 - C. When a trade can show that it is replacing at least 1/30 of its membership through apprenticeship training on an annual basis state-wide or locally; or**
 - D. Assignment of an apprentice to any work performed under a public works contract would create a condition which would jeopardize his or her life or the life, safety, or property of fellow employees or the public at large or if the specific task to which the apprentice is to be assigned is of such a nature that training cannot be provided by a journeyman.**

ARTICLE 3 - FUND CONTRIBUTIONS

- 3.1 CONTRACTOR IS REQUIRED TO MAKE CONTRIBUTIONS TO FUNDS ESTABLISHED FOR ADMINISTRATION OF APPRENTICESHIP PROGRAMS IF CONTRACTOR EMPLOYS REGISTERED APPRENTICES OR JOURNEYPERSONS IN ANY APPRENTICEABLE TRADE ON SUCH CONTRACTS AND IF OTHER**

CONTRACTORS ON THE PUBLIC WORKS SITE ARE MAKING SUCH CONTRIBUTIONS.

ARTICLE 2 - APPRENTICESHIP STANDARDS

- 4.1 INFORMATION RELATIVE TO APPRENTICESHIP STANDARDS, WAGE SCHEDULES, AND OTHER REQUIREMENTS MAY BE OBTAINED FROM THE DIRECTOR OF THE CALIFORNIA DEPARTMENT OF INDUSTRIAL RELATIONS, OR FROM THE DIVISION OF APPRENTICESHIP STANDARDS AND ITS BRANCH OFFICES.**

END OF SECTION

SECTION 00910

ADDENDA

**SONOMA CLEAN POWER AUTHORITY
ADVANCED ENERGY CENTER**

[DOCUMENT TO BE COMPLETED AS ADDENDA DURING BID PERIOD]

END OF SECTION

SECTION 01100

SUMMARY

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes Summary of Work and Work Restrictions including:
 - 1. Work Covered by Contract Documents
 - 2. Work Sequence
 - 3. Work Days and Hours
 - 4. Shutdown for Discovery of Cultural Resources
 - 5. Cooperation of Contractor and Coordination with Other Work
 - 6. Partial Occupancy/Utilization Requirements
 - 7. Contractor Use of Site
 - 8. Air Quality Standards
 - 9. Protection of Existing Structures and Underground Facilities
 - 10. Permits
 - 11. Actual Damages
 - 12. Right-Of-Way
 - 13. Document Tracking

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. Work comprises the construction of Owner's Sonoma Clean Power Advanced Energy Center located at 741 Fourth Street, Santa Rosa, Ca. The Work includes, without limitation, The Work consists of construction of tenant improvements located at 741 4th Street in the City of Santa Rosa The Work includes, but is not limited to, demolition of existing tenant improvements on the first and second floor of approximately 12, 286 sf, and the construction of tenant improvements of approximately 9,492 SF including mechanical, electrical, and fire sprinklers throughout. Contract Documents fully describe the Work.
- B. The Work of this Contract comprises construction of all the Work indicated, described in the Specifications, or otherwise required by the Contract Documents. Unless provided otherwise in the Contract Documents, all risk of loss to Work covered by Contract Documents shall rest with Contractor until Final Acceptance of the Work. Cost of maintenance of systems and equipment prior to Final Acceptance will be considered as included in prices Bid and no direct or additional payment will be made therefore.
- C. For all Bid items, furnish and install all Work, including connections to existing systems, indicated and described in Specifications and all other Contract Documents. Work and requirements applicable to each individual Bid item, or unit of Work, shall be deemed incorporated into the description of each Bid item (whether Lump Sum or Unit Price). Any Bid item may be deleted from the Work and Contract Sum, in total or in part, prior to or after award of Contract without compensation in any form or adjustment of other Bid items or prices therefore.

1.3 WORK SEQUENCE

- A. Construct Work in stages and at times to accommodate Owner operation requirements during the construction period; coordinate construction schedule and operations with Owner.

1.4 WORK DAYS AND HOURS

- A. Work Days and hours: Monday-Friday inclusive, 7:00 a.m.-5:00 p.m. local time, except Days that have been designated as holidays by Owner as listed in Paragraph 1.4A.11 of Section 01420 (References and Definitions). Work at the Site after 5:00 p.m. or on weekends or holidays is not permitted, unless Contractor requests otherwise from Owner in writing at least 48 hours in advance and Owner approves in its sole discretion.

1.5 SHUTDOWN FOR DISCOVERY OF CULTURAL RESOURCES

- A. If discovery is made of items of historical archaeological or paleontological interest, immediately cease all Work in the area of discovery. Archaeological indicators may include, but are not limited to, dwelling sites, locally darkened soils, stone implements or other artifacts, fragments of glass or ceramics, animal bones, human bones, and fossils. After cessation of excavation, immediately contact Owner. Do not resume Work until authorization is received from Owner. When resumed, excavation or other activities shall be as directed by Owner.

1.6 COOPERATION OF CONTRACTOR AND COORDINATION WITH OTHER WORK

- A. Coordinate with Owner and any Owner forces, or other contractors and forces, as required by Section 00700 (General Conditions).

1.7 PARTIAL OCCUPANCY/UTILIZATION REQUIREMENTS

- A. Allow Owner to take possession of and use any completed or partially completed portion of the Work during the progress of the Work as soon as is possible without interference to the Work.
- B. Possession, use of Work, and placement and installation of equipment by Owner shall not in any way evidence the completion of the Work or any part of it.
- C. Contractor shall not be held responsible for damage to the occupied part of the Work resulting from Owner occupancy.
- D. Make available, in areas occupied, on a 24 hour per Day and 7 Day per week basis if required, any utility services, heating, and cooling in condition to be put in operation at the time of occupancy.
 - 1. Responsibility for operation and maintenance of said equipment shall remain with Contractor.
 - 2. Make, and Owner shall certify, an itemized list of each piece of equipment so operated with the date operation commences.
 - 3. Itemized list noted above shall be basis for commencement of warranty period for equipment.
 - 4. Owner shall pay for utility cost arising out of occupancy by Owner during construction.
- E. Use and occupancy by Owner prior to acceptance of Work does not relieve Contractor of its responsibility to maintain insurance and bonds required under the Contract until entire Work is completed and accepted by Owner.

- F. Prior to date of Final Acceptance of the Work by Owner, all necessary repairs or renewals in Work or part thereof so used, not due to ordinary wear and tear, but due to Defective materials or workmanship or to operations of Contractor, shall be made at expense of Contractor, as required in Section 00700 (General Conditions).
- G. Use by Owner of Work or part thereof as contemplated by this Section 01100 shall in no case be construed as constituting acceptance of Work or any part thereof. Such use shall neither relieve Contractor of any responsibilities under Contract, nor act as waiver by Owner of any of the conditions thereof.
- H. Owner may specify in the Contract Documents that portions of the Work, including electrical and mechanical systems or separate structures, shall be substantially completed on dates described in this Section 01100, if any, prior to Substantial Completion of all of the Work. Notify Owner in writing when Contractor considers any such part of the Work ready for its intended use and Substantially Complete and request Owner to issue a Certificate of Substantial Completion for that part of the Work.

1.8 CONTRACTOR USE OF SITE

- A. Ensure that the entrance is locked at the end of each Work Day and at other times as may be necessary to control unauthorized entry.
- B. [Contractor shall contact Owner at least two Business Days prior to entering the building and performing Work to allow Owner to arrange access into the building. Access Request forms shall be submitted 48 hours in advance of anticipated on-site Work to gain permission to enter Site and to allow notification to occupants. Confine operations at Site to areas permitted by Contract Documents, permits, ordinances, and laws. Do not unreasonably encumber Site with materials or equipment.
- C. Assume full responsibility for protection and safekeeping of products stored on premises. Move any stored products that interfere with operations of Owner or other contractor.
- D. Coordinate parking, storage, staging, and Work areas with Owner. Do not store construction materials in the dripline of any tree.
- E. Prior to commencement of Work or excavation, Contractor and Owner shall jointly survey the area adjacent to the Project area making permanent note and record of such existing damage such as cracks, sags, or other similar damage. This record shall serve as a basis for determination of subsequent damage to structures, conditions, or other existing improvements due to Contractor's operations. All parties making the survey shall sign the official record of existing damage. Cracks, sags, or damage of any nature to the adjacent Project area, not noted in the original survey but subsequently noted, shall be reported immediately to Owner.
- F. It is essential that the Contractor perform the Work with as little interference and disturbance as possible to the surrounding neighborhood.
- G. When suspect materials, outside the scope of Work, are encountered during the Work or restoration process, the Contractor shall immediately contact Owner for evaluation and approval of the methods for dealing with the material.

1.9 AIR QUALITY STANDARDS

- A. Ensure that idling time for heavy equipment is minimized to reduce on-Site emissions.

- B. Maintain equipment in good mechanical condition.
- C. Cover trucks hauling dirt.
- D. Limit dust emissions during periods of high winds (greater than 15 miles per hour).
- E. Replace ground cover in disturbed areas as soon as possible.
- F. Enclose, cover, water, or apply soil binders to exposed stockpiles.
- G. Remove earth tracked onto neighboring paved roads at least once daily.
- H. Limit equipment speed to 10 miles per hour in unpaved areas.
- I. Provide land surveying and mapping services necessary for construction staking, layout, or any other activities necessary to establish and document the correct and accurate locations, alignments, elevations, grades, or quantities of Work.
- J. Ensure that land-survey related activities are in accordance with applicable laws and regulations including Sections 8726 (a) and (b) and 6731.1 (a) and (b), Business and Professions Code of the State of California.
- K. Minimum experience requirements of surveyor in responsible charge of construction staking include possession of a California Land Surveyor's license or pre-1982 California Professional Engineer's (Civil) license, completion of three projects of similar nature and complexity, and three years of experience on projects of similar nature and complexity.
- L. Owner reserves the right, at its sole discretion, to check construction staking, layout or other survey and/or mapping activities for consistency with the construction documents, accuracy, and verification of pay quantities.
- M. Ensure that survey notes, computations, and drawings used or produced to determine lines, grades, construction staking, layout, or other survey or mapping activities, be kept neat, orderly, and complete. Provide Owner copies (hard copy, and digital when possible) of such survey notes, computations, and drawings within one Business Day of request by Owner. Also, provide one complete Project set as a submittal prior to Final Completion.
- N. Protect and preserve property or right-of-way monument(s), survey control point(s), or bench mark(s). At no additional cost to Owner, replace or restore damaged or destroyed property or right-of-way monument(s), survey control point(s), or bench mark(s), including preparation and filing of a Corner Record or Record of Survey when required under Section 8771(b) of the Business and Professions Code of the State of California.
- O. Whenever Contractor knows, or reasonably should know, that any Work or activity required under the Contract Documents may, or is likely to damage, destroy, or cause any property or right-of-way monument(s), survey control point(s), or bench mark(s) to become unusable, reference property or right-of-way monument(s), survey control point(s), or bench mark(s) by survey, swing ties, or other appropriate means prior to their disturbance or destruction and notify Owner a minimum of two Business Days in advance of such Work or activity. Replace or restore, as appropriate, property or right-of-way monument(s), survey control point(s), or bench mark(s) disturbed, destroyed, or otherwise made unusable by Contractor's activities.

1.10 PROTECTION OF EXISTING STRUCTURES AND UNDERGROUND FACILITIES

- A. The Drawings may indicate existing above- and below-grade structures, drainage lines, storm drains, sewers, water lines, gas lines, electrical lines, hot water lines, and other similar items and Underground Facilities that are known to Owner. At least two Business Days, or

as otherwise noted, prior to commencement of excavation, notify the owners of the following Underground Facilities:

- B. Where overhead service to a structure, known to receive service, does not exist, then underground service shall be assumed to exist.
- C. Attention is also directed to the existence of overhead power and telephone lines.
- D. Perform pot-holing by hand within 24 inches (in any direction) of the Underground Facilities. This may be done on an area-by-area basis, but shall be accomplished at least seven Days in advance of the date of construction within such area.
- E. In addition to reporting if a utility is damaged, Contractor must take appropriate action as provided in Section 00700 (General Conditions).
- F. Additional compensation or extension of time on account of utilities not indicated or otherwise brought to Contractor's attention including reasonable action taken to protect or repair damage shall be determined as provided in Section 00700 (General Conditions).

1.11 PERMITS

- A. Permits, agreements, or written authorizations that are known by Owner to apply to this Project, and that have been or will be obtained by Owner, are listed below:
 - 1. *Bay Area Air Quality Management District*. A copy of Owner's standard requirements is included at the end of this Section 01100. Contractor will be required to obtain a separate permit.
 - 2. *City of Santa Rosa Encroachment Permit*. A copy of Owner's permit is included at the end of this Section 01100. Contractor may be required to obtain a separate permit.
 - 3. *City of Santa Rosa Building Permit*. A copy of Owner's permit is included at the end of this Section 01100.
- B. Permits, agreements, or written authorizations that are known by Owner to apply to this Project, and that shall be obtained by Contractor (and the cost of the permit will be paid by Owner to permitting agency) are listed below:
 - 1. *San Francisco Bay Regional Water Quality Control Board (SFBRWQCB), Resolution No. R1-2002-0080, Policy for Waiving Waste Discharge Requirements for Specific Types of Waste Discharge*. Obtain a waiver or permission from the SFBRWQCB in compliance with Resolution No. R1-2002-0080. A copy of Resolution No. R1-2002-0080 is available for review at Owner's Office or at:
www.waterboards.ca.gov/northcoast/index.html
 - 2. *Bay Area Air Quality Management District. City of Santa Rosa Encroachment Permit*.
 - 3. Other permits as may be discovered necessary, at Owner's discretion.
- C. All other permits that may be required, but that are not listed immediately above shall be obtained by Contractor at Contractor's sole cost and expense, and include, but are not limited to:
 - 1. *Cal/OSHA Permit*. Obtain, as applicable, permit(s) as required by Cal/OSHA for the following:
 - a. Construction of trenches or excavations that are five feet or more in depth and into which a person is required to descend.
 - b. Construction or demolition of any building, structure, or scaffolding for falsework more than three stories high, or the equivalent height (36 feet).
 - c. Erection or dismantling of vertical shoring systems more than three stories high, or the equivalent height (36 feet).

The local Cal/OSHA district office is located at:

1221 Farmers Lane, Suite 300
Santa Rosa, CA 95405
Phone: (707) 576-2388

- D. Furnish copies of Contractor-obtained permits to Owner.

1.12 ACTUAL DAMAGES

- A. In addition to damages which are impracticable or extremely difficult to determine, for which liquidated damages will be assessed as described in Section 00520 (Agreement) and Section 00700 (General Conditions), Owner may incur other actual damages, including fines imposed by any regulatory agency, resulting from loss of use of Owner facilities, or use in violation of legal or regulatory requirements where the violations result from or arise out of Contractor's activities or omissions. Violations or threatened violations may subject Owner to fines of \$25,000 or more per Day or occurrence and/or other costs or civil liabilities.
- B. Contractor shall be liable for and shall pay Owner the amount of any actual damages in addition to liquidated damages or other remedies provided by the Contract Documents.
- C. The amount of liquidated damages provided in Section 00520 (Agreement) and Section 00700 (General Conditions) is not intended to include, nor does the amount include, any damages incurred by Owner for reasons other than those listed in that paragraph. Any money due or to become due to Contractor may be retained by Owner to cover both the liquidated and the actual damages described above and, should such money not be sufficient to cover such damages, Owner shall have the right to recover the balance from Contractor or its sureties.

1.13 RIGHT-OF-WAY

- A. Contractor's entry into and use of Owner's right-of-way shall be coordinated with and approved by Owner in advance of Contractor's entry into or use of Owner's right-of-way. Contractor shall provide not less than two Business Days advanced notice of Contractor's temporary entry or continued use of Owner's right-of-way.
- B. Contractor shall contain their activities within the boundaries of the Owner's right-of-way. Owner shall be the primary point of contact for any necessary interactions required between Contractor and property owners affected by the Work unless specifically agreed to in advance by Owner.
- C. Contractor shall immediately notify Owner of any dispute with or issue raised by affected property owners, or others, in regard to Contractor's use of or activities within Owners' right-of-way. Should any issue arise regarding Contractor's activities within or use of Owner's right-of-way, Owner reserves the exclusive authority to determine or agree to any resolution of such matters.

1.14 DOCUMENT TRACKING

- A. Owner will utilize a computerized construction management system (a cloud-based enterprise content management system) to monitor the generation, status, and filing of documents. Documents such as, but not limited to, Contracts, Cost Proposals, Change Orders (proposed and approved), Meeting Minutes, Schedules and Reports, Payment Applications, certificates of insurance, Safety Reports, Requests for Information, Requests for Substitutions, correspondence, communications, notices, Submittals, transmittals, and

logs shall be submitted electronically by Contractor using the computerized construction management system, unless otherwise required by the Contract Documents. Owner will use the system to track and manage all documents on the Project after Notice to Proceed, to the greatest extent possible.

- B. If file size prohibits electronic transmittal, submit to Owner on compact disk (CD) or other electronic media format as accepted by Owner.
- C. Provide electronic format documents in searchable portable document format (PDF), unless otherwise required by the Contract Documents or directed in writing by Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01200

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Description of requirements and procedures for determining amount of Work performed and for obtaining payment for Work performed.

1.2 REFERENCES

- A. California Public Contract Code
- B. Code of Civil Procedure
- C. Government Code

1.3 COMPOSITION AND SCOPE OF CONTRACT SUM

A. Scope of Contract Sum:

1. The Contract Sum for performance of the Work under Contract Documents, or under any Bid item, allowance, or Alternate, shall include full compensation for all Work required under the Contract Documents, including without limitation, all labor, materials, taxes, transport, handling, storage, supervision, administration, and all other items necessary for the satisfactory completion of the Work, whether or not expressly specified or indicated, incidental work and unexpected expenses, and all terms, conditions, requirements, and limitations set forth in the Contract Documents.
2. Contract Sum may be expressed as lump sum, unit price, GMP, allowance, or combination thereof.

B. Unit price items (if applicable):

1. Quantity of Work to be paid for under any item for which a unit price is fixed in Contract Documents shall be determined by Owner based on, so far as practicable, actual number of units satisfactorily completed, as determined by Owner and certified by Contractor, within prescribed or ordered limits, and no payment will be made for Work unsatisfactorily performed or done outside of limits.
2. Estimated Quantities: The quantities shown in the Bid Schedule are estimated and the actual quantities required to perform the Work may be greater or less than the estimated amount. The Contract price will be adjusted to reflect the actual quantities required for the Work based on the itemized or unit prices provided in the Bid Schedule, with no allowance for anticipated profit for quantities that are deleted or decreased, and no increase in the unit price, regardless of the percentage of increase or decrease from the estimated to the actual quantities.

C. Lump Sum Items:

1. When estimated quantity for specific portion of Work is not indicated or Work is designated as lump sum, payment will be on a lump sum basis for Work satisfactorily completed in accordance with Contract Documents.
2. Payment for lump sum Work, or items of Work subject to a lump sum (e.g. without limitation, change order work), shall be made on the basis of satisfactory completion of such Work or work item, earned in progressive stages in accordance with the Contract Documents, up to but not exceeding the Contractor's percentage completion of the Work or item.
3. Lump sum items shall be paid based upon the approved Schedule of Values, which shall be used to measure progressive payments based upon satisfactory progress towards completion of the item.

D. Allowance Items:

1. Allowances: Allowance Work will be authorized by Owner in writing, following change order procedures to determine cost, supporting documentation and authorization to proceed. Unused allowance amounts at Contract completion shall reduce the Contract price accordingly.

1.4 PAYMENT PROCEDURES

A. Schedule of Values:

1. Within 21 Days from issuance of Notice to Proceed and prior to the Contractor's first Application for Payment, Contractor shall submit a detailed breakdown of its Bid by scheduled Work items and/or activities, including coordination responsibilities and Project Record Documents responsibilities. Where more than one Subcontractor comprises the work of a Work item or activity, the Schedule of Values shall show a separate line item for each subcontract. Contractor shall furnish such breakdown of the total Contract Sum by assigning dollar values (cost estimates) to each applicable Progress Schedule network activity, which cumulative sum equals the total Contract Sum. This breakdown shall be referred to as the Schedule of Values.
2. Contractor's overhead, profit, insurance, cost of bonds (except to the extent expressly identified in a Bid item) and/or other financing, as well as "general conditions costs," (e.g., Site cleanup and maintenance, temporary roads and access, off-Site access roads, temporary power and lighting, security, and the like), shall be prorated through all activities so that the sum of all the Schedule of Values line items equals Contractor's total Contract Sum, less any allowances designated by Owner. Scheduling, record documents, and quality assurance control shall be separate line items.
3. Owner will review the breakdown in conjunction with the Progress Schedule to ensure that the dollar amounts of this Schedule of Values are, in fact, reasonable cost allocations for the Work items listed. Upon favorable review by Owner, Owner will accept this Schedule of Values for use. Owner shall be the sole judge of fair market cost allocations.
4. Owner will reject any attempt to increase the cost of early activities, i.e. "front loading," resulting in a complete reallocation of monies until such "front loading" is corrected. Repeated attempts at "front loading" may result in suspension or termination of the Work for default, or refusal to process progress payments until such time as the Schedule of Values is acceptable to Owner.

B. Contractor's Requests for Progress Payments:

1. If requested by Contractor, progress payments will be made monthly, under the following conditions:
2. On a mutually agreed upon Day of each month, Contractor shall submit to Owner one electronic copy of an Application for Payment for the cost of the Work put in place during the period from the last Day of the previous month to the end of the current month, along with one electronic copy and one hard copy of an updated Progress Schedule. Such Applications for Payment shall be for the expected total value of activities completed or partially completed, based upon Schedule of Values prices (or Bid item prices if unit price) of all labor and materials incorporated in the Work up until midnight of the last Day of that one month period, less the aggregate of previous payments. Accumulated retainage shall be shown as separate item in payment summary. Owner and Contractor will reconcile any differences in the field, based on the reconciled monthly report sheets. If Contractor is late submitting its Application for Payment, that Application may be processed at any time during the succeeding one-month period, resulting in processing of Contractor's Application for Payment being delayed for more than a Day for Day basis.
3. Except as otherwise provided in a labor compliance program applicable to the Work (if any) or as otherwise required by Owner, concurrently with each Application for Payment, Contractor shall submit to the Owner the Contractor's and its Subcontractors' certified payroll records required to be maintained pursuant to Labor Code Section 1776 for all labor performed during pay periods ending during the period covered by the Application for Payment.
4. No progress payment will be processed prior to Owner receiving all requested, acceptable schedule update information and certified payrolls, and in Owner's sole and absolute discretion, Owner may deny the entire Application for Payment for noncompliance.
5. Each Application for Payment shall list each Change Order and Field Directive executed prior to date of submission, including the Change Order/Field Directive Number, and a description of the Work activities, consistent with the descriptions of original Work activities.
6. If Owner requires substantiating data, Contractor shall submit information requested by Owner, with cover letter identifying Project, Application for Payment number and date, and detailed list of enclosures. Contractor shall submit one copy of substantiating data and cover letter for each copy of Application for Payment submitted.
7. If Contractor fails or refuses to participate in monthly Work reconciliations or other construction progress evaluation with Owner, Contractor shall not receive current payment until Contractor has participated fully in providing construction progress information and schedule update information to Owner.

C. Owner's Review of Progress Payment Applications:

1. Owner will review Contractor's Application for Payment following receipt and during the Progress Schedule and Billing Meeting. If adjustments need to be made to percent of completion of each activity, Owner will make appropriate notations and return to Contractor. Contractor shall revise and resubmit. All parties shall update percentage of completion values in the same manner, i.e., express value of an accumulated percentage of completion to date.
2. If Owner determines that portions of the Application for Payment are not proper or not due under the Contract Documents, then Owner may approve the other portions of the

Application for Payment, and in the case of disputed items or Defective Work not remedied, may withhold up to 150 percent of the disputed amount from the progress payment.

3. Contractor shall submit two copies of AIA G702 and G703 payment applications with notarized wet signatures to Owner.
 4. Pursuant to California Public Contract Code Section 20104.50, if Owner fails to make any progress payment within 30 Days after receipt of an undisputed and properly submitted Application for Payment from Contractor, Owner shall pay interest to the Contractor equivalent to the legal rates set forth in California Code of Civil Procedure Section 685.010(a). The 30-Day period shall be reduced by the number of Days by which Owner exceeds the seven-Day return requirement set forth herein.
 5. As soon as practicable after approval of each Application for Payment for progress payments, Owner will pay to Contractor in a manner provided by law, an amount equal to 95 percent of the amounts otherwise due as provided in the Contract Documents, or a lesser amount if so provided in Contract Documents or Bidding Documents, provided that payments may at any time be withheld if, in judgment of Owner, Work is not proceeding in accordance with Contract, or Contractor is not complying with requirements of Contract, or to comply with stop notices or to offset liquidated damages accruing or expected. In Owner's sole discretion, if Contractor has failed to comply with either its Progress Schedule update or Project Record Documents requirements, Owner may retain an additional 5 percent of any earned amounts until such requirements are satisfied.
 6. Before any progress payment or final payment is due or made, Contractor shall submit satisfactory evidence that Contractor is not delinquent in payments to employees, Subcontractors, suppliers, or creditors for labor and materials incorporated into Work. This specifically includes, without limitation, conditional lien release forms for the current progress payment and unconditional release forms for past progress payments. This also includes copies of certified payroll from contractor and subcontractors for the current payment period.
- D. Payment for Material and Equipment Not Yet Incorporated Into the Work:
1. No payment shall be made for materials or equipment not yet incorporated into the Work, except as specified in Section 01100 (Summary) or elsewhere in the Contract Documents or as may be agreed to by Owner in its sole discretion. Where Contractor requests payment on the basis of materials and equipment not incorporated in the Work, Contractor must satisfy the following conditions:
 - a. The materials and/or equipment shall be delivered and suitably stored at the Site or at another local location agreed to in writing, for example, a mutually acceptable bonded and insured warehouse.
 - b. Full title to the materials and/or equipment shall vest in Owner at the time of delivery to the Site, warehouse, or other storage location. Obtain a negotiable warehouse receipt, endorsed over to Owner for materials and/or equipment stored in an off-site warehouse. No payment will be made until such endorsed receipts are delivered to Owner.
 - c. Stockpiled materials and/or equipment shall be available for Owner inspection, but Owner shall have no obligation to inspect them and its inspection or failure to inspect shall not relieve Contractor of any obligations under the Contract Documents. Materials and/or equipment shall be segregated and labeled or tagged to identify these specific Contract Documents.

- d. After delivery of materials and/or equipment, if any inherent or acquired defects are discovered, defective materials and/or equipment shall be removed and replaced with suitable materials and/or equipment at Contractor's expense.
- e. Contractor's Application for Payment shall be accompanied by a bill of sale, invoice or other documentation warranting that Owner has received the materials and equipment free and clear of all liens and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect Owner interest therein, all of which must be satisfactory to Owner. This documentation shall include, but not be limited to, conditional releases of mechanics' liens and stop notices from all those providing materials and equipment as to which the Application for Payment relates, as well as unconditional releases of the same from the same as to the previous Application for Payment for which they have not already been provided. Amounts previously paid for materials and equipment prior to incorporation into the Work shall be deducted from amounts otherwise due Contractor as they are incorporated.

1.5 ADJUSTMENT OF PAYMENT APPLICATION. Owner may adjust or reject the amount requested in a payment application, including application for final payment, in whole or in part, if the amount requested is disputed or unsubstantiated. Contractor will be notified in writing of the basis for the modification to the amount requested. Owner may also deduct or withhold from payment otherwise due based upon any of the circumstances and amounts listed below. Sums withheld from payment otherwise due will be released when the basis for that withholding has been remedied and no longer exists

- A. For Contractor's unexcused failure to perform the Work as required by the Contract Documents, including correction or completion of punch list items, Owner may withhold or deduct an amount based on the Owner's estimated cost to correct or complete the Work.
- B. For loss or damage caused by Contractor or its Subcontractors arising out of or relating to performance of the Work or any failure to protect the Project site, Owner may deduct an amount based on the estimated cost to repair or replace.
- C. For Contractor's failure to pay its Subcontractors and suppliers when payment is due, Owner may withhold an amount equal to the total of past due payments.
- D. For Contractor's failure to timely correct rejected, nonconforming, or defective Work, Owner may withhold or deduct an amount based on the Owner's estimated cost to correct or complete the Work.
- E. For any unreleased stop notice, Owner may withhold 125% of the amount claimed.
- F. For Contractor's failure to submit any required schedule or schedule update in the manner and within the time specified in the Contract Documents, Owner may withhold an amount equal to five percent of the total amount requested until Contractor complies with its schedule submittal obligations.
- G. For Contractor's failure to maintain or submit as-built documents in the manner and within the time specified in the Contract Documents, Owner may withhold or deduct an amount based on the Owner's cost to prepare the as-builts.
- H. For Work performed without Shop Drawings that have been accepted by Owner, when accepted Shop Drawings are required before proceeding with the Work, Owner may deduct an amount based on the estimated costs to correct unsatisfactory Work or diminution in value.

- I. For fines, payments, or penalties assessed under the Labor Code, Owner may deduct from payments due to Contractor as required by Laws and as directed by the Division of Labor Standards Enforcement.
- J. For any other costs or charges that may be withheld or deducted from payments to Contractor, as provided in the Contract Documents, including liquidated damages, Owner may withhold or deduct such amounts from payment otherwise due to Contractor.

1.6 FINAL PAYMENT

- A. Final Progress Payment:
 - 1. As soon as practicable after all required Work is completed in accordance with Contract Documents, including punchlist, testing, Project Record Documents and Contractor maintenance after Final Acceptance, Contractor shall submit its Application for Final Payment.
 - 2. Provided Contractor has met all conditions required for Final payment, Owner will pay to Contractor, in manner provided by law, unpaid balance of Contract Sum of Work (including, without limitation, retentions), or whole Contract Sum of Work if no progress payment has been made, determined in accordance with terms of Contract Documents, less sums as may be lawfully retained under any provisions of Contract Documents or by law.
- B. Final Accounting:
 - 1. Prior progress payments and change orders shall be subject to audit and correction in the final payment.
 - 2. Contractor and each assignee under an assignment in effect at time of final payment shall execute and deliver at time of final payment, and as a condition precedent to final payment, Section 00650 (Agreement and Release of Any and All Claims).
- C. Release of retention shall be made as may be required by Public Contract Code Section 7107.

1.7 SUBSTITUTION OF SECURITIES

- A. Public Contract Code Section 22300. In accordance with the provisions of Public Contract Code Section 22300, substitution of securities for any monies withheld under Contract Documents to ensure performance is permitted under following conditions:
 - 1. At request and expense of Contractor, securities listed in Section 16430 of the Government Code, bank or savings and loan certificates of deposit, interest bearing demand deposit accounts, standby letters of credit, or any other security mutually agreed to by Contractor and Owner which are equivalent to the amount withheld under retention provisions of Contract shall be deposited with Controller or with a state or federally chartered bank in California, as the escrow agent, who shall then pay such monies to Contractor. Upon satisfactory completion of Contract, securities shall be returned to Contractor.
 - 2. Alternatively, Contractor may request and Owner shall make payment of retentions earned directly to the escrow agent at the expense of Contractor. At the expense of Contractor, Contractor may direct the investment of the payments into securities and receive the interest earned on the investments upon the same terms provided for securities deposited by Contractor. Upon satisfactory completion of the work of the Contract Documents, Contractor shall receive from escrow agent all securities, interest, and payments received by the escrow agent from Owner. Contractor shall then pay to

each Subcontractor, not later than 20 Days after receipt of the payment, the respective amount of interest earned, net of costs attributed to retention withheld from each Subcontractor, on the amount of retention withheld to insure the performance of Contractor.

3. Contractor shall be beneficial owner of securities substituted for monies withheld and shall receive any interest thereon.
4. Contractor may enter into an escrow agreement, form included in Contract Documents, as authorized under Public Contract Code Section 22300, specifying amount of securities to be deposited, terms and conditions of conversion to cash in case of default of Contractor, and termination of escrow upon completion of Contract Documents.
5. Public Contract Code Section 22300 is hereby incorporated in full by this reference and shall supersede anything inconsistent therewith.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01250

MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes requirements that supplement the paragraphs of Section 00700 (General Conditions).
- B. Description of procedures for modifying the Contract Documents and determining costs for changes in contract amounts.

1.2 PROCEDURES FOR CONTRACTOR INITIATED CHANGES

A. **Contractor-Initiated Request for Information (RFI) Procedures, Requirements, and Limitations:**

1. Contractor may submit RFI's for clarifications in Owner-prepared Contract Documents or to initiate changes to the Work.
2. Whenever Contractor requires information regarding the Project or Owner-prepared Contract Documents, or receives a request for such information from a Subcontractor, or desires to initiate changes to the Work, Contractor may prepare and deliver an RFI to Owner. Contractor shall use Owner's construction management system to submit RFIs. Contractor shall not issue an RFI to Owner solely to clarify Contractor-prepared Construction Documents. Contractor must submit time-critical RFIs at least 30 Days before scheduled start date of the affected Work activity. Contractor shall reference each RFI to an activity on the Progress Schedule and shall note time criticality of the RFI, indicating the time within which a response is required. **Contractor's failure to include reference to an activity on the Progress Schedule and note time criticality on the RFI shall constitute Contractor's waiver of any claim for time delay or interruption to the Work resulting from any delay in responding to the RFI.**
3. Contractor shall be responsible for its costs to implement and administer RFIs throughout the Contract duration. Regardless of the number of RFIs submitted, Contractor shall not be entitled to additional compensation for the effort required to submit the RFIs. Contractor shall be responsible for Owner's administrative costs for answering RFIs where the answer could reasonably be found by reviewing the Contract Documents, as determined by Owner; at Owner discretion, such costs may be deducted from progress payments or final payment.
4. Owner will respond within 14 Days from receipt of an RFI with a written response to Contractor. Contractor shall distribute response to all appropriate Subcontractors.
5. If Contractor is satisfied with the response and does not request a change in Contract Sum or Contract Time, then the response shall be executed without a change.
6. If Contractor believes the Owner's response is incomplete, Contractor shall request clarification from Owner.
7. If Owner's response to an RFI is a request for Contractor to submit a Cost Proposal (CP), Contractor shall prepare and submit to Owner, within 14 Days of Owner's request, a CP using the form attached to this Section 01250. All CPs required by this Section 01250 must contain a complete breakdown of costs of credits, deducts and extras; itemizing

- materials, labor, taxes, Markup, and any requested changes to Contract Time. All Subcontractor Work shall be so indicated. Individual entries on the CP form shall include the applicable Schedule of Values (SOV) code, with all amounts determined as provided herein. After receipt of a CP with a detailed breakdown, Owner will consider the CP and respond as soon as practicable.
8. If Owner accepts the CP, Owner will prepare a Change Order.
 9. If the CP is not acceptable to Owner because Owner does not agree with Contractor's proposed cost and/or time, Owner will provide comments regarding the same. Contractor must then, within seven Days (except as otherwise provided herein), submit a revised CP.
 10. When necessity to proceed with a change does not allow Owner sufficient time to conduct a proper check of a CP (or revised CP), Owner may issue a Field Directive as provided below.

B. Time Requirements:

1. If Contractor believes that an Owner response to an RFI, submittal, or other Owner direction, results in change in the Contract Sum or Contract Time, Contractor shall notify Owner via a follow-up RFI within seven Days after receiving Owner's response or direction, always prior to starting the disputed Work, and no later than the time allowed under Article 12 of Section 00700 (General Conditions). If Contractor also requests a time extension, or has issued a notice of delay or otherwise requests a time extension with a CP, then Contractor shall submit the TIE (as defined in Section 01320 [Progress Schedules and Submittals]) required herein concurrently with the CP and in no event later than 14 Days after providing the notice of delay. If Owner disagrees with Contractor, then Contractor may give notice of a potential claim as provided in Article 12 of Section 00700 (General Conditions) and proceed thereunder.
2. If Owner agrees with Contractor's CP and/or TIE, then Owner will initiate a Change Order. If Owner disagrees with Contractor, then Contractor may give notice of potential claim as provided in Article 12 of Section 00700 (General Conditions) and proceed thereunder.
3. Contractor must submit CPs, TIEs, notices of potential claim, or Claims within the required time periods. Failure to do so is a waiver of Contractor's right to submit a CP, TIE, or file a Claim.

C. Cost Estimate Information:

1. Contractor and Subcontractors shall, upon Owner's request, permit inspection of the original unaltered cost estimates, subcontract agreements, purchase orders relating to the change, and documents substantiating all costs associated with CPs or Claims arising from changes in the Work.

1.3 PROCEDURES FOR OWNER INITIATED CHANGES

A. Owner Initiated Field Directives or Supplemental Instructions:

1. Owner may, by Field Directive or Supplemental Instruction or by following the procedures for disputed work herein, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, with or without adjustment to Contract Sum or Contract Time.
2. If at any time Owner believes in good faith that a timely Change Order will not be agreed upon using the foregoing procedures, or at any other time, Owner may issue a Field Directive or Supplemental Instruction with its recommended cost and/or time

adjustment (if any). Upon receipt of Field Directive or Supplemental Instruction, Contractor shall promptly proceed with the change of Work involved and respond to Owner as required by Subparagraph 1.3A(3), below, within seven Days.

3. Contractor's response must be any one of following:
 - a. Accept Field Directive or Supplemental Instruction, thereby accepting Owner's direction, including the Owner's proposed adjustment to time and cost (if any), by conveying a notice of acceptance through Owner's contract management system.
 - b. If Contractor does not accept Owner's direction, submit a (revised if applicable) CP with supporting documentation.
 - c. Give notice of a potential claim as described in Article 12 of Section 00700 (General Conditions).
 4. If the Field Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:
 - a. Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation.
 - b. Unit prices stated in the Contract Documents or subsequently agreed upon.
 - c. Contractor shall proceed on cost reimbursable (Force Account) basis while negotiating towards a firm price, per Paragraph 1.7 of this Section 01250.
 5. Contractor's acceptance of a Field Directive is Contractor's agreement as to all of its terms and conditions, including any adjustment in the Contract Sum and Contract Time and the method for determining such adjustments. This agreement will be memorialized as a Change Order.
 6. If Contractor submitted a CP in response to Owner's direction, and the parties cannot agree on the proper adjustment, Contractor may file a Claim per Article 12 of Section 00700 (General Conditions) and/or Owner may direct the changed Work through a unilateral Change Order. Contractor shall keep and present an itemized accounting in a manner consistent with the SOV, together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Paragraph shall be limited to those provided herein.
- B. Owner Initiated Change Order or Request for Proposal (RFP):
1. Owner may initiate changes in the Work or Contract Time by issuing a Request for Proposal (RFP) or Change Order to Contractor.
 2. Any RFP issued to Contractor will detail all proposed changes in the Work and request a quotation of changes in Contract Sum and Contract Time from Contractor.
 3. In response to an RFP, Contractor shall furnish a CP within 14 Days of Owner's RFP. Upon approval of the CP, Owner may direct Contractor to proceed with extra Work by issuing a Change Order.
 4. If the parties agree on price and time for the Work, the Owner will issue a Change Order. If the parties do not agree on the price or time for the Work, Owner may direct Contractor to proceed with the Work under Force Account, per Paragraph 1.7 of this Section 01250. Contractor shall perform the changed Work notwithstanding the existence of any unresolved claims or disagreements of any kind.

1.4 PROCEDURES THAT APPLY TO CONTRACTOR- AND OWNER-INITIATED CHANGE ORDERS

- A. **Adjustment of Schedules to Reflect Change Orders or Field Directives or Supplemental Instructions:**

1. Contractor shall revise the SOV and Application for Payment forms to record each authorized Change Order, Field Directive, or Supplemental Instruction as a separate line item and adjust the Contract Sum as shown thereon prior to the next monthly pay period.
2. Contractor shall revise the Progress Schedules prior to the next monthly pay period, to reflect Change Orders, Field Directives, and Supplemental Instructions.
3. Contractor shall enter changes in Project Record Documents prior to the next monthly pay period.

B. Required Documentation for Adjustments to Contract Amounts:

1. For all changes and cost adjustments requested by Contractor, Contractor shall provide documentation of changes in Contract Amounts asserted, with sufficient data to allow Owner's evaluation of the proposal.
2. In all requests for compensation, CPs, estimates, claims and any other calculation of costs made under the Contract Documents, Contractor shall breakout and quantify costs of labor, equipment, and materials identified herein, for Contractor and Subcontractors of any tier.
3. Contractor shall, upon request, provide additional data to support computations for:
 - a. Quantities of products, materials, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Justification for any change in Contract Time and new Progress Schedule showing revision due, if any.
 - d. Credit for deletions from Contract, similarly documented.
4. Contractor shall support each claim or computation for additional cost, with additional information including:
 - a. Origin and date of claim or request for additional compensation.
 - b. Dates and times Work was performed and by whom.
 - c. Time records and wage rates paid.
 - d. Invoices and receipts for products, materials, equipment, and subcontracts, similarly documented.
 - e. Credit for deletions from Contract, similarly documented.

C. Responses and Disputes:

1. For all responses for which the Contract Documents do not provide a specific time period, recipients shall respond within a reasonable time.
2. For all disputes arising from the procedures herein, Contractor shall comply with the procedures set forth in Article 12 of Section 00700 (General Conditions).

1.5 COST DETERMINATION

- A. Total cost of extra Work or of Work omitted shall be the sum of labor costs, material costs, equipment rental costs, and specialist costs as defined herein plus overhead and profit as allowed herein. This limit applies in all cases of claims for extra Work, whether calculating CPs, Change Orders, or Field Directives, or calculating claims of all types, and applies even in the event of fault, negligence, strict liability, or tort claims of all kinds, including strict liability or negligence. Contractor may recover no other costs arising out of or connected with the performance of extra Work, of any nature. No special, incidental or consequential damages may be claimed or recovered against Owner, its representatives or agents, whether arising from breach of Contract, negligence, or strict liability, unless specifically authorized in the Contract Documents.

- B. Markup for Overhead and Profit: (Overhead shall be as defined in Paragraph 1.8 of this Section 01250).
1. Markup for overhead and profit on labor for extra Work shall not exceed 15 percent.
 2. Markup for overhead and profit on materials for extra Work shall not exceed 15 percent.
 3. Markup for overhead and profit on owner-operated equipment for extra Work shall not exceed 15 percent.
 4. Markup for overhead and profit on equipment for extra Work shall not exceed 10 percent.
 5. When extra Work is performed by a first tier Subcontractor, Contractor shall receive a 10 percent markup on Subcontractors' total costs of extra Work. First tier Subcontractor's markup on its Work shall not exceed percentages listed in Paragraphs 1.5B.1, 1.5B.2, 1.5B.3, and 1.5B.4 immediately above.
 6. When extra Work is performed by a lower tier Subcontractor, Contractor, first tier Subcontractors, and lower tier Subcontractors shall divide (as mutually agreed) a total of 10 percent markup on the lower tier Subcontractors' total costs of extra Work.
 7. Notwithstanding the foregoing, in no case shall the total markup on any extra Work exceed 26.5 percent of the direct cost, notwithstanding the actual number of Contract tiers.
 8. On proposals covering decreases in Contract Sum, Contractor shall include a minimum of five percent (5%) total profit and overhead to be deducted with the amount of the work of the Change Order(s). If Subcontractor work is involved, Subcontractors shall also include a minimum of five percent (5%) profit and overhead to be deducted with the amount of its deducted work. Any deviation from this provision shall not be allowed. This paragraph does not apply to work performed using unit pricing.
 9. On proposals covering both increases and decreases in Contract Sum, markup for overhead and profit shall be included on the **net amount** as determined in this Paragraph 1.5.
 10. The markup shall include profit, small tools, cleanup, engineering, supervision, warranties, cost of preparing the cost proposal, jobsite overhead, and home office overhead.
- C. Taxes:
1. All State sales tax, use tax, and Sonoma County and applicable City sales taxes shall be included.
 2. Federal and Excise tax shall not be included.
- D. Owner-Operated Equipment: When owner-operated equipment is used to perform extra Work, Contractor will be paid as follows:
1. Payment for cost of equipment will be made at no more than rates of such equipment established in Paragraph 1.6C of this Section 01250.
 2. Payment for cost of labor will be made at no more than rates of such labor established by collective bargaining agreements for type of worker and location of Work, whether or not owner-operator is actually covered by such an agreement.
 3. Invoices for owner-operated equipment need not itemize labor and equipment costs, unless specifically requested by Owner. In any event, the total rate for owner-operated equipment shall not exceed the combined rates for labor and equipment listed in Paragraphs 1.5D.1 and 1.5D.2 above.
- E. Accord and Satisfaction: Every Change Order and accepted Field Directive shall constitute a full accord and satisfaction, and release, of all Contractor (and if applicable, Subcontractor) claims for additional time, money, or other relief arising from or relating to the subject

matter of the change including, without limitation, impacts of all types, cumulative impacts, inefficiency, overtime, delay, and any other type of claim. Contractor may elect to reserve its rights to dispute claims arising from or relating to the changed Work at the time it signs a Change Order or accepts a Field Directive, but must do so expressly in a writing delivered concurrently with the executed Change Order or approved Field Directive, and Contractor must also submit a Claim for these disputed matters pursuant to Article 12 of Section 00700 (General Conditions) no later than 30 Days after Contractor's first written notice of its intent to reserve its rights pursuant to this Paragraph. Execution of any Change Order or Field Directive shall constitute Contractor's representation of its agreement with this provision.

1.6 COST BREAKDOWN

- A. Labor: Contractor will be paid the cost of labor for workers (including forepersons when authorized by Owner) used in actual and direct performance of extra Work. Labor rate, whether employer is a Contractor, Subcontractor or other forces, will be the sum of following:
 - 1. Actual Wages: Actual wages paid shall include any employer payments to or on behalf of workers for health and welfare, pension, vacation, and similar purposes.
 - 2 Labor surcharge: Payments imposed by local, county, state, and federal laws and ordinances, and other payments made to, or on behalf of, workers, other than actual wages as defined in Paragraph 1.6A.1 of this Section 01250 immediately above, such as taxes and insurance.
- B. Material: Only materials furnished by Contractor and necessarily used in performance of extra Work will be paid for. Cost of such materials will be cost, including sales tax, to purchaser (Contractor, Subcontractor or other forces) from supplier thereof, except as the following are applicable:
 - 1. If cash or trade discount by actual supplier is offered or available to purchaser, it shall be credited to Owner notwithstanding fact that such discount may not have been taken.
 - 2. For materials salvaged upon completion of extra Work, salvage value of materials shall be deducted from cost, less discounts, of materials.
 - 3. If cost of a material is, in opinion of Owner, excessive, then cost of material shall be deemed to be lowest current wholesale price at which material is available in quantities concerned delivered to Site, less any discounts as provided in Paragraph 1.6B.1 of this Section 01250.
- C. Equipment: For Contractor- or Subcontractor-owned equipment, payment will be made at rental rates listed for equipment in Caltrans official equipment rental rate schedule which is in effect on the date upon which extra Work is accomplished and which schedule is incorporated herein by reference as though fully set forth herein. For rented equipment, payment will be made based on actual rental invoices. Equipment used on extra Work shall be of proper size and type. If, however, equipment of unwarranted size or type and cost is used, cost of use of equipment shall be calculated at rental rate for equipment of proper size and type, as determined by Owner. Rates paid shall be deemed to cover cost of fuel, oil, lubrication, supplies, small tools, necessary attachments, repairs and maintenance of any kind, depreciation, storage, insurance, and all incidentals. Unless otherwise specified, manufacturer's ratings, and manufacturer-approved modifications, shall be used to classify equipment for determination of applicable rates. Individual pieces of equipment or tools not listed in said publication and having a replacement value of \$100 or less, whether or not consumed by use, shall be considered to be small tools and no payment will be made

therefor as payment is included in payment for labor. Payment will not be made for time in which equipment is inoperative due to breakdowns.

1. For Contractor- or Subcontractor-owned equipment on Site, payment for equipment use will be for time equipment is in operation on extra Work being performed or on standby as approved by Owner.
 2. For rented equipment on Site, the following shall be used in computing rental time of equipment:
 - a. When hourly rates are listed, less than 30 minutes of operation shall be considered to be ½ hour of operation.
 - b. When daily rates are listed, less than four hours of operation shall be considered to be ½ Day of operation.
 3. For equipment that must be brought to Site to be used exclusively on extra Work, cost of transporting equipment to Site and its return to its original location shall be determined as follows:
 - a. Owner will pay for costs of loading and unloading equipment.
 - b. Cost of transporting equipment in low bed trailers shall not exceed hourly rates charged by established haulers.
 - c. Cost of transporting equipment shall not exceed applicable minimum established rates of California Public Utilities Commission.
 - d. Owner will not make any payment for transporting and loading and unloading equipment if equipment is used on Work in any other way than upon extra Work.
 4. For rented equipment, rental period may begin at the time equipment is unloaded at Site of extra Work and terminate at the end of the performance of the extra Work or Day on which Owner directs Contractor to discontinue use of equipment, whichever first occurs. Excluding Saturdays, Sundays, and Owner's legal holidays, unless equipment is used to perform extra Work on such Days, rental time to be paid per Day shall be four hours for zero hours of operation, six hours for four hours of operation and eight hours for eight hours of operation, time being prorated between these parameters. Hours to be paid for equipment that is operated less than eight hours due to breakdowns, shall not exceed eight less the number of hours equipment is inoperative due to breakdowns.
- D. Work Performed by Special Forces or Other Special Services: When Owner and Contractor, by agreement, determine that a special service or item of extra Work cannot be performed by forces of Contractor or those of any Subcontractors, the service or extra Work item may be performed by a specialty contractor. Invoices for the service or item of extra Work on basis of current market price thereof may be accepted without complete itemization of labor, material, and equipment rental costs when it is impracticable and not in accordance with established practice of the special service industry to provide complete itemization. In those instances when Contractor is required to perform extra Work necessitating a fabrication or machining process in a fabrication or machine shop facility away from Site, charges for that portion of extra Work performed in such facility may, by agreement, be accepted as a specialist billing. Owner must be notified in advance of all off-Site Work. In lieu of overhead and profit provided in Paragraph 1.5B of this Section 01250, 15 percent will be added to specialist invoice price, after deduction of any cash or trade discount offered or available, whether or not such discount may have been taken.

1.7 FORCE-ACCOUNT WORK

- A. If it is impracticable because of nature of Work, or for any other reason, to fix an increase or decrease in price definitely in advance, the Contractor may be directed to proceed at a not-

to-exceed (NTE) maximum price which shall not under any circumstances be exceeded. Subject to such limitation, such extra Work shall be paid for at the actual necessary cost for Force-Account Work or at the negotiated cost, as determined by Owner. The cost for Force-Account Work shall be determined pursuant to Paragraphs 1.5 and 1.6 of this Section 01250.

- B. Force-Account Work shall be used when it is not possible or practical to price out the changed Work prior to the start of that Work. In these cases, Force-Account Work will be utilized during the pricing and negotiation phase of the change. Once negotiations have been concluded and a bilateral agreement has been reached, the tracking of the Work under Force-Account is no longer necessary. Force-Account Work shall also be used when negotiations between Owner and Contractor have broken apart and a bilateral agreement on the value of the changed Work cannot be reached. Owner may approve other uses of Force-Account Work.
- C. Whenever any Force-Account Work is in progress, definite price for which has not been agreed on in advance, Contractor shall report to Owner each Business Day in writing in detail amount and cost of labor and material used, and any other expense incurred in Force-Account Work on preceding Day, by using the Cost Proposal form attached hereto. No claim for compensation for Force-Account Work will be allowed unless report shall have been made.
- D. Whenever Force-Account Work is in progress, definite price for which has not been agreed on in advance, Contractor shall report to Owner when 75 percent of the NTE amount has been expended.
- E. Force-Account Work shall be paid as extra Work under this Section 01250. Methods of determining payment for Work and materials provided in this Paragraph 1.7 shall not apply to performance of Work or furnishings of material that, in judgment of Owner, may properly be classified under items for which prices are otherwise established in Contract Documents.

1.8 OVERHEAD DEFINED FOR MODIFICATIONS

- A. The following constitutes charges that are deemed included in overhead for all Contract Modifications, including Force-Account Work or Field Directive Work, whether incurred by Contractor, Subcontractors, or suppliers, and Contractor shall not invoice or receive payment for these costs separately:
 - 1. Drawings: field drawings, Shop Drawings, as-builts, etc., including submissions of drawings
 - 2. Routine field inspection of Work proposed
 - 3. General superintendence
 - 4. General administration and preparation of cost proposals, schedule analysis, Change Orders, and other supporting documentation as necessary
 - 5. Computer services
 - 6. Reproduction services
 - 7. Salaries of project engineer, superintendent, timekeeper, storekeeper, and secretaries
 - 8. Janitorial services
 - 9. Temporary on-Site facilities:
 - a. Offices
 - b. Telephones, modems, and wireless routers
 - c. Plumbing
 - d. Electrical: Power, lighting
 - e. Platforms

- f. Fencing, etc.
- g. Water
- h. Sanitation
- 10. Home office expenses
- 11. Insurance and Bond premiums
- 12. Procurement and use of vehicles and fuel used coincidentally in Work otherwise included in the Contract Documents
- 13. Surveying
- 14. Estimating
- 15. Protection of Work
- 16. Handling and disposal fees
- 17. Permit fees
- 18. Final cleanup
- 19. Other incidental Work

1.9 EFFECT OF PAYMENT

A. Change Order Compensation is All Inclusive.

- 1. Except as provided expressly below regarding changes that extend the Contract Time, payment of calculated cost of extra work constitutes full and complete compensation for costs or expense arising from the extra Work, and is intended to be all inclusive.
- 2. Payment for Direct Cost of Construction is intended to be all-inclusive. Any costs or risks not delineated within cost of labor, equipment or materials herein, shall be deemed to be within the costs and risks encompassed by the applicable Markups and unallowable in any separate amount.
- 3. Payment of Markup is intended to be all-inclusive. Contractor waives claims for any further or different payment of cost and risk items delineated herein, other than the allowable percentage Markup on costs set forth in the Contract Documents; such separate, further or different cost or risk items shall be unallowable, waived, and liquidated within the allowable percentage Markup.
- 4. Contractor shall recover no other costs or markups on extra work of any type, nature, or description.

B. Exception for Changes Extending the Contract Time.

- 1. Where a change in the Work extends the Contract Time, Contractor may request and recover additional, actual direct costs, provided Contractor can demonstrate such additional costs are (i.) actually incurred performing the Work, (ii.) not compensated by the Markup allowed, (iii) directly result from the extended Contract Time; and (iv) are otherwise compensable pursuant to Paragraph 11.4 of Section 00700 (General Conditions). Contractor shall make such request and provide such documentation following all required procedures, documentation and time requirements in the Contract Documents, and subject to all contract limitations of liability. Contractor may not seek or recover such costs using formulas (e.g., Eichleay).

C. Limits of Liability.

- 1. The foregoing limits of compensation apply in all cases of claims for changed Work, whether calculating CPs, Change Orders, or Field Directives, or calculating claims and/or damages of all types, and applies even in the event of fault, negligence, strict liability, or tort claims of all kinds, including strict liability or negligence. Contractor

- may recover no other costs arising out of or connected with the performance of extra Work, of any nature.
2. Under no circumstances may Contractor claim or recover special, incidental, or consequential damages against Owner, its representatives or agents, whether arising from breach of contract, negligence, strict liability or other tort or legal theory, unless specifically and expressly authorized in the Contract Documents.
 3. No change in Work shall be considered a waiver of any other condition of Contract Documents. No claim shall be made for anticipated profit, for loss of profit, for damages, or for extra payment whatever, except as expressly provided for in Contract Documents.

1.10 MISCELLANEOUS REQUIREMENTS

A. Owner-Furnished Materials.

1. Owner reserves the right to furnish materials as it deems advisable, and Contractor shall have no claims for costs and Markup on such materials.

B. Records and Certification.

1. All charges shall be recorded daily and summarized in a form acceptable to Owner. Contractor or authorized representative shall complete and sign this form each Day. Contractor shall also provide with the form: the names and classifications of workers and hours worked by each; an itemization of all materials used; and a list by size type and identification number of equipment and hours operated.
2. Owner has the right to audit, inspect, or copy all records maintained or in possession of Contractor relating to or pertaining to this Contract, including financial records and Escrow Bid Documents, if any, and any transaction or activity occurring or arising out of, or by virtue of, the Contract. If Contractor is a joint venture, right of Owner shall apply collaterally to same extent to the records of the joint venture, and of each individual joint venture member. This right shall be specifically enforceable, and any failure of Contractor to voluntarily comply shall be deemed an irrevocable waiver and release of all claims then pending that were or could have been subject to the Article 12 of Section 00700 (General Conditions).

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

COST PROPOSAL (CP)**Sonoma Clean Power Advanced Energy Center**

CP Number: _____

Date: _____

In Response To _____

RFP #, etc.

Subject Ref. No: _____

(for Owner's Project Manager use only)

To: Sonoma Clean Power Authority

Attention: Contract Administration

50 Santa Rosa Avenue, Santa Rosa, CA 95404

Phone: (707) 978-3463

From: [Insert Contractor's Name/Address]_____

This Cost Proposal is in response to the above-referenced _____ [insert RFP, etc. as applicable].

Brief description of change(s): _____

ITEM DESCRIPTION	PRIME CONTR.	SUB 1	SUB 2	SUB 3	SUB 4	TOTAL
MATERIAL						
DIRECT LABOR COST						
EQUIPMENT						
Other (Specify)						
Total Cost						
Subcontractor's Markup for Overhead and Profit 15 percent						
Contractor's Markup for Overhead and Profit 15 percent (Labor and Materials)						
Contractor's Markup for Overhead and Profit 10 percent (Equipment Rental)						
Markup for Overhead and Profit to Contractor for Subcontractor's Work 5 percent						
GRAND TOTAL						
(percent of Total Cost above not including any Markup for Overhead and Profit) [Grand Total divided by Total Cost]						
REQUESTED CHANGE IN CONTRACT TIME (DAYS)						

By Contractor: _____

Signature: _____

Date: _____

SECTION 01312

CLOUD-BASED PROJECT MANAGEMENT SOFTWARE

PART 1 GENERAL

1.1 GENERAL PROJECT MANAGEMENT OBJECTIVES

- 1.1.1 Provide and utilize a cloud-based project management software to manage project documentation.
- 1.1.2 Use of this project management software will not replace or change any contractual responsibilities of the construction team members.
- 1.1.3 Each Project team member of the Contractor: Superintendent, Project Engineer, Scheduler, and Project Manager, et al., shall have access to the Internet and an Internet e-mail address in order to communicate with various project team members. The Contractor shall provide immediately upon receipt of the Notice to Proceed confirmation of these conditions and the names, positions, and e-mail addresses to the Owner.

1.2 SOFTWARE AND HARDWARE REQUIREMENTS

- 1.2.1 The Contractor is required to provide at both the field office and home office location from where this project is managed computer hardware and software that meet the requirements of Procore® Project Management software. The Contractor is required to purchase Procore® software, hardware and software required to access this system via the Internet. In addition, Contractor shall provide and pay for access for up to eight (8) Procore® users for Owner use including Architect, Construction Manager, and Owner. Owner users shall have full access to all information related to the project.
- 1.2.2 The Contractor shall provide the Owner with Procore® training. The anticipated training will take place within fifteen (15) days of Notice to Proceed and will be held in Santa Rosa, California.
- 1.2.3 The Contractor shall provide an adequate number of users to properly manage the Project in accordance with the Project schedule. The Contractor shall have Internet access through an Internet service provider of its choice at its cost.

SYSTEM MANAGEMENT AND USE

- 1.2.4 The Contractor will administer the Procore® application in accordance with the following.
 - 1.2.4.1 There shall be a digital record of all additions, deletions or changes to information included in the Procore® application
 - 1.2.4.2 Contractor shall provide a back-up of all information included in the Procore® system on a quarterly basis. Backup information shall be in a logical organized system that

that is acceptable to the Owner and that allows for expeditious retrieval of all project documentation.

1.2.4.3 Contractor shall maintain the Procore® application and Owner access to the Procore® system through end of the project Warranty.

1.2.4.4 Contractor will provide an electronic copy of all documentation included in the Procore system in a logical organized manner that allows for expeditious retrieval of all project documentation at Final Completion and at end of project Warranty.

1.2.5 All costs associated with the Contractor's use of the Procore® system, including computer hardware and internet service are the responsibility of the Contractor.

1.05 USE BY SUBCONTRACTORS

1.2.6 The Owner encourages the Contractor to utilize the Procore® project management application for communicating with its Subcontractors. The Contractor shall inform all Subcontractors of the purpose of the project management system and how it can assist them in obtaining information for the project.

1.3 COMMUNICATION PROCESS

1.3.1 The Owner's will outline and detail communication, correspondence and coordination procedures for the Project.

1.3.2 Most Project communication will take place in the Procore® project management system by creating and distributing documents directly within the system, or by entering manually in the system dates and descriptions of items to track over time. All documents requiring formal signatures will be printed, and their hard copies signed and distributed.

1.3.3 The official submittal log will be maintained within Procore®. The Contractor will use the Procore® to submit and distribute prints, documents, reports, samples, etc. Physical samples will be transmitted in Procore® but delivered in the traditional manner. The Procore® project management system will be used to track and expedite processing of these items.

1.3.4 Contractor will be required to maintain all current drawings within Procore®. The Contractor will be able to control administration of the drawings which includes but is not limited to: the ability to create a custom folder structure; folder-level permissions; auto-notifications for certain events (e.g., delete, check out) using Procore's® messaging system and the user's email address; auto-detection and uploading of a drawing's reference files; detailed history for a document, including revisions and access logs.

1.3.5 Contractor will be required to utilize modules including but not limited to: daily reports; meeting minutes; punch lists; requests for information (RFI); change items; cost events; and owner change order within the Procore® project management system. The Contractor can enter an RFI and the Architect/Engineer respond to the RFI completely within the Procore® project management system without creating a hard copy. Support documentation in hard copy format for any document in Procore® may be scanned into an electronic file and attached in Procore® to documents.

Contractor is required to use a digital camera in order to photo-document job progress and upload the associated images taken on a regular basis to Procore®. Each daily report is to be accompanied by daily progress photos.

1.4 ARCHIVING

- 1.4.1 Contractor, at its cost and expense, will provide the Owner backups (on digital media) as specified herein of documents in Procore®. In the event of any dispute as to what items are the true and correct project records, information contained the backups will control unless data has been digitally altered after distribution within the Procore® system.

PART 2 - PRODUCTS

- 2.1 Cloud Based Project Management Software shall be the following or equal:

Procore® Project Management: www.procore.com

PART 3 - EXECUTION

- 3.1 Project Management Software is an Internet-Accessed Centralized Database of project information and consists of several separate modules or master file divisions for ease of organization. Available file divisions include but are not limited to: Correspondence, Daily Reports, RFI's, Transmittals, Submittals, Meetings, Documents, Drawings, Specifications, Punch Lists, Reports, Project Photos, Project Team, Schedule of Values, change items, cost events, owner change orders, owner request for proposals, etc.
- 3.2 The Contractor shall provide the Owner with the number of user licenses for Procore® as described in paragraph 1.3.1 above. Each major team member for the Contractor (i.e. project manager, superintendent, etc.) must have a separate user license. The Contractor shall ensure that all major team members on this project have Internet access available during the duration of this Project.
- 3.3 Major Subcontractors are encouraged to utilize Procore® for the duration of their scope of work from commencement to completion of their scope of work. Major Subcontractors as a minimum shall be defined as mechanical, electrical, plumbing, structural steel, masonry, security, drywall, roofing, and others deemed beneficial by the Contractor.

END OF SECTION

SECTION 01315

PROJECT MEETINGS

PART 1 GENERAL

1.1 PRECONSTRUCTION CONFERENCE

- A. Preconstruction Conference. Owner will call for and administer Preconstruction Conference at time and place to be announced (prior to issuing Notice to Proceed). Contractor, all major Subcontractors, and major suppliers shall attend Preconstruction Conference. Agenda may include, but not be limited to, the following items:
1. Insurance
 2. Bonds
 3. Notice to Proceed
 4. Contractor's initial and original (baseline) schedule
 5. Contractor's Schedule of Values
 6. Contractor's schedule of submittals
 7. Submittal and RFI procedures
 8. SWPPP, if applicable
 9. Permits
 10. Location of the Contractor's on-Site facilities
 11. Security
 12. Housekeeping
 13. Inspection and testing procedures
 14. Utility shutdown procedures
 15. Survey procedures
 16. Safety Program
 17. Name(s) of Owner Representative(s)
 18. Jurisdictional agency requirements
 19. Owner will record and distribute meeting minutes to attendees. Attendees shall have seven Days to submit comments or additions to minutes. Minutes will constitute final memorialization of results of Preconstruction Conference.

1.2 WEEKLY PROGRESS MEETINGS

- A. Owner will schedule and administer weekly progress meetings throughout duration of Work. Progress meetings will be held weekly unless otherwise directed by Owner. Meetings shall be held at Owner's office unless otherwise mutually agreed upon.
1. Owner's Representative will prepare agenda and distribute it four Days in advance of meeting to Contractor.
 2. Participants with agenda items shall present them.
 3. The Construction Manager and other responsible entities will attend meetings unless otherwise specified in Contract Documents or provided by Owner.
 4. Owner may record and distribute the meeting minutes. Minutes will be distributed by the Owner to the Contractor within three Business Days after the meeting. Contractor shall distribute the minutes to those affected by decisions made at meeting. Attendees

- shall have five Business Days to submit comments or additions to the minutes. Minutes shall constitute final memorialization of results of meeting.
5. Progress meetings shall be attended by Contractor's job superintendent, major Subcontractors and suppliers, Owner, and others as appropriate to agenda topics for each meeting.
 6. Agenda may contain the following items, as appropriate:
 - a. Review, revise as necessary, and approve previous meeting minutes
 - b. Review of Work progress since last meeting
 - c. Status of Construction Work Schedule, delivery schedules, adjustments
 - d. Submittal, RFI, and Change Order status
 - e. Review of the Contractor's safety program activities and results, including report on all serious injury and/or damage accidents
 - f. Other items affecting progress of Work

1.3 PROGRESS SCHEDULE AND BILLING MEETINGS

- A. A meeting will be held on a mutually agreed upon date of each month to review the schedule update submittal and progress payment application.
- B. At this meeting, at a minimum, the following items will be reviewed:
 1. Percent complete of each activity
 2. Time impact evaluations for Change Orders and Time Extension Request
 3. Actual and anticipated activity sequence changes
 4. Actual and anticipated duration changes
 5. Actual and anticipated Contractor delays
- C. These meetings are considered a critical component of overall monthly schedule update submittal and Contractor shall have appropriate personnel attend. At a minimum, Contractor's General Superintendent and Scheduler shall attend these meetings.

1.4 PRE-INSTALLATION/PERFORMANCE MEETINGS:

- A. Contractor shall schedule a meeting prior to the start of Work where required by the Contract Documents or where requested by the Owner. Contractor shall invite manufacturer representatives, material fabricators, subcontractors and others whose work may be affected by the Work including and quality of the cutting and patching.
- B. Contractor shall review in detail prior to this meeting, the manufacturer's requirements and specifications, applicable portions of the Contract Documents, Shop Drawings, and other submittals, and other related work. At this meeting, invitees shall review and resolve conflicts, incompatibilities, or inadequacies discovered or anticipated.
- C. Contractor shall review in detail Project conditions, schedule, requirements for performance, application, installation, and quality of completed Work, and protection of adjacent Work and property.
- D. Contractor shall review in detail means of protecting the completed Work during the remainder of the construction period.

1.5

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01320

PROGRESS SCHEDULES AND SUBMITTALS

PART 1 GENERAL

1.1 GENERAL:

- A. Overall time of completion shown on Progress Schedule shall adhere to times in the Contract, unless an earlier (advanced) time of completion is requested by Contractor and agreed to by Owner. Any such agreement shall be formalized by a Change Order.
 - 1. Owner is not required to accept an early completion schedule, i.e., one that shows an earlier completion date than the Contract Time.
 - 2. Contractor shall not be entitled to extra compensation in event agreement is reached on an earlier completion schedule and Contractor completes its Work, for whatever reason, beyond completion date shown in its early completion schedule but within the Contract Time.
 - 3. A schedule showing the Work completed in less than the Contract Time, and that has been accepted by Owner, shall be considered to have Project Float. The Project Float is the time between the scheduled completion of the Work and Final Completion. Project Float is a resource available to both Owner and Contractor.
- B. Ownership Project Float: The progress schedule must show early and late completion dates for each task. The number of days between those dates will be designated as the "float." Any float belongs to the Project and may be allocated by the Engineer to best serve timely completion of the Project..
- C. Progress Schedule shall be the basis for evaluating job progress, payment requests, and time extension requests. Responsibility for developing Contract CPM Schedule and monitoring actual progress as compared to Progress Schedule rests with Contractor.
- D. Failure of Progress Schedule to include any element of the Work, or any inaccuracy in Progress Schedule, will not relieve Contractor from responsibility for accomplishing the Work in accordance with the Contract Documents. Owner's acceptance of schedule shall be for its use in monitoring and evaluating job progress, payment requests, and time extension requests and shall not, in any manner, impose a duty of care upon Owner, or act to relieve Contractor of its responsibility for means and methods of construction.

1.2 SECTION- NOT USED

1.3 INITIAL CPM SCHEDULE

- A. Initial CPM Schedule submitted for review at the preconstruction conference shall serve as Contractor's schedule for up to ninety (90) calendar days after the Notice to Proceed.
- B. Indicate detailed plan for the Work to be completed ninety (90) days from Notice to Proceed; details of planned mobilization of plant and equipment; sequence of early operations; procurement of materials and equipment. Show Work beyond ninety (90) calendar days in summary form.
- C. Initial CPM Schedule shall be time scaled.

- D. Initial CPM Schedule shall be cost loaded. Accepted cost loaded schedule will be used as basis for monthly progress payments until acceptance of the Original CPM Schedule. Use of Initial CPM Schedule for progress payments shall not exceed ninety (90) calendar days.
- E. Owner and Contractor shall meet to review and discuss the Initial CPM Schedule within seven (7) calendar days after it has been submitted to Owner.
 - 1. Owner's review and comment on the schedule shall be limited to Contract conformance (with sequencing, coordination, and milestone requirements).
 - 2. Contractor shall make corrections to schedule necessary to comply with Contract requirements and shall adjust schedule to incorporate any missing information requested by Owner. Contractor shall resubmit Initial CPM Schedule if requested by Owner.
- F. If, during the first ninety (90) days after Notice to Proceed, Contractor is of the opinion that any of the Work included on its Initial CPM Schedule has been impacted, Contractor shall submit to Owner a written Time Impact Evaluation ("TIE") in accordance with Article 1.9 of this Section. The TIE shall be based on the most current update of the Initial CPM Schedule.

1.4 ORIGINAL CPM SCHEDULE

- A. Submit a detailed proposed Original CPM Schedule presenting an orderly and realistic plan for completion of the Work in conformance with requirements as specified herein.
- B. Progress Schedule shall include or comply with following requirements:
 - 1. Time scaled, cost loaded CPM schedule.
 - 2. Each activity shall be assigned a unique activity number that shall not change.
 - 3. No activity on schedule shall have duration longer than fifteen (15) work days, with exception of submittal, approval, fabrication and procurement activities, unless otherwise approved by Owner.
 - a. Activity durations shall be total number of actual work days required to perform that activity.
 - 4. The start and completion dates of all items of Work, their major components, and milestone completion dates, if any.
 - 5. Owner furnished materials and equipment, if any, identified as separate activities.
 - 6. Activities for maintaining Project Record Documents.
 - 7. Dependencies (or relationships) between activities.
 - 8. Processing/approval of submittals and shop drawings for all material and equipment required per the Contract. Activities that are dependent on submittal acceptance or material delivery shall not be scheduled to start earlier than expected acceptance or delivery dates.
 - a. Include time for submittals, re-submittals and reviews by Owner. Coordinate with accepted schedule for submission of Shop Drawings, samples, and other submittals.
 - b. Contractor shall be responsible for all impacts resulting from re-submittal of Shop Drawings and submittals.
 - 9. Procurement of major equipment, through receipt and inspection at jobsite, identified as separate activity.
 - a. Include time for fabrication and delivery of manufactured products for the Work.
 - b. Show dependencies between procurement and construction.
 - 10. Activity description; what Work is to be accomplished and where.

11. The total cost of performing each activity shall be total of labor, material, and equipment, excluding overhead and profit of Contractor. Overhead and profit of the Contractor shall be shown as a separate activity in the schedule. Sum of cost for all activities shall equal total Contract Sum.
12. Responsibility code for each activity corresponding to Contractor or Subcontractor responsible for performing the Work.
13. Identify the activities which constitute the controlling operations or critical path. No more than twenty-five (25%) of the activities shall be critical or near critical. Near critical is defined as float in the range of one (1) to (10) days.
14. Twenty (20) workdays for developing punch list(s), completion of punch-list items, and final cleanup for the Work or any designated portion thereof. No other activities shall be scheduled during this period.
15. Interface with the work of other contractors, Owner, and agencies such as, but not limited to, utility companies.
16. Show detailed Subcontractor Work activities. In addition, furnish copies of Subcontractor schedules upon which CPM was built.
 - a. If requested, furnish for each Subcontractor, as determined by Owner, submitted on Subcontractor letterhead, a statement certifying that Subcontractor concurs with Contractor's Original CPM Schedule and that Subcontractor's related schedules have been incorporated, including activity duration and cost loading.
 - b. Furnish schedule for Contractor/Subcontractor CPM schedule meetings which shall be held prior to submission of Original CPM schedule to Owner. Owner shall be permitted to attend scheduled meetings as an observer.
17. Activity durations shall be in Work days.
18. Submit with the schedule a list of anticipated non-Work days, such as weekends and holidays. The Progress Schedule shall exclude in its Work day calendar all non-Work days on which Contractor anticipates critical Work will not be performed.
- C. Original CPM Schedule Review Meeting: Contractor shall, within sixty (60) days from the Notice to Proceed date, meet with Owner to review the Original CPM Schedule submittal.
 1. Contractor shall have its Project Manager, Project Superintendent, Project Scheduler, and key Subcontractor representatives, as required by Owner, in attendance. The meeting will take place over a continuous one (1) day period.
 2. Owner's review will be limited to submittal's conformance to Contract requirements including, but not limited to, coordination requirements. However, review may also include:
 - a. Clarifications of Contract Requirements.
 - b. Directions to include activities and information missing from submittal.
 - c. Requests to Contractor to clarify its schedule.
 3. Within five (5) days of the Schedule Review Meeting, Contractor shall respond in writing to all questions and comments expressed by Owner at the Meeting.

1.5 ADJUSTMENTS TO CPM SCHEDULE

- A. Adjustments to Original CPM Schedule: Contractor shall have adjusted the Original CPM Schedule submittal to address all review comments from original CPM Schedule review meeting and resubmit network diagrams and reports for Owner's review.
 1. Owner, within ten (10) days from date that Contractor submitted the revised schedule, will either:

- a. Accept schedule and cost loaded activities as submitted, or
 - b. Advise Contractor in writing to review any part or parts of schedule which either do not meet Contract requirements or are unsatisfactory for Owner to monitor Project's progress and status or evaluate monthly payment request by Contractor.
2. Owner may accept schedule with conditions that the first monthly CPM Schedule update be revised to correct deficiencies identified.
3. When schedule is accepted, it shall be considered the "Original CPM Schedule" which will then be immediately updated to reflect the current status of the Work.
4. Owner reserves right to require Contractor to adjust, add to, or clarify any portion of schedule which may later be discovered to be insufficient for monitoring of Work or approval of partial payment requests. No additional compensation will be provided for such adjustments, additions, or clarifications.
- B. Acceptance of Contractor's schedule by Owner will be based solely upon schedule's compliance with Contract requirements.
 1. By way of Contractor assigning activity durations and proposing sequence of Work, Contractor agrees to utilize sufficient and necessary management and other resources to perform Work in accordance with the schedule.
 2. Upon submittal of schedule update, updated schedule shall be considered "current" CPM Schedule.
 3. Submission of Contractor's schedule to Owner shall not relieve Contractor of total responsibility for scheduling, sequencing, and pursuing Work to comply with requirements of Contract Documents, including adverse effects such as delays resulting from ill-timed Work.
- C. Submittal of Original CPM Schedule, and subsequent schedule updates, shall be understood to be Contractor's representation that the Schedule meets requirements of Contract Documents and that Work shall be executed in sequence indicated on the schedule.
- D. Contractor shall distribute Original CPM Schedule to Subcontractors for review and written acceptance, which shall be noted on Subcontractors' letterheads to Contractor and transmitted to Owner for the record.

1.6 MONTHLY CPM SCHEDULE UPDATE SUBMITTALS

- A. Following acceptance of Contractor's Original CPM Schedule, Contractor shall monitor progress of Work and adjust schedule each month to reflect actual progress and any anticipated changes to planned activities.
 1. Each schedule update submitted shall be complete, including all information requested for the Original CPM Schedule submittal.
 2. Each update shall continue to show all Work activities including those already completed. These completed activities shall accurately reflect "as built" information by indicating when activities were actually started and completed.
- B. A meeting will be held on approximately the twenty-fifth (25th) of each month to review the schedule update submittal and progress payment application.
 1. At this meeting, at a minimum, the following items will be reviewed: Percent (%) complete of each activity; Time Impact Evaluations for Change Orders and Time Extension Request; actual and anticipated activity sequence changes; actual and anticipated duration changes; and actual and anticipated Contractor delays.

2. These meetings are considered a critical component of overall monthly schedule update submittal and Contractor shall have appropriate personnel attend. At a minimum, these meetings shall be attended by Contractor's General Superintendent and Scheduler.
3. Contractor shall plan on the meeting taking no less than four (4) hours.
- C. Within five (5) working days after monthly schedule update meeting, Contractor shall submit the updated CPM Schedule update.
- D. Within five (5) work days of receipt of above noted revised submittals, Owner will either accept or reject monthly schedule update submittal.
 1. If accepted, percent (%) complete shown in monthly update will be basis for Application for Payment by Contractor. The schedule update shall be submitted as part of Contractor's Application for Payment.
 2. If rejected, update shall be corrected and resubmitted by Contractor before the Application for Payment is submitted.
- E. Neither updating, changing or revising of any report, curve, schedule, or narrative submitted to Owner by Contractor under this Contract, nor Owner's review or acceptance of any such report, curve, schedule or narrative shall have the effect of amending or modifying in any way Final Completion or milestone dates or of modifying or limiting in any way Contractor's obligations under this Contract.

1.7 SCHEDULE REVISIONS

- A. Updating the schedule to reflect actual progress shall not be considered revisions to the schedule. Since scheduling is a dynamic process, revisions to activity durations and sequences are expected on a monthly basis.
- B. To reflect revisions to the schedule, Contractor shall provide Owner with a written narrative with a full description and reasons for each Work activity revised. For revisions affecting the sequence of Work, Contractor shall provide a schedule diagram which compares the original sequence to the revised sequence of Work. Contractor shall provide the written narrative and schedule diagram for revisions two (2) working days in advance of the monthly schedule update meeting.
- C. Schedule revisions shall not be incorporated into any schedule update until the revisions have been reviewed by Owner. Owner may request further information and justification for schedule revisions and Contractor shall, within three (3) days, provide Owner with a complete written narrative response to Owner's request.
- D. If Contractor's revision is still not accepted by Owner, and Contractor disagrees with Owner's position, Contractor has seven (7) calendar days from receipt of Owner's letter rejecting the revision to provide a written narrative providing full justification and explanation for the revision. Contractor's failure to respond in writing within seven (7) calendar days of Owner's written rejection of a schedule revision shall be contractually interpreted as acceptance of Owner's position, and Contractor waives its rights to subsequently dispute or file a claim regarding Owner's position.
- E. At Owner's discretion, Contractor can be required to provide Subcontractor certifications of performance regarding proposed schedule revisions affecting said Subcontractors.

1.8 RECOVERY SCHEDULE

- A. If the schedule update shows a completion date twenty-one (21) calendar days beyond the date set for Final Completion, or individual milestone completion dates, Contractor shall

submit to Owner the proposed revisions to recover the lost time within seven (7) calendar days. As part of this submittal, Contractor shall provide a written narrative for each revision made to recapture the lost time. If the revisions include sequence changes, Contractor shall provide a schedule diagram comparing the original sequence to the revised sequence of Work.

- B. The revisions shall not be incorporated into any schedule update until the revisions have been reviewed by Owner.
- C. If Contractor's revisions are not accepted by Owner, Owner and Contractor shall follow the procedures in paragraph 1.09.C, 1.09.D and 1.09.E above.
- D. At Owner's discretion, Contractor can be required to provide Subcontractor certifications for revisions affecting said Subcontractors.

1.9 TIME IMPACT EVALUATION ("TIE") FOR CHANGE ORDERS, AND OTHER DELAYS

- A. When Contractor is directed to proceed with changed Work, Contractor shall prepare and submit within fourteen (14) calendar days from the Notice to Proceed a TIE which includes both a written narrative and a schedule diagram depicting how the changed Work affects other schedule activities. The schedule diagram shall show how Contractor proposes to incorporate the changed Work in the schedule and how it impacts the current schedule-update critical path. Contractor is also responsible for requesting time extensions based on the TIE's impact on the critical path. The diagram must be tied to the main sequence of schedule activities to enable Owner to evaluate the impact of changed Work to the scheduled critical path.
- B. Contractor shall be required to comply with the requirements of Paragraph 1.10.A for all types of delays such as, but not limited to, Contractor/Subcontractor delays, adverse weather delays, strikes, procurement delays, fabrication delays, etc.
- C. Contractor shall be responsible for all costs associated with the preparation of TIEs, and the process of incorporating them into the current schedule update. Contractor shall provide Owner with four (4) copies of each TIE.
- D. Once agreement has been reached on a TIE, the Contract Time will be adjusted accordingly. If agreement is not reached on a TIE, the Contract Time may be extended in an amount Owner allows, and Contractor may submit a claim for additional time claimed by Contractor.

1.10 TIME EXTENSIONS

- A. Contractor is responsible for requesting time extensions for time impacts that, in the opinion of Contractor, impact the critical path of the current schedule update. Notice of time impacts shall be given in accord with the General Conditions.
- B. Where an event for which Owner is responsible impacts the projected completion date, Contractor shall provide a written mitigation plan, including a schedule diagram, which explains how (e.g., increase crew size, overtime, etc.) the impact can be mitigated. Contractor shall also include a detailed cost breakdown of the labor, equipment, and material Contractor would expend to mitigate Owner-caused time impact. Contractor shall submit its mitigation plan to Owner within fourteen (14) calendar days from the date of discovery of the impact. Contractor is responsible for the cost to prepare the mitigation plan.

- C. Failure to request time, provide TIE, or provide the required mitigation plan will result in Contractor waiving its right to a time extension and cost to mitigate the delay.
- D. No time will be granted under this Contract for cumulative effect of changes.
- E. Owner will not be obligated to consider any time extension request unless Contractor complies with the requirements of Contract Documents.
- F. Failure of Contractor to perform in accordance with the current schedule update shall not be excused by submittal of time extension requests.
- G. If Contractor does not submit a TIE within the required fourteen (14) calendar days from date of the discovery of impact for any issue, it is mutually agreed that Contractor does not require a time extension for said issue.

1.11 SCHEDULE REPORTS

- A. Submit four (4) copies of the following reports with the Initial CPM Schedule, the Original CPM Schedule, and each monthly update.
- B. Required Reports:
 - 1. Two activity listing reports: one sorted by activity number and one by total Project Float. These reports shall also include each activity's early/late and actual start and finish dates, original and remaining duration, Project Float, responsibility code, and the logic relationship of activities.
 - 2. Cost report sorted by activity number including each activity's associated cost, percentage of Work accomplished, earned value- to date, previous payments, and amount earned for current update period.
 - 3. Schedule plots presenting time-scaled network diagram showing activities and their relationships with the controlling operations or critical path clearly highlighted in format requested by the Owner.
 - 4. Cash flow report calculated by early start, late start, and indicating actual progress. Provide an exhibit depicting this information in graphic form.
- C. Other Reports:

In addition to above reports, Owner may request, from month to month, any two of the following reports. Submit four (4) copies of all reports.

 - 1. Activities by early start.
 - 2. Activities by late start.
 - 3. Activities grouped by Subcontractors or selected trades.
 - 4. Activities with scheduled early start dates in a given time frame, such as fifteen (15) or thirty (30) day outlook.
- D. Furnish Owner with electronic report files on electronic media requested by Owner containing all schedule files for each report generated.

1.12 PROJECT STATUS REPORTING

- A. In addition to submittal requirements for CPM scheduling identified in this Section, Contractor shall provide a monthly project status report (i.e., written narrative report) to be submitted in conjunction with each CPM Schedule as specified herein. Status reporting shall be in form specified below.
- B. Contractor shall prepare monthly written narrative reports of status of Project for submission to Owner. Written status reports shall include:

1. Status of major Project components (percent (%) complete, amount of time ahead or behind schedule) and an explanation of how Project will be brought back on schedule if delays have occurred.
2. Progress made on critical activities indicated on CPM Schedule.
3. Explanations for any lack of work on critical path activities planned to be performed during last month.
4. Explanations for any schedule changes, including changes to logic or to activity durations.
5. List of critical activities scheduled to be performed next month.
6. Status of major material and equipment procurement.
7. Any delays encountered during reporting period.
8. Contractor may include any other information pertinent to status of Project. Contractor shall include additional status information requested by Owner at no additional cost.
9. Status reports, and the information contained therein, shall not be construed as claims, notice of claims, notice of delay, or requests for changes or compensation.

1.13 WEEKLY SCHEDULE REPORT

At the Weekly Progress Meeting, Contractor shall provide and present a time-scaled three (3) week look-ahead schedule that is based and correlated by activity number to the current schedule (i.e., Initial, Original CPM, or Schedule Update). Schedule shall include Work actually started or completed in the previous week.

1.14 DAILY CONSTRUCTION REPORTS

On a daily basis, Contractor shall submit a daily activity report to Owner for each workday, including weekends and holidays when worked. Contractor shall develop the daily construction reports on a computer-generated database capable of sorting daily Work, manpower, and man-hours by Contractor, Subcontractor, area, sub-area, and Change Order Work. Upon request of Owner, furnish computer disk of this data base. Obtain Owner's written approval of daily construction report data base format prior to implementation. Include in report:

- A. Project name and Project number.
- B. Contractor's name and address.
- C. Weather, temperature, and any unusual site conditions.
- D. Brief description and location of the day's scheduled activities and any special problems and accidents, including Work of Subcontractors. Descriptions shall be referenced to CPM scheduled activities.
- E. Worker quantities for its own Work force and for Subcontractors of any tier.
- F. Equipment, other than hand tools, utilized by Contractor and Subcontractors.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01330

SUBMITTALS

PART 1 GENERAL

1.1 SCHEDULE OF SUBMITTALS

- A. Contractor shall prepare for Owner's review and acceptance prior to commencement of Work on the Site, for purposes of contract administration, a schedule of submittals required to complete the Work, prepared by Contractor and accepted by Owner for contract administration. Schedule of submittals shall include, for each submittal: the specification or drawing reference requiring the submittal, if applicable; the material, item, or process for which the submittal is required; the submittal number and identifying title of the submittal; the Contractor's anticipated submission date and the approval need date.
- B. Contractor shall update monthly the schedule of submittals to reflect actual submission and acceptance dates for submittals. Review by Owner of schedule of submittals does not excuse Contractor of obligation to supply, schedule, and coordinate all submittals required by the Contract Documents.

1.2 CONTRACTOR TO SUBMIT SHOP DRAWINGS, PRODUCT DATA, AND SUBMITTALS

- A. Transmit each item with the Submittal transmittal form (included at the end of this Section 01330).
- B. Within ten Days after Contract Time commences to run, submit complete list of major products proposed for use (included at the end of this Section 01330, if required), with name of manufacturer, telephone number, trade name, and model number of each product. Tabulate data by Specification Section.
- C. Contractor shall review for compliance with Contract Documents, approve and submit to Owner Shop Drawings, Product Data, Samples, and similar submittals required by Contract Documents.
- D. Contractor shall schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Contractor shall include certifications to be submitted with the pertinent drawings at the same time.
- E. Contractor shall coordinate scheduling, sequencing, preparing, and processing of all submittals with performance of Work so that work will not be delayed by submittal processing.
- F. Submittals shall specifically identify any Work depicted that does not conform to the Contract Documents.
- G. Submit one electronic copy of Submittals required by Contract Documents.
- H. Submit one hard copy, after Owner's favorable review, of Submittals that require a wet signature.

1.3 OWNER REVIEW OF SHOP DRAWINGS, PRODUCT DATA, AND SUBMITTALS

- A. After review by Owner of each Submittal, material will be returned to Contractor with actions defined as follows:
 - 1. NO EXCEPTIONS TAKEN - Accepted subject to its compatibility with general design concept of the Work, future Submittals and additional partial Submittals for any portions of the Work not covered in this Submittal. Does not constitute acceptance or deletion of specified or required items not shown on the Submittal.
 - 2. MAKE CORRECTIONS NOTED (NO RESUBMISSIONS REQUIRED) - Same as item 1 above, except that minor corrections as noted shall be made by Contractor.
 - 3. REVISE AS NOTED AND RESUBMIT - Rejected because of major inconsistencies or errors that shall be resolved or corrected by Contractor prior to subsequent review by Owner.
 - 4. REJECTED - RESUBMIT - Submitted material does not conform to Drawings and/or Specifications in major respect, i.e.: wrong size, model, capacity, or material.
- B. Favorable review will not constitute acceptance by Owner of any responsibility for the accuracy, coordination, or completeness of the Submittals. Accuracy, coordination, and completeness of Submittals shall be sole responsibility of Contractor, including responsibility to back-check comments, corrections, and modifications from Owner's review before fabrication. Contractor, Subcontractors, or suppliers may prepare Submittals, but Contractor shall ascertain that Submittals meet requirements of Contract Documents, while conforming to structural space and access conditions at point of installation. Owner's review will be only to assess if the items covered by the Submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as indicated by the Contract Documents. Favorable review of Submittal, method of Work, or information regarding materials and equipment Contractor proposes to furnish shall not relieve Contractor of responsibility for errors therein and shall not be regarded as assumption of risks or liability by Owner, or any officer or employee thereof, and Contractor shall have no claim under Contract Documents on account of failure or partial failure or inefficiency or insufficiency of any plan or method of Work or material and equipment so accepted. Favorable review shall be considered to mean merely that Owner has no objection to Contractor using, upon Contractor's own full responsibility, plan or method of Work proposed, or furnishing materials and equipment proposed.
- C. Unless otherwise specified, Owner's review will not extend to the means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
- D. Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals until the respective submittal has been favorably reviewed by the Owner; otherwise, any such Work is at Contractor's sole risk.
- E. Normally, Submittals will be processed and returned to Contractor within 30 Days of receipt.

1.4 PRODUCT DATA

- A. Product or Catalog Data:
 - 1. Manufacturers' standard drawings shall be modified to delete non-applicable data or include applicable data.
 - 2. Manufacturers' catalog sheets, brochures, diagrams, schedules, charts, illustrations, and other standard descriptive data:
 - a. Mark each copy to identify pertinent materials, products, or models.
 - b. Show dimensions and clearances required, performance characteristics and capacities, wiring diagrams and controls.
 - 3. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.
 - 4. Material Safety Data Sheets:
 - a. In addition to MSDSs otherwise required by the Contract Documents, submit MSDSs for any products containing a hazardous substance such as paints, solvents, thinners, varnish, lacquer, glues and adhesives, mastics, sealants, equipment fuel, equipment lubricant, or other materials needed for the Project as required by the individual Specification Sections or as otherwise specified in the Contract Documents.
 - b. MSDSs must be submitted with Product Data Submittal in order for the Submittal to be reviewed.
- B. Supplemental Data:
 - 1. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturer's standard data to provide information unique to Project.

1.5 SHOP DRAWINGS

- A. Minimum Sheet Size: 8½ inches by 11 inches. All others: multiples of 8½ inches by 11 inches, 34 inches by 44 inches maximum.
- B. The electronic copy will be marked with Owner's review comments and returned to Contractor.
- C. Mark each copy to identify applicable products, models, options, and other data; supplement manufacturers' standard data to provide information unique to Work.
- D. Include manufacturers' installation instructions when required by Specification Section.
- E. If Contractor submits Shop Drawings for items that Shop Drawings are not specified, Owner will not be obliged to review them.
- F. Contractor is responsible for procuring copies of Shop Drawings for its own use as it may require for the progress of the Work.
- G. Shop Drawings shall be drawn to scale and completely dimensioned, showing plan view together with such sectional views as are necessary to clearly show construction detail, materials, and methods.

1.6 SAMPLES

- A. Submit full range of manufacturers' standard colors, textures, and patterns for Owner's selection.
- B. Submit Samples to illustrate functional and aesthetic characteristics of product, with integral parts and attachment devices. Coordinate Submittal of different categories for interfacing Work.
- C. Include identification on each Sample, giving full information.
- D. Sizes: Unless otherwise specified, provide the following:
 - 1. Paint Chips: Manufacturers' standard.

2. Flat or Sheet Products: Minimum 6 inches square, maximum 12 inches square.
3. Linear Products: Minimum 6 inches, maximum 12 inches long.
4. Bulk Products: Minimum 1 pint, maximum 1 gallon.
- E. Full size Samples may be used in Work upon approval by Owner.
- F. Quantity: two.
- G. Field Samples and Mock-ups (if applicable):
 1. Erect field Samples and mock-ups at Site in accordance with requirements of Specification Sections. If testing is conducted, record and certify results and full Contract compliance.
 2. Modify or make additional field Samples and mock-ups as required to provide appearance and finishes approved by Owner.
 3. Approved field Samples and mock-ups may be used in Work upon approval by Owner.
 4. Construct or prepare as many additional Samples as may be required, as directed by the Owner, until desired textures, finishes, and/or colors are obtained.
 5. Accepted Samples and mock-up shall serve as the standard of quality for the various units of Work.
- H. No review of a Sample shall be taken in itself to change or modify the requirements in the Contract Documents.
- I. Finishes, materials, and workmanship in the completed Work shall match accepted Samples.
- J. Samples will not be returned to Contractor.

1.7 LAYOUT DRAWINGS

- A. If requested by Owner, Contractor shall prepare and submit layout drawings of all equipment and piping at not less than 1/4" scale. The layout drawings shall show the location of all equipment as well as locations of all valves, piping, fittings, and other pertinent items. The layout drawings shall also show beams, ceiling heights, walls, floor-to-floor dimensions, columns, doors, and other major architectural and structural drawings.

1.8 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.

- d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to the Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
- 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 - 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 - 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 - 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 - 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 - 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 - 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 - 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 - 9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
 - 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 3300 "Submittal Procedures."
 - a. licensing agreement in the form of AIA Document C106.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

- a. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
- b. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.
- c. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - 1) Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - 2) Digital Data Software Program: Drawings are available in Autodesk 'Revit'.
 - 3) Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.9 QUALITY ASSURANCE/CONTROL SUBMITTALS

- A. Design Data:
 1. Indicate that material or product conforms to or exceeds specified requirements.
- B. Test Reports:
 1. Indicate that material or product conforms to or exceeds specified requirements.
 2. Reports may be from recent or previous tests on material or product, but shall be acceptable to Owner. Comply with requirements of each individual Specification Section.
- C. Certificates:
 1. Indicate that material or product conforms to or exceeds specified requirements.
 2. Submit supporting reference data, affidavits, and certifications as appropriate.
 3. Certificates may be recent or from previous test results on material or product, but shall be acceptable to Owner.
- D. Manufacturers' Instructions:
 1. Include manufacturers' printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing.
 2. Identify conflicts between manufacturers' instructions and Contract Documents.
- E. Work Plans:
 1. Submit Work Plans with sufficient detail to clearly indicate compliance with Specification requirements and to clearly describe by what means and methods Contractor intends to execute the subject Work.

1.10 INSTALLATION, OPERATION, AND MAINTENANCE MANUAL (IF APPLICABLE)

- A. Sheet Size: 8½ x 11 inch
- B. Drawing Size: Reduce drawings or diagrams to an 8½ x 11 inch or 11 x 17 inch size. However, where reduction is not practical to ensure readability, fold larger drawings separately and place in vinyl envelopes bound into the binder. Identify vinyl envelopes with drawing numbers.
- C. Binding: Bind in heavy-duty white vinyl D-ring binders (locking rings), not more than 3" thick, with standard three-hole punch, two inside pockets, and a clear overlay (front pocket). Binder shall be no more than 80% full.
- D. Multiple Items: Multiple items may be combined into one binder; tab each section with plastic-coated dividers.
- E. Volumes: create volumes, numbered sequentially, as appropriate.

F. Page Protectors: Provide plastic sheet lifters prior to first page and following last page.

G. Binder title: Include the following title on front and spine of binder(s):

[FULL PROJECT NAME]
INSTALLATION, OPERATION, AND MAINTENANCE MANUAL, [YEAR]
VOLUME [__(number) of __(total number of volumes)]

H. Contents:

1. Introductory Information:

- a. Title page providing the same information as paragraph 1.10G above
- b. Contractor's name, address, email address, website address, and telephone number
- c. Table of Contents: include a complete table of contents in each volume, if applicable

2. Include, at a minimum, the following detailed information for each item as applicable and as required by individual Specification Sections:

- a. Bill of materials: include manufacturer, complete model number, quantity, and equipment location.
- b. Operational information:
 - 1) Equipment function, normal operating characteristics, limiting operations.
 - 2) Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.
 - 3) A list of recommended spare parts with a price list, predicted life of parts subject to wear, and a list of spare parts provided under this Contract.
 - 4) Instrumentation or tag numbers relating the equipment back to the Contract Documents.
- c. Maintenance information:
 - 1) Assembly, disassembly, installation, alignment, adjustment, and checking instructions.
 - 2) Lubrication and maintenance instructions including specific type and amount of lubricant and recommended lubrication interval.
 - 3) Outline, cross-section, and assembly drawings; engineering data; and electrical diagrams, including elementary diagrams, labeled wiring diagrams, connection diagrams, word description of wiring diagrams, and interconnection diagrams.
 - 4) Test data and performance curves.
 - 5) Parts lists or other documents packed with equipment when delivered.
 - 6) Instrumentation or tag numbers relating the equipment back to the Contract Documents.
 - 7)
- d. Troubleshooting guide.
- e. Delete information that is not pertinent to the Project.

3. Index: alphabetical by keyword

I. Final Submittal: Upon favorable review of Installation, Operation, and Maintenance Manual(s) by Owner, deliver one electronic copy on CD and two hard copies of the final approved Installation, Operation, and Maintenance Manual(s). Electronic media format copy shall be searchable and include all tables, charts, drawings, codes and all other matters reflected in hard copies.

SONOMA CLEAN POWER ADVANCED ENERGY CENTER 741 4TH STREET, SANTA ROSA, CA

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

Option

MAJOR PRODUCTS LIST

	Specification Section Number	Product	Name of Manufacturer, Trade Name, Model Number	Telephone number
1.		[list major items]		
2.				

SUBMITTAL, TRANSMITTAL NO.

Project Name: [Full Project Name]		Date Received:	
Owner: Sonoma Clean Power Authority Attention: Construction Management Section 50 Santa Rosa Avenue Santa Rosa, CA 95404		Checked By:	
Contractor: Address:		Log Page:	
		Specification Section Number:	
Attention:		1 st Submittal <input type="checkbox"/>	Resubmittal <input type="checkbox"/>
<p>By _____ Date _____</p> <p>Contractor's signature above shall constitute Contractor's representation that it has satisfied its obligations under the Contract Documents with respect to Contractor's review and approval of Submittals.</p>			
Date Transmitted:		Previous Transmittal Date:	
No. Copies	Description	Manufacturer	Dwg. or Data No.
			Action Taken*

Remarks:

*** The action designated above is in accordance with the following legend:**

A - No Exceptions Taken

B - Make Corrections Noted (No Resubmission Required)

C - Revise as Noted and Resubmit

D - Rejected - Resubmit

1. Not enough information for review
2. No reproducibles submitted
3. Copies illegible
4. Not enough copies submitted
5. Wrong sequence number
6. Wrong resubmittal number
7. Wrong Specification section number
8. Wrong form used
9. See comments

Comments:

By

Date

MAINTENANCE SUMMARY

1. EQUIPMENT ITEM: _____
2. MANUFACTURER: _____
3. MODEL NUMBER: _____
4. SERIAL NO. (IF APPLICABLE): _____
5. NAMEPLATE DATE (HP, VOLTAGE, SPEED, ETC.): _____
6. MANUFACTURER'S LOCAL REPRESENTATIVE
NAME: _____
ADDRESS: _____
TELEPHONE NUMBER: _____ FAX NUMBER: _____ EMAIL: _____
7. MAINTENANCE REQUIREMENTS: _____

MAINTENANCE OPERATION

List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. _____

FREQUENCY

List required frequency of each maintenance operation. _____

LUBRICANT (IF APPLICABLE)

Refer by symbol to lubricant list as required. _____

COMMENTS

8. LUBRICANT LIST: REFERENCE SYMBOL

(A-) (B-) (C-) (D-)

List symbols used. List equivalent lubricants as distributed and recommended by manufacturer's representative listed in item 6 above.

9. SPARE PARTS:

Include your recommendations regarding what spare parts, if any, should be kept on the job.

SECTION 01410

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Regulatory requirements applicable to Contract Documents.
2. Required provisions under Local Agency Disputes Act.
3. Required references under federal law.

1.2 GENERAL

A. Compliance with Laws:

1. Conform to all applicable codes, laws, ordinances, rules, and regulations, which shall have full force and effect as though printed in full in these Specifications. Codes, laws, ordinances, rules, regulations, and ordinances (Regulatory Requirements) are not furnished to Contractor, because Contractor is assumed to be familiar with these requirements.
2. Any listing of Regulatory Requirements for hazardous waste abatement Work in the Contract Documents is supplied to Contractor as a courtesy and shall not limit Contractor's responsibility for complying with all applicable Regulatory Requirements having application to the Work. Where conflict among the Regulatory Requirements or with these Specifications occurs, the most stringent requirements shall be used.
3. Specific reference in the Specifications to codes and regulations or requirements of regulatory agencies shall mean the latest printed edition of each adopted by the regulatory agency in effect at the time of the opening of Bids, except as may be otherwise specifically stated in the Contract Documents.

B. Precedence:

1. Where specified requirements differ from Regulatory Requirements, the more stringent requirements shall take precedence. Where Drawings or Specifications require or describe products or execution of better quality, higher standard, or greater size than required by Regulatory Requirements, then Drawings and Specifications shall take precedence so long as such increase is legal. Where no requirements are identified on Drawings or in Specifications, comply with all Regulatory Requirements of governing authorities having jurisdiction.
2. Should any conditions develop not covered by the Contract Documents wherein the finished Work will not comply with current codes, a Change Order detailing and specifying the required Work shall be submitted to and approved by Owner before proceeding with the Work.

END OF SECTION

SECTION 01420

REFERENCES AND DEFINITIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Reference standards, abbreviations, symbols, and definitions used in Contract Documents.
2. Full titles are given in this Section for standards cited in other Sections of Specifications.

1.2 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES; REPORTING AND RESOLVING DISCREPANCIES

A. References:

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, code, or laws or regulations in effect at the time of opening of Bids, except as may be otherwise specifically stated in the Contract Documents.
2. If during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any such law or regulation applicable to the performance of the Work or of any such standard, specification, manual, or code or of any instruction of any supplier, Contractor shall report it in writing at once to Owner, and Contractor shall not proceed with the Work affected thereby until consent to do so is given by Owner.

B. Precedence:

1. Except as otherwise specifically stated in the Contract Documents or as may be provided by Change Order, Field Directive, or Supplemental Instruction, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:
 - a. The provisions of any such standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or
 - b. The provisions of any such laws or regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such law or regulation).
2. No provision of any such standard, specification, manual, code, or instruction shall be effective to change the duties and responsibilities of Owner, Project Manager, Owner's Representative(s), Consulting Engineer, or Contractor, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents, nor shall it be effective to assign to Owner, Consulting Engineer, or any of their consultants, agents, representatives or employees any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

C. Referenced Grades, Classes, and Types:

1. Where an alternative or optional grade, class, or type of product or execution is included in a reference but is not identified in Drawings or in Specifications, provide the highest, best, and greatest of the alternatives or options for the intended use and prevailing conditions.

D. Edition Date of References:

1. When an edition or effective date of a reference is not given, it shall be understood to be the current edition or latest revision published as of the date of opening Bids.
2. All amendments, changes, errata, and supplements as of the effective date shall be included.

E. ASTM and ANSI References:

1. Specifications and Standards of the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI) are identified in the Drawings and Specifications by abbreviation and number only and may not be further identified by title, date, revision, or amendment. It is presumed that Contractor is familiar with and has access to these nationally- and industry-recognized specifications and standards.

1.3 ACRONYMS

A. Listed below are various organizations or references which may appear in the Contract Documents, along with their respective acronyms:

- | | |
|---------------|--|
| 1. AISC | American Institute of Steel Construction |
| 2. ANSI | American National Standards Institute |
| 3. ASCE | American Society of Civil Engineers |
| 4. ASHRAE | American Society of Heating, Refrigeration, and Air-Conditioning Engineers |
| 5. ASME | American Society of Mechanical Engineers |
| 6. ASTM | American Society for Testing and Materials International |
| 7. AWS | American Welding Society |
| 8. AWWA | American Water Works Association |
| 9. Cal/OSHA | California Occupational Safety and Health Administration |
| 10. Caltrans | State of California, Department of Transportation |
| 11. Greenbook | Standard Specifications for Public Works Construction |
| 12. IEEE | Institute of Electrical and Electronic Engineers |
| 13. NACE | National Association of Corrosion Engineers |
| 14. NEMA | National Electric Manufacturers Association |
| 15. OSHA | Occupational Safety and Health Administration |
| 16. PERMIT | Permits and Resource Management Department, County of Sonoma |
| SONOMA | |
| 17. UL | Underwriters' Laboratories, Inc. |
| 18. USACE | United States Army Corp of Engineers |

1.4 DEFINITIONS

- A. Meaning of Words and Phrases: Wherever any of the words or phrases defined below, or a pronoun used in place thereof, is used in any part of the Contract Documents, it shall have the meaning here set forth. Where abbreviations and symbols are used, such abbreviations

and symbols shall be given their common meaning in the construction industry. In the Contract Documents, the neuter gender includes the feminine and masculine, and the singular number includes the plural. While Owner has made an effort to identify all defined terms with initial caps, the following definitions shall apply regardless of case unless the context otherwise requires:

1. Addenda: Written or graphic instruments issued prior to the opening of Bids, which clarify, correct, or change the bidding requirements or the Contract Documents.
2. Agreement (Section 00520): Agreement is the basic Contract Document that binds the parties to construction Work. Agreement defines relationships and obligations between Owner and Contractor and by reference incorporates Conditions of Contract, Drawings, and Specifications and contains Addenda and all Modifications subsequent to execution of Contract Documents.
3. Alternate: Work added to or deducted from the base Bid, if accepted by Owner.
4. Application for Payment: Written application for monthly or periodic progress or final payment made by Contractor complying with the Contract Documents.
5. Approved Equal: Approved in writing by Owner as being of equivalent quality, utility, and appearance.
6. Asbestos: Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by OSHA or Cal/OSHA.
7. Bid: The offer or proposal of the Bidder submitted on the prescribed form(s) setting forth the prices for the Work to be performed.
8. Bidder: One who submits a Bid to Owner.
9. Bidding Documents: All documents comprising the Project Manual (including all documents and Specification Sections listed in Section 00010 [Table of Contents]), including documents supplied for bidding purposes only and Contract Documents.
10. Board: The governing body of the Owner.
11. Business Day: Any Day other than Saturday, Sunday, and the following days that have been designated as holidays by Owner. If a holiday falls on a Saturday, the preceding Friday will be the holiday. If a holiday falls on a Sunday, the following Monday will be the holiday.
 - a. New Year's Day, January 1;
 - b. Martin Luther King Jr.'s Birthday, third Monday in January;
 - c. Presidents' Day, third Monday in February;
 - d. Memorial Day, last Monday in May;
 - e. Independence Day, July 4;
 - f. Labor Day, first Monday in September;
 - g. Veterans' Day, November 11;
 - h. Thanksgiving Day, as designated by the President;
 - i. The Day following Thanksgiving Day;
 - j. Christmas Day, December 25; and
 - k. Each day appointed by the Governor of California and formally recognized by the Governing Board as a day of mourning, thanksgiving, or special observance.
12. By Owner: Work that will be performed by Owner or its agents at the Owner's expense.
13. By Others: Work that is outside scope of Work to be performed by Contractor under this Contract, which will be performed by Owner, other contractors, or other means.
14. Change Order: A written instrument prepared by Owner and signed by Owner and Contractor, stating their agreement upon all of the following:

- a. a change in the Work;
 - b. the amount of the adjustment in the Contract Sum, if any; and
 - c. the amount of the adjustment in the Contract Time, if any.
15. Code Inspector: A local or state agency responsible for the enforcement of applicable codes and regulations.
16. Concealed: Work not exposed to view in the finished Work, including within or behind various construction elements.
17. Construction Manager: The individual, partnership, corporation, joint venture, or any combination thereof, or its authorized representative, named as such by the Owner. If no Construction Manager is used on the Project that is the subject of this Contract, then all references to Construction Manager herein shall be read to refer to Owner.
18. Contract Amount: a change order price, line item price, Contract Sum, or other price assigned to a scope of work.
19. Contract Conditions or Conditions of the Contract: Consists of two parts: General Conditions and Supplementary Conditions.
- a. General Conditions are general clauses that are common to the Owner Contracts, including Section 00700 (General Conditions).
 - b. Supplementary Conditions modify or supplement General Conditions to meet specific requirements for Contract Documents, including Section 00800 (Supplementary Conditions – Insurance and Indemnification).
20. Contract Documents and Contract: Contract Documents and Contract shall consist of the documents identified as the Contract Documents in Section 00520 (Agreement), plus all changes, Addenda, and modifications thereto.
21. Contract Modification: Either:
- a. a written amendment to Contract signed by Contractor and Owner; or
 - b. a Change Order; or
 - c. a written directive for a minor change in the Work issued by Owner.
22. Contract Sum: The sum stated in the Agreement and, including authorized adjustments, the total amount payable by Owner to Contractor for performance of the Work and the Contract Documents. The Contract Sum is also sometimes referred to as the Contract Price or the Contract Amount.
23. Contract Time: The number or numbers of Days or the dates stated in the Agreement to achieve Substantial Completion of the Work or designated Milestones; and/or to achieve Final Completion of the Work so that it is ready for final payment and is accepted.
24. Contractor: The person or entity identified as such in the Agreement and referred to throughout the Contract Documents as if singular in number and neutral in gender. The term “Contractor” means the Contractor or its authorized representative.
25. Contractor’s Employees: Persons engaged in execution of Work under Contract as direct employees of Contractor, as Subcontractors, or as employees of Subcontractors.
26. Day: One calendar day of 24 hours measured from midnight to the next midnight, unless the word “day” is specifically modified to the contrary.
27. Defective: An adjective which, when modifying the word “Work,” refers to Work that is unsatisfactory or unsuited for the use intended, faulty, or deficient, that does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents (including, but not limited to, approval of Samples and “or equal” items), or has been damaged prior to final payment (unless responsibility for the protection thereof has

- been assumed by Owner). Unapproved substitutions are defective. Owner is the judge of whether Work is Defective.
28. Drawings: The graphic and pictorial portions of Contract Documents, wherever located and whenever issued, showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.
 29. Equal: Equal in opinion of Owner. Burden of proof of equality is responsibility of Contractor.
 30. Exposed: Work exposed to view in the finished Work, including behind louvers, grilles, registers, and various other construction elements.
 31. Field Directive: A written order prepared and signed by Owner, directing a change in the Work and stating a proposed basis for adjustment, if any, in the Contract Sum or Contract Time, or both.
 32. Final Acceptance or Final Completion: Owner's acceptance of the Work as satisfactorily completed in accordance with Contract Documents. Requirements for Final Acceptance/Final Completion include, but are not limited to:
 - a. Final cleaning is completed.
 - b. All systems having been tested and accepted as having met requirements of Contract Documents.
 - c. All required instructions and training sessions having been given by Contractor.
 - d. All Project Record Documents having been submitted by Contractor, reviewed by Owner, and accepted by Owner.
 - e. All punch list Work, as directed by Owner, having been completed by Contractor.
 - f. Generally all Work, except Contractor maintenance after Final Acceptance/Final Completion, having been completed to satisfaction of Owner.
 33. Force Account: Work directed to be performed without prior agreement as to lump sum or unit price cost thereof, and which is to be billed at cost for labor, materials, equipment, taxes, and other costs, plus a specified percentage for overhead and profit.
 34. Furnish: Supply only, do not install.
 35. Indicated: Shown or noted on the Drawings.
 36. Install: Install or apply only, do not furnish.
 37. Latent: Not apparent by reasonable inspection including, but not limited to, the inspections and research required as a condition to Bidding under Section 00700 (General Conditions).
 38. Law: Unless otherwise limited, all applicable laws including without limitation all federal, state, and local laws, statutes, standards, rules, regulations, ordinances, and judicial and administrative decisions.
 39. Material: This word shall be construed to embrace machinery, manufactured articles, materials of construction (fabricated or otherwise), and any other classes of material to be furnished in connection with Contract, except where a more limited meaning is indicated by context.
 40. Milestone: A principal event specified in Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all Work.
 41. Modification: Same as Contract Modification.
 42. Not in Contract or "NIC:" Work that is outside the scope of Work to be performed by Contractor under Contract Documents.
 43. Notice of Completion: Shall have the meaning provided in California Civil Code Section 9204, and any successor statute.
 44. Off Site: Outside geographical location of the Project.

45. Owner: See Section 00520 (Agreement).
46. Owner-Furnished, Contractor Installed: Items furnished by Owner at its cost for installation by Contractor at its cost under Contract Documents.
47. Owner's Project Manager: If used elsewhere in the Contract Documents, "Owner's Project Manager" shall mean a person representing the Owner in the administration of the Contract Documents. When Owner's Project Manager is referred to within the Contract Documents and no Owner's Project Manager has in fact been designated, then the matter shall be referred to Owner. If Owner's Project Manager is an employee of Owner, Owner's Project Manager is the beneficiary of all Contractor obligations to Owner, including without limitation, all releases and indemnities.
48. Owner's Representative(s): Owner's Representative(s) includes Owner's Project Manager as defined in Section 00520 (Agreement) and includes those individuals defined in Section 01315 (Project Meetings).
49. Partial Utilization: Use by Owner of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all of the Work.
50. PCBs: Polychlorinated biphenyls.
51. Phase: A specified portion of the Work (if any) specifically identified as a Phase in Section 00520 (Agreement) or Section 01100 (Summary).
52. Product Data: That information (brochures, catalog sheets, manufacturer's cut sheets, etc.) supplied by vendors having technical and commercial characteristics of the supplied equipment or materials and accompanying commercial terms such as warranties, instructions, and manuals.
53. Progress Report: A periodic report submitted by Contractor to Owner with progress payment invoices accompanying progress schedule. See Section 00700 (General Conditions).
54. Project: Total construction of which Work performed under Contract Documents may be whole or part.
55. Project Manual: Project Manual consists of Bidding Requirements, Agreement, Bonds, Certificates, Contract Conditions, Drawings, and Specifications.
56. Project Record Documents: All Project deliverables required under the Contract Documents, including without limitation, as-built drawings and Installation, Operation, and Maintenance Manuals.
57. Provide: Furnish and install.
58. Request for Information ("RFI"): A document prepared by Contractor requesting information regarding the Project or Contract Documents. The RFI system is also a means for Owner to submit Contract Document clarifications or supplements to Contractor.
59. Request for Proposals ("RFP"): A document issued by Owner to Contractor whereby Owner may initiate changes in the Work or Contract Time as provided in Contract Documents. See Section 01250 (Modification Procedures).
60. Request for Substitution ("RFS"): A document prepared by Contractor requesting substitution of materials as permitted and to the extent permitted in Contract Documents. See Section 01600 (Product Requirements).
61. RFI-Reply: A document consisting of supplementary details, instructions, or information issued by Owner that clarifies or supplements Contract Documents, and with which Contractor shall comply. RFI-Replies do not constitute changes in Contract Sum or

- Contract Time except as otherwise agreed in writing by Owner. RFI-Replies will be issued through a contract management system.
62. Samples: Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
 63. Shop Drawings: All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
 64. Shown: As indicated on Drawings.
 65. Site: The particular geographical location of Work performed pursuant to the Contract Documents.
 66. Specifications: The written portion of the Contract Documents consisting of requirements for materials, equipment, construction systems, standards, and workmanship for the Work; performance of related services.
 67. Specified: As written in Specifications.
 68. Subcontractor: A person or entity that has a direct contract with Contractor to perform a portion of the Work at the Site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and neutral in gender and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.
 69. Substantial Completion: The Work (or a specified part thereof) has progressed to the point where, in the opinion of Owner as evidenced by a notice or certificate of Substantial Completion, the Work is sufficiently complete, in accordance with Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended, and unperformed or incomplete work elements are minor in nature; or if no such certificate is issued, when the Work (or specified part) is complete and ready for final payment as evidenced by written recommendation of Owner for final payment. The terms "Substantially Complete" and "Substantially Completed" as applied to all or part of the Work refer to Substantial Completion thereof.
 70. Supplemental Instruction: A written directive from Owner to Contractor ordering alterations or Modifications that do not result in change in Contract Sum or Contract Time, and do not substantially change Drawings or Specifications.
 71. Testing and special inspection agency: An independent entity engaged to inspect and/or test the workmanship, materials, or manner of construction of buildings or portions of buildings, to determine if such construction complies with the Contract Documents and applicable codes.
 72. Underground Facilities: All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities that have been installed underground to furnish any of the following services or materials: Electricity, gases, chemicals, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems, or water.
 73. Unit Price Work: Shall be the portions of the Work for which a unit price is provided in Section 00520 (Agreement) or Section 01100 (Summary).
 74. Work: The entire completed construction, or the various separately identifiable parts thereof, required to be furnished under the Contract Documents within the Contract Time. Work includes and is the result of performing or furnishing labor and furnishing

- and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents including everything shown in the Drawings and set forth in the Specifications. Wherever the word "work" is used, rather than the word "Work," it shall be understood to have its ordinary and customary meaning.
75. Work Day: See Section 01100 (Summary).
- B. Other Defined Terms: The following terms are not necessarily identified with initial caps; however they shall have the meaning set forth below:
1. Wherever words "as directed," "as required," "as permitted," or words of like effect are used, it shall be understood that direction, requirements, or permission of Owner is intended. Words "sufficient," "necessary," "proper," and the like shall mean sufficient, necessary, or proper in judgment of Owner. Words "approved," "acceptable," "satisfactory," "favorably reviewed," or words of like import, shall mean approved by, or acceptable to, or satisfactory to, or favorably reviewed by Owner.
 2. Wherever the word "may" or "ought" is used, the action to which it refers is discretionary. Wherever the word "shall" or "will" is used, the action to which it refers is mandatory.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Temporary Electricity
 - 2. Temporary Telephone
 - 3. Temporary Water
 - 4. Temporary Sanitary Facilities
 - 5. Temporary Barriers and Enclosures
 - 6. Tree and Plant Protection
 - 7. Water Control
 - 8. Removal of Temporary Facilities and Controls

1.2 DEFINITIONS

- A. Dripline: The area on the ground from the trunk of any tree to the point directly below the outermost tips of the foliage of that tree.
- B. Tree Protection Zone (TPZ): A space above and below ground within which trees are to be retained and protected. May extend beyond the Dripline when practical. The areas to be enclosed with tree protection fencing as indicated.
- C. Tree damage: Tree damage shall include, but not be limited to, the following: significant injury to the root system or other parts of a tree including burning, application of toxic substances, damaging through contact with equipment or machinery, changing the natural grade within the TPZ, compacting the soil within the TPZ, interfering with the normal water requirements of the tree, unauthorized trenching or excavating within the TPZ, or unauthorized removal of more than 1/3 of the live wood, foliage, or roots.

1.3 SUBMITTALS

- A. None.

1.4 TEMPORARY ELECTRICITY

- A. Contractor may make arrangements with Owner to use the 120-VAC convenience power receptacles at the Site, if needed. If voltages other than 120-VAC (or higher loads than the existing circuits can provide) are required, make separate arrangements for such service with Pacific Gas and Electric Company.

1.5 TEMPORARY TELEPHONE

- A. Provide, maintain, and pay for telephone service to field office at time of Project mobilization.

1.6 TEMPORARY WATER

- A. Contractor may use Owner-provided water on site for use on this Project. Contact Owner three Days prior to commencement of Work to coordinate using Owner's water. Should Owner determine, in its sole discretion, that Contractor's use of Owner's water is excessive, Owner may terminate water delivery. No other Owner-provided water will be made available to Contractor for this Project.

1.7 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required temporary buildings with sanitary toilets for worker use.
- B. Comply with minimum requirements of the Health Department or other public agency having jurisdiction; maintain in a sanitary condition at all times.

1.8 TEMPORARY BARRIERS AND ENCLOSURES

- A. Provide barriers to prevent unauthorized entry to construction areas, to allow for Owner's use of Site, and to protect existing facilities and adjacent properties from damage from construction operations.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide concrete or galvanized-steel bases for supporting posts.
- C. Provide barricades required by governing authorities to control public access to existing buildings.
- D. Protect vehicular traffic, stored materials, Site, and structures from damage.
- E. Provide Portable Chain-Link Fencing oak trees at Driplines, or further if practical, to create a TPZ.
- F.
- G.

1.9 TREE AND PLANT PROTECTION

- A. Root protection:
 - 1. No storage of materials or equipment will be allowed within the TPZ
 - 2. Whenever possible, excavation shall be on a radial line, diverging from the tree trunk.
- B. Exposure to harmful substances: No storage or dumping of any substances that may cause minimum Tree Damage shall occur at any location on the Site.
- C. Where construction is to be performed in the vicinity of trees and shrubbery, the Work shall be carried on in a manner that will cause minimum Tree Damage. Owner will designate trees that are to be removed. Under no circumstances are additional trees to be removed without written permission from Owner. Trees and shrubbery that are not to be removed shall be protected from injury or damage resulting from Contractor's operations.
- D. Limb Protection: Use small construction equipment as necessary to minimize removal of or avoid damage to overhanging tree branches. Remove limbs only when directed by Owner. Prune or remove limbs, if authorized, in accordance with ANSI A300. "Heading" of any tree will not be permitted.

- E. Damage shall be immediately reported to Owner, who will file a report so that remedies may be determined.
- F. For any tree that is removed without Owner's permission or is irreparably damaged, in the opinion of Owner, Owner may elect to pursue any of the following remedies in its sole discretion:
 - 1. Require Contractor to repair by pruning, if possible, or replace trees not intended for removal. Whether or not a tree can be repaired by pruning will be determined by Owner. Subsequent pruning, if appropriate, shall be conducted by a Certified Arborist at Contractor's expense.
 - 2. Require Contractor to remove trees that cannot be repaired by pruning, and replace with new trees of minimum 4 inch caliper.
 - 3. Assess money damages in the amount of \$27.00 per square inch of cross section, measured at 4 ½ feet above ground, but not less than \$250.00, which damages shall be deducted from monies due or to become due under the Contract. If tree protection is not performed or is not performed adequately, and Owner determines that a tree has been irreparably damaged, Owner may assess the same damages as for unauthorized removal of a tree.

1.10 WATER CONTROL

- A. Protect Site from puddling or running water.
- B. Provide water barriers as required to protect Site from soil erosion.

1.11 MOISTURE AND MOLD CONTROL

- 1. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- 2. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - a. Protect porous materials from water damage.
 - b. Protect stored and installed material from flowing or standing water.
 - c. Keep porous and organic materials from coming into prolonged contact with concrete.
 - d. Remove standing water from decks.
 - e. Keep deck openings covered or dammed.
- 3. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - a. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - b. Keep interior spaces reasonably clean and protected from water damage.
 - c. Periodically collect and remove waste containing cellulose or other organic matter.
 - d. Discard or replace water-damaged material.
 - e. Do not install material that is wet.
 - f. Discard, replace, or clean stored or installed material that begins to grow mold.
 - g. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

1.12 REMOVAL OF TEMPORARY FACILITIES AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials prior to final inspection.

- B. Clean and repair damage caused by installation or use of temporary Work.
- C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01501

FIELD OFFICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS AND PROVISIONS:

All Contract Documents should be reviewed for applicable provisions related to the provisions in this document, including without limitation:

- A. General Conditions;
- B. Special Conditions; and
- C. Temporary Facilities and Controls.

1.02 SECTION INCLUDES:

- A. Requirements for Field Offices and Field Office Trailers.

1.03 SUMMARY:

- A. General: Contractor shall provide Owner's Field Office Trailer and contents, for Owner's use exclusively, during the term of the Contract.
- B. Property: Trailer, furniture, furnishings, equipment, and the like, supplied by the Contractor with the Office Trailer shall remain the property of the Contractor; Owner property items installed, delivered, and the like by Owner within the Office Trailer will remain Owner's property.
- C. Modifications: Owner reserves the right to modify the trailer or contents, or both, as may be deemed proper by Owner.
- D. Condition: Trailer and contents shall be clean, neat, substantially finished, in good, proper, and safe condition for use, operation, and the like; the trailer and contents shall not be required to be new.
- E. Installation Timing: Provide safe, fully furnished, functional, proper, complete, and finished trailer properly ready for entire use, within fourteen (14) calendar days of Owner's notification of the issuance of Notice to Proceed.

1.04 SUBMITTALS:

- A. General: Submit submittals to Owner in quantity, format, type, and the like, as specified herein.
- B. Office Trailer Data: One (1) copy of manufacturer's descriptive data, technical descriptions, regulatory compliance, industry standards, installation, removal, and maintenance instructions.
- C. Equipment Data: Two (2) copies of manufacturer data for each type of equipment, if directed by Owner.

- D. Furniture and Furnishings Data: Two (2) copies of manufacturer data for each type of equipment, if directed by Owner.
- E. Plans: One (1) reproducible copy of appropriately scaled plans of trailer layout. Plans shall include, but not be limited to: lighting; furniture; equipment; telephone and electrical outlets; and the like.
- F. Product Samples: One (1) complete and entire unit of each type, if directed by Owner.

1.05 QUALITY ASSURANCE

- A. Standards: In the event that provisions of codes, regulations, safety orders, Contract Documents, referenced manufacturer's specifications, manufacturer's instructions, industry standards, and the like, are in conflict, the more restrictive and higher quality shall govern.
- B. Installer: Installer or Installers engaged by Contractor must have a minimum of five (5) years of documented and properly authenticated successful experience of specialization in the installation of the items or systems, or both, specified herein.
- C. Manufacturer: Contractor shall obtain products from nationally and industry recognized Manufacturer with five (5) years minimum, of immediately recent, continuous, documented and properly authenticated successful experience of specialization in the manufacture of the product specified herein.
- D. State Personnel Training: Provide proper training for maintenance and operations, including emergency procedures, and the like, as directed by Owner.
- E. Units: Shall be sound and free of defects, and shall not include any damage or defect that will impair the safety, installation, performance, or the durability of the entire Office Trailer and appurtenant systems.

1.06 REGULATORY REQUIREMENTS

- A. General: Work shall be executed in accordance with applicable Codes, Regulations, Statutes, Enactments, Rulings, Laws, each authority having jurisdiction, and including, but not limited to, Regulatory Requirements specified herein.
- B. California Building Standards Code ("CBSC").
- C. California Code of Regulations, Title 25, Chapter 3, Sub Chapter 2, Article 3 ("CCR").
- D. Coach Insignia: Trailer shall display California Commercial Coach Insignia; such insignia shall be deemed to show that the trailer is in accordance with the Construction and Fire Safety requirements of CCR.

PART 2 - PRODUCTS

2.01 FIELD OFFICE TRAILER

- A. General: Provide entire Field Office Trailer of type, function, operation, capacity, size, complete with controls, safety devices, accessories, and the like, for proper and durable installation. Partitions, walls, ceiling, and other interior and exterior surfaces shall be appropriately finished, including, but not limited to, trim, painting, wall base, floor covering, suspended or similar ceiling, and the like; provide systems, components, units, nuts, bolts, screws, anchoring devices,

fastening devices, washers, accessories, adhesives, sealants, and other items of type, grade, and class required for the particular use, not identified but required for a complete, weather-tight, appropriately operating, and finished installation.

- B. Manufacturers: General Electric Capital Modular Space; The Space Place, Inc.; or equal.
- C. Program: Provide a wheel-mounted trailer with stairs, landings, platforms, ramps, and the like, in good, proper, safe, clean, and properly finished condition; with proper heavy duty locks, and other proper and effective security at all doors, windows, and the like. Trailer shall be maintained in good, proper, safe, clean, and properly finished condition during the Contract.
 - (1) Nominal Trailer Size: Four hundred eighty (480) square feet, minimum.
 - (2) Restroom with flushable toilet and sink. Contractor to provide domestic water, sanitary tank and waste pumping and disposal service.
 - (3) Stairs, Platform: Properly finished stairs, platforms, and ramps.
 - (4) Doors: Two (2), three (3) foot wide exterior doors with locksets; finished ramp, steps, and entry platform at each exterior door.
 - (5) Keys: Submit five (5) keys for each door, window, furniture unit, and the like. There shall be no other key copies or originals available; each key shall be identified for Owner; and shall be labeled, or tagged or both, as directed by Owner.
 - (6) HVAC: Appropriately sized Heating and Airconditioning system.
 - (7) Lighting: Sixty-five (65) foot-candles illumination minimum at any point, at thirty (30) inches above finished floor throughout from fluorescent light source, exclusively, or as directed by Owner.
 - (8) Electrical Outlets: One (1) duplex outlet evenly spaced every twelve (12) linear horizontal feet of wall face, and electrical service ready for use.

2.02 FIELD OFFICE TRAILER ITEMS

- A. General: Provide the Field Office Trailer with the following arranged into two (2) workstations:
 - (1) Desks: Two (2) desks: thirty-six (36) inches by sixty (60) inches; steel, laminated plastic top; locking, one (1) or two (2) file drawers single pedestal; steel; provide five (5) keys to Owner.
 - (2) Tables: six (6) folding tables; thirty-six (36) inches by sixty (60) inches; twenty-nine (29) inches high; steel, laminated plastic top tables; one (1) at each desk and four for meeting space.
 - (3) Chairs: Two (2) chairs: swivel; steel; with seat cushion and arms; one (1) at each desk. 10 folding chairs at meeting table
 - (4) Waste Baskets: Two (2) waste baskets, one at each desk.
- B. Furniture and Equipment: Provide in the space located to effect efficient and logical use.
 - (1) File cabinet: One (1); four (4) drawer; lateral; steel locking.

- (2) Bookshelf: One (1) bookshelf: thirty-six (36) inches deep by seventy-two (72) inches wide by forty-two (42) inches high; adjustable; wood or steel; with lockable plan and pencil drawer.
- (3) Waste Baskets: One (1) large waste basket.
- (4) Coat/Hat Hanger: Wall mounted with minimum capacity for four (4) garments and ten (10) hats.
- (5) Document Management System: Shall include an integrated high-volume printer, copier, and facsimile machine, including stand, base, and storage cabinet; and shall include the following features:
 - (a) Type: Laser, dry electrostatic transfer, plain paper, digital, multi-function imaging system.
 - (b) Network: Ethernet or Token Ring network ready, Plug-and-Play.
 - (c) Print, send/receive facsimile from any connected workstation.
 - (d) Resolution: Six hundred (600) dots per inch by six hundred (600) dots per inch, minimum.
 - (e) Print Speed: Twenty (20) pages per minute, minimum.
 - (f) Copies: Twenty (20) copies per minute, minimum.
 - (g) Document Handler: Forty (40) sheet, minimum
 - (h) Collator: Forty (40) bin, minimum, with stapling.
 - (i) Duplexing: Capable.
 - (j) Paper Size: Capable of handling paper sizes to eleven (11) inches by seventeen (17) inches.
 - (k) Paper Cassettes: One (1) each for eight and one half (8.5) inches by eleven (11) inches, eight and one half (8.5) inches by fourteen (14) inches, and eleven (11) inches by seventeen (17) inches paper sizes; minimum two hundred fifty (250) sheets per cassette.
 - (l) Reduction/Enlargement: Capable of reduction to twenty-five percent (25%) and enlargement to two hundred percent (200%).
 - (m) Facsimile Electronic Storage: Capable of storing minimum of fifty (50) speed dial numbers, group faxing and broadcast faxing.
 - (n) Facsimile Scanning: Capable of scanning into memory a minimum of one hundred (100) pages with maximum scan time of three (3) seconds per page.
 - (o) Halftone: Sixty-four (64) levels.
 - (p) Redial: Automatic and Manual.

- (6) Maintenance: Contractor shall purchase service agreements for each unit of equipment for the duration of the project plus two (2) months, and shall maintain all equipment in proper working condition. Service agreements shall include provision for replacement of toner cartridges and other items required to effect proper unit use. Service agreements shall also provide for:
 - (a) Unlimited Service Calls.
 - (b) Same Day Response.
 - (c) All parts, labor, preventative maintenance and mileage.
 - (d) All chemicals, such as toner, fixing agent, and the like.
 - (e) System training and setup.

2.03 UTILITY AND SERVICES

- A. High Speed Internet Service with WIFI: Contractor shall provide, configure and shall properly and timely pay for high speed internet services with WIFI access for Owner's use.
- B. Electrical Service: Provide all proper connections and continuously pay for service for the duration of the Work.

2.04 FINISHES

- A. General: Manufacturer standard finish system over surfaces properly cleaned, pretreated, and prepared to obtain proper bond; all visible surfaces shall be coated.
- B. Finish: Color as selected by Owner from manufacturer standard palette.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Properly prepare area and affected items to receive the Work. Set Work accurately in location, alignment, and elevation; rigidly, securely, and firmly anchor to appropriate structure; install plumb, straight, square, level, true, without racking, rigidly anchored to proper solid blocking, substrate, and the like; provide appropriate type and quantity of reinforcements, fasteners, adhesives, self-adhesive and other tapes; lubricants, coatings, accessories, and the like, as required for a complete, structurally rigid, stable, sound, and appropriately finished installation, in accordance with manufacturer's published instructions, and as indicated. The more restrictive and higher quality requirement shall govern. Moving parts shall be properly secured, without binding, looseness, noise, and the like.
- B. Installation: Install in accordance with 25 CCR 3.2.3 and as directed by Owner; jack up trailer and level both ways; mount on proper concrete piers with all load off wheels; provide required tie down and accessories per Section 4368 of referenced CCR, and as directed by Owner.
- C. Rejected Work: Work, materials, unit, items, systems, and the like, not accepted by Owner shall be deemed rejected, and shall forthwith be removed and replaced with proper and new Work, materials, unit, items, systems, and the like at no cost to Owner.

- D. Standard: Comply with manufacturer's published instructions, or with instructions as shown or indicated; the more restrictive and higher quality requirement shall govern.
- E. Location: As directed by Owner.
- F. Fire Resistance: Construct and install in accordance with UL requirements.
- G. Maintenance: Contractor shall maintain trailer and adjacent areas in a safe, clean and hygienic condition throughout the duration of the Work, and as directed by Owner. Properly repair or replace furniture or other items, as directed by Owner. Properly remove unsafe, damaged, or broken furniture, or similar items, and replace with safe and proper items. Contractor shall pay cost of all services, repair, and maintenance, or replacement of each item.
- H. Janitorial Service: Provide professional janitorial services, including, but not limited to, trash, waste paper baskets, fill paper dispensers; clean and dust all furniture, files, and the like; sweep and mop resilient and similar flooring; and vacuum carpeting and similar flooring.
 - (1) Frequency: One (1) time per week, minimum.
- I. Removal: Properly remove the Office Trailer and contents from the Site upon completion of the Contract, or as directed by Owner in writing. Forthwith properly patch and repair affected areas; replace damaged items with new items. Carefully and properly inventory, clean, pack, store, and protect Owner property; submit Owner property to Owner at a date, time and location as directed by Owner.

END OF SECTION

SECTION 01510

STORM WATER POLLUTION PREVENTION PLAN

PART 1 GENERAL

1.1 SUBMITTALS

- A. Storm Water Pollution Prevention Plan (SWPPP).

1.2 STORM WATER POLLUTION PREVENTION PLAN

- A. Prior to commencement of Work at the Site, obtain Owner approval on a Storm Water Pollution Prevention Plan (SWPPP) prepared in accordance with:
 - 1. The Caltrans Storm Water Quality Handbooks:
 - a. Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual; and
 - b. Construction Site Best Management Practices (BMPs) Manual.
- B. Revise and update the SWPPP whenever there is a change in construction operations that may affect the Site drainage patterns or discharge of pollutants to surface waters, groundwaters, or a separate municipal storm sewer system.
- C. Failure to fully comply with these requirements shall subject Contractor to fines, damages, and job delays incurred due to failure to implement the SWPPP.
- D. .
- E. Furnish SWPPP to Owner upon Owner's request.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01540

SITE SECURITY AND SAFETY

Supplements Section 00700, Paragraph 15.2

PART 1 GENERAL

1.1 SUBMITTALS

- A. Safety Program.

1.2 PROTECTION

- A. Continuously maintain protection as necessary to protect the Work, as a whole and in part, and adjacent property and improvements from accidents, injuries or damage.
- B. Properly protect the Work:
 - 1. With lights, guard rails, temporary covers and barricades.
 - 2. Enclose excavations with proper barricades.
 - 3. Brace and secure all parts of the Work against storm and accident.
 - 4. Provide such additional forms of protection that may be necessary under existing circumstances.
- C. Provide and maintain in good condition all protective measures required to adequately protect the public from hazards resulting from the Work and to exclude unauthorized persons from the Work. When regulated by Building Code, Cal OSHA, or other authority, such legal requirements for protection shall be considered as minimum requirements. Be responsible for the protection in excess of such minimum requirements as required.

1.3 CONTROL OF SITE

- A. Ensure that no alcohol, firearms, weapons, or controlled substance enters or is used at the Site. Immediately remove from the Site and terminate the employment of any employee found in violation of this provision.

1.4 SAFETY PROGRAM

- A. Prior to starting any Work at the Site, submit a Safety Program that has been reviewed and approved by an Industrial Hygienist certified by the American Board of Industrial Hygiene or by a Certified Safety Professional. The Safety Program shall include the name, certification number, and certification seal of the Industrial Hygienist or Certified Safety Professional. Comply with the Safety Program and all applicable federal, state, and local regulation codes, rules, law and ordinances.
- B. Receipt and/or review of the Safety Program by Owner or Owner's Representative shall not relieve Contractor of any responsibility for complying with all applicable safety regulations.
- C. It is essential that Contractor and each Subcontractor implement an effective and vigorous Safety and Health Program to cover their respective portions of the Work. Subject to Contractor's overall responsibility for Project safety, it shall be understood that the full responsibility for providing a safe place to work with respect to their respective portions of the Work rests with each individual Contractor and Subcontractor.

D. Safety Program components:

1. Injury and Illness Prevention Program (IIPP): Conforming to the General Industrial Safety Orders (CCR Title 8, Division 1, Chapter 4, Subchapter 7, Section 3203), and the California Labor Code (Section 6401.7).
2. Site-Specific Safety and Health Plan (SSHP): Describing health and safety procedures that shall be implemented during the Work in order to ensure safety of the public and those performing the Work. Follow the guidelines for a SSHP listed in CCR Title 8, Division 1, Chapter 4, Subchapter 7, Section 5192, Item (b)(4) f.
3. Fire protection plan that has been reviewed and acknowledged by the Santa Rosa Fire Department. It is recommended that the plan include, but not be limited to, a discussion of the following items:
 - a. Equipment spark arresters
 - b. Fire-extinguishing equipment on hand
 - c. Method of operation in case of fire
 - d. Notification to authorities of any fire
 - e. Access available during performance of Work
 - f. Educating workers of fire protection plan
 - g. Storage protection for flammable materials
 - h. Ventilation and illumination equipment

E. The wearing of hard hats shall be mandatory at all times for personnel on Site. Supply sufficient hard hats to equip properly all employees and visitors.

F. Whenever an exposure exists, appropriate personal protective equipment (PPE) shall be used by all affected personnel. Supply PPE to all personnel under Contractor's direction.

1.5 SAFETY REQUIREMENTS

A. Standards: Maintain the Project in accordance with state and local safety and insurance standards.

B. Hazards Control:

1. Store volatile wastes in covered metal containers and remove from premises daily.
2. Prevent accumulation of wastes that create hazardous conditions.
3. Provide adequate ventilation during use of volatile or noxious substances.

C. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

1. Do not burn or bury rubbish or waste material on the Site.
2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
3. Do not dispose of wastes into streams or waterways.

D. Provide accident information on the forms provided by Contractor. This information shall be provided on the same Day as the occurrence of said incident.

1.6 SITE SAFETY OFFICER

A. Designate one of Contractor's staff as "Site Safety Officer" whose duties shall include the responsibility for enforcing the environmental protection provisions of the Contract Documents including safety and health, the requirements of the Occupational Safety and Health Act, and other applicable federal, state and local standards. Submit a resume for Site Safety Officer describing experience, education, professional registrations, and experience

directly related to similar projects. Submit for review by Owner Contractor's intended traffic flow plan, security plan, program for temporary structures, housecleaning plan, demolition program, and environmental safety and health plan. After review by Owner, the implementation and enforcement of these plans shall become the responsibility of the Site Safety Officer. Any changes in the plans shall be requested by Contractor through the Site Safety Officer for written concurrence by Owner.

- B. Owner's risk management representative(s) shall be allowed access to accident/injury and illness reports, inspection reports, scheduling and construction meetings, and safety meetings.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01737

OPENINGS AND PENETRATIONS IN CONSTRUCTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 079000 (Joint Sealants)
- B. Section 099000 (Painting and Protective Coatings)
- C. Section 061000 (Rough Carpentry and Roofing)

1.2 REFERENCES

- | | |
|-------------|---|
| A. ACI 318 | Building Code Requirements for Structural Concrete |
| B. ASTM A36 | Standard Specification for Carbon Structural Steel |
| C. ASTM A53 | Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless |
| D. NFPA 70 | NEC |
| E. NFPA90A | Standard for Installation of Air Conditioning and Ventilating Systems |

1.3 DEFINITIONS

- A. Hazardous Areas: Areas shown in the Contract Documents as having Class I or Class II area classifications.
- B. Washdown Areas: Areas having floor drains or hose bibs.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. For each structure provide dimensioned or scaled (minimum 1/8 inch = 1 foot) plan view drawings containing the following information:
 - a. Vertical and horizontal location of all required openings and penetrations
 - b. Size of all openings and penetrations
 - c. Opening type
 - d. Seal type
- B. Quality Assurance/Control Submittals:
 - 1. Manufacturer's Instructions:
 - a. Installation of standard manufactured products

1.5 QUALITY ASSURANCE

- A. Obtain prior approval from Owner when any opening larger than 100 square inches must be made in existing or newly completed construction.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Pipe Sleeves: Steel, ASTM A53, Schedule 40, black.
- B. Pipe Sleeves Penetrating into Corrosive Areas: Stainless steel.
- C. Backing Rod and Sealant: See Section 079000 (Joint Sealants).
- D. Modular Mechanical Seals:
 - 1. Acceptable Manufacturers:
 - a. Link-Seal
 - b. Calpico, Inc.
 - c. Or Approved Equal
 - 2. 316 stainless steel bolts, nuts, and washers.
- E. Sheet Metal Sleeves: Steel, ASTM A36, 12 GA.
- F. Commercial Wall Castings:
 - 1. For Unclassified Areas both sides of penetration:
 - a. Ductile Iron, class equal to connecting piping system.
 - 2. For Wet/Corrosive Areas either side of penetration:
 - a. Stainless Steel, 304L.

PART 3 EXECUTION

3.1 INSTALLATION AND APPLICATION

- A. Perform HVAC penetrations in accordance with NFPA 90A.
- B. Perform electrical penetrations in accordance with NFPA 70, Article 501.
- C. Install sleeves and castings in accordance with ACI 318, Chapter #6.
- D. Hot dip galvanize or paint in accordance with Section 099000 (Painting and Protective Coatings) all steel sleeves installed.
- E. When mechanical or electrical Work cannot be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves, insets, fixtures or devices necessary to permit installation later. Lay out chases, holes or other openings that must be provided in masonry, concrete or other Work.
- F. Size sleeves, blockouts and cutouts that will receive sealant seal such that free area to receive sealant is minimized and seal integrity may be obtained.
- G. For insulated piping and ducts, size sleeves, blockouts and cutouts large enough to accommodate full thickness of insulation.
- H. Do not cut into or core drill any beams, joists, or columns.
- I. Do not install sleeves in beams, joists, or columns.
- J. Do not install recesses in beams, joists, columns, or slabs.
- K. Field Cutting and Coring:
 - 1. Saw or core drill with non-impact type equipment.
 - 2. Mark opening and drill small 3/4 inch or less holes through structure following opening outline.

3. Sawcut opening outline on both surfaces. Knock out within sawcuts using impact type equipment. Do not chip or spall face of surface to remain intact. Do not allow any overcut with saw kerf.
- L. Precast-Pre-stressed Concrete Construction:
 1. Do not cut openings nor core drill vertically or horizontally through stems of members.
 2. Do not locate or install sleeves or recess sleeves vertically or horizontally through or in stems of members.
 3. Cast openings and sleeves into flanges of units.
 4. Cast openings larger than 6 inch in diameter or 6 inch maximum dimension in units at time of manufacture.
 5. Cast openings smaller than 6 inch in diameter or 6 inch maximum dimensions in flanges of units at time of manufacture or field cut.
- M. Where alterations are necessary or where new Work joins existing, restore adjacent surfaces to their condition existing prior to start of Work.
- N. Provide waterstop plate/anchor flange for piping, ducts, castings and sleeves cast-in-place in concrete.
 1. For fabricated units, weld plate to sleeve, pipe, or ductwork.
 2. For commercial castings, cast water stop/anchor with wall pipe.
 3. Plate is to be same thickness as sleeve, pipe, casting or ductwork.
 4. For fabricated units, diameter of plate or flange to be 4 inch larger than outside diameter of sleeve, pipe or ductwork.
 5. For commercial castings, waterstop/anchor size to be manufacturer standard.
 6. Provide continuous around entire circumference of sleeve, pipe, or ductwork.
- O. Where area is blocked out to receive sheet metal sleeve at later date:
 1. If blockout size is sufficient to allow placement, utilize dowels for interface of initially placed concrete and sleeve encasement concrete that is placed later.
 - a. Size blockout based on sleeve size required plus 4 to 6 inches each side of sleeve for concrete encasement.
 - b. Provide #4 dowels at 12-inch spacing along each side of blockout with minimum of two dowels required per side.
 2. If blockout size is not sufficient to allow placement of dowels, provide keyway along all sides of blockout.
 - a. Size blockout based on sleeve size required plus 2 to 4 inches each side of sleeve for concrete encasement.
- P. For interior wall applications where backer rod and sealant are specified, provide backer rod and sealant at each side of wall.
- Q. Use full depth expanding foam sealant for seal applications into hazardous areas and applications where multiple pipes, conduits, etc. pass through single sleeve. Use full depth compressible sealant for applications involving single components passing through sleeves and for penetrations into non-hazardous area.
- R. Do not make duct or conduit penetrations below high water levels when entering or leaving tankage, wet wells, or other water holding structures.
- S. Modular Mechanical Seals:
 1. Utilize one seal for concrete thickness less than 8 inches and two seals for concrete 8 inch thick or greater.

2. Utilize two seals for piping 16 inches in diameter and larger if concrete thickness permits.
3. Install seals such that bolt heads are located on the most accessible side of the penetration.

T. Backer Rod and Sealant:

1. Install in accordance with Section 079000 (Joint Sealants).
2. Provide backer rod and sealant for modular mechanical seal applications. Apply on topside of slab penetrations and on interior, dry sidewall penetrations.

3.2 SCHEDULES

A. General Schedule of Penetrations through Floors, Roofs, Foundation Base Slabs, Foundation Walls, Foundation Footings, Partitions and Walls for Ductwork, Piping, and Conduit:

1. Provide the following opening and penetration types:
 - a. Type A - Block out 2 inches larger than outside dimensions of duct, pipe, or conduits.
 - b. Type B - Saw cut or line-drill opening. Place new concrete with integrally cast sheet metal or pipe sleeve.
 - c. Type C - Fabricated sheet metal sleeve or pipe sleeve cast-in-place. Provide pipe sleeve with water ring for wet and/or washdown areas.
 - d. Type D - Commercial type casting or fabrication.
 - e. Type E - Saw cut or line-drill opening. Place new concrete with integrally cast pipe, duct or conduit spools.
 - f. Type F - Integrally cast pipe, duct, or conduit.
 - g. Type G - Saw cut or line-drill and remove area 1 inch larger than outside dimensions of duct, pipe or conduit.
 - h. Type H - Core drill.
 - i. Type I - Block out area. At later date, place new concrete with integrally cast sheet metal or pipe sleeve.
2. Provide seals of material and method described as follows.
 - a. Category 1 - Modular Mechanical Seal.
 - b. Category 2 - Roof curb and flashing according to SMACNA specifications unless otherwise noted on Drawings. Refer to Section 061000 (Rough Carpentry and Roofing) for additional requirements.
 - c. Category 3 - 12 GA sheet metal drip sleeve set in bed of silicon sealant with backing rod and sealant used in sleeve annulus.
 - d. Category 4 - Backer rod and sealant.
 - e. Category 5 - Full depth compressible sealant with escutcheons on both sides of opening.
 - f. Category 6 - Full depth compressible sealant and flanges on both sides of opening. Flanges constructed of same material as duct, fastened to duct and minimum 1/2 inch larger than opening.
 - g. Category 7 - Full depth compressible sealant and finish sealant or full depth expanding foam sealant depending on application.
3. Furnish openings and sealing materials through new floors, roofs, partitions and walls in accordance with Schedule A, Openings and Penetrations for New Construction.

4. Furnish openings and sealing materials through existing floors, roofs, partitions and walls in accordance with Schedule B, Openings and Penetrations for Existing Construction.

**SCHEDULE A. OPENINGS AND PENETRATIONS
FOR NEW CONSTRUCTION**

	DUCTS		PIPING		CONDUIT	
APPLICATIONS	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY
Through floors with bottom side a hazardous area	C F I	7 Not Required 7	D F I ⁽¹⁾	Not Required Not Required 7	C F	7 Not Required
Through floors on grade above water table	C F I	4 Not Required 4	C F I ⁽¹⁾	7 Not Required 7	C F I ⁽¹⁾	4 Not Required 7
Through slab on grade below water table	F	Not Required	F	Not Required	F	Not Required
Through floors in washdown areas	C I	4 4	C H ⁽²⁾ I ⁽¹⁾	4 3 4	F H ⁽²⁾ I ⁽¹⁾	Not Required 3 7
Through walls where one side is a hazardous area	C F I	7 Not Required 7	D F I ⁽¹⁾	Not Required Not Required 7	C F	7 Not Required
Through exterior wall below grade above water table	C F I	7 Not Required 7	C D F I ⁽¹⁾	1 Not Required Not Required 1	F I ⁽¹⁾	Not Required 7
Through wall from tankage or wet well (above high water level) to dry well or dry area	C F I	7 Not Required 7	C D F H ⁽²⁾	1 Not Required Not Required 1	C F H ⁽²⁾ I ⁽¹⁾	7 Not Required 7 7
Through wall from tankage or wet well (below high water level) to dry well or dry area	F	Not Required	F	Not Required	F	Not Required
Through exterior wall above grade	A B C	6 6 6	A B D H ⁽²⁾	5 5 Not Required 5	C H ⁽²⁾	5 4
Roof penetrations	A	2	A	2	A	2
Through interior walls and slabs not covered by the above applications	A C	4 4	A C	4 4	A C F	4 4 Not Required

⁽¹⁾ Multiple piping 3 inches and smaller or multiple conduits.

⁽²⁾ Single pipe 3 inches and smaller or single conduit.

**SCHEDULE B. OPENINGS AND PENETRATIONS
FOR EXISTING CONSTRUCTION**

	DUCTS		PIPING		CONDUIT	
APPLICATIONS	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY
Through floors with bottom side a hazardous areas	B E	7 Not Required	B ⁽¹⁾ E ⁽³⁾ H ⁽²⁾	7 Not Required y	B ⁽¹⁾ E ⁽³⁾ H ⁽²⁾	7 Not Required 7
Through floors on grade above water table	B	7	B	7	B	7
Through slab on grade below water table	E	Not Required	E	Not Required	E	Not Required
Through floors in washdown areas	G	3	G H ⁽²⁾	3 3	G H ⁽²⁾	3 3
Through walls where one side is in hazardous area	B E	7 Not Required	B ⁽¹⁾ B ⁽³⁾ E H ⁽²⁾	7 1 Not Required 7	B ⁽¹⁾⁽³⁾ E H ⁽²⁾	7 Not Required 7
Through exterior wall below grade above water table	B	7	B ⁽¹⁾ B ⁽³⁾ H ⁽²⁾	7 1 7	B ⁽¹⁾⁽³⁾ H ⁽²⁾	7 7
Through wall from tankage or wet well (above high water level) to dry well or dry area	B E	7 Not Required	B E H ⁽²⁾	1 Not Required 1	B ⁽¹⁾⁽³⁾ E H ⁽²⁾	7 Not Required 7
Through wall from tankage or wet well (below high water level) to dry well or dry area	E	Not Required	E	Not Required	E	Not Required
Through exterior wall above grade	G	6	G ⁽¹⁾⁽³⁾ H ⁽²⁾	5 5	G ⁽¹⁾⁽³⁾ H ⁽²⁾	5 7
Roof penetrations	G	2	G ⁽¹⁾⁽³⁾ H ⁽²⁾	2	G	2
Through interior walls and slabs not covered by the above applications.	G	4	G ⁽¹⁾⁽³⁾ H ⁽²⁾	4 4	G ⁽¹⁾⁽³⁾ H ⁽²⁾	4 4

⁽¹⁾ Multiple piping 3 inches and smaller or multiple conduits.

⁽²⁾ Single pipe 3 inches and smaller or single conduit.

⁽³⁾ Single pipe or conduit larger than 3 inches.

END OF SECTION

SECTION 01740

CLEANING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Progress Cleaning
 - 2. Final Cleaning
- B. Related Sections:
 - 1. Section 01510 (Storm Water Pollution Prevention Plan)

1.2 PROGRESS CLEANING

- A. Perform periodic cleaning to ensure that any streets and other Owner and public properties are maintained free from accumulation of waste materials, dust, mud, and debris.
- B. Where required, wet down surfaces to lay dust and prevent the blowing of dust to nearby residences or public properties.
- C. Keep paved roads clean and free of dust, mud, and debris resulting from Contractor's operations. Daily cleanup throughout the job will be required as Contractor progresses with its Work, but extra attention to cleanup shall be made prior to weekends and holidays. Without limiting the foregoing, remove trench spoil along traveled ways daily; grade and vacuum broom surfaces initially where applicable and later water flush with high-pressure sprays, being careful to avoid downstream contamination.
- D. Dust, mud, spoils, and construction debris shall be removed daily from roadways, ditches, shoulders, and private property (fills or spoils placed on private property at private property owner's written request excepted).
- E. Disposal of Materials:
 - 1. Waste materials, debris, and rubbish shall be disposed of at sites to be chosen by Contractor in accordance with applicable local, state, and federal regulations.
 - 2. Contractor is cautioned that the County of Sonoma and cities within the county have regulations governing the disposal of rubble, broken pavement, and similar materials.
 - 3. Become familiar with the requirements of the agency having jurisdiction over any contemplated disposal site and comply with such requirements.
- F. Excess soil from performance of Work shall be disposed at sites to be chosen by Contractor in accordance with applicable local, state, and federal regulations, and, if applicable, in accordance with Contractor's soil disposal plan. If Contractor elects to dispose of soil on any private property, prior to any such disposal, a letter allowing such disposal shall be obtained from the property owner and presented to Owner. The letter shall state that the property owner has complied with local, state, and federal laws with respect to disposal on property owner's property. Contractor is advised that the property owner is required to obtain a fill permit from PERMIT SONOMA. Regardless of the location of the disposal area, Contractor shall specify the location in the Storm Water Pollution Prevention Plan (SWPPP) as described in Section 01510 (Storm Water Pollution Prevention Plan), if any. Any requirements in the SWPPP that pertain to the area of Work shall also apply to the disposal area. In addition, placement of fill in wetland areas is subject to permit procedures of the

US Army Corps of Engineers. At the completion of Work, a letter from each affected property owner will be required releasing Contractor, Owner, and any Owner consultant from future liability.

- G. If Contractor does not properly clean the Site, in the opinion of Owner, then Owner shall have the option of using outside equipment to perform the cleanup and such cost will be withheld from the Contract Sum.

1.3 FINAL CLEANING

- A. Execute final cleaning prior to final inspection, using only properly skilled workers.
- B. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from exposed interior and exterior finished surfaces.
- C. Repair, patch, and touch up marred surfaces to match adjacent finishes.
- D. Clean interior and exterior surfaces exposed to view: remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- E. Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment operated during construction, clean ducts, blowers and coils of units operated without filters during construction.
- F. Clean Site.
- G. Mechanically sweep paved areas.
- H. Remove waste and surplus materials, rubbish, and construction facilities from Site.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01741

CONSTRUCTION MATERIAL WASTE MANAGEMENT PLAN

PART 1 GENERAL

1.1 CONSTRUCTION MATERIAL WASTE MANAGEMENT PLAN

- A. Submit Construction Material Waste Management Plan that includes, but is not limited to:
 - 1. Management monitoring program that includes, at a minimum, multiple recyclables containers. Goal is to divert 75 percent of materials waste to recycling instead of landfill. This applies only to materials that would typically be disposed via dumpster.
 - 2. Current recycling program used by each material supplier for materials listed in Divisions 1-16.
 - 3. Estimate of on-Site material reuse (native fill) in tons.
 - 4. Completed Self-Certification of Compliance for Contractor and each listed Subcontractor. Self-Certification of Compliance form is included at the end of this Section 01741.
 - 5. Identification of disposal sites.
 - 6. Method of disposal description.
 - 7. Evidence of written permission from disposal site owner.
 - 8. Copy of permits, as applicable.
- B. Submit monthly progress reports updated with waste management log that includes which material containers have been removed, how many have been removed, and the weight of those containers.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SELF-CERTIFICATION OF COMPLIANCE WITH
CONSTRUCTION MATERIAL WASTE PLAN**

Firm Name: _____ Phone: _____

Address: _____

Principal Service or Product: _____

- | | |
|---|---|
| <input type="checkbox"/> Prime Contractor | <input type="checkbox"/> Supplier of Material/Service |
| <input type="checkbox"/> Subcontractor | <input type="checkbox"/> Broker |

- | | |
|---|--|
| <input type="checkbox"/> Sole Ownership | <input type="checkbox"/> Corporation |
| <input type="checkbox"/> Partnership | <input type="checkbox"/> Joint Venture |

I, Contractor/Subcontractor, hereby certify that I have read and understood, and agree to adopt and implement, the approved Construction Waste Management Plan for the **Sonoma Clean Power Advanced Energy Center**.

Certified by:

Name: _____ Title: _____

Signature : _____ Date : _____

SECTION 01750

STARTING AND ADJUSTING

PART 1 GENERAL - NOT USED

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 CHECKOUT PROCEDURES

- A. Upon completion of installation, conduct an initial inspection and checkout of all mechanical and electrical equipment and devices.
 - 1. Clean the interior of piping, pumps, and other equipment and make free of foreign material. If applicable, lubricate equipment in accordance with the manufacturer's instructions.
 - 2. To the extent practicable, turn rotating equipment, operate valves and gates, and operate other equipment by hand to check for binding, and interference.
 - 3. Check incoming electric power for voltage amplitude and voltage balance.
 - 4. Check electric motor-driven equipment for correct rotation.
 - 5. Check all safety guards to insure they are in place.
- B. Conduct field tests including visual and mechanical inspection of the following:
 - 1. Proper grounding.
 - 2. Blockage of ventilating passageways.
 - 3. Mechanical and electrical noise in excess of specified levels.
 - 4. Installation of vibration isolators.
 - 5. Cooling liquid type and level.
 - 6. Operation of meters and instruments.

END OF SECTION

CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Requirements and procedures for:
 - a. Project cleaning
 - b. Testing of equipment and systems
 - c. Substantial Completion
 - d. Final Completion
 - e. Close Out
 - f. Warranties

1.2 SUBSTANTIAL COMPLETION

A. Removal of Temporary Construction Facilities and Project Cleaning:

1. Prior to Substantial Completion inspection: remove temporary materials, equipment, services, and construction; clean all areas affected by the Work; clean and repair damage caused by installation or use of temporary facilities; restore permanent facilities used during construction to specified condition.

B. Equipment and Systems:

1. Prior to Substantial Completion, Contractor shall start up, run for periods prescribed by Owner, operate, adjust and balance all manufactured equipment and Project systems including, but not limited to, mechanical, electrical, safety, fire, and controls.
2. Demonstrate that such equipment and systems conform to contract standards and manufacturer's guarantees. Where applicable, use testing protocols specified, and if the contract is silent, then consistent with manufacturer's recommendations and industry standards.

C. Procedure for Substantial Completion:

1. When Contractor considers Work or designated portion of the Work as Substantially Complete, and Installation, Operation, and Maintenance Manuals have been assembled and submitted to Owner, submit written notice to Owner, with list of items remaining to be completed or corrected and explanation of why such items do not prevent Owner's beneficial use and occupancy of the Work for its intended purposes. Within reasonable time, Owner will inspect to determine status of completion.
2. Should Owner determine that Work is not Substantially Complete, Owner will promptly notify Contractor in writing, listing all defects and omissions. Contractor shall remedy deficiencies and send a second written notice of Substantial Completion. Owner will reinspect the Work. If deficiencies previously noted are not corrected on reinspection, then Contractor shall pay the cost of the reinspection.
3. When Owner concurs that Work is Substantially Complete, Owner will issue a written notice or certificate of Substantial Completion, accompanied by Contractor's list of items to be completed or corrected as verified by Owner.

4. Before a notice or certificate of Substantial Completion will be issued:
 - a. Start-up manufactured units, equipment, and systems that require startup.
 - b. Submit warranty forms to Owner for approval prior to execution. Forms shall not detract from or confuse requirements or interpretations of Contract Documents. Warranty shall be countersigned by manufacturers. Where specified, warranty shall be countersigned by Subcontractors and installers.
5. A punch list examination will be performed upon Substantial Completion. One follow-up review of punch list items for each discipline will be provided. If further Site visits are required to review punch list items due to incompleteness of the Work by Contractor, Contractor shall reimburse Owner for costs associated with these visits.

1.3 FINAL COMPLETION

A. Requirements:

1. Final Completion occurs when Work meets requirements for Owner's Final Acceptance.

B. Procedure:

1. When Contractor considers Work is Finally Complete, submit written certification that:
 - a. Contractor has inspected Work for compliance with Contract Documents, and all requirements for Final Acceptance have been met.
 - b. Except for Contractor maintenance after Final Acceptance, Work has been completed in accordance with Contract Documents and deficiencies listed with Certificate of Substantial Completion have been corrected. Equipment and systems have been tested in the presence of Owner, and are operative.
 - c. Project Record Documents are completed and turned over to Owner, and Work is complete and ready for final inspection. Project Record Documents shall include, at a minimum, a clean full-size set of Contract Drawings with record red marks, dated, and "wet signed" by Contractor. Submit a full-sized PDF (scan) to Owner. Owner shall be the sole judge of the acceptability of the Project Record Documents.
2. In addition to submittals required by Contract Documents, provide submittals required by governing authorities and submit final statement of accounting giving total adjusted Contract Sum, previous payments, and sum remaining due.
3. Should Owner determine that Work is incomplete or Defective, Owner promptly will so notify Contractor, in writing, listing the incomplete or Defective items. Contractor shall promptly remedy the deficiencies and notify the Owner when it is ready for reinspection.

C. Final Adjustments of Accounts:

1. Submit a final statement of accounting to Owner, showing all adjustments to the Contract Sum and complete and execute Section 00650 (Agreement and Release of Any and All Claims).
2. If so required, Owner shall prepare a final Change Order for submittal to Contractor, showing adjustments to the Contract Sum that were not previously made into a Contract Modification.

D. Warranties:

1. Execute Contractor's Submittals and assemble warranty documents, executed or supplied by Subcontractors, suppliers, and manufacturers. Provide table of contents and assemble in 8½ inches by 11 inches three-ring binder with durable plastic cover, appropriately separated and organized. Assemble in Specification Section order.

2. Submit material prior to final Application for Payment. For equipment put into use with Owner's permission during construction, submit within 14 Days after first operation. For items of Work delayed materially beyond Date of Substantial Completion, provide updated Submittal within 14 Days after acceptance, listing date of acceptance as start of warranty period.
 3. Rejection of Warranties: Owner reserves right to reject unsolicited and coincidental product warranties that detract from or confuse requirements or interpretations of Contract Documents.
 4. Term of Warranties: For materials, equipment, systems, and workmanship, warranty period shall be one year minimum from date of Final Completion of entire Work except where:
 - a. Detailed Specifications for certain materials, equipment, or systems require longer warranty periods.
 - b. Materials, equipment, or systems are put into beneficial use of Owner prior to Final Completion as agreed to in writing by Owner.
- E. Warranty of Title:
1. No material, supplies, or equipment for Work under Contract shall be purchased subject to any chattel mortgage, security agreement, or under a conditional sale or other agreement by which an interest therein or any part thereof is retained by seller or supplier. Contractor warrants good title to all material, supplies, and equipment installed or incorporated in Work and agrees upon completion of all Work to deliver premises, together with improvements and appurtenances constructed or placed thereon by Contractor, to Owner free from any claim, liens, security interest, or charges, and further agrees that neither Contractor nor any person, firm, or corporation furnishing any materials or labor for any Work covered by Contract shall have right to lien upon premises or improvement or appurtenances thereon. Nothing contained in this paragraph, however, shall defeat or impair right of persons furnishing materials or labor under bond given by Contractor for their protection or any rights under law permitting persons to look to funds due Contractor in hands of Owner.
- F. Turn-In. Contract Documents will not be closed out and final payment will not be made until all keys issued to Contractor during prosecution of Work and letters from property owners, pursuant to Contract Documents, are turned in to Owner.
- G. Release of Claims. Contract Documents will not be closed out and final payment will not be due or made until Section 00650 (Agreement and Release of Any and All Claims) is completed and executed by Contractor and Owner.
- H. Fire Inspection Coordination. Coordinate fire inspection and secure sufficient notice to Owner to permit convenient scheduling (if applicable).
- I. Building Inspection Coordination. Coordinate with Owner a final inspection for the purpose of obtaining an occupancy certificate (if applicable).

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01810

COMMISSIONING

PART 1 GENERAL

1.1 DEFINITIONS

- A. Functional testing: testing necessary to determine if installed equipment and systems will operate in the manner in which they are intended to operate.

1.2 TESTING, ADJUSTING, AND BALANCING PROCEDURES

A. General:

1. After the initial checkout has been completed to the satisfaction of Owner per Section 01750 (Starting and Adjusting), commence functional testing, including start up and operation of individual subsystems, pieces of equipment and instruments.
2. Debug, tune-up, and adjust as necessary.
3. In addition to functional tests, specific testing shall be required of installed equipment and systems as specified in individual Specification Sections.
4. Work will not be accepted until all functional and specific tests have been satisfactorily performed.

B. Electrical and Mechanical Functional Tests:

1. Test system with normal power source connected to building load to verify:
 - a. Operating ability of connections and continuity of combiner boxes
 - b.
 - c. Operating ability and accuracy of power monitor and monitoring system
2. Debug, tune-up, and adjust as necessary.
3. Check grounds
4. Megger all wiring and provide Owner with test results

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 02 41 20

SELECTIVE BUILDING DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Selectively remove materials, systems, components, fixtures and equipment as designated and as required for completion of Project as indicated.
 - 1. Cap and identify active utilities.
- B. Related Sections:
 - 1. Section 01 50 00: Temporary enclosures and barriers.
 - 2. Section 01 73 00: Cutting and patching.
 - 3. Section 01 74 10: Waste management.
 - 4. Section 07 01 50: Removal of existing roofing system as required for Project.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Do not interfere with use of adjacent building spaces not in Project; maintain free and safe passage to and from.
 - 2. Prevent movement of structural components, provide and place bracing and be responsible for safety and support of structural components. Assume liability for movement, settlement, damage or injury.
 - 3. Cease operations and notify Architect immediately if safety of structural components appears to be endangered; take precautions to properly support structures. Do not resume operations until safety is restored.
 - 4. Prevent dust from selective demolition from contaminating adjacent occupied building areas; clean construction dust from adjacent occupied area immediately upon direction of Building Manager.
- B. Design/Build: Provide special engineering to ensure compliance with applicable codes and Contract Documents for support systems.

1.3 SUBMITTALS

- A. Action Submittals: Submit selective demolition operational sequence to ensure Project sequencing is consistent with Owner needs.
- B. Informational Submittals: Submit permits for transport and disposal of debris.

1.4 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to finish material pollution control and for construction waste.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Debris: Maintain possession of materials being demolished except where noted as a material for reinstallation or a material to be retained by Owner. Immediately remove debris from site.
 - 1. Immediately remove from site wet materials and materials with water stains, with mold, and with mildew.
- B. Materials for Reinstallation: Refer to Drawings for materials to be removed and reinstalled as part of new construction.
 - 1. Carefully remove, store and protect materials indicated to be reinstalled. Contact Owner and Architect prior to beginning demolition to determine extent of other materials that might be suitable for reinstallation.
- C. Owner Retained Materials: Contact Owner prior to beginning demolition to determine extent of materials to be retained. Carefully remove materials indicated to be retained by Owner; deliver and store where directed.

PART 3 - EXECUTION

3.1 EXISTING SERVICES

- A. Disconnect or remove utility services as required for completion of Project; disconnect, stub off, and cap utility service lines not required for new construction.
 - 1. Do not remove utilities discovered during demolition but not indicated without first determining purpose for utility; coordinate with Architect and Engineers.
- B. Do not disrupt services to adjacent building areas not in Project.
- C. Place markers to indicate location of disconnected services; identify service lines and capping locations on Project Record Documents.

3.2 DEMOLITION

- A. Demolish indicated appurtenances as indicated and as required for Project completion in an orderly and careful manner.
 - 1. Use methods that do not damage materials indicated to remain.
 - 2. Cut concrete and masonry using masonry saws and hand tools; provide sharp clean cuts requiring minimal patching for new construction.
 - 3. Use impact tools only where specifically approved in advance for areas where operations do not disturb building occupancy.
- B. Perform demolition in accordance with authorities having jurisdiction.

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- C. Remove demolished materials from site, unless otherwise directed.
 - 1. Remove from site, contaminated, vermin infested, and dangerous materials encountered and dispose of by safe means so as not to endanger health of workers or public.
- D. Remove tools and equipment upon completion of work; leave area in condition acceptable to Owner and Architect.

3.3 REPAIR

- A. Repair damage to adjacent construction caused as result of this work.
- B. Repair demolition beyond that required.

END OF SECTION

SECTION 03 1000

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) 347 "Recommended Practice for Concrete Formwork".
- C. American Plywood Association (APA) "Concrete Forming Guide".
- D. West Coast Lumberman Inspection Bureau (WCLIB) "Standard Grading Rules for West Coast Lumber".
- E. ACI SP-066 "ACI Detailing Manual".
- F. ACI 301 "Specifications for Structural Concrete".
- G. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice".

1.3 DESIGN REQUIREMENTS

- 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.
- 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.

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 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 Chapter 3 of ACI 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. Construct cambers specified in concrete members and slabs in the formwork.

2. 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.
 3. 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.
 4. Measure formwork for elevated structural slabs, columns, wall elevations points of maximum camber and submit in writing to the Architect/Engineer prior to placing concrete.
- B. Formwork Construction: Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 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.
- 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.

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.
 - 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 301.

3.10 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.

3.11 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 insure 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.
- 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.

3.12 CLEANING

- A. Remove excess material and debris associated with this work from the job site.

END OF SECTION

SECTION 03 2000

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) 301 "Specifications for Structural Concrete for Buildings".
- C. ACI 318 "Building Code Requirements for Reinforced Concrete and Commentary".
- D. ACI SP-066 "ACI Detailing Manual".
- E. American Society for Testing and Materials (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".
- H. American Welding Society (AWS) D1.4 – "Structural Welding Code for Reinforcing Steel".

- 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 SP-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 301, and ACI 318.
- 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. Exception: Bars #3 and smaller shall be Grade 40 minimum, unless otherwise noted on the drawings.
 2. Welded reinforcement shall be ASTM A706, or A615 meeting carbon requirements of AWS D1.4. Welding shall conform with AWS D1.4.
 3. All reinforcement to be unfinished.
- B. Tie Wire: No. 16 AWG or heavier, black annealed.
- C. Concrete Blocks: On-grade conditions only, as required to support reinforcing bars in position.
- D. 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.
- E. 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.
 3. Bars with reduced cross-section due to rusting or other cause.
- C. Tag reinforcement with durable identification to facilitate sorting and placing.

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.
- 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.

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. Footings: 3 inches to any soil face, 2 inches to top.
 2. Slabs (on grade): 2 inches to grade face, 1-1/2 inches to top face.

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 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.
- 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 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.

3.6 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. 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.

3.7 CLEANING

- A. Remove excess material and debris associated with this work from the job site.

END OF SECTION

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, beams, columns, elevated slabs, slabs-on-grade, walls, and retaining 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.
- B. American Concrete Institute (ACI) 211.1 "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete"; ACI 211.2 "Standard Practice for Selecting Proportions for Lightweight Concrete".

- C. ACI 301 "Specifications for Structural Concrete".
- D. ACI 302.1R "Guide for Concrete Floor and Slab Construction".
- E. ACI 304R "Guide for Measuring, Mixing, Transporting, and Placing Concrete".
- F. ACI 305R "Hot Weather Concreting".
- G. ACI 306R "Cold Weather Concreting".
- H. ACI 308 "Standard Practice for Curing Concrete".
- I. ACI 318 "Building Code Requirements for Reinforced 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. Shop Drawings: Proposed location of construction and cold joints. Proposed location of all slab construction/dowel joints, control joints, and blockouts.
- F. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.
- G. Batch Plant Certificates: Include with delivery of each load of concrete. Provide Certificates to the Testing Agency and the Architect/Engineer as separate submittals. Concrete delivered to the site without such certificate shall be

rejected and returned to the plant. Each certificate shall include all information specified in Article SOURCE QUALITY CONTROL below.

- 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 301 and ACI 318.
- B. Concrete construction verification and inspection to conform to CBC 1705.3.
- C. Common Sourcing: Provide each of the following materials from a single source for entire project.
 - 1. Cement.
 - 2. Fly ash.
 - 3. Aggregate.
- D. Follow recommendations of ACI 305R when concreting during hot weather. Follow recommendations of ACI 306R 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

- 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 306R:

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 305R:

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.
3. Provide sunshades and/or wind breakers to protect flat work during finishing and immediate curing operations. Do not place flatwork 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 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

- 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.
- 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.
- D. Water: 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. Mid Range Water Reducing Admixtures: ASTM C494 Type A, "MasterPolyHeed" (formerly "PolyHeed") series by BASF, "WRDA" series by W.R. Grace, or equal.
 - 2. High Range Water-Reducing Admixtures: ASTM C494 Type F, "MasterRheoBuild 1000" (formerly "RheoBuild 1000") or "MasterGlenium" (formerly "Glenium") series by BASF or equal.
 - 3. Water Reducing Admixture and Retarder: ASTM C494 Type B or D, "MasterPozzolith" (formerly "Pozzolith") series or "MasterSet DELVO" (formerly "DELVO") series by BASF, "Plastiflow-R" by Nox-crete, or equal.

4. Air Entraining Admixtures: ASTM C260, product suit condition by BASF or equal.
 5. Viscosity Modifiers: ASTM C494 Type S.
- 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" (formerly "Concresive Liquid LPL") by BASF;
 2. "Rezi-Weld 1000" by W.R. Meadows.
- B. Chemical Hardener: Fluorosilicate solution designed for densification of cured concrete slabs. "MasterKure HD 300 WB" (formerly "Lapidolith") by BASF, "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.
 3. Approved Equal.
- F. Evaporation Reducer: "MasterKure ER 50" (formerly Confilm), by BASF.
- G. Permeability Reducer: Use only where specifically referred to.
1. Admixture Type: Xypex Chemical Corporation "XYPEX Admix C-500". Dosage: 2-3% of cement content by weight; 15 lb/cu. yd. max. or BASF "MasterLife 300D" (formerly "Rheomac 300D"). Dosage: 2% of cement by mass.
 2. Surface-Applied Type: Xypex Chemical Corporation "XYPEX Concentrate. Brush application: 1.25-1.50lb/sq. yd., 5 parts powder to 2 parts water. BASF "MasterSeal 500" (formerly Tegraproof"). Slurry coat: one part water to 2.25-2.5 parts powder by volume.
 3. 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: "Servicised 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. 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.
 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 318 Section 26.4, including break histories, trial batching test results, and/or a mix designed by a California Registered Civil Engineer per ACI 318 Section 26.4.3.1(b) and bearing the Engineer's seal & signature.
 6. Clearly note on mix designs with specified maximum WCR 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 318 Section 19.2.1). 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 Cement Ratios (WCR). 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 WCR 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.
 - b. Such substitution requests may be denied by the Engineer.
 5. Water Content: Mix designs with a specified maximum Water Cement Ratio (WCR) 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 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 211.1 recommendations and this section.
- D. Special mix design requirements for interior concrete floor slabs on grade:
1. Proportion concrete mixes per this specification, ACI 211.1, and the requirements below:
 2. Fly Ash Type F, shall be substituted for cement on a 1 lb. per 1 lb. basis, with a minimum replacement of 25% and a maximum of 35%.
 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. Mix Design Minimum Requirements:

Concrete Class	Coarse Aggregate Size (Inches) & Fine Aggregate ³	Maximum WCR 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
2) Slab on Grade Exterior (Walks & Patios)	1" x #4	4" \pm 1"	2,500	4.5
STRUCTURAL				
3) Interior Slab on Grade ⁵	1" x #4	WCR = .45	3,000	6.1
4) Foundation (including stem walls)	1" x #4	WCR = .53	3,000	5.0

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 water cement ratio (WCR) is limited at time of placement as noted. No water is to be added on site such that the specified WCR 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 318 section 26.4.1.2 and ASTM C33.
4. Minimum cement content includes all cementitious materials.
5. See Article 2.6D for additional requirements at interior slabs on grade.

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.

- E. Do not add water at the site to concrete mixes with a maximum specified WCR unless the water content at batch time provides for a WCR 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 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 grade, 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. 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.
 - 5. 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-Grade:
 - 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.
- 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.

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.

D. 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.

E. Unacceptable Materials:

1. Do not place concrete that has started to set or stiffen. Dispose of these materials.
2. Do not add water on site to concrete except as specified in the approved mix design, see PART 2 above.

F. 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-Grade: Maximum Length of continuous placement shall not exceed 60 feet without special review by the Architect/Engineer. Alternate or stagger placement sections.
5. Foundations: 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.
6. 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 Floor Slabs-on-Grade:
 - 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 Paving (walkways, patios) and other non-structural concrete flatwork at grade:
 - 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.

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.
 - 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-Grade: Place concrete directly over sub-base as indicated.
 - a. Sub-Base: Clean free-draining, crushed base rock, 6 inch minimum thickness, thoroughly compacted.
 - 2. Interior Concrete Slabs-On-Grade:
 - a. Sub-Base: Clean free-draining, crushed base rock, 6 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 318 Section 26.11, ACI 301 Section 2, and this specification, except that maximum permissible deviation is 1/4 inch end-to-end for any single member.

3.9 CONCRETE FINISHES

- 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

- A. Minimum Flatwork Tolerances: Measure flatness of slabs within 48 hours after slab installation in accordance with ACI 302.1R 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 manufacturer and pertinent 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 308. Maintain concrete water content for proper hydration and minimize temperature variations. Begin curing immediately following finishing.
- 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.
- F. Flatwork on Grade: 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.
 - 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 Flatwork: Cure by one of the following methods.
 - 1. Moisture-Retaining Sheet: As specified for Flatwork on Grade above.
 - 2. Water Cure: As specified above for minimum 14 days.
 - 3. Apply Membrane Curing Compound as specified above after initial curing period.

- H. 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.
- I. 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.

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: Perform 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 in accordance with ASTM D143 and 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 upon arrival of transit mixers and when taking specimens. Note weather conditions and temperature.
 - 5. Propose adjustments to reviewed mix designs for Architect / Engineer review to account for variations in site or weather conditions, or other factors as appropriate.
 - 6. 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.

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-Grade, 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 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 as cementitious material: Test remaining cylinder(s) at 70 days. If strength requirements are met, concrete strength is acceptable.
 - 2. Excessive Shrinkage, Cracking, Cracking 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.
 - 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

SECTION 03 35 50

POLISHED CONCRETE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide polished of existing concrete flooring including preparation of concrete, curing, grinding, and sealing, as required for complete finished installation.

1.2 REFERENCES

- A. Terrazzo Technical Data, National Terrazzo and Mosaic Association, Inc. (NTMA).

1.3 SUBMITTALS

- A. Product Data: Furnish manufacturer's literature for curing materials.
- B. Samples: Furnish sample panels of polished concrete.
- C. Maintenance Instructions: Provide written instructions for recommended periodic maintenance.

1.4 QUALITY ASSURANCE

- A. Applicators: Firms with not less than ten years successful experience polishing concrete or terrazzo floor surfaces similar to that required for Project.
 - 1. Associated Terrazzo Co., Inc. (South San Francisco).
 - 2. All American Tile and Terrazzo Co., Inc. (Richmond, CA).
 - 3. San Francisco Terrazzo.
 - 4. Substitutions: Refer to Section 01 25 00.

1.5 QUALITY ASSURANCE

- A. Mock-Up: Erect minimum 100 square feet of integral colored polished concrete flooring at location as approved. Approved mock-up may be incorporated into Project.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System Description: Provide polished concrete flooring including preparation of concrete substrate, curing, grinding, and sealing.
- B. Accessibility Regulatory Requirements: Provide for assuring access for persons with disabilities in accordance with state and federal regulations for slip resistance.
 - 1. California Regulations: Comply with California Building Standards Code.

2. Federal Regulations: Comply with Americans with Disabilities Act (ADA) Standards.
 3. Slip Resistance: Provide non-slip finish with minimum wet and dry value coefficient of friction of 0.60 when tested in accordance with ASTM C1028 or comparable test indicating compliance.
- C. Curing Compound, Cleaning, Sealing and Finishing Compounds: As recommended by NTMA and manufacturer for terrazzo use.
1. Curing Compound: ASTM C309, Type 1.
 2. Cleaner: Free from crystallizing salts and water-soluble alkaline salts, biodegradable and phosphate free, Ph factor between 7 and 10.
 3. Sealer: Penetrating type specifically prepared for use on terrazzo and as required to produce slip resistant finish; sealer shall not discolor or amber; Ph factor between 7 and 10.
 - a. Sealer shall produce slip resistant surface.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to application of polish ensure surfaces are level, with maximum surface variation of 1/4" in 10'-0".
- B. Ensure surfaces are clean and well cured.
- C. Do not commence work until surface conditions are within tolerances required for proper finishing.
- D. Start of work indicates acceptance of conditions.

3.2 PREPARATION

- A. Clean concrete slab free from foreign matter.

3.3 INSTALLATION

- A. Produce polished concrete finish surface to match approved samples.
- B. Finish: Follow NTMA recommendations for finishing including rough grinding, grouting, curing grout, fine grinding, cleaning and sealing.
 1. Rough Grinding: Rough grind with 24 or finer grit stones or comparable diamond plates and follow with 80 or finer grit stones.
 2. Grouting: Clean and rinse floor, remove excess rinse water and machine or hand apply grout matching concrete. Take care to completely fill voids.

3. Fine Grinding: Fine grind with 100 or finer grit stones until grout is removed from surface, and polished finished matching approved sample is achieved.
4. Low Reflectivity Polish: Provide low reflectivity as can be generally attained with 400 grit stones where floor exhibits mat finish (low gloss reading).
5. Cleaning and Sealing: Clean after grinding and allow surface to thoroughly dry; apply sealer in accordance with manufacturer's directions.

3.4 CLEANING

- A. Use clean water and stiff bristle fiber brushes to clean polished concrete flooring.
- B. Do not use wire brushes, acid type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage polished concrete.

3.5 PROTECTION

- A. Protect finished floor until Substantial Completion.
- B. Repair or replace flooring system, including dividers, damaged prior to Substantial Completion.

END OF SECTION

SECTION 04 01 20

MASONRY RESTORATION AND CLEANING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide power wash cleaning of masonry surfaces, repoint mortar joints, rebuild damaged masonry work, add new masonry at infill openings to match existing, and protect adjacent non-masonry surfaces.

1.2 REFERENCES

- A. U.S. Department of the Interior, National Park Service: "The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings."
- B. U.S. Department of the Interior, National Park Service: "Preservation Briefs."
- C. U.S. Department of the Interior, National Park Service: "Preservation Tech Notes."
- D. Building Code: Comply with applicable requirements of California Building Code for masonry work.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Convene not less than one week prior to commencing work of this Section. Require attendance of those directly affecting work of this Section.
 - 1. Review installation procedures and coordination required with related work.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's literature for chemical cleaning materials.
- B. Certificates: Submit cleaning manufacturer's certification indicating cleaning has been done in accordance with manufacturer's recommendations and instructions.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with municipal or State regulations governing cleaning, scaffolding, and protection to adjacent properties.
- B. Manufacturer's Representative Recommendations: Manufacturer's representative shall review existing facilities and provide recommendations for cleaning and restoration.
- C. Mock-Up: Perform masonry restoration and cleaning on minimum 100 sq. ft. inconspicuous area as approved by Architect. Do not begin final restoration and cleaning until mock-up is approved by Architect.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System Description: Provide power wash cleaning of masonry surfaces, repoint mortar joints, rebuild damaged masonry work, add new masonry at infill openings to match existing, and protect adjacent non-masonry surfaces.
- B. Performance Requirements: Conform to referenced U.S. Department of the Interior "Standards", "Preservation Briefs", and "Preservation Tech Notes" unless more stringent requirements are indicated.
- C. Water: Clean, drinkable, free of deleterious materials.
- D. Masonry Units: Use masonry units removed from Project matching adjacent materials being restored to maximum extent possible; provide matching masonry units where units removed from Project are not available.
- E. Mortar: ASTM C270, Cement Lime mortar to match existing; not less than Type S for brick mortar, Type N acceptable for repointing interior work only.
- F. Hydrated Lime: ASTM C207.
- G. Quicklime: ASTM C5, nonhydraulic type.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Carefully remove and store fixtures, fittings, hardware, and accessories.
- B. Close off, seal, mask or board up areas, materials and surfaces not receiving restoration and cleaning work, to protect from damage.
- C. Protect windows, doorways, trim and other surfaces from damage and immediately remove stains, efflorescence, and excess materials resulting from restoration and cleaning work.
- D. Prevent wind drift of cleaning materials onto automobile and pedestrian traffic.
- E. Construct dustproof and weatherproof partitions to close off occupied areas from restoration and cleaning work.

3.2 REBUILDING AND INFILLING

- A. Cut out damaged and deteriorated masonry with care in a manner to prevent damage to adjacent remaining materials.
- B. Needle, shore and underpin structure as necessary in advance of cutting out units.
- C. Cut away loose or unsound materials and backing to provide firm and solid bearing for new work.

- D. Build in masonry units in accordance with code requirements and to match adjacent existing work.
- E. Mortar: Match existing adjacent mortar.
- F. Ensure anchors, ties, reinforcing, stone cramps and dowels, flashings are correctly located and built in.
- G. Build in openings, fittings and accessories to align with existing, with joints and coursing true and level, faces plumb and in line.

3.3 RESTORATION CLEANING

- A. Clean surfaces and remove large particles with wood scrapers or wire brush.
- B. Clean masonry using power wash method in strict accordance with local requirements and as required to remove dirt and stains but without undue damage to existing masonry beyond possible minor loss of mortar.
 - 1. Comply with recommendations of Secretary of Interior "Standards for the Treatment of Historic Properties."
 - 2. Clean masonry after routing of joints and replacement of damaged masonry units has been completed.
 - 3. Tuck pointing may take place after cleaning.
- C. Maintain procedures to assure uniform appearance.

3.4 TUCK POINTING

- A. Cut out loose or disintegrated mortar in joints to a minimum 1/2" depth, by hand or with power tools.
- B. Do not damage masonry units.
- C. When cutting is complete, remove dust and loose material.
- D. Tuck Pointing: Prevent mortar from staining face of surrounding masonry and other surfaces. Immediately remove mortar on exposed masonry surfaces and other surfaces no later than end of each day.
 - 1. Prepare mortar joints and apply pointing mortar in layers not greater than 1/4" until uniform depth is formed.
 - 2. Fully compact each layer and allow to become thumbprint hard before applying next layer.
 - 3. Tool final joint to match original appearance of joints using tools necessary to match original joint shapes.
 - 4. Cure mortar by maintaining thoroughly damp for at least 72 hours including weekends and holidays using methods that do not damage mortar joints.

3.5 CLEANING

- A. Promptly, as work proceeds and upon completion, remove excess mortar, smears, droppings.
- B. Clean adjacent and adjoining surface of marks arising out of execution of work of this Section.
- C. Clean up daily, sweep up and remove cleaning compounds and mixtures, dirt, debris and rubbish.

END OF SECTION

SECTION 05 1100

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 insure 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

- 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. Designation of Seismic Force Resisting System (SFRS) members and connections. Locate and dimension protected zones. Brace frame gusset plates shall be drawn to scale.
 - 6. Cross-reference all shop drawing detail references to contract document detail references.
 - 7. Secure all field measurements as necessary to complete this work prior to submitting shop drawings for review.
 - 8. Provide holes, welded studs, etc. as necessary to secure work of other sections.
 - 9. 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.
- 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

- 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 529 Gr. 50
- C. Structural Steel Channels, Angles: ASTM A36 or ASTM A572 Gr. 50.
- D. HSS (Hollow Structural Sections):
 - 1. Rectangular or Square: ASTM A500, Gr. B.
- E. 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.
- F. 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.
- G. Arc-Welding Electrodes: AWS Standards E70 or equivalent, except no E70T-4 allowed.

- H. Other Welding Materials: AWS D1.1; type required for materials being welded.
- I. Welded Headed/Threaded Studs: ASTM A108. Minimum yield strength is 51,000 pounds per square inch.

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. Non-metallic where exposed to view. BASF "MasterFlow 928" or equivalent.
- 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 joined members by continuous welds. Grind welds smooth where exposed to view and where noted on drawings.
- 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.
 - 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. 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.

- K. Back-Up Bars: Required for all complete penetration welds.

- L. 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
 - 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.

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:
 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.

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 2203.1 (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:
 - 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. Bolting:
 - 1. Inspect mating surfaces to insure 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 1/4 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.
 - 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.
- F. 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.

- G. 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.
- 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

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide stock and custom fabricated metal items scheduled at end of this Section, complete in respect to function as intended.
 - 1. Metal fabrications includes items made from iron and steel shapes, plates, bars, strips, tubes, pipes and castings which are not a part of structural steel or metal systems specified elsewhere.

1.2 REFERENCES

- A. American Welding Society (AWS): D1.1, Structural Welding Code.
- B. National Association of Architectural Metal Manufacturers (NAAMM): Pipe Rail Manual.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Railing Design/Build: Provide special engineering for railings to ensure railings comply with applicable codes and Contract Documents.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's literature for products used in metal fabrications, including paint, grout and manufactured items.
- B. Shop Drawings: Submit for fabrication and erection of metal fabrications. Indicate profiles, sizes, connection, reinforcing and anchorage.
 - 1. Provide templates for anchorage installation by others.
- C. Railing Design/Build Certificates: Submit certification signed by California licensed structural engineer indicating compliance with Contract Documents and code requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System Description: Provide stock and custom fabricated metal items.
- B. Steel Shapes, Plates and Bars: ASTM A36.
- C. Structural Steel Sheet: Hot rolled, ASTM A1011; or cold rolled, ASTM A1008, Class 1; of grade required for design loading.

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- D. Steel Pipe: ASTM A53, Type S seamless, grade as selected by fabricator and as required for design loading; minimum standard weight, STD or Schedule 40.
- E. Steel Tubing: Cold formed ASTM A500; or hot rolled, ASTM A501; minimum Grade B; seamless where exposed.
- F. Castings: Gray iron, ASTM A48, Class 30; malleable iron, ASTM A47.
- G. Stainless Steel: Type 304 stainless-steel, ASTM A269 for seamless tubing and ASTM A276 or A666 for bar stock.
 - 1. Finish: BHMA 630 (US32D) or NAAMM Number 4, satin directional polished stainless steel.
- H. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron ASTM A47, or cast steel ASTM A27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A153.
- I. Grout: Non-shrink meeting ASTM C1107, non-metallic, pre-mixed, factory-packaged, non-staining, non-corrosive; type specifically recommended by manufacturer as applicable to job condition.
- J. Fasteners and Rough Hardware: Type required for specific usage; provide zinc-coated fasteners for exterior use or where built into exterior walls.
- K. Welding Materials: AWS D1.1, type required for materials being welded.
- L. Paint: Provide primers as recommended by paint manufacturers for substrates and paints specified in Section 09 90 00 – Painting and Coating.
 - 1. Galvanizing Repair Paint: High zinc-dust content paint for regalvanizing welds in galvanized steel.

2.2 FABRICATION

- A. Fabricate items with joints neatly fitted and properly secured.
- B. Grind exposed welds continuous, smooth and flush with adjacent finished surfaces, and ease exposed edges to approximate 1/32" uniform radius.
- C. Exposed Mechanical Fastenings: Flush countersunk fasteners unobtrusively located, consistent with design of structure.
- D. Fit and shop assemble in largest practical sections for delivery.
- E. Make exposed joints flush butt type, hairline joints where mechanically fastened.
 - 1. Fabricate joints exposed to weather in manner to exclude water or provide weep holes where water could accumulate.
- F. Supply components required for proper anchorage of metal fabrications; fabricate anchorage and related components of same material and finish as metal fabrication.

- G. Railings: Comply with California and ADA Standards access requirements and NAAMM "Pipe Railing Manual"; welded construction; cap exposed ends.
1. Interior Railing Design Requirements: Design railings to support a lateral force of 50 lbs. /lin. ft. uniform load and 200 lbs. at any single point without permanent set or damage; ASTM E935.
 - a. Top Rails: Design to support minimum 300 lb. concentrated single point load applied at any point vertically or horizontally.
 2. Regulatory Requirements:
 - a. Access: Comply with California Building Standards Code and Americans with Disabilities Act (ADA) Standards for access for persons with disabilities.
 - b. Code: Comply with requirements of applicable codes for railing design, except where more restrictive codes are specified.
 3. Handrails: Seamless steel tube rails, 1-1/2" outside diameter, continuous railings conforming to applicable code and design requirements.
 4. Wall Rail Brackets: Castings as approved by Architect.
 5. Wall Returns: 90° elbow return with 1/4" maximum clearance unless otherwise indicated.
 - a. Provide wall plates only where indicated and where required by applicable codes.
 6. Exterior Railings: Stainless-steel with 1-1/2" diameter tube stock and 3/4" by 1-1/2" flat vertical 'supports; welded construction; finish welds to match adjacent stainless-steel.
- H. Ladders: Comply with requirements of ANSI A14.3 and Cal/OSHA; Contractor option steel or aluminum.
1. Rungs: Fit in centerline of side rails, plug weld and grind smooth on outer rail faces; provide non-slip surface on top of rung, similar to epoxy resin and aluminum oxide granules surface.
 2. Ladder Extensions: Provide 48" ladder extension device for fixed ladders under access hatches and floor doors.
 - a. Manufacturers:
 - 1) Bilco/LadderUP Safety Post.
 - 2) O'Keeffe's/Safety Post Model SP400.
 - 3) Precision Ladder/Extend-A-Rail.
 - 4) Substitutions: Refer to Section 01 25 00.

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3. Disappearing Ladders (Attic Stairs): Match Precision Ladders, LLC/Super Simplex Disappearing Stairway with standard box frame, 1/4" thick aluminum door, and with gas type shock absorber.
 - a. Load Rating: Not less than 500 lbs.
- I. Interior Screen Wall: Fabricate with 1-1/2" by 3" flat bar stock and 16-gage perforated metal; welded construction.
 1. Perforated Metal: Match McNichols/Hexagonal Perforated Metal as indicated, as selected by Architect from manufacturer's full range of hexagonal perforated metal where not indicated.
- J. Pre-Engineered Support Systems: Provide manufactured pre-engineered support system consisting of channel supports with anchors, attachments, and accessories as required for complete installation. Sizes to support anticipated loads.
 1. Manufacturers:
 - a. Unistrut Inc./Unistrut.
 - b. Grinnell Corp./PowerStrut.
 - c. Thomas & Betts, Inc./Superstrut.
 - d. Substitutions: Refer to Section 01 25 00.
 2. Finish: Manufacturer's standard prime paint finish for channel supports; galvanized or similar plated anchors and fasteners; hot dip galvanized where at exterior and exterior exposed applications.
- K. Finishes: Galvanize and prime paint exterior work and prime paint interior work unless otherwise noted in Schedule; comply with requirements of Section 09 90 00 - Painting and Coating for preparation and priming.
 1. Thoroughly clean surfaces of rust, scale, grease and foreign matter prior to applying finish.
 2. Do not shop prime surfaces in contact with concrete or requiring field welding; shop prime in one coat.
 3. Galvanized Coating: Provide coating comparable to ASTM A924 and A653, minimum G90 hot dip galvanized coating.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible; do not delay job progress; allow for trimming and fitting where necessary.

3.2 ERECTION

- A. Obtain Architect's review prior to site cutting and adjusting which are not part of scheduled work.
 - 1. Perform necessary cutting and altering for installation and coordination with other work.
- B. Install items square and level, accurately fitted and free from distortion or defects detrimental to appearance or performance.
 - 1. Supply items required to be cast into or embedded in other materials to appropriate trades.
 - 2. Ensure alignment with adjacent construction; coordinate with related work to ensure no interruption in installation.
- C. Make provision for erection stresses by temporary bracing; keep work in alignment.
- D. Field bolt and weld to match standard of shop bolting and welding; hide bolts and screws whenever possible, where not hidden, use flush countersunk fastenings.
 - 1. Perform field welding in accordance with AWS D1.1.
- E. After installation, touch-up field welds and scratched and damaged surfaces; use primer consistent with shop coat or recommended for galvanized surfaces, as applicable.
- F. Replace items damaged in course of installation and construction.

3.3 SCHEDULE

- A. Supply and install metal fabrications listed in Schedule, complete with anchorage and attachments necessary for installation.
 - 1. Schedule lists principal items only, refer to Drawings for items not listed.
- B. Schedule:
 - 1. Miscellaneous angles, plates and attachments to be set in concrete or masonry for anchorage of other items.
 - 2. Iron and steel shapes, sleeves, anchors, connectors and fastenings required to complete construction work, and which are not provided in other Specification sections.
 - a. Rough hardware, including bolts, fabricated plates, anchors, hangers, dowels and miscellaneous metals.
 - b. Angle and channel frames for doors and wall openings.
 - c. Beams of structural shapes not supported by structural steel.

3. Guard rails and handrails, exterior and interior, including stainless-steel rails.
4. Ladders.
5. Interior screen wall with perforated metal.
6. Pre-engineered support systems.

END OF SECTION

SECTION 06 1000ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: All labor, materials and equipment and all operations required to complete all rough carpentry and structural framing as indicated on the drawings; to produce shapes and configurations as shown, as required; and as specified herein, including:
1. Structural floor, wall, and roof framing.
 2. Floor, wall, and roof sheathing.
 3. Rough hardware, framing connectors and fasteners.
 4. Treatment of wood.
 5. Concealed wood blocking for support of toilet and bath accessories, wall cabinets, wood trim, and other work requiring supporting blocking.
 6. Miscellaneous wood nailers and furring strips, including roof applications, other wood framing, furring, shims or blocking as required to complete the work.
- B. Related Sections:
1. Pertinent sections of Division 01 specifying Quality Control and Testing Agency services.
 2. Pertinent sections of Division 01 specifying Structural Product Requirements: Structural Product Options, Substitution procedures and limitations, transportation, handling and storage.
 3. Pertinent sections of Division 03 specifying wood formwork construction and/or setting anchors in concrete.
 4. Pertinent section of Division 06 specifying wood construction and materials.
 5. Pertinent sections of other divisions specifying steel or concrete construction.

1.2 REFERENCES

- A. California Code of Regulations, Title 24, latest adopted edition (herein noted as CBC): Chapter 23 Wood.
- B. American National Standards Institute (ANSI) / American Wood Council (AWC) "NDS - National Design Specification for Wood Construction".
- C. National Institute of Standards and Technology (NIST) / Engineered Wood Association (APA) "PS 1 - Voluntary Product Standard for Structural Plywood".

- D. NIST / APA "PS 2 - Performance Standard for Wood-Based Structural-Use Panels".
- E. NIST "PS 20 - American Softwood Lumber Standard".
- F. Redwood Inspection Bureau (RIS) "Standard Specifications for Grades of California Redwood Lumber".
- G. West Coast Lumber Inspection Bureau (WCLIB) "Standard Grading Rules for West Coast Lumber No. 17".
- H. Western Wood Products Association (WWPA) "Western Lumber Grading Rules".
- I. American Wood Preservers Association (AWPA) "Book of Standards".

1.3 SUBMITTALS

- A. Submit in accordance with pertinent sections of Division 01 specifying submittal procedures. Submit for review prior to fabrication. Submittals that do not meet these requirements will be returned for correction without review.
 - 1. Substitutions for products specified require conformance to substitution requirements in Division 01.
 - 2. Review of materials and hardware for substitution to products specified is at the additional expense of the Contractor.
- 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. Product Data:
 - 1. Submit manufacturer's product data, specifications, and installation instructions for & location of framing connectors, wood preservative materials, application instructions, and fasteners. Include complete, accurate equivalence data when submitting alternate products to those specified. Provide samples of these items upon request.
 - 2. Submit product data and current ICC-ES report for machine-driven nails, fasteners, and equipment, including dimensions of all fasteners, including head, shank diameter and length.
 - 3. Submit samples of each and every type and size of proposed machine-driven nails and fasteners.
- D. Shop drawings: For manufactured wood products, 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. Indicate profiles, sizes, and spacing locations of structural members.

2. Cross-reference all shop drawing detail references to contract document detail references.
 3. Secure all field measurements as necessary to complete this work.
- E. Manufacturer's Certificate: Submit all certifications of physical and chemical properties of materials as specified below in Article titled QUALITY ASSURANCE.
1. Certify that wood products supplied for rough carpentry meet or exceed specified requirements, including specified moisture content.

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. Inspection of fabricators is required per CBC 1704.2 unless fabricator is registered and approved by the building official. Wood product quality standards:
 1. All wood products to comply with article REFERENCES.
 2. Factory-mark each piece of lumber and 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).
- D. End-Jointed lumber shall not be used.
- E. Hardware and engineered wood products shall have current ICC ES Evaluation/research reports that are equivalent to products specified.
- F. Employ competent workers experienced in work of the types specified and required.

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.
3. Provide special protection for horizontal sheathing panels. Deformation of panels due to moisture is not acceptable.

1.6 PROJECT/SITE CONDITIONS

- A. Verify all conditions at project site affecting the work; work to field dimensions as required. Coordinate carpentry installation with size, location, and installation of service utilities.
- B. Sequence rough carpentry installation activities to allow sufficient time for:
 1. Review of all submittals, including machine-driven nail sample submittals.
 2. Indicate submittal review, procurement, and testing activities in the project schedule prior to the start of installation. Installation durations shall be based on hand-nailed installation methods specified.
 3. Attainment of specified maximum lumber moisture content.

PART 2 - PRODUCTS

2.1 DIMENSIONED LUMBER

- A. General
 1. Size per industry standards for nominal sizes shown; S4S (sanded four sides).
 2. Warped/twisted and excessively checked members shall not be used regardless of grade marks.
 3. At the Contractor's option, engineered lumber of equivalent size and material properties may be substituted for solid sawn lumber where material is difficult to source due to length, availability, etc. Submit proposed substitution to Engineer for review prior to purchasing materials.
- B. Moisture content of framing:
 1. All lumber to be maximum 19% at time of fastener installation, except 3x and 4x studs may be 25% at time of sheathing panel nailing. All lumber to be maximum 19% at time of close-in, unless noted otherwise.
 2. The Owner's Testing Laboratory will test for moisture content prior to commencement of close-in.
 3. The Contractor shall recognize that excessive shrinkage of lumber results from excess moisture content at the time of installation. The Contractor will compensate for use of such lumber by waiting for acceptable moisture content before close in and/or by replacing/repairing lumber that has sagged, twisted, or warped prior to close in.

4. Deviation from this specification would require structural redesign of connections and fasteners.
- C. Sills/ledgers on concrete or masonry: No. 2 pressure treated Douglas Fir and as called for on the drawings.
- D. Interior structural framing shall be Douglas Fir (D.F.) with grades as noted below, unless otherwise specified on the drawings. All grades are per WCLIB standard grading rules.
1. All permanently exposed (interior or protected from weather) framing shall be select structural grade with no box heart.
 2. Except per 1 above, unless noted otherwise, minimum grades are:
 - a. Floor/roof joists/rafters (2x) and 2x8 & larger studs: D.F. No. 2
 - b. 2x4 and 2x6 studs and plates: D.F. No. 2
 - c. 4x and larger: D.F. No. 1
 - d. Blocking: D.F. No. 2
 - e. 6x8 and larger posts and beams may be SGL/CGL per below unless noted otherwise on the drawings.
- E. Exterior structural framing (exposed to weather) shall be redwood select structural grade or pressure treated D.F. No. 1, unless noted otherwise.
- F. Structural decking shall be D.F. select decking or White Pine select where not exposed to moisture. Where directly exposed to moisture or high humidity for prolonged periods of time, decking shall be Alaskan Yellow Cedar or Port Orford Cedar. Moisture content at time of installation to be less than 12%.
- G. Framing not otherwise shown or specified: Douglas Fir construction grade per WCLIB paragraphs applicable to uses and sizes required.

2.2 MANUFACTURED LUMBER

- A. Laminated Veneer Lumber (LVL): for use as joists, beams, blocking, or studs when so noted on the drawings. Conform to ICC AC 47. Minimum $F_b = 2,600$ PSI. Minimum $E = 1,900,000$ PSI. Acceptable products:
1. "Microllam LVL" by Trus Joist, ICC ESR-1387
 2. "Redlam LVL" by RedBuilt, ICC ESR-2993
 3. Approved equal
- B. Laminated Strand Lumber (LSL): for use as blocking (flat or vertical) or rim joist when used with I-joist or LVL, when so noted on the drawings. Conform to ICC AC 124. Minimum $F_b = 1,700$ PSI. Minimum $E = 1,300,000$ PSI. Acceptable products:
1. "Timberstrand LSL" by Trus Joist, ICC ESR-1387
 2. Approved equal

2.3 MANUFACTURED STRUCTURAL PANELS

- A. Plywood: Structural sheathing shall conform to product standard PS-1 or PS-2. All panels shall have an exterior exposure rating and bear the trademark of the Engineering Wood Association (APA) or other qualified agency. Grades shall be as required on the drawings.
- B. 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.

2.4 TREATED WOOD:

- A. Treated Lumber and Plywood: Comply with requirements of AWP Standard U1. See Standard U1 for "Use Category" designations. Do not provide higher Use Category lumber than that specified. Maximum moisture content shall be the same as required for "dimensioned lumber" as specified above.
- B. Preservative Treated Lumber
 - 1. General
 - a. Preservatives shall be waterborne. Preservative retention rate shall be as required per AWP Standards U1 & T1. Lumber shall be Douglas Fir No. 2 (or better). Cut faces of treated wood shall be brush treated (two complete applications) prior to installation.
 - b. Lumber less than 8 inches above grade and lumber less than 6 inches above exterior hard-surface flatwork shall be treated.
 - c. Each piece of wood shall be stamped by the wood preservative applicator to identify its treatment and preservative retention.
 - 2. Lumber at interior, non-weather exposed locations installed adjacent to concrete or masonry shall be Use Category UC2. Examples include sill plates & ledgers and lumber in contact with roofing, flashing, or water proofing.
 - 3. Lumber at exterior locations, not in contact with soil/ground, shall be Use Category UC3B. Examples include Douglas Fir decking and deck framing.
 - 4. Lumber in contact with soil/ground shall be Use Category UC4A. Examples include timber retaining walls.
 - 5. Poles, posts, and sheathing panels shall be treated as recommended by AWP Standard U1 per use and exposure.
 - 6. Maximum Volatile Organic Compound (VOC) content of field-applied preservative shall meet local air quality standards and the California Green Building Code. Provide either of the following:
 - a. Copper Azole (CA-B) per ICC-ES AC143.
 - b. Alkaline/Copper/Quaternary (ACQ).
- C. Fire Retardant Treatment: Product and application process must be recommended by manufacturer of treatment as being suitable for painting. Application shall be by a California State Fire Marshal approved licensed contractor.

1. Exterior Type: Use Category UCFB, chemically treated, and pressure impregnated; capable of providing a maximum flame spread rating of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
 - a. Treat exposed exterior rough carpentry items, including stairways, balconies, and covered walkways.
 - b. Do not use treated wood in direct contact with the ground.
2. Interior Type: Use Category UCFA, low temperature (low hygroscopic) type, chemically treated, and pressure impregnated; capable of providing a maximum flame spread rating of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Treat rough carpentry items as indicated.
 - b. Do not use treated wood in applications exposed to weather or where the wood may become wet.

2.5 FASTENERS AND ACCESSORIES

A. General requirements for fasteners:

1. Fasteners shall be of adequate size, spacing, and number to resist design loads under intended use, and types shall be appropriate for the materials or conditions for which used.
2. Provide washers, pre-drilling, etc. as required for proper installation and to prevent damage to framing.
3. Fasteners shall be hot-dip galvanized (ASTM A153), mechanically galvanized (ASTM B695 class 55 minimum), stainless steel (type 303, 304, 305, or 316), silicon bronze, or copper by approved methods for the following applications:
 - a. Exterior, exposed use.
 - b. In contact with preservative or fire-retardant treated wood.
4. Fasteners in moist corrosive atmosphere to be of stainless steel (type 303, 304, 305, or 316).
5. Where the retention level of ACQ or MCQ preservative is greater than 0.40 pcf, CBA-A preservative is greater than 0.41 pcf, or CA-B preservative is greater than 0.21 pcf, provide stainless steel fasteners (type 303, 304, 305, or 316).
6. All fasteners specified by manufacturer shall be installed in framing hardware, unless noted otherwise.

B. Nails and nailing not otherwise shown or specified:

1. Comply with requirements of governing building code.
2. For securing materials to hardened concrete or masonry provide hardened steel masonry nails or Simpson Strong-Tie "Titen" screws.

3. For framing and general woodwork: Common bright wire nails (not box nails) per ASTM F1667. 16d cement coated sinker nails may be used in lieu of common nails for framing, where noted on the drawings.
 4. Nails for sheathing panels shall be of common wire with full round heads and shall be of sufficient length to fully develop the nails.
 5. Machine-driven nails of all types must comply with the requirements of this section. All proposed nails shall match diameter and penetration of specified nails.
 6. Staples shall conform to length and gauges specified and shall be installed to match specified patterns and spacing.
 7. Powder-Driven Pins (PDP): Use only as approved by the Architect/Engineer; operators shall be qualified.
- C. Bolts: Malleable iron washers or steel plate washers, unless otherwise shown, shall be provided under all bolt heads and nuts.
1. Machine Bolts: ASTM A307 and ANSI/ASME B18.2.1, standard semi-finished machine bolts as shown or required. Nuts shall be standard size unless noted otherwise and shall be per ASTM A563.
 2. Anchor bolts or threaded rod anchors shall conform to ASTM F1554, ASTM A307, or ASTM A36. Anchor bolts shall be headed or end in two nuts tightened against one another, unless noted otherwise. Provide embedded plate washer as indicated on drawings. No upset threads allowed. No L or J bolts allowed.
- D. Lag screws: Standard hex lag screws per ANSI/ASME B18.2.1.
- E. Wood screws: Standard wood screws per ANSI/ASME B18.6.1.
- F. Powder-Driven Pins (PDP): Hilti X-CP72, ICC ESR-2379; Simpson PDPWL-300 MG, ICC ESR-2138.
- G. Framing hardware: Fabricated sheet metal timber framing connectors shall be manufactured from painted or galvanized G90 steel by Simpson Strong-Tie (connectors specified on drawings are per Simpson Strong Tie, USP Lumber Connectors, or approved equivalent. Connectors shall be at least 16 gauge material, (1/8 inch plate materials where welded), unless otherwise noted, punched for nailing. All heavy hardware to be fabricated from A36 steel per Division 05, Metals. All hardware intended for exterior exposed use shall be galvanized per G185 ASTM A653 or stainless steel.
1. For contact with preservative or fire-retardant treated wood, provide minimum G185 galvanizing per ASTM A653.
 2. Nails and nailing shall conform to the manufacturer's instructions with a nail provided for each punched hole. Nails to be used with framing accessories are subject to the requirements specified in this Section for fasteners and anchors.
- H. Subfloor Glue: Water proof, water base, air cure type, cartridge dispensed conforming to APA Standard AFG-01 or ASTM D3498. Maximum Volatile

Organic Compound (VOC) shall meet local air quality standards and the California Green Building Code.

2.6 SOURCE QUALITY CONTROL

- A. The Testing Agency, as specified in the Article QUALITY ASSURANCE, will perform testing for moisture content of all lumber at time of fastener installation.
- B. The Testing Agency will submit reports as specified in Division 01.

PART 3 - EXECUTION

3.1 REQUIREMENTS FOR STRUCTURAL FRAMING

- A. General
 - 1. Refer to drawings for layouts, notes and details, provide framing as required; comply with governing building code requirements.
 - 2. Provide framing to achieve true alignments as surfaces receiving finish materials.
 - 3. It shall be the responsibility of the Contractor to provide and install all wood blocking, furring strips, or grounds detailed or required to provide anchorage for all finishes, accessories, fixtures, etc. as required to complete all work. All blocking and/or backing shall be securely bolted or otherwise anchored in place.
 - 4. Contractor shall be responsible for layout of anchor bolts, and other hardware embedded in concrete when placed by other trades.
 - 5. Provide and install all structural framing, blocking, fasteners, brackets, clips, etc. as required to complete work specified in the Construction Documents.
- B. Framing
 - 1. Sill Plates and Ledgers:
 - a. Sill plates and ledgers on concrete shall be anchored with bolts, unless noted otherwise, shall have full bearing on concrete, and shall be placed for sheathing panel nailing as indicated. All bolt nuts shall be provided with a cut plate steel washer for bearing on wood.
 - b. Provide a minimum of two sill anchor bolts per sill piece with a bolt no less than 4 ½" and no more than 12" from the end of the sill. Bolts to be 5/8" diameter x 12" (18" at curb) long at 48" on centers, unless otherwise shown or noted. Provide additional anchor bolts each side of a notch or hole, as per a typical plate splice, where notch or hole is in excess of 1/3 the plate width. At shear walls, provide a plate washer 3" x 3" x 0.229" minimum between the sill and nut at anchor bolts. Plate washer to extend within ½ inch of the structural wall sheathing. Offset and/or stagger anchor bolts, or provide larger plate washer as required.

- c. Anchor bolt holes in sill plates or ledgers shall be 1/16" maximum larger than anchor bolt.
2. Stud Walls and Framing:
 - a. Cut studs and posts with square ends, unless otherwise shown or noted. All posts and beams shall be "cut to bear" unless otherwise detailed.
 - b. All studs in walls shall be placed with the shortest dimension parallel to the run of the wall. Bearing studs shall extend full height to be the supporting framing as shown; non-bearing studs shall extend to the supporting framing.
 - c. Provide double studs on each side of all openings, unless shown or noted otherwise.
 - d. All openings in stud walls and partitions shall be framed with headers across the top, as shown, with a minimum size (6" nominal depth x stud width) resting on short cripple studs, and as shown on the drawings.
 - e. All stud partitions and walls shall have horizontal solid blocking not less than 2x and of the same width as the stud, fitted and nailed into the studs at mid-height of stud, for studs over 8 feet in height, except as otherwise shown or specified. This blocking shall be so spaced that there shall be no concealed air spaces greater than eight feet in any dimension.
 - f. Stud partitions containing plumbing, heating or other pipes shall be so framed as to give proper clearance for piping. Plumbing, heating and vent pipes exceeding 1-1/2" in inside diameter shall not be placed in partitions used as bearing or shear walls unless completely furred clear of the wall. No notching shall be allowed. Pipes shall be placed in the center of the plate using a neat bored hole and the plates shall be strapped on each side with 3" x 36" x 14 gauge steel punched for 10d nails 3" on center, staggered, or as shown on the drawings.
3. Top Plates
 - a. Top plates shall be double, set single. Corners where stud wall or partitions meet shall be framed with studs on all surfaces and blocking to form a "rigid" corner with nailing for all corners. Double top plates shall be lapped at corners. Lap splices and nailing per the drawings.
4. Floor, Roof and Ceiling Framing
 - a. Joists and beams shall be accurately aligned and the position and spacing of all joists and beams shall be as shown and be coordinated with other framing and to other trades prior to actual construction.
 - b. Place all joists and beams with crown up. Cantilevered joists and beams shall be placed with the crown down.
 - c. Cutting of wood girders, beams or joists for electrical and mechanical lines shall be limited to cuts and bored holes not deeper than 1/5 of the beam depth from the top and located not farther from the support than three times the beam depth and not less than the beam depth. Cuts in excess of this, or single bored holes with a diameter of more than 1" are not permitted without

- special provisions for framing the beams. Location of all cuts in framing shall receive the prior review of the Architect/Engineer.
- d. Provide vent holes in rafters and/or blocking as shown and/or directed by the Architect.

3.2 STRUCTURAL SHEATHING

A. General

1. Sheathing nailing 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.
2. Form sheathing may be re-used for concealed sheathing provided the lumber at the time of re-use is approved by the Architect, meets with the framing grade requirements specified herein, is in good condition, and is thoroughly cleaned with all nails removed.
3. Pneumatic nailing devices shall be adjustable so that nail heads do not penetrate skin of sheathing. Contractor shall submit equipment and nails for review prior to use. Refer to PART 2 for other nailing requirements.

- B. Roof and Floor Sheathing: Except "Panelized Roofs", lay with face grain perpendicular to roof rafters, roof trusses or floor joists. Stagger sheets. Block all unsupported sheet edges with 2x 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 2x materials unless noted otherwise.

- D. Panelized Roofs: Where sheathing is set @ 8'-0 1/8" spacing, cut every fourth sheet short by 1/2" to re-align structural framing that has been specified to be spaced at even units of 2, 4 or 8 feet.

3.3 ROUGH HARDWARE

- A. General: Nails, spikes, screws, fabricated sheet metal anchors, ties, hangers and any other materials shown or required for the attachment of wood to concrete and wood to steel and wood to wood shall be furnished and installed as part of this work.

- B. Framing Nailing: All framing nailing shall conform to minimum requirements of the Building Code, and with details shown on the drawing.

- C. Bolts, Lag Screws and Washers:

1. Bolts in wood shall be machine bolts unless otherwise noted and shall be of such length that the bearing length of the treads does not exceed 1/4 of the full bearing length in the member holding the treads. Bolt holes in wood shall be 1/32" oversized. Bolt holes for sill plates may be 1/16" maximum oversize. Holes in steel shall be 1/16" oversize. See Section 3.1 for anchor bolts at sill plates and ledgers.

2. Provide square plate or malleable iron washer and nut at head where bearing is against wood; cut washer under nut where it is against steel. Washer will not be required under head of carriage bolts. Provide malleable iron washers where exposed.
 3. All nuts shall be tightened when placed and retightened at completion of the job or immediately before closing with final construction.
 4. Lag screws shall be screwed (not driven) into place. Drill pilot hole to 70% of shank diameter. Drill clearance hole to full shank diameter and depth of unthreaded screw length.
- D. Wood Screws: Minimum penetration is 10 diameters unless noted otherwise. Where fastening hardwood timber species or where wood tends to split, provide pilot hole 70% of screw shank diameter.

3.4 INSTALLATION OF ACCESSORIES AND MISCELLANEOUS WOOD

- A. Coordinate installation of wood decking, metal-web wood joists, glued-laminated wood construction, shop-fabricated wood trusses, and wood I- joists.
- B. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members. Fasten curbs corner-to-corner and to rafters with framing connectors configured for this application.
- C. Blocking:
 1. Provide fire blocking at locations and spacing's as required by CBC Chapter 7. Locate other blocking, supplementary framing, backing plates and bracing to facilitate installation of finish materials, fixtures, equipment, services, accessories, and trim requiring attachment and support.
 2. Solid block joists and rafters over all supports with blocking of the same size and material as the joist or rafter.
- D. Furring:
 1. Nominal 1 inch x 3 inch minimum, continuous and spaced at 16 inches on center, maximum.
 2. Install plumb, rigid, and level. Shim where necessary to provide a true, even plane suitable to receive the finish required.
 3. Attach to concrete and masonry as shown in the contract drawings.
- E. Install miscellaneous metal angles, bolts, and other items; secure into formwork where embedded in concrete.
- F. Install accessory items not otherwise set under other sections; after completion of painting and other finishing work; in locations shown or directed by the Architect. Set items plumb, level, and secure using appropriate fastening as applicable.

3.5 FIELD APPLIED WOOD TREATMENT

- A. Field treat all end cuts and holes in preservative treated materials per PART 2.
- B. Apply two brush coats; or full-immersion dip not less than 15 minutes; or as required to thoroughly saturate all surfaces after cutting.
- C. Air dry 2-hours minimum before installation.

3.6 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.
- C. Variation from Plane (Other than Floors): 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum. Provide framed substrates meeting requirements for application of finishes specified in other sections.
- D. Exposed surfaces shall be free from dents and tool marks, unsanded rough or torn faces and corners, and other defects.

3.7 FIELD QUALITY CONTROL

- A. The Testing Agency, as specified in the Article QUALITY ASSURANCE, will perform the following tests and submit reports as specified in Division 01:
 - 1. Moisture content of all lumber at time of close-in.
 - 2. Periodic special inspection of nailing, bolting, and other fastening within the seismic-force-resisting system including shear walls, wood diaphragms, etc. per CBC Section 1705.12.2, excluding systems with sheathing nailing spacing greater than 4" on center.
 - 3. Special inspection of high load diaphragms per CBC Section 1705.5.1 where designated on documents.

3.8 ADJUSTING

- A. Replace all defective work at Contractor's expense.
- B. Replace defective or damaged work with conforming work.
- C. Correct defects using 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. Repair or replace framing lumber sagged, twisted or warped due to shrinkage from excessive moisture content at time of installation, or from other causes.
- F. Adjust to meet specified tolerances.

- G. Architect/Engineer shall review all proposals for the repair or replacement of damaged, defective, or missing work.
- H. 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.
- I. Pay expenses due to re-testing and re-inspection necessitated by incomplete, inefficiently scheduled, improperly performed, defective or nonconforming work.

3.9 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. Waste Disposal: Comply with the requirements of pertinent sections of Division 01 specifying cleaning and disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- C. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- D. Prevent sawdust and wood shavings from entering the storm drainage system.
- E. Protect work from damage by subsequent operations.

END OF SECTION

SECTION 06 40 00

ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide mill fabricated architectural woodwork with accessories as required for complete finished installation including cabinetwork hardware.
 - 1. Provide plastic laminate finished wood cabinetwork.
 - 2. Provide solid polymer countertops.
- B. Related Sections:
 - 1. Section 08 14 00: Wood doors.
 - 2. Section 09 01 66: Wood restoration.

1.2 REFERENCES

- A. North American Architectural Woodwork Standards, Edition 3.1, (NAAWS).

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's literature for manufactured items.
- B. Shop Drawings: Indicate materials and wood species, component profiles, fastening, joining details, finishes, and accessories.
 - 1. Certification: Provide Woodwork Institute Certified Compliance Label on shop drawings.
- C. Samples: Furnish samples of each exposed finish.
 - 1. Furnish samples of each exposed casework hardware.
 - 2. Furnish samples of wood paneling showing corner and edge treatment.

1.4 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to finish material pollution control for adhesives, sealants, and caulks, for composite wood products formaldehyde limitations, and for paints and coatings.
- B. Fabricator Qualifications: Member of Woodwork Institute with minimum five years successful experience fabricating woodwork like that required for Project.
- C. Standards: Perform architectural woodwork in accordance with North American Architectural Woodwork Standards (NAAWS).
 - 1. Certified Compliance Program (CCP): Comply with Woodwork Institute "Certified Compliance Program (CCP)" as defined in AWS.

2. Certified Seismic Installation Program (CSIP): Comply with Woodwork Institute Certified Seismic Installation Program.
 - a. Seismic Anchorage: Provide seismic anchorage for wall cabinets as required by California Code of Regulations (CCR), Title 24, Part 2.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver architectural woodwork until site conditions are adequate to receive work; protect items from weather while in transit.
 1. Allow architectural woodwork shop finish to completely dry prior to delivery to site; allow materials to off-gas volatile organic compound (VOC) emissions off site.
- B. Store materials indoors, in ventilated areas with constant but minimum temperature of 60-degrees F and maximum relative humidity of 25% to 55%.
- C. Do not begin installation of architectural woodwork until space is fully enclosed and mechanical systems are fully operational.
 1. Maintain interior installation areas at 70 degrees F and 50% to 55% relative humidity.
- D. Immediately remove from site materials with visible mold and materials with mildew.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System Description: Provide mill fabricated architectural woodwork with accessories as required for complete finished installation including cabinetwork hardware.
- B. Plastic Laminate Finished Casework:
 1. Quality: NAAWS/Custom Grade frameless, flush overlay.
 - a. Special: Provide each single length section of casework in largest such sections as access and openings allow, formerly WI Type II.
 - 1) Multiple self-supporting units fastened together to form larger unit allowed only where access and openings do not allow single lengths.
 2. Plastic Laminates:
 - a. Types: NEMA LD-3.1 high pressure laminates.
 - 1) Horizontal Surfaces: General Purpose Type, nominal 0.050".
 - 2) Vertical Surfaces: Vertical Surface Type, nominal 0.032".
 - 3) Unexposed Surfaces: Balanced with 0.030" melamine backing sheet.
 - b. Manufacturers:
 - 1) Formica Corp.
 - 2) Wilsonart, Wilsonart Engineered Surfaces.
 - 3) Nevamar Corp.

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- 4) Abet Laminati Co.
 - 5) Manufacturers listed on Finish Code List.
 - 6) Substitutions: Refer to Section 01 25 00.
- c. Colors: As selected by Architect from manufacturer's full range of available colors and patterns, excluding metallics.
3. Wood Core: Medium density fiberboard (MDF) or particleboard, with no added formaldehyde and free of toxic materials.
- C. Casework Hardware: Provide casework hardware items as required for complete installation as indicated; provide types as listed in North American Architectural Woodwork Standards for Grade 1, but no less than following types.
1. Adjustable Shelf Standards and Supports: Match BHMA A156.9 B04073 adjustable standards and B04083 closed shelf rest brackets for mortis mounting; flush mounted in cabinet.
 2. Cabinet Hinges: BHMA A156.9 B01602 or B01603 frameless European concealed type, minimum 160 degree opening, with spring closer.
 3. Cabinet Pulls: As indicated, as directed by Architect where not indicated.
 4. Drawer Slides: Full extension, rail mounted type, minimum 100 lb. capacity with ball-bearing rollers.
 5. Cabinet Locks: Pin and tumbler slide bolt lock with five pin tumblers as approved by Architect, two keys each.
- D. Solid Polymer Countertops: Manufacturer's standard polymer system with color throughout thickness; provide manufacturer recommended joint adhesive; exposed surfaces finished to match top.
1. Basis of Design: Porcelanosa USA/Krion Solid Surface Countertops.
 2. Quality: NAAWS/Premium Grade.
 3. Type: Not less than 1/2" thick sheet; coordinate with bowls as indicated and as specified in Division 22.
 4. Color: Manufacturer's standard color as selected by Architect.
- E. Anchors, Nails and Screws: Select 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.
- F. Wood Filler: Color to match wood being filled.

2.2 FABRICATION

- A. General: Fabricate architectural woodwork in accordance with specified North American Architectural Woodwork Standards (NAAWS).

- B. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Make corners and joints hairline; slightly bevel arises.
 - 1. Locate butt joints at least 2'-0" from cutouts.
 - 2. Cap exposed edges with plastic laminate of same finish and pattern.
 - 3. Apply laminate backing sheet to reverse side of laminate surfaces.
 - 4. Provide cutouts for inserts, fixtures and fittings; verify locations from on-site dimensions.
 - 5. Prime paint contact surfaces of cutouts.
- C. Countertops: Provide maximum sizes available. Locate butt joints at least 2'-0" from cutouts where more than one-piece countertops are required.
 - 1. Make corners and joints hairline; slightly bevel arises.
 - 2. Provide cutouts for inserts, fixtures and fittings; verify locations from on-site dimensions.
 - 3. Splashes and edges as indicated or as directed by Architect where not otherwise indicated.
- D. Use exposed fastening devices or nails only when approved and unavoidable; arrange neatly.
- E. Assemble woodwork in shop in sizes easily handled and to ensure passage through building openings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible; do not delay job progress, allow for trimming and fitting.

3.2 INSTALLATION

- A. Install work consistent with North American Architectural Woodwork Standards specified quality grade, plumb, level, true and straight with no distortions.
 - 1. Shim as required, using concealed shims.
- B. Ensure mechanical and electrical items affecting architectural woodwork are properly placed, complete, and have been inspected by Architect prior to commencement of installation.
- C. Secure work to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation.

- D. Scribe and cut for accurate fit to other finished work.
- E. Install architectural woodwork under supervision of factory-trained mechanics.
- F. Attach architectural woodwork securely in place with uniform joints providing for thermal and building movements.
- G. Acceptable Tolerances:
 - 1. Variation from True Position: Maximum 1/16" at any position and maximum 1/8" in any 10'-0" length.
 - 2. Adjoining Surfaces of Same Material: No variation permitted.
 - 3. Offset with Abutting Materials: Maximum 1/32".

END OF SECTION

SECTION 06 80 00

ACRYLIC SIGN PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide exterior acrylic sign panels with anchorage as required for complete installation.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate fabrication and installation of acrylic sign panel backing for signage with Section 10 14 00 – Signage.

1.3 SUBMITTALS

- A. Product Data: Furnish manufacturer's literature.
- B. Shop Drawings: Indicate design parameters, adjacent construction, materials, dimensions, thickness, fabrication details, tolerances, colors, finishes, methods of support and anchorages.
- C. Samples: Furnish acrylic sign panels and exposed anchors.
- D. Maintenance Instructions: Include manufacturer's recommended cleaning materials and application methods, including precautions in use of cleaning materials that may be detrimental to surfaces.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store panels in clean and dry area where temperatures are maintained at minimum 40 degrees F with normal humidity.
 - 1. Do not store in upright position.
- B. Take precautionary measures with adhesives and solvents to prevent fire hazards.

1.5 PROJECT CONDITIONS

- A. Maintain surfaces and materials at minimum 60 degrees F three days before and during application period.
- B. Provide continuous ventilation during work and after installation of wall covering.
- C. Lay panels flat and store at normal room temperature (after occupancy temperature) for not less than 32 hours before beginning installation to ensure stabilization of panels.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. 3form, LLC. (800.I726.0126)/Chroma XT.
- B. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide acrylic sign panels with accessories.
- B. Regulatory Requirements:
 - 1. Fire-Rating: Class I (UL Class A), maximum 25 flame spread, 450 smoke developed, ASTM E84.
- C. Acrylic Sign Panels: 3form/Chroma XT resin panels.
 - 1. Texture: Smooth.
 - 2. Panel Style and Size: As indicated, as directed by Architect where not indicated.
 - 3. Color: As indicated, as selected by Architect from manufacturer's full range of colors where not otherwise indicated.
- D. Anchors: As approved by Architect.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Ensure surfaces to receive acrylic sign paneling are clean, true and free of irregularities, do not commence with work until surfaces are satisfactory.
- B. Ensure surface flatness tolerance does not vary more than 1/8" in 10'-0", nor vary at a rate greater than 1/16" per running foot.

3.2 INSTALLATION

- A. Handle and install acrylic wall panels in accordance with manufacturer's recommendations and installation instructions.
- B. Secure acrylic sign panels as indicated.

3.3 CLEANING

- A. Clean panel system in accordance with manufacturer's instructions.
- B. Remove debris and leave areas neat and clean.

END OF SECTION

SECTION 07 01 50

ROOFING REPAIRS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Patch and repair existing single-ply roofing system, including insulation, as required for new construction with accessories as required for complete weathertight roof.
- B. Related Work:
 - 1. Section 07 60 00: Flashings and sheet metal.

1.2 REFERENCES

- A. National Roofing Contractors Association: The NRCA Roofing and Waterproofing Manual.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Existing Roof Analysis: Provide services of roofing consultant to analyze existing roofing system and to provide recommendations for appropriate materials for patching and repair.
 - 1. Report: Roofing consultant to prepare report indicating observations and recommendations. Report to note where testing may be necessary for verification of existing materials.
- B. Pre-Installation Meeting: Convene not less than one week prior to commencing work of this section. Require attendance of parties directly affecting work of this section.
 - 1. Review installation procedures and coordination required with related work.

1.4 SUBMITTALS

- A. Product Data: Provide literature for roofing system and each type of material; list each material proposed on Project.
 - 1. Provide report analyzing existing roofing system.
- B. Manufacturer Certificates: Certification materials and components furnished conform to Specification requirements and are compatible with each other, existing roof, roof substrate, and related work.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Roofing manufacturer certified or approved.
- B. Supervisor: Installer to maintain full-time supervisor/foreman who is on jobsite during roofing work who is experienced in installation of roofing system specified.

1.6 PROJECT CONDITIONS

- A. Do not apply roofing membrane during inclement weather or when air temperature may fall below 40-degrees F, taking into consideration added wind chill factor.
 - 1. Do not allow materials to be exposed to moisture during transportation, storage, handling or installation.
 - 2. Mark damp or wet materials, including felts which froth or foam during installation, and remove from site within 24 hours.
- B. Do not apply roofing membrane to damp, frozen, and unsuitable deck surface.
 - 1. Allow time for moisture from previous precipitation, fog or dew to evaporate before proceeding with roofing work.
- C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.7 WARRANTY

- A. Extended Correction Period: Provide for correcting failure of system to resist damage from anticipated sources including damage from wind and water penetration. Repair system and pay for or replace damaged materials and surfaces.
 - 1. Period: Two years.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Original roofing system manufacturer.
- B. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide new materials are required to patch and repair existing roofing system, including insulation, as required for new construction, with accessories.
 - 1. Materials: Provide new roofing system materials by original roof manufacturer where known, otherwise provide by single manufacturer, except where materials of other manufacturers are specified or approved by Architect.
- B. Regulatory Requirements: Provide materials capable of achieving following.
 - 1. Fire and Wind Resistance: Conform to California Building Standards Code requirements for Underwriters Laboratory (UL) Class A roof system, with UL Class 60 wind resistance classification.

- C. New Roofing Materials: Provide new materials matching existing material types and conforming to requirements of NRCA Roofing Manual applicable to existing system.
 - 1. Surfacing: Match existing using materials recommended by roofing system manufacturer and NRCA.
- D. Insulation: Match existing insulation systems to extent available; do not apply built-up roofing over plastic type insulation, where plastics used originally, cover with perlite fiber or glass fiber insulation.
- E. Accessories: Provide as required by applicable codes, recommended by system manufacturer, and as necessary for complete weathertight roofing assembly and not furnished under other sections.
 - 1. Mechanical Fasteners: As recommended by insulation manufacturer and meeting recommendations of NRCA and specified Quality Assurance requirements for fire rating and wind blowoff resistance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Remove existing roofing as required for Project; remove only as much roofing as can be replaced in same day unless otherwise approved in advance by Architect.
 - 1. Take care not to remove materials beyond those required for new construction.
 - 2. Inform Architect and Owner where existing materials beyond those required to be removed are damaged or may be unsuitable due to moisture or deterioration.
- B. Inspect substrates and roof deck to ensure substrates and deck are clean and smooth, free of depressions, waves or projections, and are properly sloped to drains, valley, or eaves.
- C. Ensure roof openings and curbs, and pipes, sleeves, ducts or vents through roof are solidly set in accordance with roofing system manufacturer recommendations and installation instructions.
- D. Inspect roofing materials to ensure they are dry at time of installation.
- E. Apply roofing over clean, dry and warm surfaces during fair weather.

3.2 PREPARATION

- A. Protect surrounding surfaces against damage from roofing work.
- B. Where hoisting is necessary, hang tarpaulins to protect walls.

3.3 INSTALLATION

- A. Insulation Application: Attach insulation in accordance with insulation manufacturer's instructions and NRCA recommendations for installation of insulation on deck involved.
 - 1. Lay insulation boards to moderate contact without forcing joints.
 - 2. Cut insulation to fit neatly to perimeter blocking and around projections through roof.
 - 3. Install tapered crickets, cants and edge strips in accordance with manufacturer's instructions and NRCA recommendations.
 - 4. Leave no insulation exposed at end of day's work; apply glaze coat of hot bitumen and two plies of felt over insulation and install cut-off weathertight.
- B. Roof Membrane Application: Apply roofing membrane in accordance with manufacturer's instructions and NRCA recommendations for roof type.
 - 1. Apply smooth, free from air pockets, wrinkles, fishmouths, prominent lap joints or tears.
 - 2. Carry up vertical surfaces and secure to nailing strips and reglets.
 - 3. Coordinate metal flashings and counterflashing.
 - 4. Coordinate installation of roof drains and related flashings.
 - 5. Seal flashings and flanges of items projecting through membrane.

3.4 CLEANING

- A. Remove markings caused by roofing operations from finished surfaces, including run-throughs into building.
- B. In areas where finished surfaces are soiled by roofing work, consult manufacturer of finished surfaces for recommended cleaning methods.
- C. Leave completed roof free from debris and uniform in appearance.

3.5 PROTECTION

- A. Where work must continue over finished roofing membrane, protect surface with plywood sheets.

END OF SECTION

SECTION 07 21 00

THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide black-faced thermal batt insulation with accessories as required for complete installation.
- B. Related Work:
 - 1. Section 07 01 50: Insulation integral with roof patching.
 - 2. Section 09 21 00: Acoustical insulation concealed in gypsum board systems.

1.2 SUBMITTALS

- A. Product Data: Furnish manufacturer's literature for each type of insulation.
 - 1. Submit Underwriter's Laboratory approval numbers for required fire ratings; approvals of other laboratories contingent upon acceptance of applicable authorities.

1.3 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to energy efficiency.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System Description: Provide thermal batt insulation with integral vapor retarder and accessories.
- B. Black Faced Thermal Batt Insulation: Preformed slag mineral or glass fiber with thermosetting resin binders, conforming to ASTM C665; formaldehyde-free.
 - 1. Manufacturers:
 - a. Johns Manville/Insul-Shield Black.
 - b. CertainTeed/CertaSound TXS.
 - c. Manson (450.659.9101)/Akousti-Liner.
 - d. Owens Corning/SelectSound Black Acoustic Board.
 - e. Substitutions: Refer to Section 01 25 00.
 - 2. R-Value: Minimum R-38 unless otherwise indicated.
 - 3. Flame Spread/Smoke Developed Rating: Maximum 25/450, ASTM E84.

- C. Penetration Type Insulation Supports: Galvanized or electroplated steel penetration supports with adhesive attachment to substrate and support disc.
- D. Tape: Minimum 2" wide self-adhering type designed to maintain vapor retarder integrity and matching facing of insulation.
- E. Accessories: Furnish as recommended by insulation manufacturer for insulation types, substrates, and conditions involved.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrate and adjacent materials are dry and ready to receive insulation; beginning installation signifies acceptance of conditions.
- B. Ensure mechanical and electrical items affecting work are properly placed, complete, and have been inspected by Architect prior to commencement of installation.

3.2 INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions with vapor retarder toward inside of building.
- B. Cut and trim insulation neatly, to fit spaces.
 - 1. Backed Insulation: Use insulation free of ripped backs and edges.
- C. Fit insulation tight within spaces and tight to and behind mechanical and electrical services within insulation plane; leave no gaps or voids; maintain integrity of thermal barrier.
- D. Friction fit in place; use tape or penetration supports as necessary to assure permanent installation.
 - 1. Taping: Tape perimeters, joints, and tears in vapor retarder, including joints between insulation and surrounding construction, to ensure vapor-tight installation.
 - 2. Penetration Supports: Cut or bend pins in locations accessible to maintenance personnel, to eliminate potential hazards from exposed pin points.

END OF SECTION

SECTION 07 28 00

WEATHER BARRIER/UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide weather barrier/underlayment air and water barrier systems for siding, sloped roofing, flashing and sheet metal, and penetrations with accessories as required for complete watertight installation.
 - 1. Wall Underlayment: Provide two layers Grade D building paper underlayment and flashing for wall applications, with related concealed metal flashings and accessories as required for complete watertight installation.
 - 2. Flashings and Sheet Metal Underlayment: Provide self-adhering sheet membrane underlayment at flashings and sheet metal, with accessories as required for complete watertight installation.
 - 3. Self-Adhering Sheet Membrane (SASM) Flashing at Penetrations: Provide SASM flashing for around penetrations through building paper including windows and doors, with accessories as required for complete watertight installation.
- B. Related Sections:
 - 1. Section 07 60 00: Exposed metal flashing.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Weather Barriers: Provide weather barrier/underlayment systems which, with other building components, comply with applicable code requirements for air barriers and water barriers.
 - 1. Air Barriers: Air barriers shall be as defined by applicable Energy Code requirements and shall include standard exterior wall components and air seal joint sealants specified in Section 07 90 00 – Joint Sealants.
 - 2. Water Barriers: Water barriers shall be as defined by applicable Building Code requirements and shall include vapor permeable systems with or without rainscreen barriers intended to extend amount of water drained to exterior.
 - 3. Self-Adhering Flexible Flashings: Intent of flexible flashings at window openings, door openings, and other wall penetrations is to ensure water cannot move from exterior surface past water barriers and into building.
- B. Pre-Installation Meeting: Convene one week prior to commencing work; require attendance of parties directly affecting underlayment.
 - 1. Review procedures and coordination required with related work.

1.3 SUBMITTALS

- A. Product Data: Furnish manufacturer's literature for each type of underlayment.
- B. Samples: Furnish samples of each material.

1.4 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to finish material pollution control for adhesives.

1.5 WARRANTY

- A. Extended Correction Period: Provide for correcting failure of system to resist damage from anticipated sources including damage from water penetration. Repair system and pay for or replace damaged materials and surfaces.
 - 1. Period: Two years.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System Description: Provide weather barrier/underlayment air and water barrier systems for siding, sloped roofing, flashing and sheet metal, and penetrations with accessories.
- B. Regulatory Requirements: Provide materials conforming to applicable air quality management district limitations on volatile organic compound (VOC) emissions.
- C. Wall Underlayment: Provide two layers Grade D water-vapor permeable kraft building paper conforming to Fed Spec UU-B-790a, Type I, Style 2, Grade D with 60-minute water resistance rather than 10 minutes.
 - 1. Manufacturers:
 - a. Fortifiber Building Systems Group.
 - b. Davis Wire.
 - c. Hal Industries.
 - d. Substitutions: Refer to Section 01 25 00.
- D. Sheet Metal and Flashing Underlayment: Self-adhering rubberized sheet membrane with primers and seam sealers as required for complete watertight installation; type as recommended by manufacturer for substrate and for applications indicated.
 - 1. Manufacturers:
 - a. GCP Applied Technologies (Grace).
 - b. Henry Company.
 - c. Carlisle Corp.
 - d. Protecto Wrap Company.
 - e. Substitutions: Refer to Section 01 25 00.
 - 2. Provide specific membrane types as recommended by system manufacturers for each type of application.

- E. Self-Adhering Sheet Membrane (SASM) Flashing at Penetrations: SASM with primers and seam sealers as required for complete watertight installation; type as recommended by manufacturer for substrate and for applications indicated.
 - 1. Manufacturers:
 - a. GCP Applied Technologies (Grace).
 - b. Henry Company.
 - c. Carlisle Corp.
 - d. Protecto Wrap Company.
 - e. Substitutions: Refer to Section 01 25 00.
 - 2. Provide specific membrane types as recommended by system manufacturers for each type of application.
- F. Concealed Metal Flashings Integral with Underlayment: Minimum 26 gage thick steel with minimum 0.90 oz/sq.ft. galvanized coating; ASTM A653.
 - 1. Fasteners: Standard round wire type of hot dipped galvanized steel; minimum 19/64" head diameter and 0.104" shank diameter; minimum 7/8" long.
- G. Accessories: Provide as recommended by underlayment manufacturers for specific applications.
 - 1. Plastic Cement: Cutback asphaltic type with mineral fiber components, for sealing and coating flashings; free of toxic solvents and free of asbestos. Capable of setting within 24 hours at temperatures of approximately 75 degrees F and 50% R.H.

2.2 FLASHING FABRICATION

- A. Fabricate metal flashings as recommended by Sheet Metal and Air Conditioning Contractors National Association (SMACNA) "Sheet Metal Manual".
- B. Form flashings to drain water to exterior at roofing and siding construction for penetrations, sill and header flashings.
- C. Form sections square, true and accurate to size, in maximum possible lengths and free from distortion and other defects detrimental to appearance or performance.
- D. Hem exposed edges of metal flashings minimum 1/4" on underside.
- E. Apply bituminous paint on concealed surfaces of metal flashings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install underlayment over surfaces that are dry, free of ridges, warps and voids that could damage paper.
- B. Coordinate installation with installation of components and items projecting through underlayment.

3.2 FLASHINGS INSTALLATION

- A. Install flashings as recommended by Sheet Metal and Air Conditioning Contractors National Association (SMACNA) "Sheet Metal Manual".
- B. Weatherlap joints minimum 2" and seal with plastic cement; secure in place.
- C. Fastenings: Concealed in completed installation.

3.3 UNDERLAYMENT INSTALLATION

- A. Install weather barrier/underlayment in accordance with installation instructions and recommendations of each manufacturer and of manufacturers of products to cover weather barrier/underlayment; comply with applicable code requirements.
 - 1. Wall Underlayment: Provide two-layers building paper underlayment.
 - 2. Flashing and Sheet Metal: Provide one-layer sheet membrane underlayment.
 - 3. Penetrations: Apply one-layer of self-adhering sheet membrane extending minimum 18" from penetrations, including windows and doors; start at bottom of penetration and weatherlap joints.
 - a. Apply top layer over metal flashing to direct water to exterior.
 - 4. Weatherlap joints as recommended by system manufacturer.
 - a. Weatherlap joints not less than 2" at building paper.
 - 5. Secure underlayment in place, stagger joints between sheet membrane layers; lap ends minimum 6"; stagger end joints.
- B. Building Paper Underlayment: Prime substrates and roll sheet membrane underlayment smooth, firmly and completely to surfaces indicated, with no fishmouths or bunches of material.
 - 1. Apply plastic cement to substrate prior to application of underlayment starter strips to prevent capillary movement of water back up beneath underlayment.
 - 2. Weatherlap items projecting through building paper underlayment and seal with plastic cement.
- C. Sheet Membranes: Weatherlap items projecting through sheet membrane underlayment and seal with sealer recommended by sheet membrane underlayment manufacturer.

END OF SECTION

SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide metal flashings and sheet metal including accessories as required for complete weathertight installation; match existing.
 - 1. Provide concealed sealants used in conjunction with installation of metal flashing and sheet metal.
 - 2. Provide miscellaneous sheet metal flashing and reglets not provided by other trades or suppliers.
 - a. Where reglets are to be installed in conjunction with other work, provide in adequate time for installation.
 - b. Where reglets are to be surface applied, provide continuous gasket between reglet and surface.
- B. Related Sections:
 - 1. Section 07 28 00: Concealed flashing at weather barrier underlayment.

1.2 REFERENCES

- A. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Architectural Sheet Metal Manual.

1.3 SUBMITTALS

- A. Product Data: Furnish literature for manufactured products.
- B. Shop Drawings: Clearly indicate dimensioning, layout, general construction details including closures, flashings, locations and types of sealants, anchorages, and method of anchorage.
- C. Samples: Furnish samples of typical metal flashing fabrication indicating standard soldered joints and edge conditions.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Provide strippable film protective covering on shop finished flashing materials to protect materials through shipping, fabrication and installation.

1.5 WARRANTY

- A. Extended Correction Period: Provide for correcting failure of system to resist damage from anticipated sources including damage from wind and water penetration. Repair system and pay for or replace damaged materials and surfaces.

1. Period: Two years.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System Description: Provide flashing and sheet metal including reglets and accessories as required for complete weathertight installation; match existing.
- B. Design Criteria: Allow for movement of components without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to 100-year seasonal temperature ranges.
- C. Flashing and Sheet Metal: Match existing but not less than following for various types of flashing and sheet metal.

1. Galvanized Steel: ASTM A924 and A653 G90 galvanized steel; minimum 24-gage.

- a. Mill phosphatized where indicated to be field painted.

2. Copper Flashing: ASTM B370, cold rolled copper except where soft temper copper is required for forming; minimum 16-oz. (0.0216" thick).

3. Shop Finished Galvanized Steel Flashing and Sheet Metal: ASTM A924 and A653 G90 galvanized steel; minimum 24-gage; with factory applied fluoropolymer coating based on Kynar 500 or Hylar 5000.

- a. Manufacturers:

- 1) Ryerson Building Products (800.328.7800)/ColorKlad.
- 2) Metal Sales Manuf. Corp.(800.406.7387)/PVDF (Kynar 500).
- 3) K&M Sheet Metal (888.567.7778)/Kynar Steel.
- 4) Substitutions: Refer to Section 01 25 00.

- b. Touch-up Paint for Prefinished Sheet Metal: Type recommended by fluoropolymer manufacturer for field touch-up.

4. Stainless Steel Flashing and Sheet Metal: Stainless steel, ASTM A666, Type 304, soft annealed, 2B finish, minimum 26-gage.

5. Aluminum and Zinc Alloy Coated Steel Flashing and Sheet Metal: Aluminum-zinc coated steel, ASTM A792, AZ55 coating; minimum 24 gage steel; coating to contain 55% aluminum, 43.5% zinc, and 1.5% silicon, or 55% aluminum and 45% zinc.

- a. Trade Names: Galvalume and Zinalume.

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6. Zinc Alloy: Zinc/copper/titanium alloy conforming to DIN EN 988; not less than 0.025" thick.
 - a. Manufacturers:
 - 1) Rheinzink America, Inc./Rheinzink.
 - 2) VM Building Solutions/VM Quartz Zinc.
 - 3) Substitutions: Refer to Section 01 25 00.
7. Mill Finished Aluminum: ASTM B209, 3003-H14, minimum thickness 0.040" unless otherwise indicated.
8. Anodized Aluminum Sheet: ASTM B209, 5005-H14, with minimum thickness of 0.050" unless otherwise indicated.
 - a. Clear Anodized Coating: AAMA 607.1 clear anodized, Architectural Class I 0.018mm or thicker coating.
 - b. Color Anodized Coating: AAMA 608.1, Architectural Class I 0.018mm or thicker coating; color as indicated on Drawings.
9. Extruded Aluminum: ASTM B221, alloy 6063-T52, with minimum thickness of primary legs 0.080" unless otherwise indicated; clear anodized unless otherwise indicated.
10. Prefinished High-Performance Coated Aluminum: Manufacturer's standard two coat thermocured fluoropolymer system containing not less than 70-percent polyvinylidene fluoride resin by weight; AAMA 605.2 and AA-C12C42R1x.
 - a. Manufacturers:
 - 1) Ryerson Building Products (800.328.7800)/AlumaKlad.
 - 2) Merchant & Evans Industries, Inc.(800.257.6215)/Custom.
 - 3) Substitutions: Refer to Section 01 25 00.
 - b. Touch-up Paint for Prefinished Sheet Metal: Type recommended by fluoropolymer manufacturer for field touch-up.
11. Accessories: Provide as required for a complete system and complying with SMACNA Manual.
12. Provide heavier gage metal where recommended by SMACNA Manual for size of component.
- D. Manufactured Reglets: Snap-on type, for two-piece flashing; metal to match flashing and sheet metal.
 1. Manufacturers:
 - a. Fry Reglet Corp./Springlok System.
 - b. W.P. Hickman Co./The Leading-Edge Drive Lock System.
 - c. Substitutions: Refer to Section 01 25 00.

- E. Solder and Fasteners: As recommended by SMACNA and complying with applicable codes and regulations; hot dipped galvanized minimum coating comparable to G90.
- F. Concealed Sealant: Butyl type for use in conjunction with sheet metal; non-staining; non-corrosive; non-shrinking and non-sagging; ultra-violet and ozone resistant for exterior concealed applications.
- G. Bituminous Paint: Acid and alkali resistant type; black color; asbestos free.
- H. Plastic Cement: Cutback asphaltic type; asbestos free.
- I. Sealing Compound: Type recommended by roofing manufacturer; asbestos free.
- J. Gaskets: Type suitable for use in conjunction with sheet metal; non-staining, non-corrosive, non-shrinking, non-sagging, ultra-violet resistant, and ozone resistant; for exterior concealed applications.
 - 1. Manufacturers:
 - a. Emseal USA, Inc./Emseal MST Multi-Use Sealant Tape.
 - b. Substitutions: Refer to Section 01 25 00.

2.2 FABRICATION

- A. Fabricate sheet metal in accordance with SMACNA Architectural Sheet Metal Manual.
- B. Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
 - 1. Fabricate corners and intersections in shop with solder joints; watertight fabrication.
- C. Form sections in maximum 10'-0" lengths; make allowance for expansion at joints.
- D. Hem exposed edges on underside 1/2".
- E. Backpaint flashings with heavy bodied bituminous paint where in contact with cementitious materials or dissimilar metals.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install metal flashing and sheet metal in accordance with SMACNA Architectural Sheet Metal Manual.
 - 1. Install tight in place, with corners square, surfaces true and straight in planes, and lines accurate to profiles as indicated on Drawings.
 - 2. Lap joints in direction of water flow.

- B. Exercise care when cutting materials on site, to ensure cuttings do not remain on finished surfaces.
- C. Provide expansion joints concealed within system.
- D. Use concealed fasteners, continuous cleat type, except where specifically approved by Architect.
 - 1. Exposed fasteners may be used, where clearly indicated on shop drawings and approved by Architect, at areas not exposed at exterior walls nor in sight of interior spaces.
- E. Apply sealing compound at junction of metal flashing and felt flashing.
- F. Lock seams and end joints; fit flashing tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- G. Counter-flash mechanical and electrical items projecting through roof membrane.
- H. Install sealants where required to prevent direct weather penetration.
 - 1. Install continuous gasket behind surface applied reglets.
- I. Completed installation shall be free of rattles, noise due to thermal and air movement, and wind whistles.

3.2 CLEANING

- A. Remove protective coating from shop finished sheet metal when no longer required to protect roofing and flashing from construction.
- B. Touch-up scratched and damaged finish to match new; remove and replace sheet metal units that cannot be repaired to look identical to adjacent sheet metal when viewed from 15'-0" away.

END OF SECTION

SECTION 07 72 00

ROOF HATCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide manufactured roof hatches with integral support curb, operable hardware, counterflashing, and accessories as required for complete, weather-tight installation.
 - 1. Provide fall protection railings where required by applicable regulations.
- B. Related Sections:
 - 1. Section 05 50 00: Ladder extenders for roof hatch access.
 - 2. Section 07 60 00: Flashing roof hatches to roof system.

1.2 SUBMITTALS

- A. Product Data: Furnish manufacturer's literature.
- B. Shop Drawings: Clearly indicate general construction, configurations, jointing methods and locations when applicable, fastening methods and general details.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Babcock-Davis Hatchways, Inc.
- B. Bilco Company.
- C. Dur-Red Products, Red Plastic Co., Inc.
- D. Milcor, Inc.
- E. Substitutions: Refer to Section 01 25 00.

2.2 ROOF HATCHES

- A. System Description: Provide manufactured roof hatches, with integral support curb, operable hardware, counterflashing, and accessories.
- B. Roof Hatches:
 - 1. Type: Single leaf type.
 - 2. Size: 2'-6" by 3'-0" unless otherwise indicated.

- C. Construction: Construct with full welded corner joints, insulated hatch lids, and internal support curbs.
 - 1. Provide complete with integral counterflashings to roof flashing system and flanges on support curb for anchorage to roof deck.
 - 2. Loading: Capable of supporting minimum 40-psf external loading and 20-psf internal loading pressure.
- D. Opening Hardware: Manufacturer's standard manually operating type.
 - 1. Capable of ensuring effortless control and smooth operation without causing damage to hatch and roofing system.
 - 2. Capable of being opened from inside and outside.
 - 3. Complete with hold-open mechanism and inside padlock hasps.
- E. Fall Protection Integral Railings (Where Required by Authorities): Provide railings fixed to roof hatch curbs (not requiring additional penetration of roof assembly); comply with applicable code requirements; welded construction; cap exposed ends.
 - 1. Railing Design Requirements: Comply with applicable codes and regulations requirements but not less than lateral force of 50 lbs. /lin. ft. uniform load and 200 lbs. at any single point without permanent set or damage; ASTM E935.
 - 2. Rails: Seamless steel tube rails, 42" height above roof surface, 1-1/2" outside diameter, continuous railings conforming to applicable code and design requirements.
 - 3. Chain Closures: Provide welded closed link chain capable of supporting same loads as railing and designed to allow easy removal for access from hatch to roof and roof to hatch.

2.3 FABRICATION

- A. Fabricate roof hatches weather-tight, and free of visual distortions and defects.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof hatches in accordance with manufacturer's recommendations and instructions for complete, weather-tight installation.
- B. Coordinate with installation of roofing system and related flashings.
- C. Apply bituminous paint on metal surfaces of roof hatches to be in contact with cementitious materials and dissimilar metals.

END OF SECTION

SECTION 07 90 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide joint sealants, for interior and exterior joints not specified elsewhere, with backing rods and accessories as required for complete installation.
 - 1. Joint sealants include joint sealers and calking as indicated.
- B. Related Sections:
 - 1. Section 07 60 00: Flashing and sheet metal concealed sealants.
 - 2. Section 09 21 00: Sealants used for acoustical treatment at gypsum board.

1.2 SUBMITTALS

- A. Product Data: Furnish manufacturer's descriptive literature.
- B. Samples: Furnish samples of each type of exposed joint sealer in required colors.
- C. Certifications:
 - 1. Furnish manufacturer's certification joint sealers comply with Contract Documents and are suitable for Project applications.
 - 2. Furnish certification indicating installers are trained in proper use of specified products, qualified, and familiar with proper installation techniques.

1.3 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to finish material pollution control for adhesives, sealants, and caulks.
 - 1. Provide joint sealants as required by applicable codes and regulations to fill joints and openings in building envelope separating conditioned space from unconditioned space.
- B. Installer Qualifications: Firm with minimum five years successful experience on projects of similar type and size, using specified products.
 - 1. Installers shall be familiar with proper application procedures to ensure maximum joint sealer expansion and contraction capabilities.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, cure time, and mixing instructions.

1.5 SITE CONDITIONS

- A. Do not proceed with installation of joint sealers under unfavorable weather conditions.
- B. Install elastomeric sealants when temperature is in lower third of temperature range recommended by manufacturer.

1.6 WARRANTY

- A. Extended Correction Period: Extend correction period to two years.
 - 1. Repair or replace joint sealers which fail to perform as intended, because of leaking, crumbling, hardening, shrinkage, bleeding, sagging, staining, loss of adhesion, and loss of cohesion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System Description: Provide joint sealants with backing rods and accessories.
- B. Performance Requirements:
 - 1. Select materials for compatibility with joint surfaces and indicated exposures.
 - 2. Where not indicated, select modulus of elasticity and hardness or grade recommended by manufacturer for each application indicated.
 - 3. Comply with applicable limitations on volatile organic compound (VOC) emissions.
- C. Regulatory Requirements: Comply with applicable regulatory requirements regarding limitations on volatile organic compound (VOC) emissions limitations.
- D. Elastomeric Sealants:
 - 1. Single Component Low Modulus Silicone Sealant: ASTM C920 Type S, Class 25, Grade NS; minimum 50% expansion and compaction capability.
 - a. Provide at exterior locations not exposed to traffic.
 - b. Manufacturers:
 - 1) GE (Momentive Performance Materials)/Silpruf, Silglaz or GESIL.
 - 2) Dow Corning Corp./790 or 795.
 - 3) Pecora Corp./864 Architectural Silicone.
 - 4) Tremco/Spectrem 3.
 - 5) Substitutions: Refer to Section 01 25 00.

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2. Multi-Component Polyurethane Sealant: ASTM C920, Type M, Grade P, Class 25, self-leveling; minimum 25% expansion and compaction capability.

- a. Provide at traffic bearing locations.

- b. Manufacturers:

- 1) Pecora Corp./Urexpan NR-200, or Dynatrol II-SG.
 - 2) Tremco/THC 900-901, or Vulkem 445 SSL.
 - 3) BASF/MasterSeal SL 2
 - 4) Substitutions: Refer to Section 01 25 00.

3. Mildew-Resistant Silicone Rubber Sealant: ASTM C920, Type S, Grade NS, Class 25, compounded with fungicide, specifically for mildew resistance and recommended for interior joints in wet areas.

- a. Provide at interior joints in wet areas.

- b. Manufacturers:

- 1) GE (Momentive Performance Materials)/SCS 1702 Sanitary Sealant.
 - 2) Dow Corning Corp./786 Bathtub Caulk.
 - 3) Pecora Corp./898 Sanitary Mildew Resistant Sealant.
 - 4) Tremco/Tremsil 200.
 - 5) Substitutions: Refer to Section 01 25 00.

E. Non-Elastomeric Sealants:

1. Acrylic-Emulsion Sealant: ASTM C834 acrylic or latex-rubber-modified acrylic sealant, permanently flexible, non-staining and non-bleeding; recommended for general interior exposure; compatible with paints specified in Section 09 90 00.

- a. Provide at general interior applications.

- b. Manufacturers:

- 1) Pecora Corp./AC-20.
 - 2) Tremco/Tremflex 834.
 - 3) Substitutions: Refer to Section 01 25 00.

2. Air Seals: Provide non-staining and non-bleeding sealers, calks, or foams appropriate to specific applications for filling openings between conditioned and unconditioned spaces.

- a. Type: As recommended by manufacturer for each specific application; compatible with adjacent materials.

- b. Manufacturers:

- 1) Dow/Great Stuff.
 - 2) Owens Corning/EnergyComplete Air Sealant.
 - 3) Hilti/Foam Filler CF 812.
 - 4) Substitutions: Refer to Section 01 25 00.

F. Miscellaneous Materials:

1. Primers/Sealers: Non-staining types recommended by joint sealer manufacturer for joint surfaces to be primed or sealed.
2. Joint Cleaners: Non-corrosive types recommended by joint sealer manufacturer; compatible with joint forming materials.
3. Bond Breaker Tape: Polyethylene tape as recommended by joint sealer manufacturer where bond to substrate or joint filler must be avoided for proper performance of joint sealer.
4. Sealant Backer Rod: Compressible polyethylene foam rod or other flexible, permanent, durable non-absorptive material as recommended by joint sealer manufacturer for compatibility with joint sealer.
 - a. Oversize backer rod minimum 30% to 50% of joint opening.

G. Colors: Provide colors indicated or as selected by Architect from manufacturer's full range of colors.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare joint surfaces in accordance with ASTM C1193 and as recommended by joint sealer manufacturer.
- B. Clean joint surfaces immediately before installation of joint sealer; remove dirt, insecure materials, moisture and other substances which could interfere with bond of joint sealer.
- C. Prime or seal joint surfaces where recommended by joint sealer manufacturer; do not allow primer/sealer to spill or migrate onto adjoining surfaces.
- D. Ensure protective coatings on surfaces in contact with joint sealers have been completely stripped.

3.2 INSTALLATION

- A. Comply with manufacturer's printed instructions and ASTM C1193, except where more stringent requirements are shown or specified.
- B. Pest Control: Install stainless steel wool prior to application of backer rods and bond breakers at air seal and as required to ensure complete pest blockage at joints where pest intrusion is a potential.
- C. Set sealant backer rods at proper depth or position in joint to coordinate with other work, including installation of bond breakers and sealant; do not leave voids or gaps between ends of backer rods.
 1. Do not stretch, twist, puncture or tear backer rods.

- D. Install bond breaker tape as required to avoid three-sided bond of sealant to substrate and where required by manufacturer's recommendations to ensure joint sealers will perform properly.
- E. Size materials to achieve required width/depth ratios.
- F. Employ installation techniques that will ensure joint sealers are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of bond surfaces equally on opposite sides.
- G. Joint Configuration: Fill sealant joint to a slightly concave surface, slightly below adjoining surfaces, unless otherwise indicated.
- H. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove, so that joint will not trap moisture or dirt.
- I. Install joint sealers to depths recommended by joint sealer manufacturer but within the following general limitations, measured at center (thin) section of bead.
 - 1. Horizontal Joints: 75% width with minimum depth of 3/8".
 - 2. Elastomeric Joints: 50% width with minimum depth of 1/4".
 - 3. Non-Elastomeric Joints: 75% to 125% of joint width.
- J. Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces.
 - 1. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.
- K. Cure joint sealers in compliance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability.
- L. Maintain finished joints free of embedded matter, ridges and sags.

END OF SECTION

SECTION 08 11 20

INTERIOR ALUMINUM FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide aluminum frames for interior wood doors, with attachments and accessories as required for complete installation.
 - 1. Prepare frames for door hardware.
- B. Related Work:
 - 1. Section 08 14 00: Wood doors.
 - 2. Section 08 35 40: Folding and sliding interior glass walls with swing door.
 - 3. Section 08 41 00: Interior aluminum and glass entrances and storefronts.
 - 4. Section 08 71 00: Door hardware.

1.2 REFERENCES

- A. National Association of Architectural Metal Manuf. (NAAMM): Metal Finishes Manual.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate hardware installation with Section 08 71 00 - Door Hardware.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's literature.
- B. Shop Drawings: Indicate pertinent dimensioning, general construction, component connections and locations, anchor methods and locations.
- C. Samples: Submit samples of aluminum finish.
 - 1. Submit frame corner construction.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Wilson Partitions.
- B. Western Integrated Materials, Inc.
- C. RACO Interior Products.
- D. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide aluminum frames for interior wood doors, with attachments and accessories.
- B. Interior Aluminum Frames: Knock-down (field assembled) door frames; extruded aluminum, ASTM B221, 6063-T5 alloy; profile as indicated.
 - 1. Door Stop Gasketing: Provide continuous elastomeric vinyl gasketing at door stop.
- C. Anodized Finish: Manufacturer's standard anodized finish conforming to NAAMM Manual requirements for anodizing, Class I and Class II acceptable.
 - 1. Color: Clear anodized unless otherwise indicated.

2.3 FABRICATION

- A. Fabricate aluminum frames to allow for clearances and shim spacing around perimeter; provide for thermal movement.
- B. Provide anchorage devices to securely and rigidly fit frames in place.
 - 1. Conceal anchorage devices and fasteners.
- C. Accurately fit together joints and corners; match components ensuring continuity of line and design; ensure joints and connections are flush and hairline.
- D. Provide required internal reinforcing for door hardware.
 - 1. Refer to Section 08 71 00 for hardware requirements.
- E. Apply coat of bituminous paint on concealed aluminum surfaces to be in contact with cementitious or dissimilar materials.
- F. Exposed Anodized Surfaces: Apply clear lacquer protective coating, minimum 5 mils dry thickness; conform to AAMA 606.2.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install aluminum frames in accordance with recommendations of manufacturer.
- B. Ensure assemblies are plumb, level and free of warp or twist; maintain dimensional tolerances and alignment with adjacent work.
- C. Use anchorage devices to securely and rigidly fasten frame assemblies to building.
- D. At Substantial Completion; remove and replace damaged frames where noticeable from 3' or more.

END OF SECTION

SECTION 08 14 00

WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide flush wood doors as indicated.
 - 1. Contractor Option: Provide shop finished wood doors.
- B. Related Work
 - 1. Section 08 11 20: Interior aluminum frames.
 - 2. Section 08 71 00: Door hardware.

1.2 REFERENCES

- A. North American Architectural Woodwork Standards, Edition 3.1, (NAAWS).

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Aluminum Jambs: Coordinate with Section 08 11 20 – Interior Aluminum Frames for prefit wood doors for door jambs.
 - 2. Hardware: Coordinate hardware installation with Section 08 71 00 – Door Hardware.
 - 3. Painting: Coordinate with Section 09 90 00 – Painting and Coating whether wood doors are to be shop finished or field painted.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's literature.
- B. Shop Drawings: Indicate general construction, jointing methods, hardware locations, and locations of cut-outs.
- C. Samples: Submit samples of wood doors indicating construction, veneering, and finish.
 - 1. Submit shop finish for wood doors where doors are furnished shop finished.
- D. Certificates: Submit manufacturer certification indicating compliance to applicable requirements of NAAWS.

1.5 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to finish material pollution control for composite wood products formaldehyde limitations and paints and coatings.

1.6 PROJECT CONDITIONS

- A. Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized in accordance with referenced standards requirements applicable to Project location.

1.7 WARRANTY

- A. Extended Correction Period: Provide for replacing, rehanging, and refinishing wood doors exhibiting defects in materials or workmanship including warp and delamination.

- 1. Period: Two years.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Algoma Hardwoods, Inc.
- B. Eggers Industries Architectural Door Division.
- C. Marshfield Door Systems, Inc.
- D. VT Industries.
- E. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide flush wood doors as indicated.
- B. Solid Core Flush Wood Doors: NAAWS/Premium Grade, 5 Ply Hot Press, 1-3/4" thick solid wood framed glued block construction or particleboard core five ply construction; Contractor option to use WDMA comparable standards.
 - 1. Opaque Painted Wood Veneers: NAAWS/Custom Grade White Birch veneers for opaque finish; nominal 1/40" thick before sanding, not less than 1/50" after sanding.
 - 2. Edges: Stile edges to match face veneer, minimum 1-1/8" thick after trim.
 - 3. Core: Bond stiles and rails to core and sand prior to assembly of face veneers.
 - 4. Bond Type: Provide Type II Bond for interior doors.

2.3 FABRICATION

- A. Fabricate doors in accordance with requirements of specified standards.
 - 1. Prefit wood doors.

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2. Prepare doors to receive hardware in shop, refer to Section 08 71 00 for hardware requirements and templates.
 3. Factory machine doors for mortise hardware.
- B. Bevel strike edge of single-acting doors, 1/8" in 2".
- C. Shop Finished Doors (Contractor Option): Conform to requirements specified in Section 09 90 00 – Painting and Coating.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wood doors in accordance with manufacturer's recommendations and installation instructions, and reference standards, plumb and square, and with maximum diagonal distortion of 1/16".
- B. Rehang or replace doors which do not swing or operate freely.

3.2 PROTECTION

- A. Protection: Protect doors as recommended by door manufacturer to ensure doors are without damage at time of substantial completion.
1. Shop Finished Doors: Refinish or replace damaged doors.

END OF SECTION

SECTION 08 31 00

ACCESS DOORS AND PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide access doors set in finished surfaces.
 - 1. Provide access doors and panels as required for access to controls and valves behind finished surfaces.
 - 2. Coordinate with various trades for controls and valves which may be concealed.

1.2 SUBMITTALS

- A. Product Data: Furnish manufacturer's literature.
- B. Shop Drawings: Indicate locations of access doors required but not indicated on Architectural Drawings.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Nystrom Building Products.
- B. J.L. Industries.
- C. Karp Associates, Inc.
- D. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide access doors and panels set in finished surfaces.
- B. Access Doors and Panels: Provide access door and panel assemblies consisting of an integral unit with flush metal doors and panels, complete and ready for installation.
 - 1. Type: Flush panel access doors; provide type with frame flange concealed in finished construction.
- C. Frames: Fabricate from not less than 16 gage steel.
- D. Doors: Flush panel type, fabricate from not less than 14 gage steel.
- E. Hinges: Provide continuous piano type hinge.
- F. Locking Devices: Provide flush, key-operated cylinder lock for each access door; provide two keys per lock and key locks alike, unless otherwise scheduled.
- G. Finish: Finish with manufacturer's factory-applied enamel prime coat applied over phosphate coating on steel.

2.3 FABRICATION

- A. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units which may vary slightly from sizes shown or scheduled.
- B. Fabricate units of continuous welded steel construction; grind welds smooth and flush with adjacent surfaces.
- C. Provide attachment devices and fasteners of type required for specific job conditions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which access doors are to be installed.
 - 1. Do not proceed with work until unsatisfactory conditions are corrected; installation signifies acceptance of conditions.
- B. Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment; coordinate installation with work of other trades.

3.2 INSTALLATION

- A. Comply with manufacturer's installation instructions for access doors.
- B. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.
- C. Adjust hardware and doors after installation for proper operation.

3.3 PROTECTION

- A. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08 35 40

FOLDING, SLIDING ALUMINUM AND GLASS WALLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide interior folding, sliding aluminum and glass walls with hardware, anchorage, glazing, and accessories as required for complete installation.
 - 1. Provide swing doors integral with folding, sliding aluminum and glass walls.
- B. Related Sections:
 - 1. Section 07 90 00: Perimeter sealants and back-up materials.
 - 2. Section 08 11 20: Interior aluminum frames for wood doors.
 - 3. Section 08 41 00: Interior aluminum and glass entrances and storefronts.
 - 4. Section 08 71 00: Key cylinders.

1.2 REFERENCES

- A. American Architectural Manufacturers Association/National Wood Window and Door Association, AAMA/NWWDA 101/I.S.2: Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors.
- B. Glass Association of North America (GANA): Glazing Manual.
- C. National Assoc. of Architectural Metal Manuf. (NAAMM): Metal Finishes Manual.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Design/Build: Provide special engineering to ensure compliance with applicable codes and Contract Documents.
- B. Pre-Installation Meeting: Convene not less than one week prior to commencing work of this Section. Require attendance of those directly affecting work of this Section.
 - 1. Review installation procedures and coordination required with related work.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's literature.
- B. Shop Drawings: Indicate pertinent dimensioning, general construction, component connections and locations, anchor methods and locations, hardware locations, and relevant details.
- C. Samples: Furnish samples of metal finish, glass and glazing gasket.
- D. Test Reports: Include laboratory test results for STC and OITC rating of units.
- E. Design/Build Certificates: Submit certification signed by California licensed structural engineer indicating compliance with Contract Documents and code requirements.

1.5 WARRANTY

- A. Extended Correction Period: Extend correction period to two years.
 - 1. Provide for correcting failure of Sound Transmission Coefficient rating (STC).
 - 2. Provide for correcting failure of insulating glass. Failure includes signs of moisture on interior surfaces of insulated glass units and bond failure of laminated glass.
 - 3. Repair or replace systems and materials which fail to perform as intended.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. NanaWall Systems, Inc. Mill Valley, CA. (800.873.5673).
- B. C.R. Laurence Co., Los Angeles, CA (800.421.6144).
- C. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide interior, acoustically rated, folding, sliding aluminum and glass walls with hardware, anchorage, glazing, and accessories and with integral aluminum and glass swing doors.
- B. Performance Criteria Requirements: Conform to ANSI/AAMA 101 for HGD-R60 rating or better.
 - 1. Acoustical Ratings: Provide system that has been tested under ASTM E90 with minimum Sound Transmission Class (STC) rating as indicated on Drawings.
- C. Regulatory Requirements, General: Comply with applicable California Building Code load requirements, without breakage, failure of any part, or malfunction of operation.
- D. Regulatory Requirements for Glazing: Comply with CPSC 16 CFR 1201, applicable code requirements, and pass ANSI Z97.1.
- E. Accessibility Regulatory Requirements: Provide for assuring access for persons with disabilities in accordance with state and federal regulations.
 - 1. California Regulations: Comply with California Building Standards Code.
 - 2. Federal Regulations: Comply with Americans with Disabilities Act (ADA) Standards.
- F. Sliding Aluminum and Glass Walls: System with profiles as indicated on Drawings; provide extruded aluminum security type glass stops of profile to suit frame design.
 - 1. Basis of Design: Nanawall.

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2. Aluminum Type: As recommended by manufacturer for application indicated, but not less than extruded aluminum, ASTM B221, 6061 or 6063 alloy and T5 or T6 temper.
 3. Finish: Anodized coating conforming to NAAMM Metal Finishes Manual, Architectural Class 1, 0.7 mil or greater.
 - a. Color: Clear anodized.
 - b. Architect reserves right to reject units of color or texture variations which are visually objectionable, but only where variation exceeds range established by manufacturer prior to work.
- G. Folding, Sliding Wall System Hardware: Barrier-free sliding wall system meeting code requirements for providing access for people with physical disabilities; by system manufacturer.
1. Metal and Finish: Match wall system.
 2. Hardware: Provide manufacturer's complete standard hardware system except as indicated; match sliding wall finish unless otherwise indicated.
 - a. Cylinders: Provided under Section 08 71 00.
 - b. Flat Handles: Powder coat finish; color as selected by Architect.
 - c. Acoustical Gasketing: Manufacturer's recommended type to suit acoustical requirements.
 - d. Sills: As indicated on Drawings, as selected by Architect from manufacturer's full range of sills (including sill-less) where not otherwise indicated and as required to achieve STC rating indicated.
- H. Integral Swing Aluminum and Glass Doors, Frames, and Hardware: Barrier-free entry doors meeting code requirements for providing access for people with physical disabilities; by glass wall manufacturer.
1. Type: As indicated on Drawings with 10" bottom rail, as selected by Architect from manufacturer's standard integral swing doors where not clearly indicated.
 2. Metal and Finish: Match wall system.
 3. Hardware: Provide complete hardware system except as indicated; match wall system finish unless otherwise directed by Architect. Coordinate with Section 08 71 00 – Door Hardware.
 - a. Hinges: Extra heavy-duty ball bearing full mortise (butt) hinges complying with requirements specified in Section 08 71 00.
 - b. Closers: Concealed adjustable type closer, maximum 5-pound operating pressure when installed in final application.

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741 4TH STREET, SANTA ROSA, CA

- c. Push/Pulls: Types as indicated on Drawings; where not otherwise indicated manufacturer's standard types as selected by Architect; match finish of similar hardware as specified in Section 08 71 00.
 - d. Security Locks: Manufacturer's standard.
 - 1) Cylinders: Provided under Section 08 71 00.
 - e. Acoustical Gasketing: Manufacturer's recommended type to suit acoustical requirements.
 - f. Thresholds: Maximum 1/2" height above adjacent surfaces, with maximum 1/4" vertical section and remainder maximum 1:2 slope.
- I. Glass: Coordinate glazing with folding, sliding wall system and integral swing door.
- 1. Acoustical Insulated Glass: Preamsembled insulated glass units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space with minus 20-degree F dew point and with STC ratings indicated.
 - a. Performance: Certified to ASTM E2190 by Insulating Glass Certification Council.
 - b. System: Manufacturer's standard dual seal system compatible with glazing system, and including spacers, desiccant, and standard corner construction.
 - c. Standard Safety Glass: ASTM C1048, Kind FT, fully tempered select glazing quality glass, safety glazing.
 - d. Laminated Safety Glass: ASTM C1172, Kind LA, two sheets of clear float glass laminated with polyvinyl buteral film; safety glass; laminated layers free of air pockets and foreign substances.
 - 1) Polyvinyl Buteral Core Thickness: Not less than 30 mil unless greater thickness required for STC rating.
 - e. Glass Lite Thicknesses: As required to achieve required STC rating.
 - f. Total Unit Thickness: As required to achieve required STC rating.
- J. Glazing Accessories: Of type recommended by manufacturer to suit security locations and applications for glazing installation and meet STC rating.
- 1. Setting Blocks: Neoprene or EPDM, 80-90 Shore A durometer hardness; 4" long by 3/8" thick by 1/4" high; ASTM C864.
 - 2. Spacer Shims: Neoprene or EDPM; 45-55 Shore A durometer hardness; 3" long by 3/32" thick by 1/4" high; ASTM C864.
 - 3. Edge Blocks: Neoprene or EPDM, 60-70 Shore A durometer hardness; 4" long with minimum two per jamb located at top and bottom edges of glass; ASTM C864.
 - 4. Glazing Gaskets: Exterior neoprene or EDPM; interior neoprene, EPDM or vinyl; miter corner joints; ASTM C509 or C864.

K. Miscellaneous Materials:

1. Fasteners: Aluminum or non-magnetic stainless steel of type that will not cause electrolytic action or corrosion.
 - a. Do not use exposed fasteners except where unavoidable for assembly or for application of hardware.
 - b. Indicate exposed fasteners on shop drawings for specific approval; exposed fasteners shall be Phillips flat-head screws or Allen screws with finish matching item fastened.
 - c. Provide concealed fasteners for glazing stops.
2. Steel Reinforcement and Brackets: Manufacturer's standard with minimum 2 oz. hot-dip zinc coating, ASTM A123, applied after fabrication.
3. Bituminous Paint: Cold-applied mastic, SSPC Paint 12, compounded for 30 mil thickness per coat.
4. Anchoring Devices: Corrosion resistant type capable of supporting walls system and superimposed design loads; design to allow adjustments of system prior to being permanently fastened in place.

2.3 FABRICATION

- A. Fabricate sliding wall system to allow for clearances and shim spacing around perimeter of assemblies to enable installation; provide for thermal movement.
- B. Provide anchorage devices to securely and rigidly fit walls assemblies in place.
- C. Accurately fit together joints and corners; match components ensuring continuity of line and design; ensure joints and connections are flush, hairline and weatherproof.
- D. Provide structural reinforcing within framing members where required to maintain rigidity and as required to accommodate design loads.
- E. Complete cutting, fitting, forming, drilling and grinding of metal work prior to cleaning, finishing, treatment, and application of coating.
- F. Finishing: After fabrication, prepare surfaces for finishing in accordance with recommendations of aluminum producer and finish manufacturer.
 1. Finish components of each assembly simultaneously to attain uniformity of color.
- G. Weld by methods recommended by metal manufacturer and AWS; grind exposed welds smooth and restore mechanical finish; remove arises from cut edges and corners to a radius of approximately 1/64".
- H. Fit and assemble work at shop to greatest extent possible; disassemble only as required for shipment and erection.
- I. Reinforce work as necessary for performance requirements and for support.

1. Provide internal reinforcing for hardware.
- J. Separate dissimilar materials with bituminous paint or preformed separators which will prevent corrosion.
- K. Separate metal surfaces at moving joints with plastic inserts or other non-abrasive concealed inserts that permanently prevent "freeze-up" of joint.
- L. Fabricate and apply hardware, disassemble only as required for transportation and installation.
- M. Apply coat of bituminous paint on concealed aluminum surfaces to be in contact with cementitious and with dissimilar materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces of openings and verify dimensions; verify rough openings are level, plumb, and square and within wall manufacturer recommended tolerances.
- B. Beginning of work constitutes acceptance of existing conditions.

3.2 INSTALLATION

- A. Install folding, sliding walls and integral swing doors in accordance with manufacturer's recommendations and to meet design requirements indicated, for weathertight installation.
- B. Ensure sliding walls are plumb, level and free of warp or twist; maintain dimensional tolerances and alignment with adjacent work.
 1. Maximum Variation from Plane or Location: 1/8" in 12'-0", with maximum 1/2" variation in total length.
 2. Maximum Offset Between Members: 1/16".
- C. Use anchorage devices to securely and rigidly fasten system to building.
- D. Install hardware in accordance with manufacturer's recommendations, using proper templates.
 1. Install to operate freely and smoothly, with a maximum operating pressure of 5 pounds in accordance California Title 24 and with ADA Standards.
 2. Coordinate installation of cylinders with Section 08 71 00.
- E. Glass Installation: Comply with GANA Glazing Manual and glazing manufacturer instructions and requirements for indicated STC rating.
 1. Do not allow glass to touch metal surfaces.

3.1 FIELD QUALITY CONTROL

- A. Site Acoustical Tests: Determine field sound transmission class values in accordance with ASTM E336; tests by Architect approved independent testing laboratory.
 - 1. Field Sound Transmission Rating: Minimum FSTC as required by Acoustical Consultant when tested in accordance with ASTM E336, using reverberant-field procedure and full octave bands rather than one-third octave bands.
 - 2. Failed Tests: Make corrections and re-test.

3.3 CLEANING

- A. Clean aluminum surfaces promptly after installation of components, exercising care to avoid damage of finish.
- B. Mark glass after installation by crossed streamers attached to framing and held away from glass; do not apply markers to surface of glass.
- C. Remove nonpermanent labels immediately after sealant cures; cure sealants for high early strength and durability.

3.4 PROTECTION

- A. Remove and replace glass which is broken, chipped, cracked, abraded or damaged during construction period, including natural causes, accidents and vandalism.

END OF SECTION

SECTION 08 41 00

ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide interior aluminum-framed entrances and storefront systems, with stock non-automatic doors, hardware, anchorage, glazing, and accessories as required for complete installation.
- B. Related Sections:
 - 1. Section 07 90 00: Perimeter sealants and back-up materials.
 - 2. Section 08 11 20: Interior aluminum frames for wood doors.
 - 3. Section 08 35 40: Folding, sliding walls with integral swing door.
 - 4. Section 08 71 00: Cylinders for door locks

1.2 REFERENCES

- A. American Architectural Metal Manufacturers (AAMA): Aluminum Store Front and Entrance Manual.
- B. Glass Association of North America (GANA): Glazing Manual.
- C. National Association of Architectural Metal Manuf. (NAAMM): Metal Finishes Manual.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Design/Build: Provide special engineering for entrances and storefronts to ensure they comply with applicable codes and Contract Documents.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's literature.
- B. Shop Drawings: Indicate pertinent dimensioning, general construction, component connections and locations, anchor methods and locations, hardware locations, and relevant details.
- C. Samples: Furnish samples of metal finish, glass and glazing gasket.
- D. Test Reports: Include laboratory test results for STC and OITC rating of units.
- E. Design/Build Certificates: Submit certification signed by California licensed structural engineer indicating compliance with Contract Documents and code requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer or firm with minimum five years successful experience in the installation of systems like type and size required for Project and approved by manufacturer.

1.6 WARRANTY

- A. Extended Correction Period: Extend correction period to two years.
 - 1. Provide for correcting failure of Sound Transmission Coefficient rating (STC).
 - 2. Provide for correcting failure of insulating glass. Failure includes signs of moisture on interior surfaces of insulated glass units and bond failure of laminated glass.
 - 3. Repair or replace systems and materials which fail to perform as intended.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Kawneer Company, Inc.
- B. Oldcastle Building Envelope.
- C. Arcadia, Inc.
- D. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide interior aluminum-framed entrances and storefront systems, with stock non-automatic doors, hardware, anchorage, glazing, and accessories.
- B. Performance Criteria Requirements: Conform to ANSI/AAMA 101 for HGD-R60 rating or better.
 - 1. Acoustical Ratings: Provide system that has been tested under ASTM E90 with minimum Sound Transmission Class (STC) rating as indicated on Drawings.
- C. Regulatory Requirements, General: Comply with applicable California Building Code load requirements, without breakage, failure of any part, or malfunction of operation.
- D. Regulatory Requirements for Glazing: Comply with CPSC 16 CFR 1201, applicable code requirements, and pass ANSI Z97.1.
- E. Accessibility Regulatory Requirements: Provide for assuring access for persons with disabilities in accordance with state and federal regulations.
 - 1. California Regulations: Comply with California Building Standards Code.
 - 2. Federal Regulations: Comply with Americans with Disabilities Act (ADA) Standards.

TLCD ARCHITECTURE SONOMA CLEAN POWER (SCP) ADVANCED ENERGY CENTER
741 4TH STREET, SANTA ROSA, CA

- F. Interior Aluminum-Framed Entrance and Storefront Systems: Systems with profiles as indicated on Drawings; provide extruded aluminum security type glass stops of profile to suit frame design.
1. Basis of Design: Kawneer.
 2. Aluminum Type: As recommended by manufacturer for application indicated, but not less than extruded aluminum, ASTM B221, 6061 or 6063 alloy and T5 or T6 temper.
 3. Finish, Clear Anodized: Clear anodized coating conforming with NAAMM Metal Finishes Manual, Architectural Class I, 0.7 mil or greater.
 - a. Architect reserves right to reject units of color or texture variations which are visually objectionable, but only where variation exceeds range established by manufacturer prior to work.
- G. Doors, Frames, and Hardware: Barrier-free entry doors meeting code requirements for providing access for people with physical disabilities; by entrance manufacturer.
1. Type: As indicated on Drawings with 10" bottom rail, as selected by Architect from manufacturer's standard integral swing doors where not clearly indicated.
 2. Metal and Finish: Match entrance system.
 3. Hardware: Provide complete hardware system except as indicated; match window wall system finish unless otherwise directed by Architect. Coordinate with Section 08 71 00 – Door Hardware.
 - a. Hinges: Extra heavy-duty ball bearing full mortise (butt) hinges complying with requirements specified in Section 08 71 00.
 - b. Closers: Concealed adjustable type closer, maximum 5-pound operating pressure when installed in final application.
 - c. Push/Pulls: Types as indicated on Drawings; where not otherwise indicated manufacturer's standard types as selected by Architect; match finish of similar hardware as specified in Section 08 71 00.
 - d. Security Locks: Manufacturer's standard.
 - 1) Cylinders: Provided under Section 08 71 00.
 - e. Acoustical Gasketing: Manufacturer's recommended type to suit acoustical requirements.
 - f. Thresholds: Maximum 1/2" height above adjacent surfaces, with maximum 1/4" vertical section and remainder maximum 1:2 slope.

TLCD ARCHITECTURE SONOMA CLEAN POWER (SCP) ADVANCED ENERGY CENTER
741 4TH STREET, SANTA ROSA, CA

- H. Glass: Provide minimum thicknesses specified, but no less than thicknesses required based on window size and configuration and required STC rating.
 - 1. Acoustical Insulated Glass: Preamsembled insulated glass units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space with minus 20-degree F dew point and with STC ratings indicated.
 - a. Performance: Certified to ASTM E2190 by Insulating Glass Certification Council.
 - b. System: Manufacturer's standard dual seal system compatible with glazing system, and including spacers, desiccant, and standard corner construction.
 - c. Standard Safety Glass: ASTM C1048, Kind FT, fully tempered select glazing quality glass, safety glazing.
 - d. Laminated Safety Glass: ASTM C1172, Kind LA, two sheets of clear float glass laminated with polyvinyl butural film; safety glass; laminated layers free of air pockets and foreign substances.
 - 1) Polyvinyl Butural Core Thickness: Not less than 30 mil unless greater thickness required for STC rating.
 - e. Glass Lite Thicknesses: As required to achieve required STC rating.
 - f. Total Unit Thickness: As required to achieve required STC rating.
- I. Glazing Accessories: Of type recommended by manufacturer to suit security locations and applications for dry glazing installation and meet STC rating.
 - 1. Setting Blocks: Neoprene or EPDM, 80-90 Shore A durometer hardness; 4" long by 3/8" thick by 1/4" high; ASTM C864.
 - 2. Spacer Shims: Neoprene or EDPM; 45-55 Shore A durometer hardness; 3" long by 3/32" thick by 1/4" high; ASTM C864.
 - 3. Edge Blocks: Neoprene or EPDM, 60-70 Shore A durometer hardness; 4" long with minimum two per jamb located at top and bottom edges of glass; ASTM C864.
 - 4. Glazing Gaskets: Exterior neoprene or EDPM; interior neoprene, EPDM or vinyl; miter corner joints; ASTM C509 or C864.
- J. Miscellaneous Materials:
 - 1. Fasteners: Aluminum or non-magnetic stainless steel of type which will not cause electrolytic action or corrosion.
 - a. Do not use exposed fasteners except where unavoidable for assembly or for application of hardware.

- b. Indicate exposed fasteners on shop drawings for specific approval; exposed fasteners shall be Phillips flat-head screws or Allen screws with finish matching item fastened.
 - c. Provide concealed fasteners for glazing stops.
- 2. Steel Reinforcement and Brackets: Manufacturer's standard with minimum 2 oz. hot-dip zinc coating, ASTM A123, applied after fabrication.
- 3. Bituminous Paint: Cold-applied mastic, SSPC Paint 12, compounded for 30 mil thickness per coat.
- 4. Flashing: Provide sub-sill flashing members; minimum 22 gage sheet aluminum of sizes and shapes indicated and as required to drain water to exterior; match adjacent aluminum member finish.
- 5. Anchoring Devices: Corrosion resistant type capable of supporting entrance system and superimposed design loads; design to allow adjustments of system prior to being permanently fastened in place.

2.3 FABRICATION

- A. Fabricate interior aluminum entrance and storefront system to allow for clearances and shim spacing around perimeter of assemblies to enable installation; provide for thermal movement.
- B. Provide anchorage devices to securely and rigidly fit entrance assemblies in place.
- C. Non-Automatic Doors: Comply with California Building Code and Americans with Disabilities Act (ADA) Standards relating to access for persons with disabilities.
 - 1. Clear Opening Width: Minimum 32" clear opening width for each door.
- D. Accurately fit together joints and corners; match components ensuring continuity of line and design; ensure joints and connections are flush, hairline and weatherproof.
- E. Provide structural reinforcing within framing members where required to maintain rigidity and as required to accommodate design loads.
- F. Allow moisture entering joints and condensation occurring within frame construction to drain to exterior.
- G. Complete cutting, fitting, forming, drilling and grinding of metal work prior to cleaning, finishing, treatment, and application of coating.
- H. Finishing: After fabrication, prepare surfaces for finishing in accordance with recommendations of aluminum producer and finish manufacturer.
 - 1. Finish components of each assembly simultaneously to attain uniformity of color.

- I. Weld by methods recommended by metal manufacturer and AWS; grind exposed welds smooth and restore mechanical finish; remove arises from cut edges and corners to a radius of approximately 1/64".
- J. Fit and assemble work at shop to greatest extent possible; disassemble only as required for shipment and erection.
- K. Reinforce work as necessary for performance requirements and for support.
- L. Provide internal reinforcing for hardware.
- M. Separate dissimilar materials with bituminous paint or preformed separators which will prevent corrosion.
- N. Separate metal surfaces at moving joints with plastic inserts or other non-abrasive concealed inserts which permanently prevent "freeze-up" of joint.
- O. Fabricate doors and apply hardware in shop. Disassemble only as required for transportation and installation.
- P. Apply coat of bituminous paint on concealed aluminum surfaces to be in contact with cementitious and with dissimilar materials.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install interior aluminum-framed storefront assemblies, including entrances, in accordance with manufacturer's recommendations and installation instructions and to meet design criteria and performance criteria indicated, for weather-tight installation.
 - 1. Separate aluminum and other corrodible metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- B. Ensure assemblies are plumb, level and free of warp or twist; maintain dimensional tolerances and alignment with adjacent work.
 - 1. Maximum Variation from Plane or Location: 1/8" in 12'-0", with maximum 1/2" variation in total length.
 - 2. Maximum Offset Between Members: 1/16".
- C. Use anchorage devices to securely and rigidly fasten assemblies to building.
- D. Install hardware in accordance with manufacturer's recommendations, using proper templates.
 - 1. Install doors to operate freely and smoothly, with a maximum operating pressure of 5-pounds in accordance with California Building Standards Code.
 - 2. Coordinate installation of cylinders with Section 08 71 00 – Door Hardware.
 - 3. Install sill members and thresholds in bed of compound, joint fillers or gaskets to provide weathertight construction.

- E. Glass Installation: Comply with GANA Glazing Manual and glazing manufacturer instructions.

- 1. Do not allow glass to touch metal surfaces.

3.1 FIELD QUALITY CONTROL

- A. Site Acoustical Tests: Determine field sound transmission class values in accordance with ASTM E336; tests by Architect approved independent testing laboratory.

- 1. Field Sound Transmission Rating: Minimum FSTC as required by Acoustical Consultant when tested in accordance with ASTM E336, using reverberant-field procedure and full octave bands rather than one-third octave bands.

- 2. Failed Tests: Make corrections and re-test.

3.2 CLEANING

- A. Clean aluminum surfaces promptly after installation of components, exercising care to avoid damage of finish.
- B. Mark glass after installation by crossed streamers attached to framing and held away from glass; do not apply markers to surface of glass.
- C. Remove nonpermanent labels immediately after sealant cures; cure sealants for high early strength and durability.

3.3 PROTECTION

- A. Remove and replace glass which is broken, chipped, cracked, abraded or damaged during construction period, including natural causes, accidents and vandalism.

END OF SECTION

SECTION 08 62 10

TUBE SKYLIGHTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide tube type factory fabricated acrylic glazed skylights, with tube connecting exterior acrylic or polycarbonate dome, tubing, interior ceiling diffuser, flashing, and accessories for complete, weathertight installation.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's literature.

1.3 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to energy efficiency.

1.4 WARRANTY

- A. Extended Correction Period: Repair or replace tube skylights which leak or fail to comply with specified requirements.
 - 1. Period: Two years.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Solatube International, Inc. (800.966.7652)/Solatube.
- B. Daylighting Technologies, Inc./Sun-Dome.
- C. Sun-Tek Manufacturing, Inc./Tube Skylights.
- D. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide tube type factory fabricated acrylic glazed skylights, with tube connecting exterior acrylic or polycarbonate dome, tubing, interior ceiling diffuser, flashing, and accessories.
- B. Performance Requirements: Fabricate and install components capable of withstanding thermal expansion and contraction movements for ambient temperatures from 20-110 degrees F. without failure, leaks, or noise.

- C. Design Requirements: Fabricate and install skylights capable of withstanding California Building Code required loads acting on skylight without failure, leaks, or permanent distortion.
- D. Tube Skylights: Provide manufacturer's standard tube skylights as indicated.
 - 1. Diameter: 16".
 - 2. Construction: Manufacturer's standard construction for tube skylights.
 - 3. Options: Provide as indicated and as recommended by skylight manufacturer.
- E. Fasteners: Aluminum, cadmium-plated steel, or austenitic stainless steel.
 - 1. Provide anodic corrosion isolation where required and provide neoprene washer or gasket where fastener penetration is subject to water penetration.
- F. Corrosion Isolation: Bitumastic paint of alkali-resistant type with minimum 15-mil dry-film thickness.

2.2 FABRICATION

- A. Fabricate skylights to profiles and dimensions indicated.
- B. Fabricate skylights with integral flashing for mounting on substrates indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install special tube skylights in accordance with manufacturer's recommendations and installation instructions.
- B. Set units plumb and true to line without warp or rack.
- C. Anchor securely to curbs with manufacturer's recommended fasteners and with neoprene-gasket heads.
- D. Provide heavy coat of bituminous paint on aluminum surfaces in contact with dissimilar materials.

3.2 CLEANING

- A. Clean aluminum and glazed surfaces in accordance with manufacturer's instructions.
 - 1. Glazing Plastic: Leave in scratch-free condition, inside and out, with labels removed.
- B. Repair or replace damaged units, including those with excessive scratches on acrylic, as determined by Architect.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding doors.
 - 3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section "Door Hardware Schedule".
 - 2. Division 08 Section "Flush Wood Doors".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series
 - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.2 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- D. Informational Submittals:
1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.3 QUALITY ASSURANCE

- A. **Manufacturers Qualifications:** Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. **Installer Qualifications:** A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. **Door Hardware Supplier Qualifications:** Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- D. **Source Limitations:** Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
- E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- F. **Keying Conference:** Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- G. **Pre-Submittal Conference:** Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

- H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.5 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.6 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 1. Structural failures including excessive deflection, cracking, or breakage.
 2. Faulty operation of the hardware.

3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
1. Seven years for heavy duty cylindrical (bored) locks and latches.
 2. Five years for exit hardware.
 3. Twenty five years for manual surface door closer bodies.

1.7 MAINTENANCE SERVICE

- 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.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.

- b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
- 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
- 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
- 4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
- 5. Manufacturers:
 - a. Hager Companies (HA).
 - b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
- B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
 - 1. Manufacturers:
 - a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
 - b. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.3 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.
 - 1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
 - 2. Furnish dust proof strikes for bottom bolts.
 - 3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.

4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:
 - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - b. Trimco (TC).

2.4 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
- C. Cylinders: Original manufacturer cylinders complying with the following:
 1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 5. Keyway: Manufacturer's Standard.
- D. Keying System:
 1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
 2. Furnish cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
- E. Key Quantity: Provide the following minimum number of keys:
 1. Change Keys per Cylinder: Two (2)
 2. Master Keys (per Master Key Level/Group): Five (5).

2.5 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified.
 1. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.
 2. Locks are to be non-handed and fully field reversible.

3. Manufacturers:

- a. Corbin Russwin Hardware (RU) – CL3300 Series.
- b. Sargent Manufacturing (SA) – 10 Line.

2.6 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
 - 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
 - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
 - 4. Dustproof Strikes: BHMA A156.16.

2.7 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
 - 1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
 - 2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
 - 3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
 - 4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 6. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 9. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
 - b. Sargent Manufacturing (SA) - 80 Series.

2.8 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
 4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Manufacturers:
 - a. Sargent Manufacturing (SA) - 351 Series.
 - b. Norton Door Controls (NO) - 7500 Series.
- C. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 certified surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.
1. Manufacturers:
 - a. Norton Door Controls (NO) - 8500 Series.
 - b. Sargent Manufacturing (SA) - 1431 Series.

2.9 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
 - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - b. Trimco (TC).

2.10 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Manufacturers:
 - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - b. Trimco (TC).

2.11 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 - 1. National Guard Products (NG).
 - 2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.12 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.13 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. The supplier is responsible for handing and sizing all products and providing the correct option for the appropriate door type and material where more than one is presented in the hardware sets. Quantities listed are for each pair of doors, or for each single door.

C. Manufacturer's Abbreviations:

1. MK - McKinney
2. RO - Rockwood
3. SA - Sargent
4. PE - Pemko
5. SU - Securitron

Hardware Sets

Set: 1.0

Doors: 1, 10

2 Continuous Hinge	MCK-12HD EPT	CL	MK
1 Removable Mullion	650A	US28	SA
1 Exit Device	55 56 AD8510 862	US32D	SA ⚡
1 Exit Device	55 56 AD8504 862 MK	US32D	SA ⚡
2 Door Closer	351 CPS (351D 581-2 as required)	EN	SA
1 Threshold	271A		PE
1 Gasketing	by door mfg.		
2 Sweep	57AV		PE
2 Frame Harness	QC-C1500P (as required)		MK ⚡
2 Door Harness	QC-C__P (as required)		MK ⚡
1 Reader	R100 (by access control)		SU ⚡
1 Power Supply	BPS Series (as required)		SU ⚡

Set: 1.1

Doors: 15

3 Hinge	MPB79	US26D	MK
1 Storeroom Lock	28 10G04 LL MK	US26D	SA
1 Door Closer	1431 O/P9	EN	SA
1 Stop	406/409/441H (as required)	US32D	RO
1 Threshold	271A		PE
1 Gasketing	294AV		PE
1 Sweep	57AV		PE

Set: 2.0

Doors: 14, 8

3 Hinge	MPB79	US26D	MK
1 Storeroom Lock	28 10G04 LL MK	US26D	SA
1 Stop	406/409/441H (as required)	US32D	RO
3 Silencer	608		RO

Set: 3.0

Doors: 11, 12, 13

3 Hinge	MPB79	US26D	MK
1 Office Lock	28 10G05 LL MK	US26D	SA
1 Stop	406/409/441H (as required)	US32D	RO
3 Silencer	608		RO

Set: 4.0

Doors: 4B

3 Hinge	MPB79	US26D	MK
1 Classroom Lock	28 10G37 LL MK	US26D	SA
1 Door Closer	1431 O/P9	EN	SA
1 Kick Plate	K1050 10"	US32D	RO
1 Stop	406/409/441H (as required)	US32D	RO
3 Silencer	608		RO

Set: 4.1

Doors: 9

3 Hinge	MPB79	US26D	MK
1 Passage Lever	28 10G15 LL MK	US26D	SA
1 Door Closer	1431 O/P9	EN	SA
2 Kick Plate	K1050 10"	US32D	RO
1 Stop	406/409/441H (as required)	US32D	RO
3 Silencer	608		RO

Set: 5.0

Doors: 6, 7

3 Hinge	MPB79	US26D	MK
1 Push Plate	70C	US32D	RO
1 Pull Plate	BF 111x70C	US32D	RO
1 Door Closer	1431 O/P9	EN	SA
1 Kick Plate	K1050 10"	US32D	RO
1 Stop	406/409/441H (as required)	US32D	RO

Set: 6.0

Doors: 4A

1 Hardware	by door mfg.
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END OF SECTION

SECTION 09 21 00

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide gypsum board systems including gypsum board, joint treatment, acoustical accessories, and general accessories for complete installation.
- B. Related Sections:
 - 1. Section 07 21 00: Building thermal insulation.
 - 2. Section 09 30 00: Cementitious backer unit tile substrates.

1.2 REFERENCES

- A. ASTM C840: Application and Finishing of Gypsum Board.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Openings: Obtain dimensions and locations from other trades and provide openings and enclosures for accessories, specialties, equipment, and ductwork.

1.4 SUBMITTALS

- A. Product Data: Furnish manufacturer's literature for framing, insulation, gypsum board, and acoustical accessories.
- B. Manufacturer's Certification: Furnish manufacturer's certification indicating products comply with Contract Documents and applicable codes.

1.5 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to finish material pollution control for adhesives, sealants, and caulks.
- B. Level 4 Finish Mock-Up: Provide Level 4 finish mock-up not less than 100 square feet in location acceptable to Architect. Approved mock-up may be incorporated into Project.

1.6 PROJECT CONDITIONS

- A. Maintain areas to receive gypsum board at minimum 50-degree F for 48 hours prior to application and continuously after application until drying of joint compound is complete; comply with ASTM C840.
- B. Immediately remove from site gypsum board for interior use exposed to water, including gypsum board with water stains, with signs of mold, and gypsum board with mildew.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. National Gypsum Co.
- B. Georgia-Pacific Corp.
- C. United States Gypsum Co., USG Corp.
- D. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide gypsum board assemblies including gypsum board, joint treatment, acoustical accessories, and general accessories.
 - 1. Systems Responsibility: Provide products manufactured by or recommended by manufacturer of gypsum board to maintain single-source responsibility for system.
- B. Performance Requirements: Perform gypsum board systems work in accordance with recommendations of ASTM C840 unless otherwise specified.
- C. Regulatory Requirements, Fire-Ratings: Provide systems listed in applicable code or by Underwriter's Laboratory, Gypsum Association (GA) File No's in GA-600 Fire Resistance Design Manual or other listing approved by applicable authorities.
- D. Gypsum Board: Comply with ASTM C840; maximum permissible lengths; ends square cut, tapered edges on boards to be finished.
 - 1. Typical: ASTM C1396, Type X, fire rated gypsum board, unless otherwise indicated.
 - 2. First Layer at Double Layer Applications: ASTM C1396 or ASTM C442, Type X, fire rated gypsum backing board.
 - 3. Mold Resistant Gypsum Board: Provide at high humidity areas not covered with tile.
 - a. USG Industries/Sheetrock Mold Tough Firecode Core.
 - b. Georgia Pacific/ToughRock Mold-Guard Fireguard X.
 - c. National Gypsum Gold Bond XP Fire-Shield Gypsum Board.
 - d. Substitutions: Refer to Section 01 25 00.
 - 4. Tile Substrates: Cementitious backer units specified in Section 09 30 00 - Tiling.

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5. Sheathing: Silicone treated glass mat gypsum sheathing, ASTM C1177, Type X, 5/8" thick unless otherwise indicated.
 - a. Manufacturers:
 - 1) Georgia Pacific/DensGlass Gold.
 - 2) Substitutions: Refer to Section 01 25 00.
- E. Gypsum Board Accessories: Comply with ASTM C840.
 1. Provide protective coated steel corner beads and edge trim; type designed to be concealed in finished construction by tape and joint compound.
 2. Corner Beads: Manufacturer's standard metal beads.
 3. Edge Trim: "J", "L", "LK", or "LC" casing beads.
 4. Reinforcing Tape, Joint Compound, Adhesive, Water, Fasteners: Types recommended by system manufacturer and conforming to ASTM C475.
 - a. Typical Joint Compound: Chemical hardening type for bedding and filling, ready-mixed or powder vinyl type for topping.
 5. Control Joints: Back to back casing beads.
 - a. Back control joints with 4 mil thick polyethylene air seal.
- F. Acoustical Accessories: Provide as indicated and as required to achieve acoustical ratings indicated.
 1. Resilient Channels: Provide resilient channels where indicated and where required to provide required sound transmission classifications.
 - a. USG/RC-1.
 - b. ClarkDietrich/RC-Deluxe.
 - c. Substitutions: Refer to Section 01 25 00.
 2. Acoustical Insulation: Preformed mineral fiber, ASTM C665, Type I; friction fit type without integral vapor barrier; as required to meet STC ratings indicated, or of thickness indicated.
 3. Acoustical Sealant: ASTM C919, type recommended for use in conjunction with gypsum board. Paintable, non-shrinking and non-cracking where exposed, nondrying, nonskinning, nonstaining, and nonbleeding where concealed.
 - a. Acoustical Sealant Manufacturers:
 - 1) USG/Sheetrock Acoustical Sealant.
 - 2) Tremco/Acoustical Sealant.
 - 3) Pecora/AC-20.
 - 4) Substitutions: Refer to Division 1.

4. Electrical Box Pads: Provide at outlet, switch and telephone boxes in walls with acoustical insulation.
 - a. Electrical Box Pad Manufacturers for Non-Fire Rated Partitions:
 - 1) Harry A. Lowry & Associates (800.772.2521)/Lowry's Electrical Box Pads.
 - 2) Tremco Sheet Caulking (650.572.1656).
 - 3) Fire rated partition material manufacturers.
 - 4) Substitutions: Refer to Section 01 25 00.
 - b. Electrical Box Pad Manufacturers for Fire Rated Partitions:
 - 1) Hevi-Duty Nelson (800.331.7325)/Fire Rated FSP Firestop Putty Pads.
 - 2) Specified Technologies, Inc. (800.992.1180)/Fire Putty Pads.
 - 3) Hilti, Corp./Hilti Box Pads.
 - 4) Substitutions: Refer to Section 01 25 00.
- G. Fire Rated Assembly Accessories: Provide materials and accessories as required to comply with fire rating requirements of UL, GA or other listing approved by applicable authorities.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Gypsum Board Installation: Install in accordance with ASTM C840 and manufacturer's recommendations.
 1. Use screws when fastening gypsum board to furring and to framing.
 2. Erect gypsum board with ends and edges occurring over firm bearing.
 - a. Ensure joints of second layer do not occur over joints of first layer in double layer applications.
 3. For fire rated systems comply with requirements for fire ratings.
 4. Place control joints to be consistent with lines of building spaces and as directed by Architect.
 - a. Provide where system abuts structural elements.
 - b. Provide at dissimilar materials.
 - c. Lengths exceeding 30'-0" in partitions.
 - d. Ceiling areas exceeding 50'-0" or 2500 square feet.
 - e. Wings of "L", "U" and "T" shaped ceilings.
 5. Place corner beads at external corners; use longest practical lengths.
 6. Place edge trim where gypsum board abuts dissimilar materials.
 7. Tape, fill, and sand exposed joints, edges, corners and openings to produce surface ready to receive finishes; feather coats onto adjoining surfaces.

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8. Finishing: Comply with Gypsum Association (GA) "Levels of Gypsum Board Finish".
 - a. GA Level 4 (Typical): Provide three-coat finishing and sanding is required for surfaces indicated to be painted; provide flush, smooth joints and surfaces ready for applied paint finishes.

9. Remove and replace defective work.

B. Acoustical Accessories Installation:

1. Place acoustical insulation tight within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
2. Place acoustical sealant within partitions in accordance with manufacturer's recommendations; install acoustical sealant at gypsum board perimeter at:
 - a. Metal Framing: One or two beads.
 - b. Base layer and face layer.
 - c. Penetrations of partitions.
3. Tolerance: Maximum 1/4" space between gypsum board at floor, ceiling, and penetrations and sealed with acoustical sealant.
4. Install electrical box pads with pads molded and pressed on back and all sides of box, closing openings, in accordance with manufacturer's instructions, for complete acoustical barrier.

END OF SECTION

SECTION 09 24 00

PORTLAND CEMENT PLASTER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide three coat Portland cement plaster (stucco) with metal lath and accessories as required for complete finished system. Match existing.
- B. Related Sections:
 - 1. Section 07 28 00: Weather barrier underlayment.
 - 2. Section 09 90 00: Painting of stucco.

1.2 REFERENCES

- A. ASTM C926: Application of Portland Cement Based Plaster.
- B. ASTM C1063: Installation of Lathing and Furring for Portland Cement Plaster.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product information for each lathing material and accessory, and for plaster materials.
- B. Shop Drawings: Indicate locations of control and expansion joints where not shown on Drawings.
- C. Samples: Furnish 24" by 24" samples using materials and methods specified including lath.

1.4 QUALITY ASSURANCE

- A. Mock-Up: Provide not less than 100-sf mock-up of plaster; approved mock-up may be incorporated into Project.

1.5 PROJECT CONDITIONS

- A. Take precautionary measures to ensure plaster is not subjected to excessive sun and wind which could cause uneven and excessive evaporation, premature dehydration, or cracking.
- B. Cold-Weather Requirements: Do not apply plaster unless minimum ambient temperature of 40 degrees F has been and continues to be maintained for minimum 48 hours prior to application and until plaster is cured.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System Description: Provide three-coat Portland cement plaster (stucco) with metal lath and accessories.

- B. Regulatory Requirements: Comply with applicable codes.
- C. Portland Cement Plaster: Provide ready-mixed plaster materials unless otherwise approved in writing by Architect; comply with ASTM C926.
 - 1. Scratch and Brown Coat Materials:
 - a. Cement: Normal Type 1 or 1A Portland cement, ASTM C150.
 - b. Hydrated Lime: Special finishing hydrated lime, Type S, ASTM C206.
 - c. Aggregate: Natural sand, conforming to ASTM C897 or C144.
 - 2. Brown Coat Water Acrylic Admix: Acrylic polymer specifically manufactured for use in Portland Cement Plaster (Stucco) applications and which will not detrimentally affect finish.
 - a. Manufacturers:
 - 1) Larsen Products Corp./Acrylic Admix 101.
 - 2) BASF/Thoro Acryl 60.
 - 3) Chem-Masters Corp./Cretelox.
 - 4) Substitutions: Refer to Section 01 25 00.
 - 3. Finishing Materials: Same as brown coat with acrylic admix. Factory premix finish coat is acceptable.
 - 4. Water: Clean, fresh and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances.
- D. Metal Components: Comply with requirements of ASTM C1063.
 - 1. Manufacturers:
 - a. ClarkDietrich Building Systems.
 - b. Phillips Manufacturing Co.
 - c. Alabama Metal Industries Corp. (AMICO).
 - d. Substitutions: Refer to Section 01 25 00.
 - 2. Exterior Components: Hot-dip galvanized finish; ASTM A924 and A653 minimum G90 for 18-gage and lighter formed metal products, ASTM A123 galvanized after fabrication for 16-gage and heavier products.
 - a. Exposed Exterior Components: Zinc accessories unless fully concealed in plaster.
 - 3. Exterior Metal Lath: Expanded diamond mesh; minimum 2.5-lbs per square yard.
 - a. Backing: Specified in Section 07 28 00 – Weather Barrier Underlayment.
 - b. Self-Furring: Where over solid substrate, provide “V” groove type to hold lath approximately 1/4" from supporting base.
 - c. Tie Wire: ASTM A641, soft temper, Class 1 zinc coated; minimum 16-gage for tying metal lath to furring channels and metal lath to metal lath.
 - 4. Inside Corner Mesh: Minimum 26-gage steel; perforated or expanded flanges or clips shaped to permit complete embedding in plaster; minimum 2" by 2" size.

- E. Accessories: Provide as indicated, as recommended by referenced standards, and as required for complete installation.
 - 1. Manufacturers:
 - a. Keene Products from Metalex, a Division of The Koller Group.
 - b. Delta Star, Inc., Superior Metal Trim.
 - c. Lath manufacturers.
 - d. Substitutions: Refer to Section 01 25 00.
 - 2. Casing Beads and Base Screeds: Minimum 26-gage, square edges at casing beads, drip type base screeds; provide with expanded flanges.
 - 3. Expansion Joints: Two-piece slip type joints; commonly referred to as No. 40.
 - 4. Control Joints: One-piece metal joint designed to interlock with plaster similar to Keene/XJ15-3.
 - 5. Aluminum Vent Strips and Channel Screeds: Extruded aluminum alloy 6063 and temper T5 or T6, minimum 0.05" thick; with manufacturer's standard baked-on finish.
 - a. Manufacturers:
 - 1) Fry Reglet Corp./Plaster Moldings.
 - 2) Gordon Inc./Final Forms II.
 - 3) Substitutions: Refer to Section 01 25 00.
 - b. Color: As selected by Architect.
- F. Anchorages: Tie wire, nails, screws and other approved metal supports, of type and size to suit application.
 - 1. Staples not permitted.

2.2 PLASTER MIXES

- A. Provide plaster mixes in accordance with ASTM C926 as appropriate to the substrate indicated and the approved samples.
- B. Mix only as much plaster as can be used in one hour.
- C. Mix materials dry, to uniform color and consistency, before adding water.
- D. Protect mixes from frost, dust and evaporation.
- E. Do not retemper mixes after initial set has occurred.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to application ensure mechanical and electrical services behind surfaces to receive cement plaster have been tested and approved.
- B. Ensure framing has been properly installed and rigidly secured.

3.2 INSTALLATION

- A. Erect furring and lath in accordance with ASTM C1063.
- B. Install work true to lines and levels and to provide surface flatness with maximum variation of 1/8" in 10'-0" in any direction.
- C. Isolation: Isolate lathing and metal support system where it abuts building structure horizontally, and where partition/wall work abuts overhead structure, to prevent transfer of building loads into plaster.
 - 1. Install slip or cushion type joints to absorb deflections but maintain lateral support.
- D. Frame both sides of expansion joints independently unless otherwise indicated, do not bridge joints with furring and lathing or accessories.
- E. Fixture Support Framing: Install supplementary framing, blocking and bracing where work is indicated to support fixtures, equipment, services and similar work requiring attachment and support.
- F. Coordinate installation of anchors, blocking, electrical and mechanical work which is to be placed in or behind framing; allow such items to be installed after framing is complete.
- G. Install expansion and control joints so plaster areas do not exceed 120-sf, and with area sides having a maximum one to two and a half (1:2-1/2) ratio, unless otherwise approved by Architect.
- H. Metal Lathing: Apply lath taut, with long dimension perpendicular to supports; secure end laps with tie wire where they occur between supports; lap sides minimum 1-1/2"; secure with tie wires.
 - 1. Continuously reinforce internal angles.
 - 2. Place 6" wide by 12" long strips of metal lath diagonally at corners of openings; secure rigidly in place.
 - 3. Place 6" wide strips of metal lath at junctions of dissimilar materials; place parallel with dissimilar materials; secure rigidly in place.
- I. Installation of Metal Accessories:
 - 1. Fasten in place true to line and in correct relation to adjacent materials and as required to prevent dislodging and misalignment by subsequent operations.

2. Fasten at both ends and at maximum 12" on center along sides.
3. Bring grounding edge of accessories to true lines, plumb, level, and straight.
4. Install accessories to provide required depth of plaster and to bring plaster surface to required plane.
5. Install continuous corner reinforcement for full length of external corners.
6. Install sill and drip screeds with paper sheathing and lath installed over attachment flange of screeds.
7. Beads: Use single length of metal beads wherever length of run does not exceed longest standard stock length available; miter or cope corners.
 - a. Provide casing beads where plaster abuts dissimilar construction and at perimeter of openings where edges of plaster will not be concealed by other work.

J. Portland Cement Plaster: Conform to ASTM C926.

1. Apply three coat cement plaster system, scratch, brown, and finish coats.
2. Apply each base coat (scratch and brown) to minimum thickness of 3/8"; allow each coat to moist cure for minimum period of 48 hours;
 - a. Moist cure first base coat (scratch coat) during 48-hour period.
3. Allow base coats to cure for minimum 7 days prior to application of finish coat.
4. Evenly dampen base coat, to ensure uniform suction, and apply finish coat; apply thickness sufficient to secure required texture but in no case less than 1/8".
 - a. Apply pre-mixed finish coat in accordance with manufacturer's recommendations.
5. Maintain surface flatness, with maximum variation of 1/8" in 10'-0".
6. Avoid excessive working of surface, delay trowelling as long as possible to avoid drawing excess fines to surface.

K. Finish: Provide surfaces with finish to match existing.

3.3 CUTTING AND PATCHING

- A. Cut, patch, point, and repair plaster as necessary to accommodate other work and to restore cracks, dents, and imperfections.
- B. Repair or replace work to eliminate blisters, buckles, crazing, check cracking, dry-outs, efflorescence, sweat-outs, and similar defects.
- C. Finish cutting and patching to match undamaged plaster; patching shall not be visible in finished installation.

3.4 CLEANING

- A. Promptly remove plaster from surfaces not indicated to be plastered.
- B. Repair surfaces stained, marred or otherwise damaged during plastering.

END OF SECTION

SECTION 09 30 00

TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide tile installations with accessories, as required for complete installation.
 - 1. Provide waterproofing membrane integral with tile setting beds.
 - 2. Provide cementitious backer unit tile substrate.
- B. Related Sections:
 - 1. Section 09 21 00: Gypsum board.

1.2 REFERENCES

- A. ANSI A108.5: Installation of Tile with Latex-Portland Cement Mortar.
- B. ANSI A108.10: Installation of Grout in Tilework.
- C. ANSI A108.11: Interior Installation of Cementitious Backer Units.
- D. Tile Council of North America (TCNA): Handbook for Ceramic Tile Installation.

1.3 SUBMITTALS

- A. Product Data: Furnish manufacturer's literature for each type of material for Project.
- B. Samples: Furnish each type of tile clearly indicating pattern, coloration and joints.
 - 1. Color Charts: Submit actual tile sections showing full range of colors, textures and patterns available for each type of tile.
 - 2. Prepare two 12" square sample panels of each selected type of tile and grout.

1.4 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to finish material pollution control for adhesives, sealants, and caulks.

1.5 PROJECT CONDITIONS

- A. Provide heat and ventilation in areas where ceramic tile work is being performed, to allow tile to properly set.
- B. Take precautionary measures necessary to ensure excessive temperature changes do not occur.

1.6 WARRANTY

- A. Extended Correction Period: Provide for correcting failure of system to resist water penetration except where failure is result of structural failure of building. Repair system and pay for or replace damaged materials and surfaces.
 - 1. Hairline cracking due to temperature or shrinkage is not considered structural failure.
 - 2. Period: Two years.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System Description: Provide tile installations with tile, grout, setting materials, and accessories as indicated.
- B. Regulatory Requirements: Provide non-slip units complying with applicable code and ADA Standards requirements for slip resistance.
 - 1. Provide floor tile with wet and dry value 0.60 coefficient of friction or better when tested in accordance with ASTM C1028 or comparable test indicating compliance with Americans with Disabilities Act (ADA) Standards.
 - 2. Interior Adhered Veneer: Comply with applicable California Code requirements for interior adhered veneer; maximum 20-psf.
- C. Tile: Types as indicated.
 - 1. Manufacturers:
 - a. Dal-Tile Corp.
 - b. Crossville Tile.
 - c. Summitville Tiles, Inc.
 - d. Manufacturers listed on Finish Schedule.
 - e. Substitutions: Refer to Section 01 25 00.
 - 2. Color, Style and Pattern: As indicated on Finish Schedule, as selected by Architect from manufacturer's full range of types of tiles indicated where not otherwise indicated
 - a. Match Architect approved samples.
 - 3. Base and Trim: Provide matching trim pieces, coordinated with sizes and coursing of adjoining flat tile as directed by Architect; types as indicated, as selected by Architect where not indicated.

TLCD ARCHITECTURE SONOMA CLEAN POWER (SCP) ADVANCED ENERGY CENTER
741 4TH STREET, SANTA ROSA, CA

- D. Latex Thin Set: Thinset bond coat, consisting of latex-cementitious mortar conforming to ANSI A118.4.
1. Manufacturers:
 - a. Laticrete International Inc.
 - b. Bostik Construction Products/Hydroment.
 - c. Custom Building Products.
 - d. Mapei Corp.
 - e. Parex USA/Mer-Krete.
 - f. Substitutions: Refer to Section 01 25 00.
 2. Leveling Material: Where substrate irregularity is not suitable for large format floor tile applied over thin set, apply leveling material such as Ardex/K-15 to achieve substrate suitably level for large format floor tile.
- E. Latex-Cement Grout: ANSI A118.7, latex-cementitious type, uniform in color, resistant to shrinkage.
1. Manufacturers:
 - a. Laticrete International Inc.
 - b. Bostik Construction Products/Hydroment.
 - c. Custom Building Products.
 - d. Mapei Corp.
 - e. Parex USA/Mer-Krete.
 - f. Substitutions: Refer to Section 01 25 00.
 2. Color: Match tile unless otherwise indicated.
- F. Waterproofing and Crack Isolation Membrane: Manufacturer's standard liquid rubber polymer designed specifically for application under tile in non-immersed applications.
1. Manufacturers:
 - a. Laticrete International Inc./9235 Waterproof Membrane.
 - b. Bostik Construction Products/Hydroment Ultra-Set.
 - c. Custom Building Products/RedGard Membrane.
 - d. Parex USA/Mer-Krete Hydro-Guard 2000.
 - e. The Nobel Company/NobelSeal TS.
 - f. Substitutions: Refer to Section 01 25 00.
- G. Cementitious Backer Units: ANSI A118.9 aggregated Portland cement with woven glass-fiber mesh on both faces; approximately 1/2" thick; UL fire rated as required to maintain integrity of fire rated assemblies.
1. Manufacturers:
 - a. USG Industries, Durabond Division/Durock.
 - b. National Gypsum Co./PermaBase Cement Board.
 - c. Custom Building Products/Wonderboard.
 - d. Substitutions: Refer to Section 01 25 00.
 2. Contractor Option Coated Glass Mat Backer Units: Georgia Pacific/DenShield, UL fire rated as required to maintain integrity of fire rated assemblies.

- H. Cleaning and Sealing Materials: As recommended by tile and grout manufacturers, such as Bostik Construction Products/Hydroment CeramaSeal.

2.2 MIXES

- A. Mix and proportion cementitious materials for site-made leveling coats, setting beds and grout as recommended by the TCNA Handbook for Ceramic Tile Installation.
- B. Mix and proportion pre-mixed setting beds and grout materials in accordance with manufacturer's recommendations.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to installing tile, ensure surfaces are level; comply with TCNA and tile manufacturer recommendations but not greater than following.
 - 1. Thin Set Tile Tolerance: Maximum surface variation of 1/8" in 10'-0" for standard tile flooring; comply with large format tile manufacturer recommendations for maximum surface variations.
- B. Ensure surfaces are clean and well cured.
- C. Do not commence work until surface conditions are within tolerances required for proper installation; apply latex leveling material where necessary to meet required tolerances.
- D. Waterproof and Crack Isolation Membrane: Install waterproof membrane at tile areas located above grade, in accordance with manufacturer's recommendations; extend membrane minimum 6" up walls.
 - 1. Comply with waterproof membrane manufacturer recommendations for installation of tile over waterproof membrane.
- E. Backer Units: Install units in accordance with ANSI A108.11, manufacturer's recommendations, and as required to provide fire ratings indicated on Drawings.

3.2 INSTALLATION

- A. Install tile in accordance with referenced ANSI Standards and TCNA recommendations for type of substrate and indicated setting method.
 - 1. Latex-Cement Thin Set Floors over Waterproof and Crack Isolation Membrane: TCNA F122.
 - 2. Latex-Cement Thin Set Wall Tile over Cementitious Backer Units: TCNA W244.
 - 3. Latex-Cement Thin Set Wall Tile over Coated Glass Mat Backer Units: TCNA W245.

**TLCD ARCHITECTURE SONOMA CLEAN POWER (SCP) ADVANCED ENERGY CENTER
741 4TH STREET, SANTA ROSA, CA**

- B. Place tile in accordance with patterns indicated on Drawings or as directed by Architect; carefully plan tile layouts, ensure pattern is uninterrupted from one surface to the next and through doorways.
 - 1. Apply latex thin set to back of tile where necessary to ensure 100% bond between bond coat and substrate; replace tiles which break due to voids between tile and substrate.
- C. Neatly cut tile around fixtures and drains; accurately form corners, base, intersections and returns.
 - 1. Base, Coves: Flush cove type with base grout joint on wall, cove tile on floor, unless otherwise indicated.
 - 2. Corners and Edges: Bullnose tile unless otherwise indicated.
- D. Locate expansion joints, control joints, contraction joints, and isolation joints where indicated; where not indicated, provide as recommended by TCNA Handbook and as approved by Architect.
- E. Ensure tile joints are uniform in width, subject to normal variance in tolerance allowed in tile size; ensure joints are watertight, without voids, cracks, excess mortar or grout.
- F. Sound tile after setting, remove and replace hollow sounding units.
- G. Allow tile to set for a minimum 48 hours prior to grouting.
- H. Grout tile to comply with recommendations of TCNA and as specified.
- I. Leave completed installation free of broken, damaged and faulty tile.

3.2 CLEANING AND SEALING

- A. Clean tile surfaces free of foreign matter upon completion of grouting.
- B. Seal tile and grout surfaces where recommended by manufacturer for materials and applications involved; comply with manufacturer's recommendations.

END OF SECTION

SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide acoustical ceiling systems AP1 and AP2 with exposed suspended metal grid system, trim, and accessories as required for complete finished installation.
- B. Related Sections:
 - 1. Section 07 21 00: Black-faced thermal batt ceiling insulation.
 - 2. Divisions 21 through 28: Facilities services for ceiling penetrations.

1.2 REFERENCES

- A. ASTM C635: Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- B. ASTM C636: Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- C. ASTM E580: Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of acoustical ceiling systems with items installed above ceilings to ensure work above ceilings is complete, space is sufficient for items in ceiling while allowing required ceiling heights, and building is enclosed.

1.4 SUBMITTALS

- A. Product Data: Furnish manufacturers' literature.
- B. Shop Drawings: Clearly indicate grid layout and related dimensioning, junctions with other work and ceiling finishes, and inter-relation of mechanical and electrical items related to system.
- C. Samples: Furnish samples of exposed grid finish and each type of ceiling unit.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Firm with minimum five years successful experience in projects of similar type and scope; acceptable to manufacturer of integrated acoustical ceiling system.

1.6 SITE CONDITIONS

- A. Do not install ceilings until building is enclosed, sufficient heat is provided, dust generating activities have terminated and overhead mechanical work is completed, tested and approved.
 - 1. Do not allow acoustical ceiling units to be exposed to moisture; immediately remove acoustical ceiling units with stains, units with signs of mold, and units with mildew.
- B. Allow wet work to dry prior to commencement of installation.
- C. Maintain uniform temperatures of minimum 60 degrees F and humidity of 20% to 40% prior to, during and after installation.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Armstrong World Industries, Inc.
- B. CertainTeed.
- C. Rockfon North America, Chicago Metallic Corp.
- D. USG Corporation.
- E. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide acoustical ceiling systems with exposed suspended metal grid system, trim, and accessories as required for complete finished installation.
- B. Regulatory Requirements:
 - 1. Seismic Design Requirements: Comply with California Building Code requirements for seismic bracing of ceiling suspension system, and with ASTM E580.
 - a. Ceiling Struts: Provide struts as detailed on Drawings and as required by code, placed maximum 12'-0" on center in both directions and within 6'-0" of each wall.
 - b. Slack Wires: Provide safety slack wires, two per fluorescent fixture on diagonally opposite corners and a single wire for each recessed down light.
 - 2. Fire Performance Characteristics: Provide products listed by Underwriters Laboratories (UL) or other independent testing laboratory acceptable to applicable authorities.
 - a. Flame Spread/Smoke Developed: Provide products meeting code requirements for maximum 25 flame spread and maximum 450 smoke developed.

- C. Suspension Systems: Comply with ASTM C635, as applicable to type of suspension system required for type of ceiling units indicated.
 - 1. Exposed Grid System: Direct hung, aluminum or steel exposed grid system.
 - a. AP1: Provide black suspension system standard with manufacturer for system indicated in Finish Code List.
 - b. AP2: Provide white suspension system standard with Armstrong/Interlude XL Grid as indicated in Finish Code List.
 - 2. Attachment Devices: Size for 5 times design load indicated in ASTM C635, Table 1, Direct Hung.
 - 3. Hanger Wires: Galvanized carbon steel, ASTM A641, soft temper, pre-stretched, yield-stress load of at least three times design load, but not less than 12-gage.
 - 4. Straps, Tubes and Angles: Provide galvanized steel as required to meet state and local requirements for seismic design loads.
 - 5. Structural Class: Minimum intermediate-duty system.
 - 6. Edge Molding: Manufacturer's standard angle molding for edges and penetrations of ceiling, with single flange of molding exposed.
 - 7. Maximum Allowable Deflection: L/360.
- D. Acoustical Panels AP1: Type as indicated on Finish Code List.
 - 1. Panels: Armstrong/Soundscapes Shapes 5446 and 5447 as indicated.
 - 2. Size: 48" by 48".
 - 3. Finish: Standard washable white painted finish.
- E. Acoustical Panels AP2: ASTM E1264 type as indicated on Finish Code List.
 - 1. Panels: Armstrong/Cala with square tegular edge designed to be compatible with specified suspension system.
 - 2. Size: 24" by 24", except where otherwise indicated on Drawings.
 - 3. Finish: Standard washable white painted finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Furnish layouts for inserts, clips and other supports required to be installed by other trades for support of acoustical ceilings.
 - 1. Install inserts, clips, and supports where not previously installed and where additional supports are required for complete installation.

- B. Measure ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling; do not use less than half width units at borders.
- C. Coordinate with other work supported by or penetrating through ceilings, including integral air handling systems, light fixtures, and other systems.

3.2 INSTALLATION

- A. Install acoustical ceiling systems in accordance with manufacturer's recommendations and ASTM C636.
 - 1. Coordinate installation of air handling systems and electrical systems integral with integrated acoustic ceiling systems.
 - 2. Finished Ceilings: True to lines and levels and free from warped, soiled or damaged grid or acoustical units.
- B. Install ceiling systems in a manner capable of supporting superimposed loads, with maximum permissible deflection of 1/8" in 10'-0".
- C. Install after major above-ceiling work is complete; coordinate location of hangers with other work.
 - 1. Ensure suspension system is located to accommodate fittings and units of equipment which is to be placed after installation of ceiling grid.
- D. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest adjacent hangers and related carrying channels as required to span required distance.
- E. Install ceiling suspension system to resist seismic loads as required by state and local codes, including extra hanger wires and compression supports for ceilings and light fixtures.
- F. Hang system independently of walls, columns, ducts, pipes and conduit. Where suspension system members are spliced, avoid visible displacement of the longitudinal axis or face plane of adjacent members.
- G. Do not support lighting fixtures from or on main runners or cross runners if weight of fixture causes total dead load to exceed deflection capability.
 - 1. Support fixture loads independently or provide supplementary hangers located within 6" of each corner.
- H. Do not install fixtures so main runners and cross runners are eccentrically loaded; where fixture installation would produce rotation of runners, provide stabilizer bars.
- I. Install edge moldings at intersection of ceiling and vertical surfaces, using maximum lengths, straight, true to line and level; miter corners.
 - 1. Provide edge moldings at junctions with other ceiling finishes.

- J. Where required form expansion joints to accommodate movement and maintain visual closure without distorting system.
- K. Fit acoustic units in place, free from damaged edges or defects detrimental to appearance and function.
 - 1. Lay directionally patterned units one way with pattern as directed.
 - 2. Fit border units neatly against abutting surfaces.
- L. Install system level, in uniform plane and free from twist, warp and dents.
- M. Install hold-down clips where required by applicable codes and where ceiling is within 20'-0" of an exterior door.

3.3 ADJUSTING

- A. Adjustment: Adjust sags or twists which develop in ceiling system and replace any part which is damaged or faulty.

END OF SECTION

SECTION 09 65 10

RESILIENT BASE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide resilient base and accessories as required for complete finished installation.
- B. Related Sections:
 - 1. Section 09 68 10: Tile carpeting edge strips.

1.2 SUBMITTALS

- A. Product Data: Furnish manufacturer's product literature.
- B. Samples: Furnish samples of each base color and type.

1.3 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to finish material pollution control for adhesives and resilient flooring.

1.4 SITE CONDITIONS

- A. Comply with manufacturer recommendations for site conditions but not less than following; maintain minimum 70-degree F air temperature at installation area for three days prior to, during, and for 24 hours after installation.
- B. Store materials in area of application; allow three days for material to reach same temperature as area.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Burke Flooring, Division of Burke Industries.
- B. Roppe Rubber Corporation.
- C. Johnsonite, Inc.
- D. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide resilient base and accessories as required for complete finished installation.

TLCD ARCHITECTURE SONOMA CLEAN POWER (SCP) ADVANCED ENERGY CENTER
741 4TH STREET, SANTA ROSA, CA

- B. Performance Requirements: Provide materials tested under ASTM E648, Flooring Radiant Panel Test, with results of 0.45 watts/sq. cm or higher.
- C. Resilient Base: Conform to ASTM F1861, with premolded end stops and external corners; 1/8" gage; provide coved base at hard floor surfaces, straight base at carpet unless otherwise indicated.
 - 1. Type: Extruded rubber, in rolls.
 - 2. Height: 4" unless otherwise indicated.
 - 3. Color: As indicated on Finish Schedule, as selected by Architect from manufacturer's full range of available colors where not otherwise indicated.
- D. Primers and Adhesives: Water-resistant nontoxic types recommended by base manufacturer for specified material and application.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Apply to walls, columns, pilasters, casework, and other permanent fixtures in rooms and areas where base is required.
 - 1. Fit base joints tight and vertical.
 - 2. Maintain minimum measurement of 18" between joints.
- B. Miter internal corners; use molded sections for external corners and exposed ends.
- C. Install base on solid backing, adhere tightly to wall and floor surfaces; fill voids along top edge of base with manufacturer's recommended adhesive filler.
- D. Scribe and fit to door frames and other obstructions.
- E. Install straight and level to variation of plus or minus 1/8" over 10'-0".

3.2 CLEAN-UP

- A. Remove excess adhesive from floor, base and wall surfaces without causing damage.
- B. Clean surfaces in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 09 65 20

RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide static dissipative resilient tile flooring and accessories as required for complete finished installation and indicated on Finish Code List.
- B. Related Sections:
 - 1. Section 09 65 10: Resilient rubber base.
 - 2. Section 09 68 10: Tile carpeting edge strips.

1.2 SUBMITTALS

- A. Product Data: Furnish manufacturer's product literature for each type of resilient tile including information regarding static resistance (conductivity) for RF3.
- B. Samples: Furnish samples of each type of flooring color and pattern.

1.3 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to finish material pollution control for adhesives and resilient flooring.

1.4 SITE CONDITIONS

- A. Ensure floor surfaces are smooth and flat with maximum variation of 1/8" in 10'-0".
- B. Ensure concrete floors are dry and exhibit negative alkalinity, carbonizing, and dusting.
- C. Maintain minimum 70-degree F air temperature at flooring installation area for three days prior to, during, and for 24 hours after installation.
- D. Store flooring materials in area of application; allow three days for material to reach same temperature as area.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System Description: Provide standard and static resistant resilient tile flooring and accessories.
- B. Regulatory Requirements:
 - 1. Flammability: Provide materials tested under ASTM E648, Flooring Radiant Panel Test, with results of 0.45 watts/sq cm or higher.
 - 2. Slip Resistance: Provide materials tested under ASTM D2047, James Slip Test with minimum 0.6 rating for floors.

- C. Performance Criteria:
 - 1. Conductivity (Static Dissipative Resistance) RF3: Meet UL Standard 779, Standard for Electricity Conductive Flooring.
- D. Standard Resilient Rubber Tile RF1 and RF2: 24" by 24" rubber tile.
 - 1. Manufacturers:
 - a. Mondo Contract Flooring.
 - b. Substitutions: Refer to Section 01 25 00.
 - 2. Color and Pattern: As indicated on Finish Code List; as selected by Architect from manufacturer's full range of available colors where not otherwise indicated.
- E. Static Dissipative Rubber Tile RF3: Manufacturer's standard ESD (electrostatic dissipative) rubber floor tile system with accessories as required for complete static-resistant floor installation.
 - 1. Manufacturers:
 - a. Roppe Corporation, USA/ESD Rubber Static Control Tile.
 - b. Substitutions: Refer to Section 01 25 00.
 - 2. Color and Pattern: As indicated on Finish Code List; as selected by Architect from manufacturer's full range of available colors where not otherwise indicated.
 - 3. Static Dissipative Flooring: Provide conductive type tile flooring designed to conduct static charges to grounding cables preventing static buildup. Provide accessories as required for complete static dissipative flooring system.
- F. Edge Strips: Homogeneous rubber, tapered or bullnose edge, colors as selected by Architect.
- G. Sub-Floor Filler: White premixed latex-cement paste designed for providing thin solid surface for leveling and minor ramping of subsurface to adjacent floor finishes.
 - 1. Use material capable of being applied and feathered out to adjacent floor without spalling.
- H. Primers and Adhesives: Waterproof nontoxic types as recommended by flooring manufacturer for specified material and application.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Conform to manufacturer's recommendations for preparation and to ASTM F710.
- B. Remove sub-floor ridges and bumps; fill low spots, cracks, joints, holes and defects with sub-floor filler.

- C. Clean floor and apply, trowel and float filler to leave smooth, flat hard surface; prohibit traffic until filler is cured.
- D. Test substrate for moisture content in accordance with flooring manufacturer recommendations; where moisture content exceeds recommendations take measures recommended by flooring manufacturer.

3.2 INSTALLATION

- A. Conform to manufacturer recommendations and installation instructions including special instructions to ensure static resistance (conductivity) of flooring installation at static resistant tile floors RF3.
 - 1. Open floor tile cartons, enough to cover each area, and mix tile to ensure shade variations do not occur within any one area.
- B. Spread cement evenly in quantity recommended by manufacturer to ensure adhesion over entire area of installation; spread only enough adhesive to permit installation of flooring before initial set.
- C. Set flooring in place using methods to ensure full adhesion.
- D. Lay flooring with joints parallel to building lines to produce symmetrical pattern.
- E. Install minimum 1/2 tile at room and area perimeter.
- F. Terminate resilient flooring at centerline of door openings where adjacent floor finish is dissimilar.
- G. Install edge strips at unprotected and exposed edges where flooring terminates.
- H. Scribe flooring to walls, columns, floor outlets and other appurtenances, to produce tight joints.
- I. Consult with Architect for floor pattern desired in each area.
- J. Edge Strips: Install where edge of tile would otherwise be exposed; butt to flooring without gaps; set in adhesive.

3.3 CLEAN-UP AND PROTECTION

- A. Remove excess adhesive from floor, base and wall surfaces without causing damage.
- B. Prohibit traffic from floor for 48 hours after installation.

END OF SECTION

SECTION 09 68 10

TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide carpet tile including edge strips where carpeting terminates at other floor finishes and accessories as required for complete finished installation.
- B. Related Sections:
 - 1. Section 09 65 10: Resilient base.

1.2 SUBMITTALS

- A. Product Data: Prior to final acceptance of carpet tile installation, submit manufacturer's detailed maintenance recommendations for care, cleaning and repair of carpet tiles installed.
- B. Shop Drawings: Clearly indicate carpet tile layout, direction of carpet tiles, adhesive to be used, method of integrating edge strips with carpet tile, and installation procedures.
- C. Samples: Submit samples of each carpet tile type and color, and of each color of edge strip.
- D. Certificate of Compliance: Furnish manufacturer's certificate of compliance stating each material delivered conforms to Specifications.
- E. Maintenance Recommendations: Prior to final acceptance of carpet tile installation, furnish carpet tile manufacturer's detailed maintenance recommendations for care, cleaning and repair of carpet tiles installed.
- F. Maintenance Materials: Submit unused carpet tiles. Box unused carpet tiles and mark boxes indicating color and location installed.

1.3 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to finish material pollution control for carpet systems and adhesives.
- B. Installer Qualifications: Firm with minimum five years successful experience in carpet tile installation and approved by carpet tile manufacturer.
 - 1. Upon request, submit letter from carpet manufacturer stating installer is acceptable.
- C. Mock-Up: Provide minimum 12' by 12' mock-up of carpet tile for approval prior to beginning installation; approved mock-up may be incorporated into finished installation.

1.4 PROJECT CONDITIONS

- A. Do not commence carpet tile installation until painting and finishing work is complete and ceiling and other overhead work has been tested, approved and completed, unless specifically approved.
- B. Maintain room temperature at minimum 60 degrees F for at least 24 hours prior to installation; relative humidity shall be approximately that at which area is to be maintained.
- C. Schedule, receive, and place carpet tile on floors indicated; protect from soiling and damage during transit, storage, and installation.

1.5 WARRANTY

- A. Extended Correction Period: Provide for promptly making good or replacing defective materials or workmanship. Repairs shall take place within ten days of written notification.
 - 1. Period: Two years.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Interface Flooring Systems, Inc.
- B. Mannington Commercial Division, Mannington Carpets, Inc.
- C. Lees Carpets, Division of Burlington, Inc.
- D. Milliken Contract Carpets.
- E. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide carpet tile including edge strips where carpeting terminates at other floor finishes and accessories.
- B. Regulatory Requirements: Carpet tiles shall have passed following fire and smoke tests.
 - 1. DOC-FF-1-70: Pass.
 - 2. ASTM E662 (Smoke Density): 450 or less.
 - 3. ASTM E648 or NFPA 253 (Flooring Radiant Panel Test): 0.45 or higher.
- C. Design Criteria: Provide carpet materials that bear Carpet and Rug Institute "Green Label Plus".
- D. Performance Requirements, Static: Carpet tile shall develop less than 3.0 kilovolts of static at 70 degrees F and 20 percent relative humidity.

- E. Carpet Tile: Types as indicated on Finish Code List.
 - 1. Basis of Design: Interface/Human Nature Collection.
 - 2. Colors and Patterns: Combination of multiple patterns in Collection as directed by Architect.
- F. Adhesive: Nontoxic type recommended by carpet tile manufacturer to suit application and expected service.
- G. Leveling and Ramping Material: Latex-cement material designed for providing thin solid surface for leveling and minor ramping of subsurface to adjacent floor finishes.
 - 1. Use material capable of being applied and feathered out to adjacent floor without spalling.
- H. Edge Strips: Vinyl or rubber; manufacturer's standard colors as selected.
- I. Accessories: Provide as required for complete finished installation.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean floors of dust, dirt, solvents, oil, grease, paint, plaster and other substances detrimental to proper performance of adhesive and carpet tile; allow floors to thoroughly dry.
- B. Ensure floors are level, with maximum surface variation of 1/4" in 10 feet.
- C. Ensure concrete floors are free from scaling and irregularities and exhibit neutrality relative to acidity and alkalinity.
- D. Use leveling and ramping material to patch cracks, small holes, leveling and for ramping to provide finished carpet tile within 1/2" of adjacent flooring materials.
- E. Test substrate for moisture content in accordance with flooring manufacturer recommendations; where moisture content exceeds recommendations take measures recommended by flooring manufacturer.

3.2 INSTALLATION

- A. Install carpet tiles in accordance with manufacturer's recommendations and installation instructions.
 - 1. Adhere tiles to subfloor unless otherwise approved.
- B. Prime substrate if required and as recommended by manufacturer. Spread adhesive in quantity recommended by manufacturer to ensure proper adhesion. Apply only enough adhesive to permit proper adhesion of carpet tile before initial set.

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- C. Lay carpet tile with run of pile in direction of anticipated traffic; do not change run of pile in any one room or from one room to next where continuous through a wall opening.
 - 1. Finished installation to provide monolithic carpet tile appearance as approved by Architect.
- D. Cut and fit carpet tile neatly around projections through floor and to walls and other vertical surfaces.
- E. Fit carpet tiles snugly to walls or other vertical surfaces, leaving no gaps.
- F. Lay installation tight and flat to subfloor well fastened and uniform in appearance; ensure monolithic color, pattern and texture match within any one area.
- G. Edging Strips: Install in accordance with manufacturer recommendations and installation instructions.
 - 1. Install edging strips where carpet terminates at other floor coverings.
 - 2. Use full length pieces only, butt tight to vertical surfaces. Where splicing cannot be avoided, butt ends tight and flush.
- H. Do not place heavy objects such as furniture on carpet tiled surfaces for not less than 24 hours or until adhesive is set.

3.3 CLEANING

- A. Upon completion of carpet tile installation in each area, visually inspect carpet tile installed in that area and immediately remove dirt, soil and foreign substance from exposed face.
- B. Clean in accordance with manufacturer's recommendations and as specified in Section 01 70 00 – Execution Requirements.
- C. Inspect adjacent surfaces and remove marks and stains caused by carpet tile installation.
- D. Remove packaging materials, carpet tile scraps, and other debris from carpet tile installation.

END OF SECTION

SECTION 09 77 10

ACOUSTIC WALL COVERING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide acoustic wall covering system with accessories as required for complete installation.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Scheduling: Schedule installation of wall covering as late in construction schedule as possible to prevent damage during construction.

1.3 SUBMITTALS

- A. Product Data: Furnish manufacturer's literature.
- B. Shop Drawings: Indicate design parameters, adjacent construction, materials, dimensions, thickness, fabrication details, tolerances, colors, finishes, methods of support and anchorages.
- C. Samples: Furnish acoustic wall covering system and exposed accessories.
- D. Maintenance Instructions: Include manufacturer's recommended cleaning materials and application methods, including precautions in use of cleaning materials that may be detrimental to surfaces.

1.4 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to finish material pollution control for adhesives, sealants, and caulks.
- B. Mock-Up: Provide mock-up of acoustic wall covering system, minimum 40 sf. Approved mock-up may be incorporated into Project.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer recommendations. Store panels in clean and dry area where temperatures are maintained at minimum 40-degrees F with normal humidity.
 - 1. Do not store in upright position.
- B. Take precautionary measures with adhesives and solvents to prevent fire hazards.

1.6 PROJECT CONDITIONS

- A. Comply with manufacturer recommendations. Maintain surfaces and materials at minimum 60-degrees F three days before and during application period.

- B. Provide continuous ventilation during work and after installation of wall covering.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Autex Industries Limited of New Zealand/Sordino
- B. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide acoustic wall covering with accessories.
- B. Regulatory Requirements:
 - 1. Fire-Rating: Class I (UL Class A), maximum 200 flame spread, 450 smoke developed, ASTM E84, unless otherwise indicated.
- C. Acoustic Wall Covering: Thermally bonded 100% high density polyester.
 - 1. Noise Reduction Coefficient: Not less than 0.40, ASTM C423.
 - 2. Rolls: 48" wide by 36' long.
 - 3. Thickness: 0.39" to 0.47".
 - 4. Weight: 5.67 oz/sf.
 - 5. Finish: Flat-pile finish.
- D. Adhesive: Nontoxic type recommended by wall covering manufacturer to suit application.
- E. Primer: Provide non-staining, non-toxic release coat primer as recommended by wall covering manufacturer.
 - 1. Provide primer which allows removal of wall covering from gypsum board without damaging paper facing of board, and without premature separation of wall covering from wall.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Ensure surfaces to receive wall covering are clean, true and free of irregularities, do not commence with work until surfaces are satisfactory.
- B. Ensure wall surface flatness tolerance does not vary more than 1/8" in 10'-0", nor vary at a rate greater than 1/16" per running foot.

3.2 PREPARATION

- A. Fill nicks, gouges and other minor imperfections of substrates with latex filler; sand smooth, flush with surface.
 - 1. Apply prime coat in accordance with manufacturer's recommendations.
- B. Wash down painted surfaces with tri-sodium phosphate, rinse with clear water; open up glossy surfaces with rough sandpaper for bond then seal; remove bleeding paint, flaky paint or wood stain.
- C. Remove rust, dirt and grease from metal surfaces, prime with recommended metal primer.
- D. Fill in nicks, gouges and other minor imperfections of wood surfaces with patching plastic; follow with coat of sealer recommended by wall covering manufacturer.

3.3 APPLICATION

- A. Handle and apply wall covering in accordance with manufacturer's recommendations and installation instructions.
- B. Mix and apply adhesive in accordance with adhesive manufacturer's recommendations.
- C. Use panels in exact order as cut from rolls; use rolls in consecutive order as numbered by manufacturer.
- D. Apply secure, smooth, clean, and without wrinkles, gaps or overlaps; eliminate air pockets and ensure full bond to wall surface.
- E. Horizontal seams and cutting at corners are not acceptable; cut no closer than 2" of an inside corner and not closer than 6" of an outside corner.
- F. Fill in spaces above and below windows, above doors and similar areas in sequence from roll.
- G. Install wall covering before installation of bases, hardware, and similar accessories.

3.4 CLEANING

- A. Clean wall coverings of adhesives, dust, dirt and other contaminants.
- B. Remove debris and leave areas neat and clean.
- C. Replace accessories.

END OF SECTION

SECTION 09 77 30

FIBERGLASS WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide glass fiber reinforced polyester resin fabricated wall panels for use in wet areas such as adjacent to Janitor Closet mop sinks with trim pieces and accessories as required for complete installation.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Scheduling: Schedule installation of wall paneling as late in construction schedule as possible to prevent damage during construction.

1.3 SUBMITTALS

- A. Product Data: Furnish manufacturer's literature.
- B. Shop Drawings: Indicate design parameters, adjacent construction, materials, dimensions, thickness, fabrication details, tolerances, colors, finishes, methods of support and anchorages.
- C. Samples: Furnish fiberglass wall panels and exposed trim.
- D. Maintenance Instructions: Include manufacturer's recommended cleaning materials and application methods, including precautions in use of cleaning materials that may be detrimental to surfaces.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store panels in clean and dry area where temperatures are maintained at minimum 40 degrees F with normal humidity.
 - 1. Do not store in upright position.
- B. Take precautionary measures with adhesives and solvents to prevent fire hazards.

1.5 PROJECT CONDITIONS

- A. Maintain surfaces and materials at minimum 60-degrees F three days before and during application period.
- B. Provide continuous ventilation during work and after installation of wall covering.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Construction Specialties/Acrovyn Wall Covering.
- B. Crane Composites/Glasbord.
- C. Nudo Products, Inc./Fiber-Lite Panels or Marlite FRP Panels.
- D. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide wall panels with trim pieces and accessories.
- B. Regulatory Requirements: Provide system acceptable by applicable authorities for use on walls in wet areas including at locations adjacent to mop sinks.
- C. Panels: Fiberglass reinforced plastic (FRP) panel system acceptable for use in wet areas; ASTM D5319.
 - 1. Basis of Design: Construction Specialties/Acrovyn Wall Covering.
 - 2. Thickness: 0.075" nominal thickness.
 - 3. Fire-Rating: Class III (UL Class C), maximum 200 flame spread, 450 smoke developed, ASTM E84.
 - 4. Surface: As selected by Architect from manufacturer's full range of surface textures.
 - 5. Color: As selected by Architect from manufacturer's full range of colors.
- D. Trim Pieces: Manufacturer's standard matching moldings and trim pieces as required for complete, finished installation, and as required for joints, corners and panel edges; suitable for applications indicated.
- E. Adhesive: Manufacturer's standard nontoxic, waterproof adhesive suitable for substrates indicated.
- F. Primer: Provide non-staining nontoxic release coat primer as recommended by wall panel manufacturer where panels are applied to gypsum board.
 - 1. Primer: Type designed to allow removal of wall paneling from gypsum board without damaging paper facing of board, and without premature separation of wall paneling from wall.
- G. Mechanical Fasteners: Concealed type only; types as recommended by system manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Ensure surfaces to receive wall paneling are clean, true and free of irregularities, do not commence with work until surfaces are satisfactory.
- B. Ensure wall surface flatness tolerance does not vary more than 1/8" in 10'-0", nor vary at a rate greater than 1/16" per running foot.

3.2 INSTALLATION

- A. Handle and install wall panels in accordance with manufacturer's recommendations and installation instructions.
- B. Cope and miter trim pieces.
- C. Securely adhere panels to wall surfaces; use blind nailing methods as required to support panels until adhesive dries; exposed mechanical fasteners shall not be acceptable.
 - 1. Install panels in maximum size increments available.
- D. Remove excess adhesive from edges; wipe seam clean with dry cloth towel.
- E. Install wall paneling before installation of plumbing, bases, hardware, and similar accessories.

3.3 CLEANING

- A. Clean panel system in accordance with manufacturer's instructions.
- B. Remove debris and leave areas neat and clean.
- C. Replace accessories.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide painting and finishing of exposed items and surfaces requiring field painting and finishing including shop primed items.
 - 1. Specified surface preparation, priming and coats of paint are in addition to shop-priming and surface treatment specified under other sections of work.
 - 2. Painting and finishing include field finishing of exterior and interior items not listed as "Surfaces not to be Painted" unless clearly indicated otherwise.
 - 3. Painting and finishing include field finishing of select shop finished items such as mechanical grilles and registers and shop primed items such as access panels and louvers in doors, to match adjacent surfaces.
 - a. Match adjacent surfaces in color and sheen unless otherwise indicated.
 - 4. Field paint exposed bare and covered pipes, ducts, and hangers, exposed steel and iron work, and primed metal surfaces of equipment installed under mechanical and electrical work in occupied spaces.
 - 5. Wood Doors: Contractor option to factory finish or field finish, coordinate with Section 08 14 00 - Wood Doors.
- B. Surfaces Not to be Painted:
 - 1. Finished items including finished metal surfaces.
 - 2. Walls and ceilings in concealed areas and generally inaccessible areas.
 - 3. Moving parts of operating mechanical and electrical units.
 - 4. Labels: Keep equipment identification and fire rating labels free of paint.
 - 5. Plastic smoke stops and weather-stripping at doors.
- C. Related Sections: Shop priming of ferrous metal items is included under various Specification sections.
 - 1. Section 06 40 00: Shop finishing of architectural woodwork.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical information, including paint label analysis and application instructions for each material.

- B. Samples: Submit samples for review of color and texture; provide list of material and application for each coat of each finish sample.
 - 1. Brush-Outs: Submit samples of each color and material with texture to simulate actual conditions, on hardboard.
 - a. Submit 8" by 10" samples of wood finishes on actual wood surfaces; label and identify each as to location and application.
 - b. Submit samples of Conference Room special paint system of base paint and clear markerboard covering (nominal 4" square).
 - 2. Field Samples: Duplicate painted finishes of approved samples on actual wall surfaces and components for approval prior to commencing work.
 - a. Size: Minimum 100 sf located where approved.
 - b. Components: One full component as directed.
 - c. Simulate finished lighting conditions for review.
- C. Manufacturer Certificates: Furnish certificates from each manufacturer stating materials are top quality lines and suitable for intended use on this Project.

1.3 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to finish material pollution control for paints and coatings.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, with:
 - 1. Name of material, color and sheen.
 - 2. Manufacturer's name, stock number and date of manufacture.
 - 3. Contents by volume, for major pigment and vehicle constituents.
 - 4. Thinning and application instructions.

1.5 SITE CONDITIONS

- A. Apply water-base paints when temperature of surfaces and surrounding air are between 50 and 90-degrees F.
- B. Do not apply paint in rain, fog or mist; or when relative humidity exceeds 85 percent; or to damp or wet surfaces.
- C. Painting may be continued during inclement weather if areas to be painted are enclosed and heated within temperature limits specified.
- D. Provide additional temporary ventilation during interior application of paints to eliminate volatile organic compound (VOC) emissions from interior spaces as quickly as possible.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Benjamin Moore & Co.
- B. Sherwin-Williams Co.
- C. Pittsburgh Paints, PPG Pittsburgh Paints, including Glidden Professional.
- D. Dunn-Edwards Corp.
- E. Kelly Moore Paint Co.
- F. Vista Paint Co.
- G. Frazee Paint Co.
- H. Paints listed on Finish Code List.
- I. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide painting and finishing of exposed items and surfaces requiring field painting and finishing including shop primed items.
 - 1. Definition: "Painting" and "coating" as used herein means systems including primers, emulsions, enamels, stains, sealers and fillers, whether used as prime, intermediate or finish coats.
- B. Regulatory Requirements:
 - 1. Volatile Organic Compound (VOC) Emissions: Furnish materials approved for use by applicable air quality management district for limitations of volatile organic compounds for architectural or special coatings as applicable.
- C. Material Quality: Provide top line quality commercial grade (professional painter) paints; materials not bearing manufacturer's identification as their top line product shall not be acceptable.
 - 1. Primers: Provide premium grade primers recommended by paint manufacturer for substrates indicated and for finish systems specified.
 - 2. Undercoats and Barrier Coats: Provide undercoat paints produced by same manufacturer as finish coats; use only thinners approved by paint manufacturer and use only within recommended limits.

3. Finish Coats: Provide finish coats capable of being washed with mild detergent without loss of color, sheen, or pigments.
 - a. Color pigments: Pure, non-fading, applicable types to suit substrates and service indicated; no lead content permitted.
 4. Finish Coat Coordination: Provide finish coats which are compatible with prime paints, undercoats, and barrier coats used.
 - a. Review other Specification sections in which prime paints are provided; ensure compatibility of total coatings systems.
 - b. Upon request from other trades furnish information on characteristics of finish materials proposed for use.
 - c. Provide barrier coats over incompatible primers or remove and prime as required.
 - d. Notify Architect in writing of any anticipated problems in use of specified coating systems with substrates primed by others.
- D. Colors and Finishes: Prior to commencement of painting work, Architect will furnish color chips for surfaces to be painted.
1. Use of proprietary names in color selection is not intended to imply exclusion of equivalent products of other manufacturers.
 2. Final acceptance of colors will be from samples applied on site.
 3. Colors: As indicated on Finish Schedules, as directed by Architect where not otherwise indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Inspection: Examine areas and conditions under which painting work is to be applied.
1. Start of painting work indicates acceptance of surfaces and conditions of surfaces and conditions within any area.
 2. Where exposed items or surfaces are not specifically mentioned in Schedules, paint same as adjacent similar materials or areas.
 3. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to a durable paint film.

- B. Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as specified for substrate condition.
 - 1. Existing Painted Finishes:
 - a. Clean existing painted surfaces and remove oil, grease, dust, stains, scale, efflorescence, mildew, mold, algae, blisters, and non-adhering paint.
 - b. Measure adhesion of existing paints using ASTM D3359 tape test; remove existing coatings where poor adhesion is indicated.
 - c. Feather edges of severely deteriorated paint where several coats are removed as part of cleaning, to provide smooth transition for new paint.
 - d. Fill holes, cracks, and defects and fill and sand smooth, ready for new paint finish.
- C. Remove hardware, accessories, and items in place and not to be painted, or provide protection prior to surface preparation and painting; after painting reinstall removed items.
- D. Clean surfaces before applying paint; remove oil and grease prior to mechanical cleaning; program cleaning so contaminants from cleaning process do not fall onto wet, newly painted surfaces.
- E. Cementitious Materials: Prepare by removing efflorescence, chalk, dirt, grease, oils, and by roughening as required to remove glaze.
 - 1. Determine alkalinity and moisture content of surfaces to be painted.
 - 2. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, neutralize before application of paint.
 - 3. Do not paint over surfaces where moisture content exceeds manufacturer's printed directions.
- F. Wood: Clean wood surfaces of dirt, oil, and other foreign substances; sandpaper smooth surfaces exposed to view and dust off.
 - 1. Scrape and clean seasoned knots and apply thin coat of recommended knot sealer, before application of priming coat.
 - 2. Prime, stain, or seal wood required to be job-painted immediately upon delivery to job; prime edges, ends, faces, undersides, and backsides of wood.
 - 3. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler; sandpaper smooth when dry.
- G. Ferrous Metals: Touch up shop-applied prime coats wherever damaged using same type of primer as applied in shop or barrier coat compatible with finish paint.
 - 1. Bare Surfaces: Clean surfaces that are not galvanized or shop-coated, of oil, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.
 - 2. Galvanized Surfaces: Clean free of oil and surface contaminants, using non-petroleum-based solvent; primer and touch-up primer to be zinc-rich primer.

- H. Mix painting materials in accordance with manufacturer's directions.
- I. Store materials in tightly covered containers; maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.
- J. Stir materials before application to produce mixture of uniform density and stir as required during application; do not stir surface film into material, if necessary, strain material before using.

3.2 APPLICATION

- A. Apply paint in accordance with manufacturer's directions; use applicators and techniques best suited for substrate and type of material being applied.
 - 1. Apply additional coats when stains or blemishes show through final coat, until paint is a uniform finish, color and appearance.
 - 2. Provide extra attention during application to assure dry film thickness at corners and crevices is equivalent to that of flat surfaces.
 - 3. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces; paint surfaces behind permanently-fixed equipment and furniture with prime coat only.
 - 4. Finish doors on tops, bottoms and side edges same as faces.
 - 5. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 - 6. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.
 - 7. Sand lightly between coats when recommended by system manufacturer.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated or prepared for painting as soon as practicable after preparation.
 - 1. Allow time between successive coatings to permit proper drying.
 - 2. Do not recoat until paint feels firm and does not deform or feel sticky under moderate thumb pressure.
- C. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as recommended by coating manufacturer.
- D. Prime Coats: Apply to items not previously primed; recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat.

- E. Finish Coats: Provide even texture; leave no laps, irregularity in texture, skid marks, or other surface imperfections.
 - 1. Opaque Finishes: Provide opaque, uniform finish, color and coverage; cloudiness, spotting, holidays, brush marks, runs, sags, ropiness, and other surface imperfections are not acceptable.
 - 2. Transparent and Stained Finishes: Produce glass smooth surface film of even luster; provide with no cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, and other surface imperfections.
- F. Completed Work: Match approved samples for color, texture and coverage; remove, refinish or repaint work not accepted.

3.3 PAINTING SCHEDULE

- A. Exterior Work: Provide following paint systems; refer to sheens on Drawings.
 - 1. Plaster:
 - a. 1st and 2nd Coat: Heavy body vapor permeable waterproof elastomeric acrylic coating.
 - 2. Metal:
 - a. 1st Coat: Touch-up primer, prime if none.
 - b. 2nd and 3rd Coat: Exterior 100% acrylic enamel.
 - 3. Stained Wood: Flat sheen.
 - a. 1st Coat: Exterior semi-transparent penetrating stain.
- B. Interior Work: Provide following paint systems; refer to sheens on Drawings.
 - 1. Gypsum Board Systems:
 - a. 1st Coat: Universal primer.
 - b. 2nd and 3rd Coat: Interior latex or acrylic latex emulsion.
 - 2. Metal:
 - a. 1st Coat: Touch-up primer, prime if none.
 - b. 2nd and 3rd Coat: 100% acrylic enamel.
 - 3. Opaque Finished Wood:
 - a. 1st Coat: Primer undercoat.
 - b. 2nd and 3rd Coat: 100% acrylic enamel.

C. Special Whiteboard (Liquid Markers) Interior Wall Paint: Manufacturer's standard.

1. Manufacturers:

- a. IdeaPaint (800.393.5250)/White Dry Erase Paint.
- b. Sherwin-Williams/Dry Erase Coating.
- c. Substitutions: Refer to Section 01 25 00.

D. Sheens: Comply with ASTM D523, reflectance of paint.

1. Flat: 1-10.
2. Satin: 15-30.
3. Eggshell: 30-45.
4. Semigloss: 45-75.
5. Gloss: 75-100.

3.4 CLEAN-UP, PROTECTION, AND REPAIR

A. Clean-Up: During progress of work, remove discarded paint materials, rubbish, cans and rags from site at end of each work day.

1. Clean glass and paint-spattered surfaces immediately by proper methods of washing and scraping, using care not to scratch or damage finished surfaces.

B. Protection: Protect work of other trades, whether to be painted or not; correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

1. Provide "Wet Paint" signs to protect newly-painted finishes.
2. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

C. Repair: At completion of work of other trades, touch-up and restore damaged surfaces or defaced painted surfaces.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide general signage as indicated complete with attachment devices and accessories as required for complete installation.
- B. Related Sections:
 - 1. Section 06 80 00: Acrylic sign panels, panel backing for signage as indicated.
 - 2. Section 10 44 00: Fire extinguisher cabinet graphics.
 - 3. Division 26: Photoluminescent exit signs.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate signage with acrylic sign panel backing for signage in Section 06 80 00 – Acrylic Sign Panels.

1.3 SUBMITTALS

- A. Product Data: Furnish manufacturer's literature and indicate each sign type, style, color, and method of attachment.
- B. Shop Drawings: Furnish listing of sign types, lettering and locations, along with dimensions of each sign.
 - 1. Computerized Output: Furnish computerized samples of signs and graphics at full scale duplicating final appearance.

1.4 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to finish material pollution control for adhesives.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package separately or in like groups of names, labeled as to names enclosed; include installation template, attachment system and installation instructions.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. ASI Modulex, ASI Sign Systems, Inc.
- B. Mohawk Sign Systems.
- C. Vomar Products, Inc.
- D. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide signage as indicated with attachment devices and accessories.
- B. Regulatory Requirements: Provide signs for assuring access for persons with disabilities in accordance with state and federal regulations.
 - 1. California Regulations: Comply with California Building Code.
 - 2. Federal Regulations: Comply with Americans with Disabilities Act (ADA) Standards.
- C. Toilet Room Door Signs: Provide door signs conforming to California requirements for signs for toilet rooms; concealed mounting system.
 - 1. Material, Plastic: Manufacturer's standard colored plastic/photopolymer signs; color as indicated, as selected by Architect from manufacturer's full range of colors where not otherwise indicated.
 - a. Texture: Smooth.
 - 2. Total Thickness: 0.25".
 - 3. Provide signs required by California Code of Regulations Title 24.
 - a. Men's Room: 12" equilateral triangle, vertex pointing up.
 - b. Ladies' Room: 12" diameter circle.
 - 4. Colors: As selected to contrast with doors.
 - 5. Symbols: As selected from manufacturer's standard symbols.
 - 6. Adhesive: Type as recommended by sign manufacturer for type of substrate involved.
- D. Toilet Room Wall Signs: Provide signs conforming to California Building Code and ADA Standards for signs for permanent rooms, with inset symbols and with raised and Braille characters; concealed mounting system.
 - 1. Material, Plastic: Manufacturer's standard colored plastic/photopolymer signs; color as indicated, as selected by Architect from manufacturer's full range of colors where not otherwise indicated.
 - a. Texture: Smooth.
 - 2. Comply with California Building Code and ADA Standards for raised and Braille characters, pictorial symbols, finish, and contrasts requirements.

TLCD ARCHITECTURE SONOMA CLEAN POWER (SCP) ADVANCED ENERGY CENTER
741 4TH STREET, SANTA ROSA, CA

- E. Tactile Exit Door Signs: Provide colored plastic/photopolymer signs, conforming to California Building Code Section 1011.3 and ADA Standards for signs for permanent rooms, with tactile raised and Braille characters; concealed mounting system.
 - 1. Colors: As selected by Architect.
 - 2. Size and Style: As indicated on Drawings.
- F. Room Identification and Direction Signs: Provide signs conforming to California and ADA Standards for permanent signs, total thickness 0.125"; provide raised and Braille characters conforming to California and ADA Standards; concealed mounting.
 - 1. Material, Plastic: Manufacturer's standard colored plastic/photopolymer signs; color as indicated, as selected by Architect from manufacturer's full range of colors where not otherwise indicated.
 - a. Texture: Smooth.
 - 2. Sizes and Styles: As indicated on Drawings, as directed by Architect where not otherwise indicated.
- G. Applied Copy Signs and Graphics: Letters and graphics as indicated on Drawings; Contractor option of silk-screen or vinyl applied.
 - 1. Silk-screen Signs and Graphics: Computer design screens for signs and graphics to designs and criteria established by Architect.
 - a. Silk-screen Lacquer: Match Advanced Screen Products/Industrial Gloss Lacquer Silk-screen Ink; colors as selected by Architect.
 - 2. Vinyl Signs and Graphics: Computer design vinyl signs and graphics to designs and criteria established by Architect.
 - a. Vinyl: Opaque non-reflective vinyl film, minimum 0.0035" thick, with pressure sensitive adhesive backing suitable for applications indicated; match 3M/Scotchcal Vinyl Film.
- H. Tactile Emergency Evacuation Signs: Silk-screened polycarbonate with screening on back and with tactile and Braille information conforming to California requirements and ADA Standards.
 - 1. Information: Provide sign system with information as required by applicable authorities for emergency egress.
 - 2. Silk-Screen Colors: As selected by Architect.
 - a. Silk-screen Lacquer: Similar to Advanced Screen Products/Industrial Gloss Lacquer Silk-screen Ink; colors as selected by Architect.
 - 3. Size and Style: As indicated on Drawings and acceptable to applicable authorities.
 - 4. Attachment: Method subject to Architect approval.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs in accordance with manufacturer recommendations and installation instructions, free from distortions and defects.
- B. Toilet Room Door Signs: Install signs on doors after doors are painted and finished.
 - 1. Location: Mount signs with centerline of sign between 58" and 60" height as required by applicable code.
 - 2. Install centered and level, in line, in accordance with the manufacturer's recommendations.
 - 3. Clean and polish, remove excess adhesive.
- C. Toilet Room Wall Signs: Install signs on walls after surfaces on which they are to be mounted are painted and finished.
 - 1. Location: Mount signs at 48" to 60" height as required by applicable codes on strike side of door.
 - 2. Install level, in line, in accordance with California Building Code and ADA Standards to allow a person to approach within 3" of signs without being within a door swing and without encountering protruding objects.
 - 3. Clean and polish, remove excess adhesive.
- D. Tactile Exit Door Signs: Install at doors with lighted "EXIT" signs; apply after walls are finished.
 - 1. Location: Mount signs at 48" to 60" height as required by applicable codes on strike side of door.
 - 2. Install level, in line, in accordance with the manufacturer's recommendations and ADA Standards to allow a person to approach within 3" of signs without being within a door swing and without encountering protruding objects.
 - 3. Clean and polish, remove excess adhesive.
- E. Room Identification and Direction Signs: Install signs after walls are finished.
 - 1. Location: Mount signs at 48" to 60" height as required by applicable codes on strike side of door for room identification signs, where indicated for direction signs.
 - 2. Install signs level, in line, in accordance with the manufacturer's recommendations, California Building Code and ADA Standards.

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741 4TH STREET, SANTA ROSA, CA**

3. Install room identification signs at doors to allow a person to approach within 3" of signs without being within a door swing and without encountering protruding objects.
 4. Clean and polish, remove excess adhesive.
- F. Applied Copy Signs and Graphics: Examine surfaces and construction for conditions adversely affecting installation, performance and quality of work.
1. Apply signage and graphics centered and level, in line, in accordance with manufacturer's recommendations.
- G. Emergency Evacuation Signs: Install signs after walls are finished.
1. Location: Mount signs at locations indicated, as directed by Architect and applicable authorities if not otherwise indicated.
 2. Install signs level and in accordance with the manufacturer's recommendations and requirements of applicable authorities.
 3. Clean and polish.

END OF SECTION

SECTION 10 21 10

METAL TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide metal partitions for toilet compartments including hardware, attachment devices, and integral accessories as required for complete installation.
 - 1. Urinal Screens: Provide wall mounted metal partitions for urinal screens including attachment hardware for complete finished installation.
- B. Related Sections:
 - 1. Section 10 28 00: Toilet accessories.

1.2 REFERENCES

- A. Americans with Disabilities Act (ADA) Standards.
- B. California Building Code: California Code of Regulations, Title 24, Part 2, requirements for providing accessibility for persons with disabilities.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's literature.
- B. Shop Drawings: Clearly indicate partition layouts, swing of doors, elevations, anchorage and mounting details, panel construction, hardware, finishes and relevant dimensions.
- C. Samples: Submit samples of metal finish.

1.4 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with *CALGreen* requirements including those relative to finish material pollution control for adhesives, sealants, and caulks.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Hadrian Inc.
- B. Global Partitions, an ASI Group Company.
- C. Flush Metal Partition Corp.
- D. Bradley Corporation Mills Partitions.
- E. General Partitions Mfg. Corp.
- F. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide metal partitions including hardware, attachment devices, and integral accessories.
 - 1. Toilet Compartment Type: Floor mounted, overhead braced.
- B. Regulatory Requirements, Access: Comply with California Building Code and Americans with Disabilities Act (ADA) Standards.
 - 1. Door Width: Provide minimum 32" clear door openings when front entry, minimum 34" clear door openings when side entry.
 - 2. Spacing: Provide minimum 60" clear width, and front space as applicable for type of compartment.
 - 3. Reinforcing: Provide reinforcing for grab bars indicated to be partition mounted.
 - 4. Urinal Screens: Provide minimum 30" clear space at urinal.
- C. Stainless Steel: Stainless steel, ASTM A666, Type 304, with Number 4 polished finish; manufacturer's standard gages for units specified.
 - 1. Pilaster Shoes: 3" high; No. 4 polished finish; stainless steel.
- D. Attachments, Screws and Bolts: Stainless steel; tamper proof type; heavy duty extruded aluminum brackets.
- E. Hardware: Manufacturer's standard stainless steel hardware.
 - 1. Hinges: Cast pivot hinges, gravity self-closing type, adjustable for door close positioning; nylon bearings.
 - 2. Latch: Slide latch; door strike and keeper with rubber bumper.
 - 3. Coat Hook/Bumper: Combination coat hook and bumper unit, maximum 48" above finished floor.
 - 4. Wall Bumper: Wall mounted rubber bumper for out-swinging doors.
 - 5. Pulls: Manufacturer's standard; provide two "U-shaped" pulls immediately below latch at compartments accessible to persons with disabilities (compartments with grab bars), one inside and one outside.
- F. Overhead Braced Partition Headrails: 1" by 1-5/8" tubular stainless steel, with socket type wall brackets.

2.3 FABRICATION

- A. Fabricate partitions in accordance with FS RR-P-1352.

- B. Doors and Panels: Minimum 1" thick by minimum 24" wide by minimum 58" high sheet steel face pressure bonded to sound deadening core.
 - 1. Provide wider doors where required for accessibility for persons with disabilities.
- C. Pilasters: 1-1/4" thick, constructed same as doors, of sizes required to suit cubicle widths and spacing.
- D. Provide formed and closed edges for doors, panels and pilasters; miter and weld corners and grind smooth.
- E. Internal Reinforcement: Concealed type as required for attached hardware, fittings, and accessories; mark locations of reinforcement for compartment mounted washroom accessories.
 - 1. Coordinate location of accessories with Section 10 28 00.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine site conditions to which work is to be applied.
- B. Take site dimensions affecting this work.
- C. Ensure correct spacing and size of plumbing fixtures; take special note of fixtures in compartments indicated to be designed for persons with disabilities to assure clearances complying with access regulations.
- D. Ensure correct location of built-in framing, anchorage, and bracing, where required.

3.2 INSTALLATION

- A. Install units in accordance with manufacturer recommendations and installation instructions, secure, plumb, level, and square.
- B. Leave maximum 1/2" space between wall, panels and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to bracket with through sleeve tamper proof bolts and nuts.
- E. Locate headrail joints at pilaster center lines.
- F. Provide for adjustment of floor variations with screw jack through steel saddles integral with pilaster; conceal floor fastenings with stainless steel shoes.
- G. Equip each door with hinges, latch, and coat hook/bumper combination.
- H. Install door strike keeper and door bumper on each pilaster in alignment with door latch.

**TLCD ARCHITECTURE SONOMA CLEAN POWER (SCP) ADVANCED ENERGY CENTER
741 4TH STREET, SANTA ROSA, CA**

- I. Adjust and align hardware to uniform clearance at vertical edges of doors not exceeding 3/16".
- J. Adjust hinges to locate doors in partial open position when unlatched, except adjust hinges to return doors to closed position at stalls designed for use by persons with disabilities.
- K. Anchor urinal screen panels to walls with either two panel brackets each or continuous angle brackets on both sides.

3.3 CLEANING

- A. Clean surfaces of oil and imperfections.
- B. Field touch-up of scratches and defaced finishes will not be permitted; replace damaged, scratched and marred defective materials with new, undamaged materials.

END OF SECTION

SECTION 10 28 00

TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide toilet accessories and Janitor closet mop holders with attachment hardware and rough-in frames as required for complete, operational installation.
- B. Related Sections:
 - 1. Section 10 21 00: Hardware for toilet partitions, including coat hook/bumper mounted on partition doors, and wall bumpers for outswinging doors.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data illustrating each accessory at large scale.

1.3 QUALITY ASSURANCE

- A. Sustainability Requirements: Comply with CALGreen requirements including those relative to finish material pollution control for adhesives.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver inserts and rough-in frames to jobsite at appropriate time for building in.
- B. Do not deliver accessories to site until rooms in which they are to be installed are ready to receive them.
- C. Pack accessories individually, protect each item and its finish.

1.5 PROJECT CONDITIONS

- A. Protect adjacent or adjoining finished surfaces from damage during installation of work of this section.
- B. Before starting work notify Architect in writing of conditions detrimental to installation or operation of units.
- C. Verify with Architect exact location of accessories.

1.6 WARRANTY

- A. Extended Correction Period:
 - 1. Replace mirrors which exhibit signs of desilvering or distortion.
 - 2. Period: Two years.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. Bobrick Washroom Equipment, Inc.
- B. Bradley Corporation.
- C. American Specialties, Inc.
- D. Manufacturers listed on Toilet Accessories Schedules.
- E. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide toilet accessories with attachment hardware and rough-in frames.
 - 1. Provide standard materials and finishes for accessories listed; where more than one material or finish is available and not otherwise indicated provide as selected by Architect from manufacturer's standard materials and finishes.
- B. Regulatory Requirements - Access for Persons with Disabilities: Comply with California Building Standards Code and Americans with Disabilities Act (ADA) Standards.
- C. Stainless Steel Sheet: ASTM A666, commercial grade, Type 304, gages as standard with manufacturer of specified items.
- D. Stainless Steel Tubing: ASTM A269, commercial grade, seamless welded.
- E. Mirror Glass: ASTM C1036, q1 mirror select clear float glass with full silver coating, copper coating and organic coating; minimum 1/4" thick.
- F. Sheet Steel: ASTM A1008, cold rolled stretcher leveled; minimum G90 galvanized coating, ASTM A924 and A653.
- G. Adhesive: Epoxy type contact cement as recommended by accessory manufacturer.
- H. Fasteners, Screws, and Bolts: Hot dip galvanized; as recommended by accessory manufacturer for component and substrate.
- I. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing and supply.
 - 1. Provide minimum six keys to Owner representative.
 - 2. Coin Operated Units: Provide locked coin box keyed separately from standard units, coin operated units keyed alike.

2.3 FABRICATION

- A. Weld and grind smooth joints of fabricated components.
- B. Form exposed surfaces from one sheet of stock, free of joints.
- C. Fabricate units with tight seams and joints, exposed edges rolled; hang doors and access panels with continuous piano hinges; provide concealed anchorage where possible.
- D. Provide steel anchor plates and anchor components for installation on building finishes.
- E. Form surfaces flat without distortion; maintain flat surfaces without scratches and without dents; finish exposed edges eased, free of sharp edges where potential exists for physical contact.
- F. Back paint components where contact is made with building finishes, to prevent electrolysis.
- G. Hot-dip galvanize ferrous metal anchors and fastening devices.
- H. Assemble components in shop; package complete with anchors and fittings.
- I. Janitor Closet Mop Holders: Spring loaded anti-slip mop holders with rubber cam, with three mop holders on stainless steel.
 - 1. Manufacturers:
 - a. Bobrick Washroom Equipment, Inc./Model B-223.
 - b. Bradley Corp./Model 9953.
 - c. American Specialties Inc./Model 0796A.
 - d. Substitutions: Refer to Section 01 25 00.

2.4 FINISHES

- A. Exposed Finishes: Stainless steel, number 4, satin finish; satin chrome finish acceptable where stainless steel not available for accessory item listed or scheduled.
- B. Concealed Surfaces: Treat and clean, spray-apply one coat primer and baked enamel finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide templates and rough-in measurements.

3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's printed instructions using fasteners appropriate to substrate.

**TLCD ARCHITECTURE SONOMA CLEAN POWER (SCP) ADVANCED ENERGY CENTER
741 4TH STREET, SANTA ROSA, CA**

- B. Install true, plumb and level, securely and rigidly anchored to substrate.
- C. Use tamper-proof, security type fasteners.
- D. Adjust accessories for proper operation and verify mechanisms function smoothly.
- E. Replace damaged and defective items.
- F. Clean and polish exposed surfaces after removing temporary labels.

3.3 TOILET ACCESSORIES SCHEDULE

- A. Refer to Drawings.

END OF SECTION

SECTION 10 44 00

FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide cabinets for portable fire extinguishers with accessories as required for complete installation.
 - 1. Fire Extinguishers: Owner furnished and installed.
- B. Related Sections:
 - 1. Division 21: Fire protection systems.

1.2 SUBMITTALS

- A. Product Data: Furnish manufacturer's literature.

PART 2 - PRODUCTS

2.1 SYSTEMS MANUFACTURERS

- A. J.L. Industries.
- B. Larsen's Manufacturing Co.
- C. Potter Roemer.
- D. Substitutions: Refer to Section 01 25 00.

2.2 MATERIALS

- A. System Description: Provide cabinets for portable fire extinguishers with accessories.
- B. Fire Extinguisher Cabinets: Provide semi-recessed mounting unless otherwise indicated, maximum 4" extension beyond wall finish surface, provide trim suitable for installation indicated.
 - 1. Type:
 - a. J.L. Industries/Ambassador Series.
 - b. Larsen's Mfg. Co./Architectural Series.
 - c. Potter Roemer/Alta Series.
 - d. Substitutions: Refer to Section 01 25 00.
 - 2. Cabinet Depth: Provide cabinets designed for space available in walls with fire extinguisher cabinets, and of depth to house 2A-10BC multi-purpose dry chemical type fire extinguisher.
- C. Trim: Manufacturer's standard edge trim for specified models.

- D. Metal Gages: Provide manufacturer's standard gages for cabinets specified.
- E. Construction: Mitered and welded one-piece tubular door frames; weld joints and grind smooth; manufacturer's standard steel box with white baked enamel interior finish and primed exterior finish.
 - 1. Steel Doors and Trim: Manufacturer's standard, prime coat finished.
 - 2. Doors: Break-glass type secured access, with inside latch and lock.
 - 3. Door Hardware: Continuous hinge permitting door to open 180-degrees.
- F. Fire Rated Wall Construction: Provide fire extinguisher cabinet manufacturer's material as required to maintain integrity of fire rated partitions where cabinets are in fire rated partitions.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine substrates and conditions under which fire extinguisher cabinets are to be installed.
- B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cabinets in locations and at mounting height to comply with requirements of governing authorities; prepare recesses in walls as required.
- B. Securely fasten to structure, square and plumb, in accordance with manufacturer's instructions.
 - 1. Wherever exact location of units is not shown, locate as directed by Architect.

3.3 IDENTIFICATION

- A. After installation and finishing is completed, silk screen or apply decal letters spelling "FIRE EXTINGUISHER" as applicable.
- B. Letter size, style and location as selected by Architect.

END OF SECTION

SECTION 11 31 00

RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Install Owner furnished residential type appliances; provide accessories as required for complete finished operational installation and not furnished with appliances.
- B. Related Sections:
 - 1. Section 01 10 00: Owner furnished, Contractor installed requirements.
 - 2. Section 06 40 00: Cabinets and countertops.
 - 3. Division 22: Plumbing connections.
 - 4. Division 26: Electrical connections.

1.2 DELIVERY, STORAGE, AND HANDLING

- A. Receive and inspect Owner furnished appliances in manufacturer's undamaged protective containers, after spaces are ready to receive them.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System Description: Install Owner furnished residential type appliances; provide accessories required but not furnished with appliances.
- B. Accessories: As recommended by appliance manufacturer, as required by applicable codes and regulations, and as required for complete operational installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions under which appliances are to be installed.

3.2 INSTALLATION

- A. Install appliances in accordance with manufacturer's instructions.
- B. Coordinate with mechanical and electrical trades as necessary for proper service connections.
- C. Ensure operating parts work freely and fit neatly.

3.3 ADJUSTING

- A. Adjust hardware and moving parts as necessary.

3.4 PROTECTION

- A. Protect appliances until Substantial Completion.
- B. Repair or replace damaged parts, dents, buckles, abrasions, or other defects affecting appearance or serviceability, so appliances are undamaged at time of Substantial Completion.

END OF SECTION

SECTION 22 0100

GENERAL REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Comply with the requirements of DIVISION 1.
- B. The requirements of this SECTION apply to all work of this DIVISION.
- C. 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 the Contract Amount.

1.2 QUALITY ASSURANCE

- A. Related Work Specified Elsewhere:
 - 1. Refer to DIVISION 26 for all electrical wiring (except that specifically indicated on Control Drawings) for motor starters (except pre-wired packaged systems, in which case they must conform to DIVISION 26).
 - 2. Special hospital, laboratory, (but trim, piping and connections are included).
 - 3. Refer to Section 018113 Commissioning
- B. Examination of the Site:
 - 1. Visit the site prior to bidding. Take measurements and such other information as to locations, depths, capacities and sizes of existing piping and ductwork to which connections may be made or which may be abandoned or which require rerouting. If any of the above requires extra work due to discrepancies or omissions on the drawings if such omissions or discrepancies have been revealed by examination before bidding, the Contractor should report the discrepancy to the Architect a minimum of three days prior to receipt of bids. If additional work is required due to omissions and discrepancies after the contract for the work is signed and if such omissions or discrepancies would have been revealed by a visit to the site before receipt of bids, then the corrective additional work shall be performed at no additional cost to the Owner.
- C. Requirements of Regulatory Agencies:
 - 1. Standards Compliance: When materials or equipment must conform to the standards of organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials

(ASTM), National Electrical Manufacturers Association (NEMA), American Society of Mechanical Engineers (ASME), American Refrigeration Institute (ARI), and Underwriters' Laboratories (UL), proof of such conformance shall be submitted to the Architect for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization, which is competent to perform acceptable testing and is approved by the Architect. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.

2. Any specific reference in these Specifications to codes, rules, regulations, standards, manufacturer's instructions or requirements of regulatory agencies shall mean the latest printed edition of each in effect at date of submission of Bid, unless the Document is shown dated.
3. Perform the work in conformance with the applicable requirements of all regulatory agencies, including, but not limited to the following:
 - a. National Electrical Code.
 - b. International Building Code
 - c. California Code of Regulations (CCR).
 - (1) Title 8, Division 1, Chapter 3.2 - California Occupational Safety and Health Regulations (CAL/OSHA).
 - (2) Title 8, Division 1, Chapter 4 - Safety Orders.
 - (3) Title 24, Building Standards.
 - (a) Part 2 - California Building Code
 - (b) Part 3 - California Electrical Code
 - (c) Part 4 - California Mechanical Code
 - (d) Part 5 - California Plumbing Code
 - (e) Part 6 - California Energy Code
 - (f) Part 9 - California Fire Code
 - (4) Acceptance Requirements of California Energy Code: Perform work necessary to complete the Acceptance Requirements of the California Energy Code, including but not limited to:

- (a) Reviewing plans and specifications to ensure conform to the Acceptance Requirements
 - (b) Perform construction inspection prior to testing to ensure that the equipment installed is capable of complying with the requirements of the Standards, the equipment is installed correctly and calibrated.
 - (c) Undertake all required Acceptance Requirement procedures and identify all performance deficiencies, ensuring that they are corrected. Document the results of the Acceptance Requirement procedures on the Acceptance Test forms and indicate satisfactory completion by signing the Certificate of Acceptance.
 - d. National Fire Protection Association (NFPA), including but not limited to:
 - (1) Life Safety Code, NFPA 101.
- 4. Nothing in the Drawings or Specifications shall be construed to permit Work not conforming to applicable laws, ordinances, rules, regulations.
- 5. When Drawings or Specifications exceed requirements of applicable laws, ordinances, rules, regulations, Drawings and Specifications take precedence.
- 6. It is not the intent of Drawings or Specifications to repeat requirements of codes except where necessary for completeness or clarity.
- 7. Work herein shall comply with all applicable requirements of CCR Title 8, Division 1, as they apply to this project, both in reference to Contractor's operations in performing his work and also in construction result to be accomplished. Where an omission or a conflict appears between OSHA requirements and the Drawings and Specifications, OSHA requirements shall take precedence.
- D. When there is an ambiguity or discrepancy between Drawings and Specifications the more stringent requirement of the two shall be provided.
- E. Licenses, Permits and Fees
 - 1. Provide, procure and pay for all permits, licenses, fees, etc., required to carry on and complete the Mechanical Work. Contact all applicable utility authorities and include in bid all fees, charged by any such authorities.

F. Operating and Maintenance Instruction:

1. Furnish the services of competent instructors who will give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the equipment or system specified. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation.

1.3 SUBMITTALS**A. General**

1. Submit shop drawings, catalog data, supplemental data, for all materials, equipment in all Sections of this DIVISION in accordance with the requirements of SECTION 013300, "SHOP DRAWINGS, PRODUCT DATA AND SAMPLES," and as specified hereinafter.
2. Four weeks after award of the Contract, or earlier it deemed appropriate by the Architect, submit a schedule of all submittals with the date of each equipment submittal or shop drawing submittal clearly indicated.
3. Forward all submittals to Architect, together, at one time. Individual or incomplete submittals are not acceptable. Six (6) copies are required.
4. Submittals shall have been reviewed and stamped by the General Contractor in accordance with the requirements of the GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION. Submittals not so stamped will be returned without review.
5. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment. Words "as specified" are not sufficient identification.
6. Identify each submittal item by reference to Specification SECTION Paragraph in which item is specified or drawing and detail number.
7. Organize submittals in same sequence as they appear in specification sections, articles, or paragraphs.
8. Submit signed Acceptance Test forms indicating completion of California Energy Code Acceptance Test requirements.

B. Indexing:

1. Submittals shall be indexed according to specification DIVISION and SECTION number and paragraph to identify each item. Sporadic submittals, incomplete data, or unidentified data, or data not showing features to coordinate item with other work will not be accepted.

C. Binders: Prepare submittal material in accordance with the following:

1. Insert all literature in standard three (3) ring binders for 8-1/2 x 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 one binder "No. 1 Architect's Copy" and another "No. 2 Engineers Copy". Both these binders shall contain original manufacturer's literature.
3. Reference each item to the appropriate contract drawing sheet detail and to specification section and paragraph, and to the Mark Numbers appearing on the equipment schedule.
4. Provide an index with each binder. This index shall follow the same sequence as the project Specifications.

D. Submittal literature, Drawings and wiring diagrams shall be specifically applicable to this project and shall not contain extraneous material. The literature shall be clearly marked to indicate the proposed item and any accessories or options to be furnished. Submittals shall include, but not be limited to the following:

- a. Valves with Service and Location, Motors * Drives and Guards
- b. Pipe Trim, Hangers and Seismic Bracing, Insulation, Vibration Isolators, Heat Exchangers
- c. Tanks, Vents, Pumps*
- d. Fire Protection Equipment
- e. Fixtures, Fixture Trim,
- f. Pipe Trim, Hangers and Seismic Bracing, Insulation, Vibration Isolators
- g. Boilers, Chillers, Duct Trim, Filters, Sound Attenuators,
- h. Temperature Controls, Air Handling Equipment, Air Inlets and Outlets +
- i. Fire Protection Equipment
- j. Fixtures, Fixture Trim

- k. Boilers, Chillers, Duct Trim, Filters, Sound Attenuators
- l. Temperature Controls, Air Handling Equipment, Air Inlets and Outlets +

Notes:

* Include a family of rating curves. See applicable specification section.

+ With a detailed list including Room Nos., neck sizes, throws and NC levels.

- E. Resubmittals shall respond to comments made on the original submittal and shall be marked with a resubmittal number and dated. Resubmittals not in conformance with these requirements will be returned without review.
- F. Shop Drawings: (Also see Division 1 requirements)
 - 1. Submit shop drawings for piping, ductwork, and equipment. Do not begin fabrication until shop drawings have been coordinated with all trades and have been reviewed and accepted by the Architect.
 - 2. Drawings shall be a minimum of 8-1/2 inches by 14 inches in size, with a minimum scale of 1/8 inch per foot, except as specified otherwise. Drawings shall include floor plans, sectional views, wiring diagrams, and installation details of equipment; and equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping, ductwork, and other items that must be shown to assure a coordinated installation. Ductwork and piping layouts and Mechanical Room layouts shall be drawn at a minimum scale of 1/4 inch per foot. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
 - 3. The Architect's review of Shop Drawings is not intended to verify dimensions or quantities, nor to coordinate items shown on these Drawings. He will review them for general conformance with design concept of the project and general compliance with the information given in the contract requirements of the plans and Specifications. Contractor is responsible for dimensions, which shall be confirmed and correlated at the job site, for fabrication processes and techniques of construction, for coordination of his work with that of all other trades and the satisfactory performance of his work.
- G. Record Drawings
 - 1. Installation drawings shall be drawn at the site by the Contractor on reproducible paper and shall be fully coordinated for interferences by all trades. The Contractor shall maintain at the jobsite a complete set of prints of the installation drawings for all mechanical work. These prints shall be kept up to date by recording all changes daily. The progress of the work shall be clearly, neatly and accurately

designated, coloring in the various pipes, ducts and equipments as they are erected. This process shall incorporate all changes to the original drawings including formal change orders or other instructions issued by the Architect. Principal dimensions of all concealed work shall be recorded including inverts of buried piping and height to underside of ducts.

2. These marked up prints will be used as a guide for determining the progress of the work installed. They will be inspected monthly by the Architect and shall be corrected immediately if found either inaccurate or incomplete.
3. Prior to final acceptance of the Work of this Division, submit properly certified Record Drawings to the Architect for review and make changes, corrections, or additions as the Architect may require. After the Architect's review and any required Contractor revisions, deliver the Record Drawings to the Owner on electronic media in AutoCAD format. The Architect and Engineer do not assume any responsibility for the accuracy or completeness of the Record Drawings.

H. Operating & Maintenance Manuals:

1. Manuals shall conform to SECTION 017823, OPERATION AND MAINTENANCE DATA.
2. Furnish an operation and maintenance manual for each item of equipment. Furnish copies of the manual bound in hardback binders or an approved equivalent. Furnish one complete manual prior to the time that equipment tests are performed, and furnish the remaining manuals before the contract is completed. Inscribe the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the name and location of the equipment or the building, the name of the Contractor, and the contract number. The manual shall include the names, addresses, and telephone numbers of each subcontractor installing equipment, and of the local representatives for each item of equipment. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start-up, operation and shutdown; description of the function of each principal item of equipment; the procedure for starting; the procedure for operating; shutdown instructions; installation instructions; maintenance instructions; lubrication schedule including type, grade, temperature range, and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. The parts lists for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the project site. The manual shall be complete in all respects for equipment, controls, accessories,

and associated appurtenances provided.

3. Submit a DVD disk containing all Operations and Maintenance data in Adobe "pdf" format. Also include an index of Internet web site addresses Section No. and title, equipment name, Web site address for the O&M manual of the equipment, and the O&M Manual filename.
- I. Letters from manufacturers certifying their supervision of equipment installation and start-up procedures.
- J. Three (3) copies of certification signed by Owner's representative, attesting to their receipt of instructions required by paragraph "Operation and Maintenance Instruction" of this Section.

1.4 PRODUCT DELIVERY AND STORAGE

- A. Identify materials and equipment delivered to site to permit check against approved materials list, reviewed shop Drawings.
- B. Protect from loss or damage. Replace lost or damaged material and equipment with new at no increase in the Contract Amount.
 1. Store material in clean, dry locations. Store material off of floor, and wrap material or otherwise protect from contamination by construction debris, dust, etc.

1.5 DRAWINGS AND COORDINATION WITH OTHER WORK

- A. Contract Drawings:
 1. For purposes of clarity, legibility, the Contract Drawings are essentially diagrammatic to extent that many offsets, bends, unions, special fittings are not shown. Exact locations of items are not indicated, unless specifically dimensioned.
 2. Exact routing of piping, ductwork, etc., shall be governed by structural conditions, obstructions. Contractor shall make use of data in Contract Documents. Architect reserves right, at no increase in price, to make any reasonable change in location of mechanical items, exposed at ceiling and/or on walls, to group them into orderly relationships and/or increase their utility. Verify Architect's requirements in this regard prior to roughing-in.
 3. In addition to the Shop Drawings called for under SUBMITTALS the Contractor shall prepare large scale layout drawings showing location of equipment, piping and duct runs, and all other elements of mechanical systems provided under this DIVISION. Include sections of congested areas to show relative position and spacing of affected elements.

4. Refer to the electrical "E" series drawings and specifications, Division 26 for the service voltage, power feed, control and interlock wiring for equipment specified under this section. Review the electrical "E" series drawings and Division 26 documents to verify that the electrical services (power, control, interlock, etc.) provided are adequate and compatible with the equipment requirements. Include the cost to furnish and install the additional electrical services, if it is required over and above what is indicated on the electrical "E" series drawings and in Division 26, such as additional control interlock conductors, larger feeder, or separate 120V control power source.
 - a. Prior to proceeding with the installation of any additional electrical work, submit detailed drawings indicating the exact scope of additional electrical work to the Architect for review and approval.
 5. Provide templates, information, and instructions to other DIVISIONS to properly locate holes and openings to be cut or provided for electrical Work.
 6. Not all offsets in ductwork or piping are shown. Decide which item to offset or relocate. Maintain required slope in piping.
- B. Coordination:
1. Work out all "tight" conditions involving Work under this DIVISION and Work in other DIVISIONS in advance of installation.
 2. Maintain minimum 1 inch clearance from adjacent work, including piping, ductwork, insulation, etc. except as noted or approved.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two year use shall include applications of equipment and materials under similar circumstances and of similar size.
- B. Alternative Service Record: Products having less than a two-year field service record may be acceptable on approval of the Architect if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.
- C. Service Support: Major equipment items shall be supported by service organizations. The Contractor shall submit a certified list of qualified permanent service organizations for support of the equipment, which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis

during the warranty period of the contract.

- D. Identify materials, equipment by manufacturer's name, nameplate data. Remove unidentified materials, equipment from site.
- E. 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.
- F. 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 and meets acceptance.
- G. Equipment or material damaged during transportation, installation or operation is considered as totally damaged. Replace with new. Variance with this permitted only with written acceptance.
- H. Provide an authorized representative to constantly supervise work of this DIVISION, check all materials prior to installation for conformance with Drawings and Specifications.
- I. Equipment shall be as described in the respective SECTIONS of THIS DIVISION and as shown.

2.2 SUBSTITUTIONS

- A. See SECTION 002600, "PROCUREMENT SUBSTITUTION PROCEDURES" and the following.
- B. Where more than one specific name is used, it is to be understood that the name mentioned first represents the manufacturer whose equipment has been used as the basis of design. All other names mentioned are to be considered substitutions within the meaning of this paragraph, and no additional cost to the Owner shall accrue due to any revisions, additions or deletions required to make substituted equipment perform in accordance with the plans and specifications.
- C. Any redesign necessitated by substitutions shall be provided by the Contractor and shall be subject to review and approval by the Architect.
- D. Substitutions will not be considered if they are indicated or implied on Shop Drawings or Project Data Submittal without the formal request required by Division 1.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Manufacturer's Recommendations
 - 1. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material or equipment being installed, printed copies of these

recommendations shall be furnished prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

2. Provide complete systems in accordance with manufacturers' requirements.
 3. Where dimensions or specific installation and operating instructions of equipment are not provided in the Drawings or Specifications, perform the Work according to approved manufacturer's specifications and recommendations. Any material and work required under this heading shall be supplied at no additional cost to the Owner.
 4. Assemble equipment which is required to be field assembled, under the direct supervision of the manufacturer's agent. Prior to the final acceptance submit letters from the manufacturers that this has been done.
- B. 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 failure on part of Contractor to foresee means of bringing in or installing equipment into position inside building.
- C. Piping Systems:
- D. Piping Systems:
1. Worked into complete, integrated arrangement with like elements to make work neat appearing, finished.
 2. Run concealed, except as shown or noted otherwise; where exposed, run parallel with walls or structural elements; vertical runs plumb; horizontal runs parallel with structure and level or uniformly pitched as appropriate.
 3. Install with adequate passageways free from obstructions, as high as practicable to maintain adequate head room, as shown or as required. Notify Architect before installation whenever head room of less than 7-feet 6-inches will result. Coordinate with work of other DIVISIONS to achieve proper head room as specified in this DIVISION.
 4. Provide bases, piers, metal frames and backings, hangers and supports for the fixtures and systems furnished under this DIVISION.
 5. Expansion and Contraction: Make adequate provisions, whether those provisions are shown on Drawings or not.
 6. Cleaning and Closing: Inspect all piping, ductwork, and equipment before placing; clean interior before closing. Close all piping and ductwork at end of each day's work.

7. Cleaning and Closing: Inspect all piping and equipment before placing; clean interior before closing. Close all piping at end of each day's work.
- E. Sleeves, Chases, and Concrete Inserts:
1. Cutting and Patching: In accordance with SECTION 017329: "CUTTING AND PATCHING".
 2. Provide, to cause no delay, all required sleeves, chases, inserts, anchor bolts, etc., and be responsible for correct location, installation of same.
 3. Locating and sizing of openings for ductwork through walls, etc., under this DIVISION. Framing of openings provided by respective DIVISIONS in whose work opening is made.
 4. Penetrations of fire or smoke rated walls, partitions, and floors:
 - a. Pack space between piping and sleeve or opening with materials approved by Underwriters Laboratories for use in through-penetration fire stop systems. Materials, methods, and installation shall be in accordance with UL approved listings and shall be designed to act as a firestop as well as a cold smoke, noxious gas, and water sealant. Submit UL listings for all such systems to be used.
 - b. Through-penetrations of fire rated walls shall be protected by an approved through-penetration firestop system installed as tested in accordance with ASTM E814 or UL1479, and shall have an F rating of not less than the required fire-resistance rating of the wall penetrated.
 - c. Through penetrations of horizontal assemblies that are not contained inside fire-rated shafts shall be protected by an approved through-penetration firestop system installed as tested in accordance with ASTM E814 or UL1479, and shall have an F and T rating of not less than 1 hour and not less than the required fire-resistance rating of the floor penetrated.
 - (1) Floor penetrations contained and located within the cavity of a wall above or below the floor do not require a through-penetration firestop system with a T rating.
 5. Pipe Sleeves: Where not otherwise indicated or specified, sleeves through outside walls, floors or roof slabs shall be zinc coated steel pipe conforming to ASTM A53. Sleeves through inside partitions shall be zinc coated sheet steel not less than 0.0217-inches thick conforming to ASTM A653.

F. Cutting and Repairing:

1. Do all cutting, repairing, including structural reinforcing, necessary for Work under this DIVISION.
2. Do no cutting or patching without Architect's review. Repair damage done by this cutting equal to original condition in Architect's opinion.
3. Assume responsibility for all damage to any part of premises or Work of other DIVISIONS, caused by leaks or breaks in piping or equipment furnished and/or installed under this DIVISION during construction and guarantee period.

3.2 TESTING AND ADJUSTING

- A. Do not start or operate any equipment until the unit as well as all services connected thereto have been supported and seismically braced. Services connected to equipment includes piping and its in-line components, ductwork and its in-line components, wiring, or other in-line components.
- B. Furnish all labor and test equipment required under this DIVISION and in accordance with SECTION 230593 and as follows.
- C. Clean and purge equipment and piping before each test.
- D. Test various Mechanical systems in portions as work progresses. Any system or portion previously tested shall become part of any repeated test when it becomes part of distribution or collection system.
- E. Repair leaks by remaking with new material. Makeshift leak stopping methods are not acceptable.
- F. Should any piece of equipment or material fail in any of the tests, immediately remove, replace with new; retest system.
- G. Maintain test pressures for periods stated, or as directed without loss in pressure, except that due to change in temperature or atmospheric pressure during test.
- H. Perform all tests in accordance with the requirements and under supervision of authorities having jurisdiction.
- I. Water Prebalancing Requirements:
 1. Complete and test all systems early enough to enable completion of air and water balancing prior to Owner move in.
 - a. Submit all quantities measured above to the Architect. Do not proceed with demolition or construction until Architect has approved this submittal.

2. If the measured quantities differ from the amount shown by more than plus or minus 10-percent, report the discrepancy to the Architect. The Architect will then issue the necessary instructions how to proceed.
 3. Complete or perform the following Work prior to commencement of the balancing procedure:
 - a. Testing of all systems.
 - b. Prior to the start of balancing, complete all punch list items that will affect balancing of the system.
 - c. Schedule the Work of all other trades to eliminate system shutdown for any reason once balancing is started.
 - d. Schedule the Work of other trades to assure uninterrupted access to mechanical equipment rooms as well as conditioned spaces.
 4. When all the above testing and adjusting Work has been completed, submit a written statement to the Architect, stating that all the testing and prebalancing requirements have been met. Final Balancing shall not begin until the certificate has been approved by the Architect.
- J. At completion of Work, provide written certification that all systems are functioning properly without defects.

3.3 CLEANING AND PAINTING

- A. Refinish Work supplied with final finish under this DIVISION if damaged to satisfaction of Architect.
- B. Thoroughly clean all equipment, piping and all other materials under this DIVISION free from all rust, scale, and all other dirt before covering or painting is done, or the systems put in operation. Leave in condition satisfactory to the Architect.
- C. Thoroughly flush out all domestic water piping with domestic water under pressure before faucets, flush valves and other constantly operated devices are installed.
- D. Thoroughly flush out all domestic water piping with domestic water under pressure before faucets, flush valves and other constantly operated devices are installed.
- E. Protect all finished surfaces of fixtures with heavy paper pasted thereon, or by other means, throughout the period of construction.
- F. Properly prepare Work under this DIVISION to be finished painted under SECTION 099100, "PAINTING".

1. All exposed work which in general includes piping, ductwork, insulation, metal items, equipment and supports shall be painted except that polished aluminum, stainless steel, chrome plate and other finely finished materials shall not be painted unless otherwise noted.
2. Unless otherwise noted all finish colors shall be selected by the Architect.
3. Materials previously shop prime coated by the manufacturer and which have been scuffed or otherwise damaged shall be touched up with the same materials used for priming. Prime coats shall be of a lighter tint than final coats.

3.4 SIGNS, LABELS AND IDENTIFICATION FOR PIPING, VALVES AND EQUIPMENT

A. Signs and Labels:

1. Fasten a red-headed tack to each T-bar suspended ceiling pushout tile at any equipment, component or control devices, requiring maintenance or access.
2. A printed sign shall be posted at water treating equipment stating, "USE NO CHROMATES".
3. Post a printed sign at each automatically started equipment stating, "WARNING THIS MACHINE IS AUTOMATICALLY CONTROLLED AND MAY START AT ANY TIME".

B. Pipe Identification:

1. Identify and color-code all piping including piping in furred ceiling spaces. Provide directional arrows on circulating systems. Identification shall be in accordance with ANSI A13.1-1981, Scheme for Identification of Piping Systems (OSHA) and as specified herein.
2. Plastic Markers: Seton Setmark, or equal, for concealed locations or if located in mechanical rooms; or Seton Opticode, or equal, for exposed pipes in public areas, with wording as selected by the Architect. Each marker must show approved color-coded background, proper color of legend in relation to background color, approved legend letter size, approved marker length.
3. Location for Pipe Identification:
 - a. Adjacent to each valve and fitting (except on plumbing fixtures and equipment).
 - b. At each branch and riser take-off.
 - c. At each pipe passage through wall, floor and ceiling construction.

- d. On all horizontal runs spaced 25-feet maximum but not less than one per room.

C. Valve Identification:

- 1. Provide tags on all control and line shut-off valves. Tags shall note valve service and number as hereinafter specified and shall be Seton Style
 - a. 250-BL, Brady, or equal, brass tag fastened to the valve stem with copper wire.
- 2. Provide three (3) typewritten schedules giving numbers, service and locations, and notations of normally open or closed, of all tagged valves, where purpose of location is not easily identifiable. Enclose each schedule in separate transparent plastic binder.

3.5 EQUIPMENT IDENTIFICATION

- A. Properly identify each piece of equipment and its controls using engraved laminated plastic descriptive nameplates, attached to equipment and controls using round head brass machine screws, pop rivets or contact cement. Cardholders in any form not acceptable.
- B. For equipment installed under a raised floor, properly identify each fan powered unit, damper, control valve and other equipment requiring maintenance or access. Such identification shall be approved by the Architect and located at the carpet tile or top of raised floor, at the ceiling or other location approved by the Architect.

END OF SECTION

SECTION 22 0500

BASIC MATERIALS AND METHODS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. The requirements of this SECTION apply to all Work of this DIVISION, where applicable. The materials, equipment and methods herein are generally common to the various SECTIONS of this DIVISION of the Specification. Materials that apply to only one SECTION are generally included in that SECTION. Where items specified in other SECTIONS of this DIVISION conflict with requirements of this SECTION, the former shall take precedence.

1.2 QUALITY ASSURANCE

- A. Equipment and Accessories
1. Supply all equipment and all accessories new, free from defects.
 2. All items of a given type shall be the product of the same manufacturer.
 3. Electrical Equipment: Listed by U.L. and bearing their label.
- B. Reference Standards: Refer to individual Mechanical SECTIONS for additional reference standards.
1. Section 018113 Commissioning
 2. ANSI/ASME - B31.9 Building Services Piping
 3. ANSI B2.1 - Pipe Threads
 4. ASTM D1557 - Test Methods for Moisture Density Relationships of Soil and Soil Aggregate Mixtures.
 5. AWWA C209-83 - Cold applied tape coatings for exterior of connections and fittings for steel water pipe lines.
 6. AWWA C214-83 - Tape Coating Systems for exterior of steel water pipe lines.
 7. AWWA C506-69 Standard for Backflow Prevention Devices.
 8. ASC - Adhesive and Sealant Council.
 9. Copper Development Association - Copper Tube Handbook.
 10. NEMA-MG1 National Electrical Manufacturer's Association, Motor and Generator Standards.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Access Doors in Ceilings or Walls:

1. Furnish under this DIVISION where shown, or required by Regulatory Agencies and for access to all concealed valves, shock absorbers, unions, fire dampers, etc., even though access doors are not shown for Mechanical Work. Mark each door to establish its location and deliver doors for installation under SECTION 083100. Access doors shall be as specified in SECTION 083100.
2. Unless otherwise shown or designated, access doors for reaching valves, traps, air vents, duct access doors, and handholes and cleanouts set in walls shall be 12" x 12" for reaching small items within wrist reach of walls, or 24" x 24" for larger items, or items at greater distances than wrist reach, or at ceilings. All ceiling access door locations shall be coordinated with Architectural Reflected Ceiling Plan.
3. Access doors are not required in T-bar suspended pushout ceilings or accessible tile ceilings.
4. For any access door not specifically shown on reflected ceiling plans or Architectural elevations, obtain the Architect's approval of the location, size and type.
5. Access doors shall be Milcor, Bilco, or equal.
 - a. Style A for acoustic tile. Size of this unit must exactly fit single or multiple acoustic tiles.
 - b. Style K for plaster surfaces.
 - c. Style M for masonry, tile, wall board and other non-plastered surfaces.
 - d. U.L. 1 hour B label for one-hour fire rated surfaces.

B. Piping Schedules:

1. Refer to individual Mechanical SECTIONS for general information, materials, and execution of the proper piping for each system.

C. Valve Schedules: See Valve Schedules in SECTION 220523: VALVES

D. Dielectric Waterways or Dielectric Flanges: Victaulic Clearflow, Watts, or equal.

E. Expansion Tank:

1. Provide a pressurized expansion tank for the chilled water and heating hot water system (and other systems as shown or indicated on the drawings), as manufactured by Bell & Gossett, Armstrong, Amtrol, Taco or Wessels.
2. Pressurized expansion tank shall be of a vertical design with a heavy-duty replaceable bladder. Construct unit of a welded ASME stamped and rated steel shell suitable for systems' working pressure. Provide unit with a replaceable heavy duty Butyl rubber bladder capable of filling the entire inside volume of the tank. The bladder shall be fixed in place by a flange assembly and shall have a flexible internal sparging tube to minimize bladder failures. The unit shall have a flanged bladder connection for ease of bladder removal and service. The unit shall be fitted with lifting rings, a floor mounted skirt for vertical installation, a NPT drain plug, and a 0.302" – 32 charging valve (standard tire valve) connection to facilitate on-site charging of the tank to meet system requirements. Ship tank from factory precharged with 12 PSIG air, but field charge in accordance with the manufacturer's installation manual, to the same pressure as the system's pressure fill valve is set to maintain, on the system.
3. The tank must be designed, constructed and stamped in accordance with Section VIII, Division I of the ASME Boiler and Pressure Vessel Code and registered with the National Board of Boiler and Pressure Vessel Inspectors.

F. Automatic Air Vent:

1. Provide automatic air vents on the system as indicated on the drawings. Automatic air vents shall be as manufactured by Bell & Gossett, Hoffman, or Taco.
2. Valves shall be capable of passing 50 SCFM of air at 100PSI and shall be constructed of a cast iron body with 3/4" system connection; designed for the operating pressure of the system. The valve shall prevent air from entering the system if system pressure drops below that of atmospheric pressure, and shall have internal components made of stainless steel, brass, and EPDM. Provide isolation valve before vent.

G. Escutcheon: Beaton, Corbin, or equal.

H. Pipe Hangers: See schedule on Drawings, and individual mechanical specification SECTIONS; see also SECTION 220548: NOISE, VIBRATION, AND SEISMIC CONTROL.

I. Pipe Hanger Shields:

1. Calcium silicate inserts and jacket such as Pipe Shields A1000 with painted galvanized steel jacket, Kin-Line or equal.

2. High density (30 pcf) blown polyurethane inserts such as Rilco CC2000 or high density calcium silicate (28 pcf) such as Pipe Shields A9000. Provide with galvanized steel jacket.
- J. Shock Absorbers: Wade "Shockstop", Josam, or equal.
- K. Backflow Preventers:
1. Reduced Pressure Type: Febco 825 or 825Y, Watts No. 909, or equal, with two independently operating check valves and shall be designed for installation in a normal horizontal flow attitude. An independent relief valve shall be located between the two check valves. Sizes 2-inch and smaller shall include ball valve shut-offs; 2-1/2 inch and larger shall include OS&Y gate valves. All backflow preventers shall meet all the specifications of AWWA C506-69 Standard for Backflow Prevention Devices.
 2. Vacuum Breaker:
 - a. Atmospheric applications: Febco No. 710/715, Watts No.288A, polished chrome plate.
 - b. Continuous Pressure applications: Febco No. 765, Watts No. 800, with ball valve shutoffs.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Installation of Piping:
1. Definition of "PIPING": The term "piping" as used in Drawings or these Specifications, means all pipe, fittings, nipples, valves, unions, etc., as may be required for a complete, functional system.
 2. The general layout of piping on the drawings indicates branch runouts terminated at individual or groups of fixtures or equipment. The piping shall be considered continuous and finally connected to all fixtures and equipment.
 3. Run all pipes in the approximate locations shown. Sizes are given on the Drawings. Unless otherwise shown, lines shall be installed in furred spaces. Offset piping wherever necessary to obtain headroom. In all cases, install pipe lines to conform to actual conditions such as offsetting to clear structural members, lights, ducts, etc. Run all piping true to line and grade. The finished work shall present a neat and workmanlike appearance. Unless otherwise noted, minimum pipe size is 1/2" for all piping systems.
 4. Accurately cut pipe and work into place without springing or forcing, except when cold springing is required.

5. Install pipe lines free from traps, air pockets, sags and bends. Arrange water piping for draining at low points and provide vent valve at high points. Drain valves shall be accessible.
6. Wherever changes in size of pipes occur, the changes shall be made with reducing fittings, as the use of bushings will not be permitted.
7. Securely fasten all piping and equipment in the building to the building construction. Secure branch piping runouts in partitions to steel partition members with tie wire. Provide pipe taping separation between steel and copper.
8. Make branch takeoffs with reducing tees or with line size tee and reducers, except that branches less than half diameter of main may be made with forged branch welding outlet fittings.
9. Piping in any partitions, through plates, studs, etc. shall have sufficient clearance from structure to allow for expansion, contraction of piping. No bare piping should touch wood, concrete, etc., any time.
10. All pipes piercing roof membranes shall be flashed water-tight. Hot pipes shall be fitted with a welded cowl with air space between cowl and flashed curb to allow for any expansion.
11. Provide all piping passing through finished floors, ceilings, partitions, or walls exposed to view with chromium-plated escutcheons in bathrooms, prime coated elsewhere. Fit escutcheons for insulated pipe over insulation.
12. Pipe penetrations at Fire and Smoke rated walls and floors: As specified under SECTION 210100: GENERAL REQUIREMENTS.
13. Pipe penetrations at Fire and Smoke rated walls and floors: As specified under SECTION 220100: GENERAL REQUIREMENTS.
14. Pipe penetrations of exterior foundation walls or slabs on grade are to be sealed using Thunderline Link Seal, Calpico, or equal.
15. Cut copper tubing with copper tube cutters, ream and size with sizing tools, and thoroughly clean before application of flux or solder.
16. Tees may be cut into 2-inch and larger copper tubing using Bonney, Brazolets or equal or by using Tubemaster Tee Turner, T-Drill, or equal.
17. Copper to Steel Connections:
 - a. Make all copper pipe connections to ferrous piping in domestic water systems with Clearflow, Watts, or equal, dielectric waterway or isolation flanges. Dielectric unions not acceptable.

- b. All uninsulated copper pipe shall be isolated from supports by means of Stoneman Trisolators or Unistrut Unicushion.
- 18. Unless otherwise indicated, drains from all equipment and piping having drain connection, where shown or required, shall be run to the nearest adequately sized clear water waste receptacle.
- 19. The 90-degree turn nearest to the pump at the suction end of pump shall be five suction pipe diameters minimum distance from the pump's suction inlet. Alternatively, a suction diffuser may be used.
- 20. Install vacuum breakers at all under-the-rim water connections at fixtures and equipment and at all location required by code or code authority. Locate a minimum of 12-inches above the rim of the fixture or equipment.
- 21. Install an appropriate sized shock absorber at all solenoid valves and at all groups of 2 or more flush valves.
- 22. Install an appropriate sized shock absorber at all solenoid valves.
- 23. Install an appropriate sized shock absorber at all groups of 2 or more flush valves.
- 24. Unless otherwise shown or specified, strainers, located at pumps, reducing and control valves, or at other line devices or equipment, shall be of full line size. Provide Wye-type strainers ahead of all automatic valves, pumps, pressure regulating valves and similar devices. Provide basket-type strainers where shown.
- 25. Provide ground joint unions at all regulating valves, steam traps, equipment, and where required in lines 2-inches and smaller. Use flanges in lines 3-inches and larger. 2-1/2-inch valves and equipment may have unions or flanges at the option of the Contractor.
- 26. Open-ended line valves shall be provided with plugs or blind flanges.
- B. Flexible Connections: See SECTION 220548: NOISE, VIBRATION AND SEISMIC CONTROL.
- C. Piping Joints:
 - 1. Threaded Joints
 - a. Pipe threads shall be tapered threads in accordance with ANSI/ASME B31.9 and ANSI B2.1 for IPS threaded work. No screwed pipe joints shall be caulked or screwed up with rope or packing of any kind. Teflon pipe tape may be used where appropriate. When erecting plated, polished, or soft metal piping, friction wrenches shall be used exclusively.

2. Brazed and Soldered Joints:
 - a. Brazed joints and soldered joints shall be in accordance with ANSI/ASME B31.9-1982 with preparation, techniques and procedures in accordance with the Copper Tube Handbook publication of the Copper Development Association. Brazing materials shall be as specified in the various Sections of these specifications.
 - b. Soldered joints in domestic water systems shall be lead free.
3. Welded Joints:
 - a. Welding shall comply with the provisions of the latest revision of ASME Code for Pressure Piping ANSI/ASME B31.9-1982 Building Service Piping.
 - b. Boiler External Piping: For steam boilers with pressure greater than 15 psig or water heating units operating at pressures greater than 160 psig and temperature greater than 250 degrees F., the boiler external piping shall comply with the provisions of the latest revision of Section I of the ASME Boiler and Pressure Vessel Code ANSI/ASME BPV-1. For boilers not exceeding the above pressure and temperature limits ANSI/ASME B31.9 shall apply.
 - c. Boiler External Piping: For steam boilers with pressure greater than 15 psig or water heating units operating at pressures greater than 160 psig and temperature greater than 250 degrees F., the boiler external piping shall comply with the provisions of the latest revision of Section I of the ASME Boiler and Pressure Vessel Code ANSI/ASME BPV-1. For boilers not exceeding the above pressure and temperature limits ANSI/ASME B31.9 shall apply.
 - d. Unless otherwise indicated, welding shall be permitted on 1-1/2 inch and larger black steel pipe lines. Use long radius forged steel welding elbows. Tees may be cut in where the branch pipe does not exceed one size less than half the size of the main. If a larger branch is used, then only weldolets or threadolets may be installed.
- D. Provide relief valves at expansion tanks, pressure tanks and as indicated. Install relief valves in upright position with discharge piped to nearest floor drain.
- E. System relief valve capacity shall equal makeup valve capacity. Equipment relief valve capacity shall exceed flow rating of connected equipment. Where one pipe vents several relief valves, cross section area shall equal sum of individual vent areas.

- F. Allow ample space for basket removal for strainers and suction diffusers. Where pumps are mounted on inertia pads, support suction diffuser with steel pipe section on inertia pad; for other installations, the suction diffuser shall be supported by steel pipe section on a neoprene pad 1-inch thick. Remove start-up strainer after start-up and pipe cleaning has been accepted by Owner.

3.2 FIELD QUALITY CONTROL

A. Welding:

1. Welding Procedure Specifications: Before any welding is performed, the Contractor shall submit copies of his welding procedure specification for all metals included in the work together with proof of its qualification as outlined in ANSI B31.1.
2. Performance Qualification Record: Before any welder or operator shall perform any welding, the Contractor shall submit 3 copies of the Welder's Performance Qualification Record in conformance with ANSI B31.1 showing that the welder was tested under the approved procedure specification submitted by the Contractor. In addition the Contractor shall also submit each welder's assigned number, letter, or symbol which shall be used to identify the work of the welder which shall be affixed immediately upon completion of the weld. Welders making defective welds after passing a qualification test shall be given a requalification test and upon failing to pass the test shall not be permitted to work this contract.
3. Surface Conditions: Surfaces to be welded shall be free from frost, moisture, loose scale, slag, rust, paint, oil, and other foreign material. Joint surfaces shall be smooth, uniform, and free from fins, tears, and other defects which might affect proper welding. Slag shall be removed from flame cut edges to be welded by grinding, but temper color need not be removed. Each layer of weld metal shall be cleaned thoroughly by wire brushing prior to inspection and deposition of additional weld metal.
4. Base Metal Preparation: Follow ANSI B31.1 for base metal preparation and alignment.
5. Quality of Welds: The quality of welds shall be in accordance with ANSI B31.1. The surface of the finished welds shall have a bright metallic luster after cleaning, shall be fairly smooth with regular, even ripples, and shall be uniform in contour. Except as necessary to correct defects, the surfaces shall not be dressed, smoothed, or finished for improving their appearance unless required specifically by the project specification, its accompanying drawings, or the approved detail drawings of the work. Welds shall be sound throughout and fused thoroughly, and shall be free from gas pockets, oxides, slag inclusions, and surface porosity, except that very small pores or specs of oxides or slag will be allowed if dispersed widely and if not larger or more numerous than those produced in passing qualification tests.

Welds shall be free from overlaps, undercuts and excessive convexity. The inside of the pipe shall be free from globules of weld metal which would restrict the pipe area or might become loose.

6. Correction of Defects: Defective or unsound welds shall be corrected by removing and replacing the welds with new welds, or as follows:
 - a. Excessive convexity: Chip or grind weld to required size.
 - b. Undercutting, shrinkage cracks, craters, blowholes, and excessive porosity: Chip or grind weld to sound weld and base metal and deposit additional weld metal.
 - c. Undersize and excessive concavity: Clean weld and deposit additional weld metal.
 - d. Overlapping and lack of fusion: Remove weld by chipping or grinding and reweld.
 - e. Slag inclusions: Chip or grind weld to remove slag and fill with weld metal.
 - f. Removal of adjacent base metal during welding: Chip or grind weld to sound base and weld metal and form full size by depositing additional weld metal. Pipe or fittings which cannot be rewelded satisfactorily shall be replaced with new pipe or fittings at the Contractor's expense. Caulking of welds shall not be done. Before adding weld metal or rewelding, the surfaces shall be cleaned thoroughly. The removal of weld metal from a defective weld shall not extend into the base metal beyond the weld penetration. Where incomplete fusion is disclosed by chipping or grinding to correct defects, that part of the weld shall be removed and rewelded. In chipping or grinding welds, the weld or base metal shall not be nicked or undercut.

B. Brazing and Soldering:

1. Brazing and soldering procedure qualification shall conform to ANSI B31.1. Brazing procedure for joints shall be as outlined in the Copper Tube Handbook published by the Copper Development Association.
2. Soldering, soldering preparation and procedures for joints shall be in accordance with ANSI B31.1 and as outlined in the Copper Tube Handbook published by the Copper Development Association.

C. Inspection, Examination and Testing of Pipe Joints shall be in accordance with Chapter VI of ANSI/ASME B31.9-1982 and SECTION 220593: TESTS AND BALANCING.

END OF SECTION

SECTION 22 0519

INSTRUMENTATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE

- A. This Section includes meters and gages used in mechanical systems.

1.3 WORK INCLUDED IN THIS SECTION

- A. Materials, equipment fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Pressure gauges
 - 2. Thermometers

1.4 RELATED REQUIREMENTS

- A. Refer to piping Sections of this Division for requirements relating to this Section.
- B. Meters and gages furnished as part of factory-fabricated equipment are specified as part of the equipment assembly in other Sections of this Division.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of meter, gage, and fitting specified. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit a meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.
- C. Product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.
- D. Maintenance data to include in the "Operating and Maintenance Manuals" specified in Division 1 Section "Project Closeout." Include data for the following:
 - 1. Thermometers

2. Pressure gauges

1.6 QUALITY ASSURANCE

- A. Comply with applicable portions of American Society of Mechanical Engineers (ASME) and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.
- B. Design Criteria: The Drawings indicate types, sizes, capacities, ranges, profiles, connections, and dimensional requirements of meters and gages and are based on the specific manufacturer types and models indicated. Meters and gages having equal performance characteristics by other manufacturers may be considered, provided that deviations do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of meters and gages is on the proposer.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ashcroft
 - 2. Palmer
 - 3. Terice
 - 4. Wexler
 - 5. Marsh
 - 6. Peterson
 - 7. Watts
 - 8. Bell & Gossett
 - 9. Fischer & Porter
 - 10. Taco
 - 11. Wallace & Tiernan
 - 12. Badger
 - 13. Dwyer
 - 14. Hersey

15. Or equal

2.2 THERMOMETERS, GENERAL

- A. Scale Range: Temperature ranges for services listed as follows:
 - 1. Domestic Hot Water: 30 to 240 deg F, with 2 deg scale divisions (0 to 115 deg C, with 1 deg scale divisions).
 - 2. Domestic Cold Water: 0 to 100 deg F, with 2 deg scale divisions (minus 18 to 38 deg C, with 1 deg scale divisions).
- B. Accuracy: +/- 1 percent of range span or +/- one scale division to maximum of 1.5% of range span.

2.3 LIQUID-IN-GLASS THERMOMETERS

- A. Description: ASTM E 1, liquid-in-glass thermometer.
- B. Case: Die-cast and aluminum-finished in baked-epoxy enamel, glass front, spring secured, 9 inches (230 mm) long.
- C. Adjustable Joint: Finished to match case, 180-degree (3.1rad) adjustment in vertical plane, 360-degree (6.3rad) adjustment in horizontal plane, with locking device.
- D. Tube: Red-reading, organic liquid-filled instead of mercury-filled, with magnifying lens.
- E. Scale: Satin-faced nonreflective aluminum with permanently etched markings.
- F. Stem: Copper-plated, steel, aluminum, or brass for a separable socket of length to suit installation.

2.4 REMOTE-READING, FILLED-SYSTEM DIAL THERMOMETERS

- A. Description: Vapor-actuated remote-reading dial thermometer.
- B. Case: Drawn steel or cast aluminum, with 4-1/2-inch (115-mm) -diameter glass lens.
- C. Movement: Brass, precision geared.
- D. Scale: Progressive satin-faced nonreflective aluminum with permanently etched markings.
- E. Tubing: Bronze double-braided armor-over-copper capillary of length to suit installation.
- F. Bulb: Copper with separable socket for liquids; averaging element for air.

2.5 INSERTION DIAL THERMOMETERS

- A. Description: Bimetal dial thermometer.
- B. Dial: 1-inch (25-mm) diameter.
- C. Case: Stainless steel.
- D. Stem: Dustproof and leakproof 1/8-inch (3-mm) -diameter tapered-end stem with nominal length of 5 inches (125 mm).

2.6 THERMOMETER WELLS

- A. Description: Brass or stainless-steel thermometer well.
- B. Pressure Rating: Not less than piping system design pressure.
- C. Stem Length: To extend 2 inches (50 mm) into fluid.
- D. Extension for Insulated Piping: 2 inches (50 mm) nominal, but not less than thickness of insulation.
- E. Threaded Cap Nut: With chain permanently fastened to well and cap.

2.7 PRESSURE GAGES

- A. Description: ASME B40.1, Grade A phosphor-bronze Bourdon-tube pressure gage, with bottom connection.
- B. Case: Drawn steel, brass, or aluminum with 4-1/2-inch (115-mm) -diameter glass lens.
- C. Connector: Brass, 1/4-inch (DN 8).
- D. Scale: White-coated aluminum, with permanently etched markings.
- E. Accuracy: +/- 1% of range span.
- F. Range: Conform to the following:
 - 1. 30 inches Hg (100 kPa) of vacuum to 2 times operating pressure.

2.8 PRESSURE-GAGE ACCESSORIES

- A. Syphons: 1/4-inch (DN 8) straight coil of brass tubing with threads on each end.
- B. Snubbers: 1/4-inch (DN 8) brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

PART 3 – EXECUTION**3.1 METER AND GAGE APPLICATIONS**

- A. General: Where indicated, install meters and gages of types, sizes, capacities, and with features indicated.

3.2 METER AND GAGE INSTALLATION, GENERAL

- A. Install meters, gages, and accessories according to manufacturers' written instructions for applications where used.

3.3 THERMOMETER INSTALLATION

- A. Install thermometers and adjust vertical and tilted positions.
- B. Install in the following locations and elsewhere as indicated:
 - 1. At inlet and outlet of each thermal storage tank.
- C. Remote-Reading Dial Thermometers: Install in control panels with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- D. Thermometer Wells: Install in vertical position in piping tees where thermometers are indicated.
 - 1. Install wells with stem extending minimum of 2 inches (50 mm) into fluid.
 - 2. Install wells with stem extending to center of pipe.
 - 3. Fill wells with oil or graphite and secure caps.

3.4 PRESSURE GAGE INSTALLATION

- A. Install pressure gages in piping tee with pressure gage valve located on pipe at most readable position.
- B. Install in the following locations and elsewhere as indicated:
 - 1. At suction and discharge of each pump.
 - 2. At discharge of each pressure-reducing valve.
 - 3. At building water service entrance.

3.5 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow servicing and maintenance.

3.6 ADJUSTING AND CLEANING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.
- C. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION

SECTION 22 0523

VALVES

PART 1 – GENERAL**1.1 DESCRIPTION**

- A. The requirements of this SECTION apply to all Work of this DIVISION where applicable. The valves, materials, and methods herein are generally common to the various mechanical systems described in other SECTIONS of this DIVISION. Automatic valves, control valves, backflow preventers and other specialty valves are specified on the drawings or in other SECTIONS of this DIVISION.
- B. Provide valves as specified herein for:
 - 1. Domestic Hot and Cold Water

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. SECTION 220100: GENERAL REQUIREMENTS.
- B. SECTION 223000: PLUMBING SYSTEMS.
- C. Where valves specified in other SECTIONS of DIVISION 22 conflict with requirements of this SECTION, the former shall take precedence.

1.3 QUALITY ASSURANCE

- A. Valves and Accessories
 - 1. Supply all valves and all accessories new, free from defects.
 - 2. All items of a given type shall be the product of the same manufacturer.
- B. Product Delivery and Storage: Store valves in a protected area. Keep valves in closed position to protect valve seats.
- C. Reference Standards: (Refer to individual Mechanical SECTIONS for additional standards)
 - 1. American Society for Testing and Materials (ASTM) Publications:
 - a. A 47-77 Malleable-Iron Castings
 - b. A 126 Grey Iron Castings for Valves, Flanges and pipe fittings.
 - c. A 216 Grade WCB Cast Carbon Steel

- d. A 217 Grade CA15 Cast 11-1/2 -13 Chromium Stainless Steel
- e. B 61 Cast Steam Bronze Castings
- f. B 62 Composition Bronze or Ounce Metal Castings
- g. B 584 Copper Alloy Bronze Castings
- 2. American Water Works Association (AWWA) Publications:
 - a. C500-86 Gate Valves, 3 through 48 inch NPS, for Water and Sewage Systems.

PART 2 – PRODUCTS

2.1 PRODUCTS

	Globe Valves	Angle Valves
<u>Stockham</u>	B-13T	B-216
<u>Crane</u>	7 TF	17TF
<u>Nibco</u>	T-211-Y	T-311-Y

	Globe Valves	Angle Valves
Stockham	G-514T	G-515
Nibco	F-718-B	F-818-B

2.2 DOMESTIC HOT AND COLD WATER

- A. Shut-off or sectional valves 2 inch and smaller shall be:
 - 1. Ball Valves, 600 psi CWP, with cast brass bodies, replaceable reinforced teflon seats, conventional port, blowout proof stems, chrome plated brass ball, and threaded or solder ends with extended cups.
 - a. Threaded:
 - (1) Stockham S-216-BR-RT
 - (2) Crane 9302
 - (3) Nibco T-580-BR-R-70
 - b. Soldered:
 - (1) Stockham S-216-BR-RS
 - (2) Crane 9322
 - (3) Nibco S-580-BR-R-70
 - (4) Milwaukee

2. Gate Valves, Class 125, body and bonnet of ASTM B-62 cast bronze composition, with threaded or soldered ends, solid disc, copper silicon rising stem, brass packing gland, Teflon-impregnated packing and malleable handwheel.
 - a. Threaded:
 - (1) Stockham B-100 (RS)
 - (2) Crane 428
 - (3) Nibco T-111
 - (4) Milwaukee UP148
 - b. Soldered:
 - (1) Stockham B-108 (RS)
 - (2) Crane 1334
 - (3) Nibco S-111
 - (4) Milwaukee UP149
- B. Shut-off or sectional valves 2-1/2 inch and larger shall be Gate Valves, non-rising stem, solid wedge disc, Class 125 iron body and bonnet, flanged ends, conforming to ASTM-A-126 Class B cast iron, bronze mounted, with Teflon impregnated packing and two-piece gland assembly.
 1. Stockham G-612
 2. Crane 461
 3. Nibco F619
- C. Exterior shut-off or sectional valves 3 inch or larger.
- D. Butterfly Valves shall be wafer lug type body, 200 psi CWP, conforming to ASTM A-126 Class B cast iron, with field replaceable EPDM sleeve, aluminum bronze disc, 410 stainless steel stem, and EPDM O-ring stem seals. Lever operated from 2-1/2 inch through 6 inch, above 6 inch gear operated.
 - a. Lever operated:
 - (1) Stockham LG-712-BS3-E
 - (2) Demco NE-150-5214351
 - (3) Crane 44-BXZ-TL
 - b. Gear operated:

- (1) Stockham LG-722-BS3-E
- (2) Demco NE-150-5214359-2098
- (3) Crane 44-BXZ-G

E. Globe valves and angle valves 2 inch and smaller shall be Class 125, body and union bonnet of ASTM B-62 cast bronze composition, threaded or solder ends, copper silicon alloy stem, replaceable Teflon disc, brass packing gland, Teflon impregnated packing.

1. Threaded:

	Globe Valves	Angle Valves
Stockham	B-13T	B-216
Crane	1700	17TF
Nibco	T-211-Y	T-311-Y

2. Soldered:

	Globe Valves	Angle Valves
Stockham	B-14T	---
Crane	1700S	---
Nibco	S-211-Y	---

F. Globe Valves and angle valves 2-1/2 inch and larger shall be Class 125, OS0&Y, iron body bronze mounted with body and bonnet conforming to ASTM A-126 Class B cast iron, with flanged ends, Teflon-impregnated packing and two-piece packing gland assembly.

	Globe Valves	Angle Valves
Stockham	G-514T	G-515
Nibco	F-718-B	F-818-B

G. Check Valves 2 inch and smaller shall be Class 125, threaded ends, body and cap shall be of ASTM B-62 bronze composition, swing type.

1. Threaded:

- a. Stockham B-319
- b. Crane 1707
- c. Hammond IB940

2. Soldered:

- a. Stockham B-309
- b. Crane 1707S
- c. Hammond IB941

- H. Check Valves 2-1/2 inch and larger shall be Class 125, iron body and bolted cap of ASTM A-126 Class B cast iron, bronze mounted, ends for flanged type connections, aluminum bronze disc.

1. Stockham G-931
2. Crane 373
3. Nibco F918-B

2.3 BALANCING VALVES

- A. Domestic Hot Water Return:

1. Water circuit balancing valves in sizes 1/2-inch through 3-inch shall have cast bronze or cast copper alloy bodies with threaded end connections, or optionally cast iron body with flanged ends in sizes 2-1/2 inch and 3-inch. Valves 4-inch and larger shall have cast iron body with flanged ends. Valves shall be rated for an operating pressure of 250 psi minimum at 250 degrees F.
2. Threaded valves to be brass venturi or ball or tapered plug type and shall provide positive shut-off. Flanged valves to be brass vane type or teflon disc globe type.
3. Valves shall have levers, handwheels or manual adjusting knobs and position indicators, memory stops, and readout ports. For insulated pipe read out ports shall be extended beyond insulation.
4. Each valve shall include factory furnished, two-piece molded insulation.
5. Bell & Gosset Circuit Setter type CB, Armstrong Type CBV-I, CBV-II, Preso B-Plus.
6. Furnish manufacturer's portable read out kit with carrying case.

2.4 SAFETY AND RELIEF VALVES

- A. Valve size shall be designated by the nominal size of the inlet connection. Size, capacity, pressure relief setting, accumulation, and blowdown, as shown on the drawings and schedules.
- B. Domestic Water:
1. Cold Water: All bronze cast body with threaded connections, cadmium plated steel spring.
 - a. Kunkle 20, Chas. M. Bailey No. 25, or equal.

2.5 PRESSURE REDUCING AND TEMPERATURE REGULATING VALVES

- A. See Schedules, details and diagrams on the Drawings.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation of Valves:

1. Valve sizes and types shall be as shown on the drawings. For 2-1/2-inch pipe size, connections may be flanged, or screwed.
2. Before installing valves, blow out with compressed air and clean with water or steam.
3. Install valves only in accessible locations. Manually operated valves shall be positioned so that stems are in any suitable angle from horizontal to upright position.
4. Install lift check valves in horizontal position. Swing check valves may be installed in vertical lines with upward flow.
5. Install a check valve at the discharge of each pump.
6. All exposed valves requiring frequent operation and located more than 8-feet above the floor shall be fitted with chains and chain operators extending to within 6-feet 0-inches of the floor.
7. All hand-controlled line valves 2 inch and smaller shall be ball or gate valves, except that where frequent operation is required ball valves shall be used.
8. All hand controlled line valves 2-1/2 inch and larger shall be gate or butterfly valves.
9. Angle valves may be used for making a 90 degree turn in a line in lieu of a globe valve and elbow.
10. Where hand throttling is required provide globe or angle valves, unless otherwise shown.
11. Install all globe and angle valves to close against the pressure.
12. Line valves larger than 2" shall be supported at the valve in addition to regularly spaced pipe supports.
13. Flanges, Gaskets, Flange Bolts, nuts and washers shall be suitable for the intended service and shall be in accordance with ANSI/ASME B31.9-1982 Building Service Piping.
14. Unless otherwise noted, furnish and install balancing valves one size smaller than line size for 3/4-inch through 1-1/2-inch pipes; line size for 1/2-inch pipes, and pipes 2-inch and larger.

END OF SECTION

SECTION 22 0529

SUPPORTS AND ANCHORS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. Work included in this Section: Materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Pipe Hangers and Supports
 - 2. Equipment Anchors

1.2 RELATED WORK AND REQUIREMENTS

- A. Section 220100: General Requirements
- B. Section 220548: Noise, Vibration and Seismic Control

1.3 QUALITY ASSURANCE

- A. Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:
 - 1. Pipe Supports: ANSI B31.1, Power Piping.
 - 2. Automatic Sprinkler Pipe Supports: NFPA No. 13, Standard for the Installation of Sprinkler Systems.
 - 3. Automatic Sprinkler Pipe Supports: NFPA No. 13, Standard for the Installation of Sprinkler Systems.
 - 4. Standpipe Hose System Pipe Supports: NFPA No. 14, Standard for the Installation of Standpipe and Hose Systems.
 - 5. California Code of Regulations, Title 24, Building Standards.
 - a. Part 2, California Building Code (CBC).
 - b. Part 4, California Mechanical Code (CMC).
 - c. Part 5, California Plumbing Code (CPC).
- B. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.
- C. All items of a given type shall be the products of the same manufacturer.

1.4 SUBMITTALS

- A. Submit the following:
 - 1. Shop Drawings showing attachments to structure.
 - 2. Calculations showing deflections of trapeze hangers or other multiple pipe supports.
 - 3. Include structural calculations when required by Section 210548 Noise, Vibration and Seismic Control.
 - 4. Include structural calculations when required by Section 220548 Noise, Vibration and Seismic Control.

PART 2 – PRODUCTS**2.1 MANUFACTURERS**

- A. Hangers and Supports:
 - 1. B line
 - 2. Superstrut
 - 3. Unistrut
 - 4. Or equal
- B. Expansion Shields:
 - 1. ITT Phillips Drill Co.: Red Head
 - 2. Hilti Fastening Systems
 - 3. Or equal
- C. Miscellaneous Attachment Accessories:
 - 1. B-line
 - 2. Superstrut
 - 3. Or equal

2.2 PIPE HANGERS AND SUPPORTS

- A. Where pipe supports are not shown but are required to avoid excessive pipe deflections, provide in accordance with schedule and to meet seismic code requirements. Pipe supports shall be similar in construction to those detailed on the Drawings for similar applications.

B. Spacing:

1. Piping not otherwise indicated:

a. Maximum spacing for horizontal piping:

Type of Pipe	Size	Maximum Spacing	Hanger Size (inch)
Steel	1-1/2 in and smaller	7 ft	3/8
	2 in. to 4 inches	10 ft	1/2
	5 inches and larger	12 ft	5/8
Brass or Copper	3/4 in. and smaller	5 ft	3/8
	1 - 1-1/4 in.	6 ft	3/8
	1-1/2 - 3 in.	8 ft	1/2
	4 in. and larger	10 ft	5/8
Bell and Spigot (Notes 1, 2, 3)	All to 6 inches	10 ft	5/8
	8 inches	10 ft	3/4
Hubless C.I. (Notes 2, 4)	All to 6 inches	10 ft	5/8
	8 inches	10 ft	3/4

b. Spacing Notes:

- (1) Typical of cast iron.
- (2) Not less than one support per joint.
- (3) Support to be with 18 inches of hub or joint.
- (4) Support to be placed on or immediately adjacent to coupling.

C. Supports

1. Provide additional supports at:

- a. Changes in direction.
- b. Branch piping and runouts over 5 ft.
- c. Concentrated loads due to valves, strainers and other similar items.

- d. At valves 4 in. and larger in horizontal piping.
 - e. Support piping on each side of valve.
 - f. Brace hubless piping to prevent horizontal and vertical movement.
 - g. Where number of grooved couplings exceeds 3 between supports or provide continuous steel between supports.
- 2. Sanitary waste and vent, roofdrains per UPC Section 316.
 - a. Vertical supports are not required within 2.5 feet of wall penetrations for pipes 8 inches in diameter and smaller, and not more than 3 feet for 10 inches and larger.
- 3. Sanitary waste and vent, roof drains per CPC Section 314.0.
 - a. Vertical supports are not required within 2.5 feet of wall penetrations for pipes 8 inches in diameter and smaller, and not more than 3 feet for 10 inches and larger.
- 4. Other piping support spacing shall be as scheduled on Drawing or as required by referenced standard.
- D. Pipe Bracing shall be provided as required by other Sections of this Division.
- E. Fastening: Non-metallic Pipes shall be anchored for limiting expansion where shown or required by means of non-metallic clamps or other approved means, fastened to the pipe by approved means and rigidly attached to the building construction.
- F. Multiple pipes shall be attached to zinc coated steel channels using zinc coated clips or pipe clamps with zinc coated steel nuts and bolts, channel nut springs to be 18-8 stainless steel. For external supports use hot dipped galvanized or baked epoxy coated steel channels and angles.
- G. Single pipe hanger to be zinc coated steel Clevis type with spacer bar and nuts and rod. Similar to B-Line Fig. B3100.
- H. Struts, mounting brackets, channels, structural box sections, etc. shall be galvanized steel with zinc rich touch up of cut edges.
- I. Floor stands shall only be used where indicated on the Drawings.
 - 1. Pipe sections and fittings may be used for supports where lightly loaded. Floor stands shall be anchored to the floor with no less than 4 bolts.
 - 2. Floor stands may be used only for vertical loads. Pipe diameter shall be a minimum of 1/12 of vertical height of stand.

- J. Riser clamps at each floor:
 - 1. Non metallic pipes shall be supported with solvent welded collar above loose pipe clamp.
 - 2. Galvanized steel riser clamp for steel pipes. Similar B line B3373C.
 - 3. Plastic coated steel riser clamp for copper pipe. Similar B line B3373CTC.

2.3 STRUCTURAL ANCHORS

- A. Expansion Bolts
 - 1. Hilti Kwik Bolt TZ, ITW Red Head "Trubolt", or equal conforming to Appendix D ACI 318, as modified by CBC-2007.
 - 2. Do not exceed manufacturer's published allowable working loads.
- B. Beam Clips: B-Line Fig. B3060 side angle clips, Superstrut, or equal.
- C. Concrete Inserts:
 - 1. B-line B2505, Stainless Steel, for roof slab and external.
 - 2. B-line B2505 or Superstrut 452, Galvanized, for internal use only.
- D. Beam Clamps: B-Line Fig. B3055, Superstrut, or equal.
- E. Maximum load safety factors:
 - 1. Static loads: 5
 - 2. Vibratory loads: 8
 - 3. Shock loads: 10

2.4 PIPE SHIELDS

- A. For all insulated pipe and uninsulated pipe, see Section 220500 Basic Materials and Methods.
- B. Copper pipe bearing on metal surface, including hangers, use minimum 1/16 inches separation strip, or approved cushion strip. Minimum length 12 inches. Where pipe bears on wood, no shield is required.

2.5 SUPPLEMENTARY SUPPORTS

- A. Where support spacing is more frequent than distance between structural members provide steel angles, channels or beams sized to provide a deflection less than 1/240 of span when fully loaded, to transfer pipe support loads to structural members.

- B. Where deflection of center of trapeze support exceed $1/240$ of distance between hanger rods provide additional hanger rods.
- C. Where multiple risers are supported within shafts provide steel angles, channels, or beams, sized to provide a deflection of less than $1/240$ of span when fully loaded, to transfer loads to the concrete floor slab. Anchor supplemental supports to the slab, and provide resilient element where required by other Sections of this Division.
- D. Hot dip galvanize all supports exposed to weather.

2.6 DUCT HANGERS AND SUPPORTS

- A. See Section 233100 Ductwork.

PART 3 – EXECUTION

3.1 PIPE HANGERS, SUPPORTS AND GUIDES

- A. General:
 - 1. Assure adequate support for pipe and contents.
 - 2. Prevent vibration or swaying.
 - 3. Provide for expansion and contraction.
 - 4. Supports of wire, rope, wood, chain, strap perforated bar or any other makeshift device not permitted.
 - 5. Comply with applicable requirements at ANSI B31.1.0 and B31.2 for piping.
 - 6. Support piping independently so that equipment is not stressed by piping weight or expansion.
 - 7. See other Sections of this Division for hangers, guides, anchors and supports requiring vibration isolation units.
 - 8. Hangers and supports shall have minimum safety factor of 5, based on ultimate tensile or compressive strength, as applicable, of material used.
- B. Horizontal piping, except as noted:
 - 1. Adjustable clevis type and rod:
 - a. All services at or below 250 deg F.
 - 2. Rollers or slide bases:
 - a. At pipe stands.

3. Trapeze hangers:
 - a. Provide individual guides for pipes on trapezes.
 - b. Where rods are unequally loaded, design for maximum load at both ends.
 - c. Deflection of channel not to exceed 1/240th of span.
 4. Threaded rods:
 - a. 2 in vertical adjustment with 2 nuts each end for positioning and locking.
 - b. Size as indicated hereinbefore.
 - c. For double rod hangers: 1 size smaller than scheduled.
 5. For drainage piping buried below slab on grade see Section 220500 Basic Mechanical Materials and Methods.
 6. Adjust trapeze and individual hanger rods so as to equalize loads on successive hangers.
- C. Vertical piping:
1. Base support:
 - a. Hanger within 24 inches of elbow
 - b. Provision for expansion.
 2. Guides at every floor
 3. Top support:
 - a. Riser clamp/anchor within 24 inches of elbow.
 4. Intermediate supports: pipe clamp at floor:
 - a. See 2.2J.
 - b. Extension ends bearing on concrete.
- D. Install Cushion strip pipe isolators between steel hangers and:
1. Uninsulated copper tubing.
 2. Wherever any pipe requires sound and vibration isolation.

3.2 ATTACHMENT TO STRUCTURE**A. Concrete and CMU**

1. Install attachments with expansion shields. Shot in anchors may not be used.

B. Side Wall Supports:

1. Stud Walls:
 - a. Toggle bolts.
 - b. Lag screws into wood backing.

C. Wood Beams and Roof Decks;

1. Through-bolts for roof mounted ducts, pipe and equipment. Provide weatherproofing of penetration where exposed to outdoors.
2. Beam clamps or beam clips for suspended ducts, pipe and equipment.

D. Steel Beams:

1. Beam clamps with retaining clips shall be used unless a substitution request for omission of the retaining clip has been approved.

END OF SECTION

SECTION 22 0548

NOISE, VIBRATION, AND SEISMIC CONTROL

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Provide complete systems including design, materials, equipment and installation for vibration isolation and seismic restraints for equipment, piping and ductwork.
- B. The work of this Section includes, but is not limited to:
 - 1. Seismic Restraints.
 - 2. Flexible Pipe Connections.

1.2 WORK INCLUDED

- A. Objective: It is the objective of this specification to provide the necessary design for the avoidance of excessive noise or vibration in the building due to the operation of machinery or equipment, and/or due to interconnected piping, ductwork or conduit.
- B. Description of Work: Furnish, install, assemble, set up, test (hereinafter "provide") the following systems and equipment in accordance with the Contract Documents.
 - 1. Isolation for piping (including but not limited to domestic hot and cold water, waste, soil, vent and including all piping connected to vibrating equipment).
 - 2. Inspection of installation of vibration isolation to equipment.
 - 3. Provision of all Motion Restraints required by applicable codes for noise and vibration control equipment/systems specified herein.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Concrete: Division 3.
- B. Thermal and Moisture Protection: Division 7.
- C. Finishes: Division 9.
- D. Section 220529: Support and Anchors.
- E. Electrical: Division 26.

1.4 QUALITY ASSURANCE**A. General:**

1. Anchor, support, and brace all equipment and systems to resist seismic forces as specified hereinafter.
2. Comply with CCR 2010 California Building Codes.
3. Where anchorage support and bracing for various manufactured and fabricated items and systems are detailed and scheduled on the drawings, provide as shown.
4. For anchorage, support and bracing not detailed, provide in accordance with OSHPD Certified systems or submit details of anchors, supports and bracings complete with calculations. Details and calculation shall be signed and stamped by a Structural Engineer licensed in the state having jurisdiction over the project.

B. Reference Standards:

1. Standards: Provide equipment in accordance with the latest edition and revisions of all applicable standards and specifications of all appropriate agencies including, but not limited to, the following:
 - a. ARI - Air Conditioning and Refrigeration Institute
 - (1) ARI 280 - 1995 Standard for Requirements for the Qualification of Reverberant Rooms in the 63 Hz Octave Band.
 - (2) ARI 575 - 1994 Standard for Method of Measuring Machinery Sound Within an Equipment Space.
 - b. ASCE American Society of Civil Engineers
 - (1) Standard 7-10 – Minimum Design Loads for Buildings and Other Structures
 - (a) Chapter 13 – Seismic Design Requirements for Non-Structural Components
 - c. ASTM - American Society for Testing and Materials
 - (1) Specification A123/A123M-01a Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - (2) Test Method ASTM D471-98e1 Standard Test Method for Rubber Property-Effect of Liquids.
 - (3) Test Method ASTM D2240-02 - Standard Test Method for Rubber Property- Durometer Hardness.

- (4) Test Method ASTM E84-01 - Surface Burning Characteristics of Building Materials.
 - d. ASA - Acoustical Society of America/ANSI
 - (1) ANSI S12.2-1995 (R1999) American National Standard Criteria for Evaluating Room Noise
 - (2) ANSI S12.18-1994 (R1999) American National Standard Procedures for Outdoor Measurement of Sound Pressure Level
 - (3) ANSI S12.30-1990 (R1997) American National Standard Guidelines for the Use of Sound Power Standards and for the Preparation of Noise Test Codes
 - (4) ANSI S12.31-1990 (R2001) American National Standard Precision Methods for the Determination of Sound Power Levels of Broad-Band Noise Sources in Reverberation Rooms
 - (5) ANSI S12.36-1990 (R1997) American National Standard Survey Methods for the Determination of Sound Power Levels of Noise Sources
 - (6) ANSI S12.54-1999 ISO 3744:1994 NAIS Standard Acoustics - Determination of sound power levels of noise sources using sound pressure - Engineering method in an essentially free field over a reflecting plane
 - e. AWS - American Welding Society, Inc.
 - (1) AWS D1.1 - 2002 Structural Welding Code - Steel
 - f. ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers
 - (1) 1999 HVAC Applications Manual, Chapter 46
- C. Codes: Perform installation in accordance with all applicable international, federal, state, county, municipal and local codes and regulations, including but not limited to Chapters 16 and 17 of the California Building Code.
- D. Conflicts: Present any conflicts between codes, regulations, specifications and/or requirements at least thirty (30) days prior to the commencement of the scheduled work.
- E. Schedules: See contents of this Section for specific specifications and schedules of vibration isolators, frames and static deflections. Also see equipment support schedule on the drawings.

- F. Product Suppliers: All vibration isolation devices, equipment bases and frames for equipment and piping furnished under this Division shall be designed and furnished by no more than two different isolator manufacturers and no single vibrating element shall be isolated by the products of more than one isolator manufacturer.
- G. Supervision: The installation of all vibration isolation units, and associated hangers and bases shall be under the direct supervision of the vibration isolation manufacturer's representative.

1.5 COORDINATION

- A. Coordinate with all trades and Electrical Division for installation of Vibration Isolation. Coordinate with Concrete trade for equipment inertia bases. Coordinate Work of this Section with all other impacted trades.

1.6 SUBMITTALS

- A. Descriptive Data - Submit the following:
 - 1. Catalog cuts and data sheets on specific vibration isolators to be utilized showing compliance with the specifications and schedules herein. Include load versus deflection curves.
 - 2. An itemized list showing the items of equipment, piping, etc., to be isolated, the isolator type and model number selected, isolator loading and deflection, wire diameter and number of coils in springs, and references to specific shop drawings showing frame construction where specified.
 - 3. Written approval of the frame design to be used, obtained from the equipment manufacturer.
- B. Seismic Bracing
 - 1. Where pre-approved bracing systems will be employed, submittals shall include:
 - a. Approval identification number.
 - b. System component brochure describing components used and detailed installation instruction.
 - c. Loads to be transmitted to structure at anchor point.
 - 2. Where anchorage, support and bracing are not detailed on the drawings and pre-approved systems are not used, Contractor shall submit designs and calculations of proposed systems. Submittals shall include:
 - a. Detailed sketches showing system to be installed, stamped and signed by a California registered Structural Engineer.

- b. Written instructions from the vibration isolation manufacturer as to the proper installation and adjustment of vibration isolation devices, including hangers and bases; alternatively the equipment may be installed by the vibration isolation manufacturer.
 - c. For each Motion Restraint, a stress analysis prepared by a Structural Engineer licensed to practice in the State of project jurisdiction.
 - (1) Provide sufficient detail to permit architect and authorities having jurisdiction to verify compliance with all applicable Codes and these specifications.
 - (2) For vibration isolation used with floor or roof mounted equipment over 400 pounds or suspended equipment over 20 pounds, provide calculations for:
 - (a) shear
 - (b) pull-up
 - (c) primary overturning
 - (d) secondary overturning
 - d. A certification in the calculation cover sheet stating:
 - (1) "These calculations demonstrate that the system detailed complies with the requirements of Chapter 16 of the California Building Code."
 - 3. An itemized list of all items of equipment to be fitted with flexible piping and/or duct connections.
 - a. Flexible piping and/or duct submittals shall contain all information and calculations to demonstrate conformance and suitability for the equipment operating conditions including but not limited to pressure, temperature, capacity, mounting, maintenance, etc.
- C. Shop Drawings - Submit the following and secure approvals prior to fabrication:
 - 1. Drawings showing equipment frame construction for each machine, including dimensions, structural member sizes, support point locations, etc.
 - 2. Drawings showing methods, for isolation of ducts, pipes, etc., piercing walls, slabs, beams, etc.

3. Drawing showing methods numbers and details of Motion Restraints and anchors for equipment, frames, isolators, piping, ductwork, etc., including calculations as above.
 4. Details for concrete and steel bases including anchor bolt locations.
 5. Specific details of restraints including anchor bolts for mounting and maximum loading at each location, showing compliance with Code and coordination with the Project Architectural, Structural and Mechanical Documents.
 6. Details of flexible piping and duct connections for all typical conditions listed in the schedule provided above.
- D. Seismic Qualification Requirements Certificate of Compliance: Submit certificates of compliance for all applicable equipment as required by the California Building Code, Chapter 17, paragraph 1708.5.
- E. Anchorages and Supports
1. Where Contractor-proposed substitutions change the weight, size, configuration or other aspects of systems and equipment that will affect the performance of anchorages and/or supports, the Contractor shall submit calculations for proposed anchors and supports, and install them as shown in these calculations. The calculations shall include the same certification and engineer's stamp as required above for seismic bracing.
 2. Where contractor-proposed substitutions are claimed to have no effect on anchors and supports detailed on the Contract Documents, Contractor shall submit information on sizes, weights, center of gravity and other relevant information to demonstrate this fact.
 3. Contractor shall submit details and calculations for all embedded inserts, drilled inserts and other fasteners for attachments of suspended components showing the load-carrying capacity of each device calculated in accordance with Chapter 16 of the California Building Code. The calculations shall include the same certification and engineer's stamp as required above for seismic bracing.
 4. For all anchorages and supports not detailed on the Contract Documents, Contractor shall submit details and calculations. The calculations shall include the same certification and engineer's stamp as required above for seismic bracing.

PART 2 – PRODUCTS

2.1 GENERAL PROPERTIES

- A. Deflection: Vibration isolators shall have either known undeflected heights or other markings so that, after adjustment, when carrying their load, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration

isolation is being provided according to the design.

- B. Range: Isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range 60 percent above the design deflection.
- C. Ratio: Ratio of lateral to vertical stiffness shall not be less than 1.0 or greater than 1.3.
- D. Nested: Unless specifically noted, nested spring designs shall not be permitted.
- E. Uniformity: Vertical natural frequency for each support point, based upon the load per isolator and isolator stiffness, shall not differ by more than +/- 10 percent.
- F. Isolation: Wave motion through the isolator shall be reduced to the following extent: Isolation above the primary vertical system resonance frequency shall follow the theoretically predicted isolation curve for single degree of freedom systems within 10% up to 50 dB or greater at all frequencies above 150 Hz.
- G. Protection: Isolators installed outdoors shall be designed for such exposure suitable to the Project conditions.
 - 1. Springs shall be coated in neoprene or PVC. Spring housings shall be hot dip galvanized.
 - 2. All neoprene mountings shall have a Shore A hardness of 30 to 50, after minimum aging of 20 days or corresponding oven aging.
- H. Internal Isolation: Where vibration isolators and associated equipment frames have been specified herein for "package" air handling units which are available with "internal" isolation; the contractor shall comply with the following:
 - 1. Provide neoprene mounts for the "internal" isolation supplied by the air handling unit manufacturer. Such mounts shall be of 30 to 60 durometer neoprene and shall have a static deflection no greater than 0.25 times the scheduled static deflections.
 - 2. "Internal" isolation in lieu of the specified vibration isolators and scheduled equipment frames is unacceptable. Where internal isolation is provided, in addition to the specified isolation, same shall be removed or made ineffective.

2.2 ACCEPTABLE MANUFACTURERS

- A. Pipe Bracing Systems:
 - 1. Badger Industries
 - 2. Bline

- 3. Super Strut
- 4. Or equal
- B. Vibration Isolators:
 - 1. Mason Industries
 - 2. Peabody Kinetics
 - 3. M.W. Sausse & Co.
 - 4. Or equal

2.3 PIPING RESILIENT SUPPORT AND SUSPENSION

- A. Execution Cross-Reference: Refer elsewhere in this Section for the requirements of Resilient Penetrations and Flexible Connections. Refer to Part 3 for the extent of the resilient piping support cited below.
 - 1. At pipe anchors for piping attached to vibrating equipment provide Types MN or HN to avoid direct contact of piping with building.
 - 2. Pipe sway braces where required and attached to vibrating equipment shall utilize neoprene elements of 40 durometer maximum and of 3/8" minimum thickness, Type MN shall be used where such braces are required to accommodate both tension and compression forces.
- B. Domestic Water: At horizontal Domestic water piping provide wool felt isolator backed with metal similar to Stoneman Trisolator at each pipe hanger rigging or clamp specified under Division 15 at vertical runs provide by Mason Type N mounts attached to pipe clamps specified under Division 21.

2.4 FLEXIBLE PIPING CONNECTIONS

- A. Provide elastomeric flexible piping connections between piping and vibrating equipment including but not limited to the inlets and outlets of pumps, cooling towers, coils and compressors. Alternately, provide appropriately sized metallic hoses as described below.
 - 1. Provide flexible piping connections to units listed above and similar at all connection points via flexible neoprene connectors consisting of multiple plies of nylon tire cord fabric and neoprene. Neoprene elements shall form at minimum a dual sphere muffler construction at each connection. Connectors up to and including 1-1/2" diameter may have threaded ends. Connectors 2" in diameter or larger shall be manufactured with floating metal flanges recessed to lock the connector's raised face neoprene flanges.
 - 2. Connectors shall be rated to suit system pressure with a minimum of 150 psi at 220 degree F. Flanged equipment shall be directly connected to neoprene elbows in the size range of 2-1/2" to 12" diameter if the piping makes a 90 degree turn at the equipment.

All straight through connections shall be made via twin sphere configuration per A above.

3. Provide steel restraint cables with fittings, nuts, steel washer, and acoustical washers where elongation would exceed manufacturer's limits at operating pressure. Elastomeric connectors shall have either tubular or spherical configuration as required or indicated. Spherical type straight connectors shall have two spheres. Elastomeric elbow connectors will not be acceptable.
- B. Acceptable subject to above:
1. Safeflex SFDEJ by Mason Industries, Inc.
 2. Type 242 by Proco.
 3. Style 2600 by Amber/Booth Company.
 4. Merflex Style 5500 TS by Mercer Rubber Company.
 5. Type VMT by Vibration Mounting & Controls.
- C. Provide metallic hoses at all piping crossing seismic joints in the building, sized appropriately to accommodate the seismic movement specified on the structural and/or architectural drawings.
1. Provide two each at every location where A applies above.
 2. Provide flexible connectors fabricated of Grade E phosphor bronze, monel or corrugated stainless steel tube covered with comparable bronze or stainless steel braid restraining and pressure cover. Stainless steel grades shall be 304, 316, or 321 as required for the application. Live lengths shall be as indicated, but not less than that recommended by the manufacturer for continuous vibration application.
 3. Acceptable:
 - a. Type BBS, SS or BBF by Mason Industries, Inc.
 - b. Type BBS, SS or BBF by Mercer Rubber Company.
 - c. Metal-Flex by Amber/Booth Company.
 - d. Stainless steel flexible connectors by DME, Inc.
 - e. Type MFP by Vibration Mountings & Controls, Inc.

2.5 RESILIENT PENETRATIONS

- A. For piping or ductwork, (Field Fabricated Method):
1. Sleeves: Sleeves of appropriate gage galvanized sheet metal shall be formed to at least the thickness of the penetrated construction and

3/4" to 1" larger in each cross-sectional dimension than the penetrating element.

- a. Acceptable:
 - (1) Century-Line Sleeves by Thunderline Corporation
 - (2) Custom by Contractor
2. Batt: Glass fiber of batt or mineral wool, 1 to 3 lb/cu ft density.
 - a. Acceptable Manufacturers
 - (1) Certain-Teed
 - (2) Johns Manville
 - (3) Owens-Corning
3. Acoustical Sealant:
 - a. Acceptable Manufacturers:
 - (1) DAP
 - (2) Pecora
 - (3) Tremco
 - (4) U.S. Gypsum
4. Firestop Sealant:
 - a. Where duct and piping penetrate sound isolation partitions or walls around mechanical rooms, the penetration shall have a maximum clearance of 3/4-inch on all sides and shall be packed with glass fiber and caulked airtight on both sides with acoustically rated sealant, or equal.

Acoustic sealant shall be fire rated to meet UL designs for applicable fire rated wall assemblies. For smoke or fire rated partitions see other Sections of this Division.
 - b. Fully hardened firestop caulk shall develop a Shore A hardness of no greater than 35.
 - c. Acceptable, subject to approval for intended application by Authorities Having Jurisdiction:
 - (1) G.E. Pensil 100 Firestop Sealant
 - (2) Tremco Fyre-Sil Silicone Fire-stop Construction Sealant

- B. For piping penetrations (Factory Fabricated Component Method):
1. A factory fabricated sleeve assembly with outer sleeve of sheet metal and inner resilient liner of moisture and vermin resisting felt neoprene, glass fiber or foam rubber 2 to 3/4" thick and bonded to the sheet metal sleeve. Sleeve inside diameter shall be equal to outside diameter of penetrating element. Sleeve length shall be at least equal to the thickness of the penetrated construction. Sleeve shall be set and caulked airtight in penetrated construction and clamped tightly around penetrating element.
 2. Acceptable:
 - a. Mason Type SWS
 - b. Peabody Type PS-1-D
 - c. Potter-Roemer PR-Isolator
 - d. Stoneman Engineering Trisolator
 3. Where required, a fire rated factory fabricated sleeve and inner resilient liner of solid rubber links may be substituted for the preceding when installed in strict accordance with the manufacturer's instructions.
 - a. Acceptable, subject to by Authorities Having Jurisdiction:
 - (1) Link Seal by ThunderLine Corp.

PART 3 – EXECUTION

3.1 INSTALLATION/APPLICATION/PERFORMANCE/ERECTION

- A. Seismic Restraint Systems: Maintain equipment, piping, ductwork in a captive position. Do not short circuit vibration systems or transmit objectionable vibration or noise. Structural bases shall be reinforced as required to prevent flexure, misalignment of drive and driven unit or stress transferal into equipment.
- B. Piping mounted on roof or floor slab: Attach all support points to roof structural member and provide seismic bracing of all piping at an interval of not more than 40 feet.

3.2 FIELD QUALITY CONTROL

- A. Testing and Inspection: See SECTION 014523.
 1. Special Inspections as defined in CBC Chapter 17, paragraph 1707.8.5, shall be provided as required.

- B. Testing of Concrete Anchors: Anchors drilled into concrete and which are to be loaded in tension (pull-out) will be proof-tested by the Owner to two times the maximum allowable load. 50% of all anchors will be proof-tested. In the event of a single failure, testing of all remaining anchors will be performed as directed by the Architect. Additional testing required because of a test failure shall be paid for by the Contractor.

3.3 INSPECTION OF CONDITIONS

- A. Examine related Work and surfaces before starting Work of this Section. Report to the Architect, in writing, conditions which will prevent proper provision of this work. Beginning the Work of this Section without reporting unsuitable conditions to the Architect constitutes acceptance of such conditions by Contractor. Perform any required removal, repair, or replacement of this Work caused by unsuitable conditions at no additional cost to the Owner.

3.4 GENERAL INSTALLATION REQUIREMENTS

- A. Stress: Installation or use of vibration isolators must not cause any change of position of equipment or piping which would result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, equipment and piping shall be maintained in a rigid position during installation. The load shall not be transferred to the isolator until the installation is complete and under full operational load.
- B. Prior Approval: The Contractor shall not install any equipment, duct or piping which makes rigid contact with the "building" unless it is approved in this specification or by the Architect. "Building" includes, but is not limited to slabs, beams, columns, walls, partitions, ceilings, studs, ceiling framing and suspension systems.
- C. Rigid Contact: Prior to installation, bring to the Architect's attention any conflicts between trades which will result in unavoidable rigid contact at equipment or piping or ducts, as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- D. Discrepancies: Prior to installation, the Contractor shall bring to the Architect's attention any discrepancies between the specifications and field conditions or changes required due to specific equipment selection. Corrective work necessitated by discrepancies after installation shall be at the Contractor's expense.
- E. Protection: Isolators exposed to the outdoors during construction shall either be designed for such exposure or shall be protected by suitable means.
- F. Access: The Contractor shall obtain inspection and approval from the Architect of any installation to be covered or enclosed, prior to such closure.

- G. Instructions: The Contractor shall obtain written instructions from the vibration isolation manufacturer as to the proper installation and adjustment of vibration isolation devices; alternatively, the equipment may be installed by the vibration isolation manufacturer.
- H. Defective Installations: Correct, at no additional cost to the Owner, all installations which are deemed defective in workmanship or materials by the Architect or Consultant.
- I. Component Importance Factors: The following equipment shall be procured and installed to meet the requirements of a Component Importance Factor of 1.5 as defined in ASCE 7-05 and CBC Chapters 16 and 17. All other equipment shall be furnished and the associated anchors/isolators designed to meet a Component Importance Factor of 1.0 as defined in ASCE 7-05 and CBC Chapters 16 and 17.

3.5 EQUIPMENT ISOLATORS

- A. Structural Frames: Machines to be isolated shall be supported by a structural steel frame, Type RS, or Type IRSF frames as described herein.
- B. Brackets: Brackets shall be provided as required to accommodate the isolator and provide a mechanical stop. The vertical position and size of the bracket shall be submitted by the isolator manufacturer.
- C. Clearance: Operating clearance between the bracket and the pad or floor shall be 3/8" 1/16". The minimum operating clearance between the frame and the housekeeping pad or floor shall be 1", for rigid steel and 2" for concrete inertia base.
- D. Support: Isolators shall be installed without raising the machine and frame assembly.
- E. Adjustment: After the entire system installation is completed and under full operation load, the isolator shall be adjusted so that the load is transferred from the shims to the isolator. When all isolators are properly adjusted, the shims should be barely free and shall be removed. Thereafter, the shims should be used as a gauge to check that the 3/8" clearance is maintained so that the system will remain free of stress.

3.6 INSTALLATION REQUIREMENTS, MOTION RESTRAINTS

- A. Inspection: All installations shall be inspected and approved by a Civil or Structural Engineer licensed in the Project jurisdiction for adequate motion restraint and to assure that such does not short-circuit vibration isolators during normal operation. Adjustments, as reasonably required, shall be made by the Contractor at no expense to the Owner. Such inspector shall be provided by the Contractor, and the Engineers shall certify the installation in writing.

3.7 PIPING RESILIENT SUPPORT AND SUSPENSION

- A. Applies: Pipes included under this Section of the Specifications are all pressurized water piping including that connected to vibrating equipment.
- B. Does Not Apply: Piping not included is compressed air and fire standpipe and sprinkler piping.
- C. Domestic Water: Domestic water piping not connected to vibrating equipment shall be resiliently supported by the products listed under Part 2, in accordance with the manufacturer's instructions.

3.8 INSTALLATION REQUIREMENTS, FLEXIBLE PIPING CONNECTIONS

- A. Application: Flexible piping connections shall be installed within 10 feet of all vibrating equipment, or prior to penetration of the building, whichever is shorter, on all piping connected to such equipment.
- B. Placement: Flexible piping connections shall be located such that their length is at right angles to the principal direction of movement and thus such that the movement of the equipment does not alternately place the connection into tension and compression.
- C. Length: Flexible piping connectors shall be installed in accordance with the manufacturer's recommended procedures and in lengths complying with Table 28, Chapter 52, ASHRAE 1995 Applications Handbook.
- D. Braided metal hose: Where permitted as a substitution, shall be installed in pairs, one in the vertical plane and one in the horizontal plane at each location that a single flexible piping connection is required in this section.

3.9 INSTALLATION REQUIREMENTS, RESILIENT PENETRATIONS

- A. Application: Penetrations included in this Section of the Specifications include all piping and ducts connected to vibrating equipment within 30 feet of such equipment.
- B. Alternate A for round penetrations:
 - 1. Cut a clean opening in the penetrated construction very nearly the size of the sleeve for each penetrating element. Provide lintels above, relief structure below and vertical framing between and to the sides, as required. Provide the above, escutcheon plates and such related construction as is necessary to make the penetrated structure as solid and massive near the penetrations as the surrounding construction.
 - 2. Set the metal sleeve into the penetrated construction in an airtight manner around its outer periphery, using grout, dry packing, plaster or drywall compound full depth and all around - but only to a maximum width of 2" - or the requirements of the above paragraph shall not have been satisfied.

3. Pack annular opening with glass fiber between metal sleeve and penetrating element full depth, all around to a firm degree of compaction. Leave a 2" deep annular opening free at each end of the metal sleeve; fill this fully with sealant.
- C. Alternate B for round penetrations: Observe requirements above, except that use of sealant at sleeve ends is not required. In lieu of sealant, clamp factory fabricated sleeve assemblies specified in Part 2 tightly around penetrating elements, using built-in or field supplied clamping devices. Apply clamping of sleeves to penetrating services before sealing of sleeves to penetrated constructions. Refer to manufacturer's instructions for installation of fire rated rubber link systems.

END OF SECTION

SECTION 22 0700

INSULATION

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Provide complete systems of insulation for piping, and equipment as specified.
- B. The intent of these Specifications is that all hot equipment, piping and other items noted be insulated. The Contractor shall carefully advise himself of the extent of all the factory insulated packaged equipment where piping and miscellaneous parts will be furnished without insulation. Provide insulation as required for all packaged equipment requiring insulation, whether furnished with equipment or not.
- C. Piping:
 - 1. From 105 degrees F to 140 degrees F: insulate piping and fittings except flanges, unions, and valves.
 - 2. Above 140 degrees F: insulate piping and fittings including flanges, unions, and valves, except stems and operators.
 - 3. Below 60 degrees F: Insulate domestic and industrial cold water piping in exterior walls & under roofs, and all condensate drain lines to prevent condensation.
- D. Non-insulated Piping:
 - 1. Vent, overflow, drain, and relief; except where noted otherwise.
- E. Non-insulated Equipment:
 - 1. N/A.
- F. Definitions:
 - 1. Finished Spaces: Habitation or occupancy spaces where surfaces are plastered, panelled, or otherwise treated to provide a pleasing appearance.
 - 2. Unfinished Spaces: Storage or work areas where appearance is not a factor; unexcavated spaces, crawl spaces, etc.
 - 3. Concealed Spaces: Spaces between a ceiling and floor construction above; between double walls or furred-in areas; pipe and duct shafts, etc.

4. Exposed: Open to view inside the building (including interstitial spaces). For example, pipe run through a room, and not covered by other construction, is exposed.
5. Outside or exterior: Open to view beyond the exterior side of walls; above the roof; unexcavated or crawl spaces, above or beneath pier floors; in tunnels or exposed on all sides in trenches connected or not connected to an exterior portion of a building.

1.2 QUALITY ASSURANCE

A. Reference Standards:

1. ASTM American Society for Testing and Materials.
 - a. B 209 Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. C 195 Mineral Fiber Thermal Insulating Cement.
 - c. C 449 Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - d. C 533 Calcium Silicate Block and Pipe Thermal Insulation.
 - e. C 547 Mineral Fiber Preformed Pipe Insulation.
 - f. C 553 Mineral Fiber Blanket and Felt Insulation (Industrial Type).
 - g. C 612 Mineral Fiber Block and Board Thermal Insulation.
2. CCR California Code of Regulations, Title 24
 - a. Part 6, California Energy Code.
 - b. Part 4, California Mechanical Code (CMC).
3. Federal Specifications (Fed. Spec.):
 - a. L-P-535E Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) and Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
 - b. L-T-80B Tape, Pressure-Sensitive Adhesive (Aluminum-Backed).
 - c. HH-B-100B Barrier Material Vapor (For Pipe, Duct and Equipment Thermal, Insulation).
 - d. HH-I-573B Insulation, Thermal, Flexible Unicellular Sheet and Pipe Covering.

4. UBC Uniform Building Code.
 - a. Standard 42-1 Test Method for Surface Burning Characteristics of Building Materials.
5. UL Underwriters Laboratory, Inc.

1.3 SUBMITTALS

- A. Product Data:
 1. Submit manufacturer's data on the following:
 - a. Insulation Materials.
 - b. Jackets and casings.
 - c. Adhesives.
 - d. Fastening Devices.
 - e. Vapor Barriers.
 - f. Material Safety Data Sheets (MSDS) shall be submitted for all insulation materials including adhesives, cements and finishing materials.
 - g. Proof of California Quality Standards Certification.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Manufacturer's Stamp or Label: Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to the project site for use must have the manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material. Insulation packages and containers shall be marked "asbestos-free."
- B. All insulation materials subject to regulation under CCR Title 24, Part 6, shall meet the requirements of Section 123 and 124, and Table 123-A, and shall be so certified. Submit proof of certification.
- C. Fire Resistance: Insulation, adhesives, vapor-barrier materials, and other accessories, except as specified herein, shall be noncombustible. Materials shall not have a flame-spread rating more than 25 and a smoke-developed rating not more than 50 in accordance with UBC Standard 42-1, except for flexible unicellular insulation which, in thickness greater than 1/2-inch, may have a smoke-developed rating not to exceed 100.

- D. Materials Tests: Test factory-applied materials assembled. Field-applied materials may be tested individually. UL label, or satisfactory certified test report from an approved testing laboratory, will be required to show that fire hazard ratings for materials proposed for use do not exceed those specified. Flame-proofing treatments subject to deterioration due to effects of moisture or high humidity are not acceptable.
- E. Piping Insulation:
1. Exterior surface of insulation shall be cleanable, grease resistant, nonflaking and nonpeeling. Pipe insulation shall conform with the referenced publications and the specified temperature ranges and densities in pounds per cubic foot (pcf). Insulation for fittings, flanges, and valves shall be premolded, precut, or job-fabricated insulation of the same thickness and conductivity as used on adjacent piping.
 2. Mineral Fiber: ASTM C 547, for temperature range of 0 to 850 degrees F., preformed, jacketed, vapor barrier, with double adhesive self-sealing lap. Owens-Corning ASJ/SSL-II, Certain-Teed, or equal.
 3. Flexible unicellular: Fed. Spec. HH-I-573B, for temperature range from -40 degrees to +180 degrees F.
 - a. Use for cold water piping and elsewhere where specified.
 - b. Minimum Density: 5.5 lbs./cu.ft.
 - c. Thermal Conductivity: 0.28 K factor at 75 degree F.
 - d. Rubatex, Armaflex, or equal.
 4. Fiberglass Duct Wrap: Fiberglass blanket with foil reinforced kraft (FRK) paper vapor barrier; 250 degrees F. maximum; 0.24 Btu/in/hr/sq.ft./degree F. at 75 degree F. mean temperature with 25% compression. Owens Corning Type ASW with FRK facing; Certain-Teed or equal.
 5. Flexible Mineral Fiber Blanket: ASTM C 553, Type I (flexible resilient), up to 1000 degrees F, 0.28 Btu/in/hr/sq.ft./degree F. at 100 degree F. mean temperature. Owens Corning TIW Type I; Certain-Teed or equal
 6. Rigid Mineral Fiber: ASTM C 612, board type, to 450 degrees F, 3 pcf, foil reinforced kraft facing or all-service jacket facing. Owens Corning Type 703 with FRK jacket; Certain-Teed or equal.
 7. Mineral Fiber Block: ASTM C 612, semi rigid, bonded fiberglass fibers, 850 degrees F. maximum; 3.0 pcf; 0.23 Btu/in/hr/sq.ft./degree F. at 75 degree F. mean temperature. Owens Corning Insul-Quick; Certain-Teed or equal.

F. Insulation Jackets:

1. Vapor Barrier Material: HH-B-100, Type I. Material shall be resistant to flame and moisture penetration and not support mold growth. Provide foil reinforced kraft facing in concealed locations. Provide vapor barrier material all service jacket on insulation in exposed locations with a white surface suitable for painting without sizing. Lamtec 70JASJ or approved equal.
2. Aluminum Jackets: ASTM B 209, Temper H14, 0.016 inch thick, smooth. Do not use on calcium silicate surfaces or surfaces above 200 degrees F operating temperature. Pabco-Childers Aluminum Roll Jacketing for straight piping and Pabco-Childers Sure-Fit for elbows, or approved equal. Secure in place with Childers Fabstraps, Pabco Pab-Bands, or approved equal.
3. Weatherproof: Aluminum jacket, ASTM B 209, minimum 0.016-inch thick, moisture barrier adhered to inside face. Fabricate and install jacketing with a continuous modified Pittsburgh Z-Lock on the longitudinal seam. Seal each butted section of jacketing with a butt strap containing high temperature sealant and secure with Childers Lock-On, Pabco Z-Lock, or approved equal.
4. PVC Jackets: (limited to indoor piping only). Fed. Spec. L-P-535, Composition A, Type II, Grade GU. One-piece premolded plastic covers for fittings, flanges, and valves. Zeston, Speedline, or approved equal.

G. Removable/Reuseable Insulation: Shall be one or two piece design with silicone coated fiberglass cloth liners, minimum of 1/2-inch thick fiberglass insulation, and a weather barrier of teflon coated fiberglass. Sewing thread shall be teflon coated fiberglass. Quilting pins shall be used to prevent shifting of insulation. Covers shall have rain flaps and straps with stainless steel double buckles or Velcro fasteners. Johnson Energy Products, Accessible Products Co., or approved equal.

H. Adhesives, Sealants, and Compounds: Shall be compatible with materials to which applied and suitable for the service. Shall comply with South Coast Air Quality Management District VOC regulations (SCAQMD Rule #1168, effective date of July 1, 2005, rule amendment date of January 7, 2005).

1. Vaporseal Adhesive: Spark-fas 85-20 or approved equal, U.L. Label
2. Lagging Adhesive: Fosters 30-36 or equal, U.L. Label
3. Insulation Cement: ASTM C 195, mineral fiber, thermal conductivity 0.85 max. at 200 degrees F mean when tested per ASTM C 177. Fibrex, Pabco, or approved equal.
4. Vapor Barrier Coating: Fosters Tite-fit 30-35, or approved equal, U.L. Label, (indoor only above 60 degrees F).

5. Adhesive for Flexible Unicellular insulation: Rubatex R-373, Armstrong 520 or approved equal.
- I. Accessories:
 1. Staples: Corrosion resistant outside clinch type. Bostitch, Duo-Fast or approved equal.
 2. Insulation Bands: $\frac{3}{4}$ -inch wide; 0.018-inch stainless steel or 0.020-inch aluminum. Band-It, Houdaille, or approved equal.
 3. Bands for Metal Jackets: $\frac{3}{8}$ -inch minimum width; 0.018-inch stainless steel or 0.020-inch aluminum. Pabco-Childers or approved equal.
 4. Wire: Minimum 16-gauge stainless steel or copper-clad annealed steel wire.
 5. Anchor Pins: Anchor pins, clips and speed washers; AGM Industries, Accessible Products, or approved equal.
 6. Glass Cloth and Tape: Childers No. 10, J.P. Stevens Glass-Tex, open weave, white color cloth; Childers VI-CRYL CP 10, Fosters Aquafas, Eco-Mastic 55-50, or approved equal, weatherproof Mastic.
 7. Aluminum Foil Backed Pressure Sensitive Adhesive Tape: Fed. Spec. L-T-80, 50 degrees F max. and limited to use on insulation with factory applied jacket with aluminum foil facing. Venture Tape, Compac Corp. or approved equal.
 8. Vapor Barrier Material Tape: Fed. Spec. HH-B-100, Type I, pressure sensitive adhesive backed, Lamtec 70JASJ, Ideal Tape Co. or equal.

PART 3 – EXECUTION

3.1 INSTALLATION/APPLICATION/ERECTOR

- A. General:
 1. During the installation and when putting insulated systems into service, the contractor shall observe all instructions, recommendations, and Cautions issued or published by the insulation materials manufacturers.
 2. Preparation: Do not apply insulation until surfaces to be covered have been leak tested, have had rust and scale removed, and have been cleaned, dried, and inspected.
 3. Application: Insulation shall be clean and dry when installed and kept dry during finish application. Wetted insulation will not be approved for installation. Install materials neatly with smooth and even surfaces with jackets drawn tight and smoothly cemented down on longitudinal and end laps. Scrap pieces shall not be used where a full-length

section will fit. All surface finishes shall be extended to protect all surfaces, ends, and raw edges of insulation. Coatings and adhesives shall be applied at the manufacturer's recommended coverage per gallon.

4. Name Plates and Access Plates: Do not insulate name plates or ASME labels. Bevel insulation around name plates and ASME stamps.
5. Calcium Silicate: Do not install on aluminum surfaces.

B. Piping:

1. Provide insulation of thickness specified for the applicable temperature and service in accordance with California Energy Code. Installed insulation thickness shall exceed required code thickness by 10% (minimum).
2. Pipe Insulation (Except Flexible Unicellular): Install with joints tightly butted. Overlap longitudinal jacket laps not less than 1-1/2 inches. Wrap butt joints with 3-inch wide strips of the same material as jacket. Cement jacket laps and butt strips with adhesive or bedding compound and joint sealer and additionally secure with flared staples on 4-inch centers outside clinched without complete penetration of insulation. A factory applied self-sealing system may be used without staples unless fishmouths develop.
3. Where vapor barrier jacket on piping with liquid of less than 60 deg F is stapled or punctured, the jacket shall be brush coated with vapor barrier coating. Adhesive is not required on hot piping jackets when staples are used.
4. Finish for Outdoor Locations: Weatherproof aluminum jacket.
5. Flanges, Unions, Valves, and Fittings: Except where Flexible Unicellular is applied, use pre-molded, precut, or job fabricated insulation of the same thickness and conductivity as used on adjacent piping. Provide fittings with one-piece insulation covers. When segments of insulation are used, provide elbows with not less than three segments. For other fittings and valves, cut segments to required curvature. Place and join the segments of the insulation with adhesive. After the segments are in place, apply vapor barrier coating. Cover unions and flanges with removable sections of insulation vapor barrier sealed inside and out with adjacent insulation ends neatly finished and vapor barrier sealed. Where unions, flanges, and valves are specified not to be insulated, terminate the covering neatly at the ends with insulation cement trowelled on a bevel. Apply a vapor barrier coating to the beveled ends.
6. Provide Removable/Reusable type insulation for strainers, expansion joints, fittings, valves, and accessories requiring servicing or inspection; or insulation removable and replaceable without damage, within two-piece, No. 18-gauge aluminum covers fastened with

cadmium-plated bolts and nuts. Removable covers for strainers may be applied to the strainer removal section only.

7. Flexible Unicellular Insulation: Temperature range minus 30 to plus 220 degrees F. Flexible unicellular insulation shall not be used in pipe chases and fire walls, nor penetrate fire walls. Use an adhesive recommended by insulation manufacturer and apply in accordance with manufacturer's published instructions. Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Vapor seal unicellular insulation to piping in accordance with manufacturer's instructions. Do not apply unicellular insulation in multiple layers.
 - a. All flexible connections in cold water piping shall be insulated with flexible unicellular insulation.
8. At Pipe Hangers:
 - a. Insulation protection saddles and shields are specified in SECTION 220500, "BASIC MATERIALS AND METHODS". Tape all butt joints where insulation butts against hanger shield. On hot piping, apply 3-inch wide canvas strip dipped in lagging adhesive over butt joints.
 - b. Embed no hangers in insulation.
 - (1) Match sizes of reinforcing and connecting angles. Verify sizes of angles in field: Minimum 1-inch thick.
 - (2) In General:
 - (a) To 42-Inches Wide: 1-inch.
 - (b) 43-Inches Wide and Over: 1-1/2-inches.

C. Equipment:

1. Insulate heating equipment and accessories above 105 degrees F. Insulate cold surfaces with operating temperatures below 60 degrees F.
2. Equipment Insulation:
 - a. Less than 850-degrees F.: Fiberglass board applied in accordance with manufacturer's instructions. All insulation edges and butt joints shall be sealed with pressure-sensitive joint sealing tape to match the jacket. Use 3-inch wide tape on flat surfaces, or where edges are shiplapped and stapled. 5-inch wide tape may be used in lieu of shiplapping.

- b. Apply equipment insulation to fit as closely as possible to equipment. Insulation shall be grooved or scored where necessary to fit the contours of equipment. Stagger end joints where possible. Secure the insulation with 16-gage stainless steel or copper-clad wire or with 3/4-inch wide 0.018-inch stainless steel, or 0.020-inch aluminum bands spaced on 12-inch centers. Bevel the edges of the insulation for cylindrical surfaces to provide tight joints. Fill joints, seams, chipped edges, or depressions with bedding compound to form a smooth surface. Seal joints with insulating cement and cover insulation with a coat of finishing cement. Insulation on equipment that must be opened periodically for inspection, cleaning, and repair shall be constructed so insulation can be removed and replaced without damage.
3. Cold Equipment - Flexible Unicellular Sheets:
 - a. Sheets shall be adhered with full adhesive coverage on curved or flat metal surfaces, using manufacturer's recommended adhesive. Seal all joints.
 - b. Apply tack coat of mastic to the exposed surface of the sheets. Embed white glass cloth fabric into wet coating, smoothing to avoid wrinkles. Overlap seams at least 2-inches. Apply a finish coat of mastic to the entire fabric surface. Finish to be applied not later than one hour after tack coat.
4. Equipment Insulation Thicknesses:
 - a. Mineral fiber block: 1-1/2 inch minimum.
 - b. Flexible unicellular: 3/4-inch.
 - c. The specified insulation thicknesses for equipment shall be increased where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface.
- D. Insulation Finish:
 1. Provide Fed. Spec. HH-B-100, Type I, vapor barrier covering for piping and ducts. Vapor barrier surfaces shall be suitable for painting.
 2. Hot and cold piping and Equipment:
 - a. Insulation exposed within the building shall be finished with a PVC jacket.
 - b. Provide Aluminum jacket at all insulated piping located 9' or less above the finished floor in mechanical rooms. Provide PVC jacket at all other insulated piping in mechanical rooms and indoor piping exposed to view.

- c. Cold Piping, and Equipment:
 - (1) Pipe, Fittings, flanges, elbows, and irregular surfaces shall be insulated the same as hot piping with special care taken to seal all joints including butts to ensure a continuous vapor barrier.
- d. Insulated piping exposed to weather shall be provided with weatherproof aluminum jacket; seamed to insulation with aluminum or stainless steel bands.

END OF SECTION

SECTION 22 1100

PLUMBING PIPE AND PIPE FITTINGS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. Work included in this Section: Materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:

1. Sanitary drainage and vent system piping.
2. Domestic and recycled water system piping.
3. Compressed air system piping.
4. Equipment drain piping.

1.2 APPLICABLE PUBLICATIONS: THE PUBLICATIONS LISTED BELOW FORM A PART OF THIS SPECIFICATION TO THE EXTENT REFERENCED. THE PUBLICATIONS ARE REFERRED TO IN THE TEXT BY THE BASIC DESIGNATION ONLY.

- A. American National Standards Institute (ANSI) Publications:

1. B16.5 Steel Pipe Flanges, Flanged Valves, and Fittings.
2. B16.9 Factory Made Wrought Steel Butt Welding Fittings
3. B16.11 Forged Steel Fittings, Socket Welding and Threaded
4. B16.12 Cast Iron Threaded Drainage Fitting
5. B16.18 Cast Bronze Solder Joint Pressure Fittings
6. B16.21 Nonmetallic Gaskets for Pipe Flanges
7. B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
8. B16.3 Malleable Iron Screwed Fittings
9. B18.2.1 Square and Hex bolts and Screws, including Hex Cap Screws and Lag Screws
10. B18.2.2 Square and Hex Nuts
11. B31.1 Power Piping

12. B31.9 Building Service Piping
 13. B40.1 Gages, Pressure, Indicating Dial Type, Elastic Element
- B. American Society for Testing and Materials (ASTM) Publications:
1. A 47 Malleable Iron Castings
 2. A 53 Pipe, Steel, Black and Seamless Steel Pipe
 3. A 74-82 Cast-Iron Soil Pipe and Fittings
 4. A 183 Carbon Steel Track Bolts and Nuts
 5. A 307 Carbon Steel External and Internally Threaded Standard Fasteners
 6. A 123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 7. A125-96(2001) Standard Specification for Steel Springs, Helical, Heat-Treated
 8. A 536 Ductile Iron Castings
 9. B 32 Solder Metal
 10. B 88 Seamless Copper Water Tube
 11. C 564 Rubber Gaskets for Cast-Iron Soil Pipe and Fittings
- C. American Society of Mechanical Engineers (ASME) Publications:
1. ASME Boiler and Pressure Vessel Code and Interpretations
 2. Section VIII - Pressure Vessels - Division 1
- D. American Welding Society Inc. (AWS) Publication:
1. A5.8-76 Brazing Filler Material
- E. Copper Development Association Inc. Publication:
1. Copper Tube Handbook
- F. Underwriters Laboratories Inc. (UL).
- G. Cast Iron Soil Pipe Institute Publications 301-78 and 310-78.
- H. National Bureau of Standards Voluntary Product Standard PS15.

1.3 QUALITY ASSURANCE

- A. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.
- B. Supply all equipment and accessories new and free from defects.
- C. Supply all equipment and accessories in compliance with the applicable standards listed in article 1.03 of this section and with all applicable national, state and local codes.
- D. All items of given type shall be the products of the same manufacturer.
- E. Welding materials and labor to conform to ASME code and applicable state Labor Regulations.
- F. Use fully qualified welders licensed by state authorities.
- G. Each length of pipe, fitting, trap, fixture or device used in any piping system shall be stamped or indelibly marked with:
 - 1. Weight or quality.
 - 2. Maker's name or mark.

1.4 SUBMITTALS

- A. Manufacturer's Literature and Data
 - 1. Piping and Fittings, Gaskets, Brazing and Soldering Metals, Piping Accessories, Shop Drawings and Catalog Cuts: Submit shop drawings and catalog information showing plan, elevations, dimensions, capacities.

PART 2 – PRODUCTS**2.1 CLASSES AND MAXIMUM WORKING PRESSURES**

- A. Equipment and piping components shall be suitable for use under the maximum working pressures indicated. Except as modified herein, the pressure temperature limitations shall be as specified in the referenced standards and specifications.

2.2 MATERIALS FOR PLUMBING PIPING

- A. Relief, Safety Valve, discharge
 - 1. Steel, Schedule 40, welded or screwed, ASTM A53 Grade B
- B. Equipment Drains and Overflow, Atmospheric Vent, Make-up Water
 - 1. Copper Type L, ASTM B88

- C. Mechanical Condensate Drains
 - 1. Sizes 1-1/4" and smaller: Copper Type L, ASTM B88
 - 2. Sizes 1-1/2" and larger: Copper Type DWV
- D. Drainage Systems
 - 1. Aboveground (inside building)
 - a. Sanitary waste and vent
 - (1) Hubless Cast Iron to CISPI 301
 - (2) Type DWV, hard temper, ASTM B-306
 - 2. Sanitary piping to meet requirements of National Sanitation Foundation standard 14.
- E. Domestic Water Piping, Industrial Water Piping
 - 1. Inside, above ground
 - a. Type L hard copper ASTM B 88
 - 2. Exposed at plumbing fixtures and all kitchen, fixtures and equipment
 - a. Chrome plated brass pipe
- F. Compressed Air
 - 1. Type L ASTM B88, hard copper
- G. Fire Protection
 - 1. Inside and underground:
 - a. Sch 40 steel to ASTM A53 or A135, grooved end, screwed or welded.

2.3 PIPING AND FITTINGS

- A. Pressure Piping
 - 1. Pressure piping shall be:
 - a. Ferrous and copper piping conform to requirements of ANSI Safety Code for Pressure Piping, B31.1.
 - b. Be commercially round and straight.
 - c. Be of uniform quality and workmanship.
 - d. Be free from all defects.

- e. Be identified.
- 2. Pressure ratings herein are "W.O.G." or "Water Working Pressure."
- 3. Black Steel, Welded: Schedule 40, ASTM A-53.
 - a. 2-1/2" and larger.
 - b. Steel welding fittings, ANSI B16.9. Shaped nipples and saddles not permitted.
 - c. Steel welding-neck flanges and flanged fittings, ANSI B16.5, 150 psi.
- 4. Black Steel, grooved end, ASTM A-53 1-1/4" and larger, grooved end fittings as hereinafter specified.
 - a. Roll-grooved - Schedule 40
 - b. Schedule 10 pipe shall not be used.
- 5. Copper Tubing:
 - a. ANSI H23.1.
 - b. Wrought-copper, solder joint fittings, ANSI B16.22, in sizes available.
 - c. Cast-bronze solder-joint fittings, ANSI B16.18, only in sizes not available in wrought copper.
 - d. Cast bronze, threaded, ground-joint unions, ANSI B16.18, 2" and smaller.
 - e. Cast-bronze, flanged unions, ANSI B16.24, 150 psi class, 2-1/2" and larger.
 - f. Copper tubing flared fittings: bronze castings for flared type joints, ANSI B-16.26.
 - g. VIRGA ProPress fittings: using the crimping of the fitting to secure connections to the pipe around both sides of the EPDM o-ring sealing gasket.
- 6. Brass:
 - a. Standard weight and red brass pipe, 85 percent copper, 15 percent zinc, ANSI H27.1.
 - b. 125 psi threaded brass fittings, ANSI B16.15

7. Grooved end piping
 - a. Couplings of painted malleable iron to ASTM A47 or ductile iron to ASTM A536.
 - b. Gaskets to be product of coupling manufacturer.
 - c. Gaskets to be elastomer conforming to ASTM D2000 EDPM to 200 degree F water.
- B. Drainage Piping:
 1. Cast Iron pipe and fittings with hubless joints to CISPI 310 or Factory Mutual Standard 1680, Class 1 as required below.
 2. FM 1680 Class 1 (Clamp-All or Anaco Husky) for waste piping above and below grade and vent piping below grade, stainless steel clamp for vent piping above grade.
 3. Copper Tubing:
 - a. ASTM B-306, Type DWV, hard temper.
 - b. Cast-bronze, solder-joint drainage fittings. ANSI B-16.23 or wrought copper ANSI B16.29.
- C. Fittings shall be long radius fittings, except fittings in vent piping may be short radius fittings. Minimum Size piping shall be 2 inches for buried piping and 1.5 inches for aboveground piping.
- D. Pipe Threads: ANSI B2.1.
- E. Flange Gaskets:
 1. Full faced or flat ring type to suit flange facings, selected from one of following materials:
 - a. Steel Piping Systems:
 - (1) Full face fluorinated elastomer.
 - (2) 1/16" thick.
 - b. Domestic Hot and Cold Water:
 - (1) Red rubber, ASTM D1330.
 - (2) 1/16" thick.
 - (3) Similar to Crane Style 555. Garlock 3000.
 - c. PVDF Piping Systems: EDPM

2. Gaskets coated with thread lubricant when being installed.
- F. Flange Bolts, Nuts and Washers:
 1. Plastic piping systems, pultruded FRP, ASTM D638 or 316 stainless steel.
 2. Steel piping, carbon steel conforming to ASTM A307, grade B, and material for nuts shall conform to ASTM A194, grade 2. Dimensions of bolts, studs, and nuts shall conform to ANSI B18.2.1 and ANSI B18.3.2 with threads conforming to ANSI B1.1 coarse type with class 2A fit for bolts and studs, and class 2B fit for nuts.
 3. Copper piping systems, bronze bolts.
- G. Unions:
 1. Steel piping 2-1/2" and smaller:
 - a. 250 psi: ground joint
 - b. Similar to Grinnell Fig. J-3, Watts 3004.
 2. Steel piping larger than 2-1/2": welding flanges.
 3. Copper Piping:
 - a. Similar to Nibco No. 733.
 4. Other systems to match piping.
- H. Dielectric flanges, waterways, and couplings.
 1. 2-1/2" and smaller:
 - a. 250 psi WOG conforming to ASTM F-492-77
 - b. Threaded ends, electro-zinc plated steel body with thermoplastic liner.
 - c. Similar to Victaulic "Clearflow".
 2. 3" and larger:
 - a. Flanged, 175 psi WOG. ANSI B16.42 (iron) and B16.24 (bronze).
 - b. Similar to Watts 3110. EPCO Model X.
 3. Dielectric unions shall not be used.

2.4 ESCUTCHEONS, FLASHINGS AND SLEEVES

- A. Escutcheons:
 - 1. Similar to Grinnell Fig. 2 for copper tubing.
 - 2. Similar to Grinnell Fig. 13 for steel pipe.
 - 3. Brushed chrome plated brass.
- B. Flashings for pipes through roofs:
 - 1. See Architectural drawings.
 - 2. Secure pipe below roof to prevent relative movement.
- C. Sleeves; of following types as required:

2.5 MINIMUM 22 GAUGE, GALVANIZED STEEL SLEEVES IF REMOVED ENTIRELY AFTER CONCRETE POUR. SHOCK ABSORBERS

- A. For Copper Piping:
 - 1. Brass body, with diaphragm or piston, pre-charged similar to Watts Series 15, "or approved equal".
 - 2. In domestic water system, bearing National Sanitation Foundation Seal.

2.6 FLEXIBLE COUPLINGS

- A. Provide flexible couplings at pump suctions and discharges. Use molded spherical or convoluted rubber couplings at flanged pump and braided hose at screwed pump connections.
- B. Molded-rubber covered, "Twin Sphere" type design, multi-layered cord fabric design suitable for working pressures ranging from negative ten psi to positive 50psi on continuous basis. Backing rings and other flange plates shall be of galvanized steel. For unrestrained applications provide stainless steel wire restraints.
- C. Metal Flexible Connectors: Provide flexible connectors fabricated of Grade E phosphor bronze, monel or corrugated stainless steel tube covered with comparable bronze or stainless steel braid restraining and pressure cover. Stainless steel grade shall be 304. Live lengths shall be as indicated, but not less than that recommended by the manufacturer for continuous vibration application.
- D. For flanged pumps, flex couplings to be installed outboard of pump supports.

2.7 EXPANSION JOINTS

- A. 304 or 321 stainless steel bellows type with stainless steel flow liner, carbon steel flanges, minimum 3" axial compression. Similar to Hyspan series 2500.

2.8 EXPANSION TANK

- A. Heavy duty replaceable butyl rubber bladder 135 PSIG rated, removable for inspection. Fabricated steel shell designed and constructed per ASME Section VIII, Division 1.
 - 1. Maximum operating temperature 240 degree F.

PART 3 – EXECUTION**3.1 INSTALLATION**

- A. Arrangement:
 - 1. piping is diagrammatically indicated. Install generally as shown.
 - 2. Do not scale Drawings for exact location of piping.
 - 3. Install piping to coordinate with other trades and accommodate field conditions.
 - 4. Piping arrangement unless otherwise noted:
 - a. Arrange piping neatly along walls.
 - b. In neat, horizontal groups.
 - c. Each group to be in one plane, in so far as possible.
 - d. Piping connections to equipment shall be arranged so that removal of equipment or components of equipment including tube withdrawal from chillers, pump casing, shaft seals and similar work can be accomplished with the least amount of disassembly or removal of the piping system. Piping connected to equipment with vibration isolators shall be provided with flexible connections conforming to vibration and sound isolation requirements of other Sections of this Division.
 - 5. Do not sleeve structural members without consent of Architect.
 - 6. Maintain minimum 1" clearance from adjacent work, including insulation, except as noted or approved.
 - 7. Install piping concealed above ceilings or in walls unless otherwise indicated.
 - 8. All steel pipe and fittings not insulated or wrapped to be cleaned.
- B. Expansion, Contraction and Bending:
 - 1. Install piping with provisions for expansion and contraction.
 - a. Provide expansion loops, offsets, swing joints, and/or expansion joints where indicated or otherwise required.

Nesting of grooved joint couplings for expansion provision not permitted.

2. Do not spring or force piping during installation.
 3. Do not bend piping without use of pipe bending machine.
- C. Sloping, Air Venting and Draining:
1. Sanitary and Rainwater Drainage Piping:
 - a. Slope horizontal sanitary drainage piping 1/4" per foot minimum, unless shown otherwise or approved by Owner.
 - b. Slope horizontal rainwater drainage piping 1/8" per foot minimum, unless shown otherwise or approved by Owner.
 - c. Make all changes in direction of drainage piping by use of 45-degree wyes, long turn tee wyes, long sweep quarter bends, sixth, eighth or sixteenth bends.
 - d. Short-turn sanitary tees permissible on horizontal to vertical where space conditions require.
 2. Provide drain valves and hose adaptors at all low points in piping on Domestic systems, other systems provide drain valves and hose adaptors at system low point and at equipment connections.
- D. Strainers:
1. Provide strainers in pumps. Strainer shall be located close to equipment it is intended to protect. Strainers shall have isolating service valves to permit servicing the strainer with minimum loss of fluid. Provide clearance for removal and replacing of strainer screens.
- E. Valves:
1. Install at equipment to allow maintenance or isolation, and to establish proper and sequential operation of the complete system.
- F. Piping Specialties:
1. Locate and orient thermometers and gauges to permit observation by personnel standing on floor.
 2. Provide instrument cocks at pressure gauges.
 3. Provide straight runs of piping upstream and downstream from flow meters as recommended by manufacturer.

G. Grooved Couplings:

1. Where grooved couplings occur at a frequency greater than 4 joints in 10 feet use rigid style.
2. See other Sections of this Division for support requirements.

H. Copper:

1. Crimping of copper tubing, piping or fittings is prohibited.
2. Isolate copper pipe and tubing from contact with steel.
3. For branch drops and rises to plumbing fixtures, anchor branch to wall with drop-ear ell or tee.
4. On exposed piping wipe clean all solder joints.

I. Care of Floors:

1. Do not set pipe vises or threading machines on any unprotected concrete floors.
2. Cover floor when making plumbing connections to avoid staining floors with oil, white or red lead or other substances.
3. Contractor shall bear cost of removing any stains.

3.2 SYSTEMS INSTALLATION**A. Domestic Water:**

1. Connect copper tubing to fixtures with hard brass fittings.
2. Chrome plated where exposed at fixtures.
 - a. Prevent damage to chrome-plated surfaces.

B. Waste, Vent

1. Provide accessible cleanouts:
 - a. 100 feet on center, maximum, for soil and waste piping.
 - b. 100 feet on center, maximum, for storm water piping.
2. Install cleanouts accessible.
3. Install grade cleanouts in 16" x 16" x 4" thick concrete block.
 - a. Slope top of concrete down to edges.
 - b. 45 degree bevel top corner edges.

- C. Fire Protection:
 - 1. See Section 15300, Automatic Fire Protection System.
- D. Threaded Joints for steel, copper pipes.
 - 1. Sealed with sealant compounds or teflon tape.
 - 2. Sealant compounds:
 - a. General Service: John Crane JC-40, Permatex "Blue", "or equal".
 - b. Fuel gas, refrigerant: John Crane No. 2 Plastic Lead Seal "or equal".
- E. Welded Joints:
 - 1. In addition to requirements of Section 15050, welding of pressure piping shall be done by welders who have been qualified by recognized agency within 6 months prior to date of Contract.
 - a. Perform welding in accordance with provisions of latest issue of all applicable codes including:
 - (1) ASME Boiler Construction Code
 - (2) ANSI Code for Pressure Piping
 - b. Standard Procedure Specifications of, and operators qualified by National Certified Pipe Welding Bureau will be considered as compliance with requirements of Specifications.
 - 2. Where required, peen and wheel-grind welds.
 - 3. Ends of pipe may be burned for welding:
 - a. Grind bevel and remove scale between welding joint.
 - b. Ragged edges with metal beads, poor alignment other inferior work will be rejected.
 - 4. Perform welding with oxyacetylene or electric arc process.
 - 5. Welded Branches:
 - a. Welded branch connections not permitted with schedule 10 pipe.
 - b. Where welded branches have intersecting center lines provide stress calculations per ASME B31.1.

F. Soldered and Brazed Joints:

1. Use 95-5, tin-antimony for domestic water, solder for other copper piping. Use flux meeting ASTM B813 requirements. Assemble solder joints in accordance with ASTM B828.
2. Brazing filler material BCuP-3 or BCuP-4 to AWS A5.8 during brazing of the pipe connections, the interior of the pipe shall be purged continuously with dry nitrogen. Use a flow meter and regulator to control flow rates.
3. Clean surfaces to be jointed, of oil, grease, rust and oxides.
 - a. Remove grease form fittings by washing in solution of 1/16 sodium carbonate and three gallons hot water.
 - b. Clean socket of fitting and end of pipe thoroughly with emery cloth to remove rust and oxides.

3.3 ADJUSTMENT AND CLEANING

A. General:

1. During construction:
 - a. Keep openings in piping closed to prevent entrance of foreign matter.
 - b. Clean pipe, fittings and valves internally.
 - c. Hammer welds to remove slag and weld beads.

3.4 DISINFECTION OF WATER SYSTEMS:

A. After domestic water systems have been installed and tested, all piping shall be sterilized by the following method:

1. Inject a solution of chlorine gas and water containing not less than 50-ppm of free chlorine into the system, in such a manner as to ensure that the entire system is completely filled with the solution. During this procedure all valves shall be operated and outlets shall be tested for residual chlorine. Continue injection until all outlets indicate at least 50-ppm of free chlorine.
2. After injection, isolate the system and hold solution in retention, for a period of not less than 24-hours. Make tests for residual chlorine after retention. If such tests indicate less than 50-ppm of residual chlorine, repeat the entire procedure. After satisfactory sterilization has been effected, flush the system with water from any acceptable source, until all traces of chlorine have been removed or until the chlorine content is not greater than that in the existing supply.

- B. Until sterilization of the water system has been made, the Contractor shall maintain signs at all outlet locations stating that the water system has not been sterilized and the water shall not be used for human consumption.
- C. Prior to filing of Notice of Completion, submit a certificate of sterilization/chlorination, together with bacteriological reports, stating the work has been done in accordance with the requirements set forth above.

3.5 FIELD QUALITY CONTROL

- A. General Tests:
 - 1. Less than 100 psi operating pressure lines.
 - a. Test hydrostatically to 150 psi.
 - b. Plumbing waste and vent test as Section
 - 2. Over 100 psi operating pressure:
 - a. Test hydrostatically to 1-1/2 times operating pressure.
 - b. Never exceed test pressure ANSI B16.1 basis.
 - 3. Duration: 2 hours.
 - a. With system valves capped and pressure apparatus disconnected.
 - (1) Pressure change: none
 - (2) Compensate for temperature change.
 - 4. Leaks and defects:
 - a. Repair or replace as directed.
 - b. Without additional cost.
 - 5. Test concealed piping prior to concealment.
 - 6. Refer to other section for tests to plumbing systems and other special piping systems.
 - 7. Notify Architect and Owners inspector in writing one week before test.
 - 8. Furnish written report and certification that tests have been satisfactorily completed.

9. It is the Contractor's responsibility to plan for the testing procedure and to provide all necessary plugs, flanges and fittings, or to temporarily cap pipes to perform the tests.

END OF SECTION

SECTION 22 3000

PLUMBING SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Provide:
 - 1. Complete sanitary waste and vent systems.
 - 2. Complete domestic hot and cold water systems.
 - 3. Plumbing and drainage fixtures and trim.
 - 4. Connect to existing systems where shown.
- B. Plumbing systems including fixtures, equipment, materials, installation, and workmanship shall be as described herein and as required by applicable codes. Piping shall include all water, sanitary, and drainage piping buried and above ground from the building to five (5) feet outside of the building walls, unless otherwise shown on the drawings. Buried piping includes piping up to but not more than 6 inches above ground or floor slab on grade.
 - 1. The work also includes providing roughing in and making final plumbing connections to equipment furnished under other sections of this specification. See Equipment Connection Schedule on the drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

- A. SECTION 221100: PLUMBING PIPE AND PIPE FITTINGS.
- B. SECTION 220548: NOISE, VIBRATION AND SEISMIC CONTROL.
- C. SECTION 220593: TESTS AND BALANCING.

1.3 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: All Work in accordance with the California Plumbing Code and local codes.
- B. Applicator (Erector) Qualifications:
 - 1. Sterilization shall be accomplished by a firm which is thoroughly familiar with statutes and procedures required by regulatory bodies in the area, possesses the necessary sterilization/chlorination equipment, and has chemical laboratory facilities capable of rendering bacteriological examinations and reports.

2. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture. Supply all equipment and accessories new, free from defects. All items of a given type shall be the product of the same manufacturer.
- C. In all cases where FS, CS, ANSI, NSF, or other standards are shown specified or required, products shall meet or exceed the standards established for material, quality, manufacture, and performance.
- D. As required by the California Health and Safety Code Section 116875, all piping, fittings, and fixture faucets intended to convey or dispense water for human consumption through drinking or cooking shall be lead free, except for main gate valves 2" and larger. "Lead free" shall mean not more than 0.2 percent lead when used with respect to solder and flux and not more than a weighted average of 0.25 percent when used with respect to the wetted surfaces of pipes and pipe fittings, and plumbing fittings and fixtures. All pipe, pipe or plumbing fittings or fixtures, solder, or flux shall be certified by an independent American National Standards Institute (ANSI) accredited third party, including, but not limited to, NSF International, as being in compliance with this section.
- E. Referenced Standards:
1. California Health and Safety Code Section 116875 (Lead-Free Products)
 2. ANSI American National Standards Institute.
 3. ASSE American Society of Sanitary Engineers.
 4. CCR California Code of Regulations, Title 24, Building Standards Code
 5. CS Commercial Standards, Commodity Standards Division, U.S. Department of Commerce.
 6. FM Factory Mutual System
 7. FS Federal Supply Service, Standards Division, General Services Administration.
 8. IAPMO International Association of Plumbing and Mechanical Officials.
 9. NSF National Sanitation Foundation.
- F. APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Unless otherwise indicated the latest issue shall apply.
1. American National Standards Institute (ANSI) Publications:

- | | | |
|----|---|--|
| a. | A112.6.1M
for Public Use | Supports for Off-the-Floor Plumbing Fixtures |
| b. | A112.19.1M | Enameled Cast Iron Plumbing Fixtures |
| c. | A112.19.2M | Vitreous China Plumbing Fixtures |
| d. | A112.19.4M
Fixtures | Porcelain Enameled Formed Steel Plumbing |
| e. | A112.19.5
Urinals | Trim for Water-Closet Bowls, Tanks, and |
| f. | A112.21.1M | Floor Drains |
| g. | A112.36.2M | Metallic Cleanouts |
| h. | B16.1-89 | Cast-iron Pipe Flanges and Flanged Fittings |
| i. | B16.3-92 | Malleable Iron Threaded Fittings |
| j. | B16.12-91 | Cast-iron Threaded Drainage Fittings |
| k. | B16.18-84
Fittings | Cast Copper Alloy Solder Joint Pressure |
| l. | B16.22-95
Joint | Wrought Copper and Copper Alloy Solder
Pressure Fittings |
| m. | B16.39-86 | Malleable Iron Threaded Pipe Unions |
| n. | B40.1-2000
Elastic | Gages, Pressure, Indicating Dial Type,
Element |
| 2. | American Society for Testing and Materials (ASTM) Publications: | |
| a. | A 47/47M-99 | Malleable Iron Castings |
| b. | A 53/53M-02
Coated | Pipe, Steel, Black and Hot Dipped, Zinc
Welded and Seamless |
| c. | A 74-03b | Cast-iron Soil Pipe and Fittings |
| d. | A 121-99
Coated
Ordinary Uses | Pipe, Steel, Black and Hot Dipped Zinc
(Galvanized) Welded and Seamless for |
| e. | A 183-03 | Carbon Steel Track Bolts and Nuts |
| f. | A 536-84 | Ductile Iron Castings |
| g. | B 32-03 | Solder Metal |
| h. | B 88-02 | Seamless Copper Water Tube |

- i. C 564-03 Rubber Gaskets for Cast-iron Soil Pipe and Fittings
- 3. American Society of Sanitary Engineers (ASSE) Publications:
 - a. 1010-98 Water Hammer Arrestors
- 4. American Water Works Association (AWWA) Publications:
 - a. C651-99 Disinfecting Water Mains
- 5. Cast-iron Soil Pipe Institute (CISPI) Publications:
 - a. 301-97 Cast-iron Soil Pipe and Fittings for Hubless Cast-iron Sanitary System
 - b. 310-97 Patented Joint for use in Connection with Hubless Cast-iron Sanitary System

1.4 SUBMITTALS

- A. Shop Drawings and Product Data:
 - 1. Descriptive Data:
 - a. Plumbing Fixtures.
 - b. Plumbing supply fixtures.
 - c. Pipe and fittings
 - d. Drains
 - e. Water hammer arrestors
 - f. Backflow preventers
 - g. Fixture supports.
 - 2. Certificate of Sterilization/Chlorination of Domestic Water System.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Drains: Zurn, Smith or Josam, as shown and scheduled.
- B. Cleanouts: Zurn, J.R. Smith, or Josam.
- C. Flush Valves: Zurn, Sloan or equal.
- D. Seats: Olsonite, American Standard, Kohler, Church or Beneke.
- E. Supplies: Chicago, BrassCraft Speedway, or equal.

- F. Stops: Chicago, BrassCraft Speedway, or equal.
- G. Fixture Traps: IAPMO or CSA listed. TWI, McGuire, or equal.
- H. Fixture Supports: Zurn, J.R. Smith, or equal, or as Scheduled.
- I. "P" Traps:
 - 1. Cast Iron: AB&I, Tyler, or equal.
 - 2. Each trap shall be self-cleaning. Where cast iron traps are not used, traps shall be 17 gauge cast brass. Each trap shall have the manufacturer's name and gauge of the tubing stamped legibly in the metal of the trap. Every trap shall have a smooth and uniform interior waterway.
 - 3. The traps manufacturer shall be able to demonstrate to the Authority Having Jurisdiction that it meets these requirements as well as any other pertinent requirements of Chapter 10 of the California Plumbing Code.
- J. Fixtures:
 - 1. Fixtures and trim shall be complete for proper installation as described in the manufacturer's catalog with the modifications as indicated on the Plumbing Fixture Schedule.
 - 2. All fixtures, specified to be of vitreous ware, shall be fired vitreous chinaware of the best quality, non-absorbent and burned so that the whole mass is thoroughly fused and vitrified producing a material white in color, which when fractured will show a homogeneous mass, close-grained and free from pores. The glazed and vitreous china fixtures shall be white, thoroughly fused and united to the body, without discoloration, chips, or flaws and shall be free from cracks. Warped or otherwise imperfect fixtures will not be acceptable.
 - 3. Unless otherwise specified, water closets shall have a waste passage to pass a 2-1/2 inch ball minimum.
 - 4. Unless otherwise specified, enameled ware shall be white cast iron with acid-resisting enamel.
 - 5. Fixtures shall be free from imperfections, true as to line, angles, curves, and color; smooth, watertight, and practically noiseless in operation.
 - 6. Fixture trim and exposed metal items including piping shall be polished chrome-plated, unless otherwise noted, and pipes passing through walls have polished chrome-plated escutcheon plates.
 - 7. Provide fixtures with:
 - a. Faucets with renewable seats or replaceable internal units.

- b. Composition washers.
- K. Refer to other Sections of this Division for:
 - 1. Dielectric Unions, couplings or flanges.
 - 2. Strainers.
 - 3. Vacuum Breakers.
 - 4. Backflow Preventers.
 - 5. Pipe Hanger Shields.
 - 6. Air Vents.
 - 7. Pipe Sleeves.
 - 8. Escutcheons.
 - 9. Shock Absorbers.
- L. Piping Isolators: Stoneman Engineering Trisolators, Unistrut Unicushion, or equal.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to other Sections of this Division for Trenching and backfill:
- B. Sanitary Drainage Piping:
 - 1. Slope horizontal sanitary drainage piping 1/4-inch per foot minimum.
 - 2. Make all changes in direction of drainage piping by use of 45-degree wyes, long turn tee wyes, long sweep quarter bends, sixth, eighth or sixteenth bends.
 - 3. Short-turn sanitary tees permissible on horizontal to vertical where space conditions require.
 - 4. All drainage joints occurring above Hospital Surgeries, Recovery, Nurseries, ICU, CCU and other areas listed in Section 310(h), Part 5, Title 24, CCR shall be made with couplings complying with FM Standard 1680 - Class I.
- C. Installation of Cleanouts:
 - 1. General: Install cleanouts where required by local code or code authority and where shown. Install cleanouts in accessible locations and in no case more than 50-feet apart. Provide threaded bronze or thermoplastic cleanout plugs; install with teflon thread tape.

2. Floor Cleanouts: Provide cast-iron floor cleanout with [anchor] flange, polished bronze or nickel bronze rim and scoriated floor plate with CO cast in the plate. Secure floor plate with countersunk screws for installation flush with finished floor.
3. Wall Cleanouts: Provide polished stainless steel or chromium- plated bronze frame and cover plate.
4. Cleanouts Exterior to Buildings: Provide cast-iron cleanouts and countersunk plugs. Provide 24- by 24- by 4-inch thick concrete slab with top 1.0 inch above grade with cleanout located in center of slab. Provide cast-iron cleanout box with cover.

D. Installation of Floor Drains:

1. Provide sanitary floor drains and floor sinks with cast iron "P" traps.
2. Set floor drains flush with finished floors.
3. Vent all floor drains and floor sink systems.
4. Provide cast-iron body with white lab resisting porcelain enameled or epoxy interior, double drainage flange, nickel bronze rim and slotted grate, removable stainless steel or aluminum slotted buckets. Set floor sinks as required by code.
5. Provide drains with clamping rings where a membrane or drain pan is used.

E. Domestic Water:

1. Piping:
 - a. Free of traps.
 - b. Grade piping and provide valves for complete control and drainage of system with drain cocks at low points and base of risers.

F. Plumbing and Drainage Fixtures:

1. Prevention of Water Contamination: Water-supply connections to plumbing fixtures and equipment shall be over-rim or protected by vacuum breakers and/or check valves or backflow preventers as indicated or required. All hose connections shall be so protected.
2. Connections to equipment:
 - a. Flanges or unions.
 - b. Threaded adaptors used for swing connections.

- c. Terminate plugged or capped connections with threaded plug or threaded nipple and cap as required.
- 3. Install fixtures in accordance with fixture manufacturer's recommendations.
 - a. Set fixtures level and equally spaced when installed in bank of more than two (2).
 - b. Rough-in supplies level, equally spaced and symmetrical with the fixture.
 - c. Rough-in wastes in alignment with the fixture drain. Offsetting trap and waste will not be acceptable, unless specifically approved in writing on a case-by-case basis by the Architect. Install flush valves level with flush connections vertically. Offsetting and misalignment will not be acceptable.
 - d. Caulk all deck mounted trim at the time of assembly, including fixture and casework mounted. Caulk all self-rimming sinks installed in casework. The butted space between fixtures and the wall, counter, or floor on which they are mounted shall be sealed with white acrylic plastic compound.
 - e. Exposed fixture fastening nuts and bolts shall be covered with china bolt caps filled with putty.
 - f. Makeup trim with care and with the proper tools in order that no tool marks show after installation.
- 4. Water Supplies:
 - a. The general layout of piping on the drawings indicates branch runouts terminated at individual or groups of fixtures. The piping shall be considered continuous and finally connected to all fixtures and equipment.
 - b. Each water supply to a fixture, equipment or faucet shall have a stop in the branch connecting thereto. The stop shall be loose key partition stop at finished wall locations and a rough brass globe valve at rough location. Angle stops for deck mounted faucets shall have an IPS inlet.
 - c. At handicapped toilets the flush valve operating handle shall be installed on the side having the largest clearance.
 - d. Provide water hammer arrestors in the supply line to each fixture or group of two or more fixtures using flush valves or quick-acting valves. Unless otherwise indicated, locate and size the shock absorber in accordance with the manufacturer's recommendations and instructions. Install sectional valve upstream of water hammer arrestor, and provide access for replacement.

- e. Water supplies to other fixtures (except drinking fountains and lavatories faucets with flow rates less than 0.6 GPM) shall be fitted with ANSI /ASSE 1010-2004 listed maintenance-free water hammer arrestor (similar to PPP part number SWA). No access for replacement shall be required.
 - f. Water supplies to fixtures shall be minimum 1/2-inch size.
 - g. Cover unoccupied fixture faucet holes with faucet hole covers.
 - h. Securely fasten screwed adaptor fittings behind water supply stubouts to the structure.
 - i. Fixture trim, faucets and shower heads shall be certified in accordance with CCR Title 24, Section 2-5314.
5. Mounting supports: Unless otherwise shown or scheduled, bracket all wall mounted fixtures to 12-gauge steel plates, fastened to face of steel studs, with metal screws, and with bracket screwed to backing or as otherwise indicated on Architectural drawings.

3.2 DISINFECTION OF WATER SYSTEMS:

- A. After domestic water systems have been installed and tested, all piping shall be sterilized by the following method:
 - 1. Inject a solution of chlorine gas and water containing not less than 50-ppm of free chlorine into the system, in such a manner as to ensure that the entire system is completely filled with the solution. During this procedure all valves shall be operated and outlets shall be tested for residual chlorine. Continue injection until all outlets indicate at least 50-ppm of free chlorine.
 - 2. After injection, isolate the system and hold solution in retention, for a period of not less than 24-hours. Make tests for residual chlorine after retention. If such tests indicate less than 50-ppm of residual chlorine, repeat the entire procedure. After satisfactory sterilization has been effected, flush the system with water from any acceptable source, until all traces of chlorine have been removed or until the chlorine content is not greater than that in the existing supply.
- B. Until sterilization of the water system has been made, the Contractor shall maintain signs at all outlet locations stating that the water system has not been sterilized and the water shall not be used for human consumption.
- C. Prior to filing of Notice of Completion, submit a certificate of sterilization/chlorination, together with bacteriological reports, stating the work has been done in accordance with the requirements set forth above.

END OF SECTION

SECTION 23 0100

GENERAL REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Comply with the requirements of DIVISION 1.
- B. The requirements of this SECTION apply to all work of this DIVISION.
- C. 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 the Contract Amount.

1.2 QUALITY ASSURANCE

- A. Related Work Specified Elsewhere:
 - 1. Refer to DIVISION 26 for all electrical wiring (except that specifically indicated on Control Drawings) for motor starters (except pre-wired packaged systems, in which case they must conform to DIVISION 26).
- B. Examination of the Site:
 - 1. Visit the site prior to bidding. Take measurements and such other information as to locations, depths, capacities and sizes of existing piping and ductwork to which connections may be made or which may be abandoned or which require rerouting. If any of the above requires extra work due to discrepancies or omissions on the drawings, and if such omissions or discrepancies have been revealed by examination before bidding, the Contractor should report the discrepancy to the Architect a minimum of three days prior to receipt of bids. If additional work is required due to omissions and discrepancies after the contract for the work is signed and if such omissions or discrepancies would have been revealed by a visit to the site before receipt of bids, then the corrective additional work shall be performed at no additional cost to the Owner.
- C. Requirements of Regulatory Agencies:
 - 1. Standards Compliance: When materials or equipment must conform to the standards of organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), American Society of Mechanical Engineers (ASME), American Gas Association (AGA), American Refrigeration Institute (ARI), and Underwriters' Laboratories (UL), proof of such conformance shall be submitted to the Architect for approval.

If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization, which is competent to perform acceptable testing and is approved by the Architect. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.

2. Any specific reference in these Specifications to codes, rules, regulations, standards, manufacturer's instructions or requirements of regulatory agencies shall mean the latest printed edition of each in effect at date of submission of Bid, unless the Document is shown dated.
3. Perform the work in conformance with the applicable requirements of all regulatory agencies, including, but not limited to the following:
 - a. National Electrical Code.
 - b. Uniform Plumbing Code.
 - c. International Building Code
 - d. California Code of Regulations (CCR).
 - (1) Title 8, Division 1, Chapter 3.2 - California Occupational Safety and Health Regulations (CAL/OSHA).
 - (2) Title 8, Division 1, Chapter 4 - Safety Orders.
 - (3) Title 24, Building Standards.
 - (a) Part 2 - California Building Code
 - (b) Part 3 - California Electrical Code
 - (c) Part 4 - California Mechanical Code
 - (d) Part 5 - California Plumbing Code
 - (e) Part 6 - California Energy Code
 - (f) Part 9 - California Fire Code
 - (4) Acceptance Requirements of California Energy Code: Perform work necessary to complete the Acceptance Requirements of the California Energy Code, including but not limited to:
 - (a) Testing of minimum ventilation controls, zone temperature and scheduling controls, duct leakage, Air-side economizer controls, demand control ventilation systems and fan volume controls.

- (b) Reviewing plans and specifications to ensure conform to the Acceptance Requirements
 - (c) Perform construction inspection prior to testing to ensure that the equipment installed is capable of complying with the requirements of the Standards, the equipment is installed correctly and calibrated.
 - (d) Undertake all required Acceptance Requirement procedures and identify all performance deficiencies, ensuring that they are corrected. Document the results of the Acceptance Requirement procedures on the Acceptance Test forms and indicate satisfactory completion by signing the Certificate of Acceptance.
- 4. Nothing in the Drawings or Specifications shall be construed to permit Work not conforming to applicable laws, ordinances, rules, regulations.
- 5. When Drawings or Specifications exceed requirements of applicable laws, ordinances, rules, regulations, Drawings and Specifications take precedence.
- 6. It is not the intent of Drawings or Specifications to repeat requirements of codes except where necessary for completeness or clarity.
- 7. Work herein shall comply with all applicable requirements of CCR Title 8, Division 1, as they apply to this project, both in reference to Contractor's operations in performing his work and also in construction result to be accomplished. Where an omission or a conflict appears between OSHA requirements and the Drawings and Specifications, OSHA requirements shall take precedence.
- D. When there is an ambiguity or discrepancy between Drawings and Specifications the more stringent requirement of the two shall be provided.
- E. Licenses, Permits and Fees
 - 1. Provide, procure and pay for all permits, licenses, fees, etc., required to carry on and complete the Mechanical Work. Contact all applicable utility authorities and include in bid all fees, charged by any such authorities.
- F. Operating and Maintenance Instruction:
 - 1. Furnish the services of competent instructors who will give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the equipment or system specified. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The number of man days (8 hours) of instruction furnished shall be 2.

1.3 SUBMITTALS

A. General

1. Submit shop drawings, catalog data, supplemental data, for all materials, equipment in all Sections of this DIVISION in accordance with the requirements of SECTION 013323, "SHOP DRAWINGS, PRODUCT DATA AND SAMPLES," and as specified hereinafter.
2. Four weeks after award of the Contract, or earlier if deemed appropriate by the Architect, submit a schedule of all submittals with the date of each equipment submittal or shop drawing submittal clearly indicated.
3. Forward all submittals to Architect, together, at one time. Individual or incomplete submittals are not acceptable. Six (6) copies are required. Electronic copies of submittals shall be appropriately bookmarked, annotated and organized, as described below for paper submittals, for clarity so that the submitted items can be easily compared to the corresponding specified item.
4. Submittals shall have been reviewed and stamped by the General Contractor in accordance with the requirements of the GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION. Submittals not so stamped will be returned without review.
5. The contractor shall allow for adequate time for submittal review by the engineer. In general, the contractor shall allow for a minimum of 15 working days from the day the general contractor sends the submittal to the architect to the day the architect returns the submittal to the general contractor. Additional time shall be allowed for large or complex submittals.
6. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment. Words "as specified" are not sufficient identification.
7. Identify each submittal item by reference to Specification SECTION Paragraph in which item is specified or drawing and detail number.
8. Organize submittals in same sequence as they appear in specification sections, articles, or paragraphs.
9. Submit signed Acceptance Test forms indicating completion of California Energy Code Acceptance Test requirements.

B. Electronic Submittals: Electronic submittals is the preferred method of review. Follow these procedures:

1. Provide one pdf file for each submittal. PDF file must be unlocked, editable and printable to accommodate electronic mark-ups or printing a hard copy from markup.

2. Electronic submittals are to be complete and self-contained with each item requiring Architect's action highlighted.
3. Web links or other electronic submittals requiring the Architect to surf websites or navigate to find documents on websites or posting services are not acceptable.
4. The use of construction phase file hosting services or programs such as BIM 360 or Prolog or Primavera may not be used before prior approval from the Architect.
5. Any electronic submittal procedures should not require the Architect to search for submittals but should follow procedures that are the electronic equivalent of hard copy submittals sent by Contractor to the Architect in a manner acceptable to the Architect including indexing requirements mentioned below.
6. No electronic submittals for samples (if needed) will be permitted.
7. Architect will return one marked up electronic submittal for Contractor to process and distribute to subcontractors and for Owner according to agreed procedure.
8. On each electronic submittal, provide Contractor review and approval stamp.

C. Indexing:

1. Submittals shall be indexed according to specification DIVISION and SECTION number and paragraph to identify each item. Sporadic submittals, incomplete data, or unidentified data, or data not showing features to coordinate item with other work will not be accepted.

D. Submittal literature, Drawings and wiring diagrams shall be specifically applicable to this project and shall not contain extraneous material. The literature shall be clearly marked to indicate the proposed item and any accessories or options to be furnished. Submittals shall include, but not be limited to the following:

- a. Motors * Drives and Guards
- b. Hangers and Seismic Bracing, Insulation, Vibration Isolators
- c. Pipe Trim, Hangers and Seismic Bracing, Insulation, Vibration Isolators
- d. Duct Trim, Filters, Sound Attenuators.
- e. Temperature Controls
- f. Air Handling Equipment
- g. Air Inlets and Outlets (with a detailed list including Room Nos., neck sizes, throws and NC levels).

- E. Resubmittals shall respond to comments made on the original submittal and shall be marked with a resubmittal number and dated. Resubmittals not in conformance with these requirements will be returned without review.
- F. Shop Drawings: (Also see Division 1 requirements)
 - 1. Submit shop drawings for piping, ductwork, and equipment. Do not begin fabrication until shop drawings have been coordinated with all trades and have been reviewed and accepted by the Architect.
 - 2. Contractor shall prepare and submit coordinated shop drawings for our review prior to installation of work. Shop drawings shall show mechanical (including plumbing), electrical, lighting, low-voltage, and fire protection systems including piping, ducting, equipment, devices, fixtures, supports, drains, panels, connections, etc. to show that all equipment/systems can be constructed without interference between components. Equipment access as required by code or as recommended by the manufacturer shall be accounted for and shown.
 - 3. Drawings shall be a minimum of 11 inches by 17 inches in size, with a minimum scale of 1/4 inch per foot, except as specified otherwise. Drawings shall include floor plans, sectional views, wiring diagrams, and installation details of equipment; and equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping, ductwork, and other items that must be shown to assure a coordinated installation. Ductwork and piping layouts and Mechanical Room layouts shall be drawn at a minimum scale of 1/4 inch per foot. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment and devices.
 - 4. Submit wiring diagrams for packaged equipment and controls. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment.
 - 5. The Architect's review of Shop Drawings is not intended to verify dimensions or quantities, nor to coordinate items shown on these Drawings. He will review them for general conformance with design concept of the project and general compliance with the information given in the contract requirements of the plans and Specifications. Contractor is responsible for dimensions, which shall be confirmed and correlated at the job site, for fabrication processes and techniques of construction, for coordination of his work with that of all other trades and the satisfactory performance of his work.

G. Record Drawings

1. Installation drawings shall be drawn at the site by the Contractor on reproducible paper and shall be fully coordinated for interferences by all trades. The Contractor shall maintain at the jobsite a complete set of prints of the installation drawings for all mechanical work. These prints shall be kept up to date by recording all changes daily. The progress of the work shall be clearly, neatly and accurately designated, coloring in the various pipes, ducts and equipments as they are erected. This process shall incorporate all changes to the original drawings including formal change orders or other instructions issued by the Architect. Principal dimensions of all concealed work shall be recorded including inverts of buried piping and height to underside of ducts.
2. These marked up prints will be used as a guide for determining the progress of the work installed. They will be inspected monthly by the Architect and shall be corrected immediately if found either inaccurate or incomplete.
3. Prior to final acceptance of the Work of this Division, submit properly certified Record Drawings to the Architect for review and make changes, corrections, or additions as the Architect may require. After the Architect's review and any required Contractor revisions, deliver the Record Drawings to the Owner on electronic media in AutoCAD .DWG format. The Architect and Engineer do not assume any responsibility for the accuracy or completeness of the Record Drawings.

H. Operating & Maintenance Manuals:

1. Manuals shall conform to SECTION 017823, OPERATION AND MAINTENANCE DATA.
2. Furnish an operation and maintenance manual for each item of equipment. Furnish 5 copies of the manual bound in hardback binders or an approved equivalent. Furnish one complete manual prior to the time that equipment tests are performed, and furnish the remaining manuals before the contract is completed. Inscribe the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the name and location of the equipment or the building, the name of the Contractor, and the contract number. The manual shall include the names, addresses, and telephone numbers of each subcontractor installing equipment, and of the local representatives for each item of equipment. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start-up, operation and shutdown; description of the function of each principal item of equipment; the procedure for starting; the procedure for operating; shutdown instructions; installation instructions; maintenance instructions; lubrication schedule including type, grade, temperature

range, and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. The parts lists for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the project site. The manual shall be complete in all respects for equipment, controls, accessories, and associated appurtenances provided.

3. Submit a DVD disk containing all Operations and Maintenance data in Adobe "pdf" format. Also include an index of Internet web site addresses Section No. and title, equipment name, Web site address for the O&M manual of the equipment, and the O&M Manual filename.

- I. Letters from manufacturers certifying their supervision of equipment installation and start-up procedures.
- J. Three (3) copies of certification signed by Owner's representative, attesting to their receipt of instructions required by paragraph "Operation and Maintenance Instruction" of this Section.

1.4 PRODUCT DELIVERY AND STORAGE

- A. Identify materials and equipment delivered to site to permit check against approved materials list, reviewed shop Drawings.
- B. Protect from loss or damage. Replace lost or damaged material and equipment with new at no increase in the Contract Amount.
 1. Store material in clean, dry locations. Store material off of floor, and wrap material or otherwise protect from contamination by construction debris, dust, etc. Follow manufacturer's recommendation for storing the material at all times.

1.5 DRAWINGS AND COORDINATION WITH OTHER WORK

- A. Contract Drawings:
 1. For purposes of clarity, legibility, the Contract Drawings are essentially diagrammatic to extent that many offsets, bends, unions, special fittings are not shown. Exact locations of items are not indicated, unless specifically dimensioned.
 2. Exact routing of piping, ductwork, etc., shall be governed by structural conditions, obstructions. Contractor shall make use of data in Contract Documents. Architect reserves right, at no increase in price, to make any reasonable change in location of mechanical items, exposed at ceiling and/or on walls, to group them into orderly relationships and/or increase their utility. Verify Architect's requirements in this regard prior to roughing-in.
 3. In addition to the Shop Drawings called for under SUBMITTALS the Contractor shall prepare large scale layout drawings showing location of equipment, piping and duct runs, and all other elements of mechanical systems provided under this DIVISION. Include sections of congested areas to show relative position and spacing of affected elements.

4. Refer to the electrical "E" series drawings and specifications, Division 26 for the service voltage, power feed, control and interlock wiring for equipment specified under this section. Review the electrical "E" series drawings and Division 26 documents to verify that the electrical services (power, control, interlock, etc.) provided are adequate and compatible with the equipment requirements. Include the cost to furnish and install the additional electrical services, if it is required over and above what is indicated on the electrical "E" series drawings and in Division 26, such as additional control interlock conductors, larger feeder, or separate 120V control power source.
 - a. Prior to proceeding with the installation of any additional electrical work, submit detailed drawings indicating the exact scope of additional electrical work to the Architect for review and approval.
 5. Provide templates, information, and instructions to other DIVISIONS to properly locate holes and openings to be cut or provided for electrical Work.
 6. Not all offsets in ductwork or piping are shown. Decide which item to offset or relocate. Maintain required slope in piping.
- B. Coordination:
1. Work out all "tight" conditions involving Work under this DIVISION and Work in other DIVISIONS in advance of installation.
 2. Maintain minimum 1 inch clearance from adjacent work, including piping, ductwork, insulation, etc. except as noted or approved.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year use shall include applications of equipment and materials under similar circumstances and of similar size.
- B. Alternative Service Record: Products having less than a two-year field service record may be acceptable on approval of the Architect if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.
- C. Service Support: Major equipment items shall be supported by service organizations. The Contractor shall submit a certified list of qualified permanent service organizations for support of the equipment, which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of

the contract.

- D. Identify materials, equipment by manufacturer's name, nameplate data. Remove unidentified materials, equipment from site.
- E. 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.
- F. 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 and meets acceptance.
- G. Equipment Guarding
 - 1. Rotating Equipment Safety:
 - a. Couplings, Motor Shafts, Gears and other exposed rotating or rapidly moving parts shall be fully guarded in accordance with OSHA requirements. The guards shall be cast iron or expanded metal. Guard parts shall be rigid and suitably secured and shall be readily removable without disassembling the guarded unit.
 - b. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts located so that any person can come in close proximity thereto shall be fully enclosed or properly guarded in accordance with Title 8, Division 1, Chapter 4, Subchapter 7, Group 6. High temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of a type as specified herein. Items such as catwalks, ladders, and guardrails shall be provided where required for safe operation and maintenance of equipment.
- H. Equipment or material damaged during transportation, installation or operation is considered as totally damaged. Replace with new. Variance with this permitted only with written acceptance.
- I. Provide an authorized representative to constantly supervise work of this DIVISION, check all materials prior to installation for conformance with Drawings and Specifications.
- J. Equipment shall be as described in the respective SECTIONS of THIS DIVISION and as shown.

2.2 SUBSTITUTIONS

- A. See SECTION 002600, "PROCUREMENT SUBSTITUTION PROCEDURES" and the following.
- B. Where more than one specific name is used, it is to be understood that the name mentioned first represents the manufacturer whose equipment has been used as the basis of design. All other names mentioned are to be considered

substitutions within the meaning of this paragraph, and no additional cost to the Owner shall accrue due to any revisions, additions or deletions required to make substituted equipment perform in accordance with the plans and specifications.

- C. Any redesign necessitated by substitutions shall be provided by the Contractor and shall be subject to review and approval by the Architect.
- D. Substitutions will not be considered if they are indicated or implied on Shop Drawings or Project Data Submittal without the formal request required by Division 1.

PART 3 – EXECUTION

3.1 DEMOLITION

- A. Remove all piping, ducts, fixtures, equipment, etc., where shown or otherwise indicated to be removed. Cap piping at mains or source.

3.2 INSTALLATION

- A. Manufacturer's Recommendations
 - 1. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material or equipment being installed, printed copies of these recommendations shall be furnished prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
 - 2. Provide complete systems in accordance with manufacturers' requirements.
 - 3. Where dimensions or specific installation and operating instructions of equipment are not provided in the Drawings or Specifications, perform the Work according to approved manufacturer's specifications and recommendations. Any material and work required under this heading shall be supplied at no additional cost to the Owner.
 - 4. Assemble equipment which is required to be field assembled, under the direct supervision of the manufacturer's agent. Prior to the final acceptance submit letters from the manufacturers that this has been done.
- B. 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 failure on part of Contractor to foresee means of bringing in or installing equipment into position inside building.
- C. Piping and/or Ductwork Systems:
 - 1. Worked into complete, integrated arrangement with like elements to make work neat appearing, finished.

2. Run concealed, except as shown or noted otherwise; where exposed, run parallel with walls or structural elements; vertical runs plumb; horizontal runs parallel with structure and level or uniformly pitched as appropriate.
 3. Install with adequate passageways free from obstructions, as high as practicable to maintain adequate head room, as shown or as required. Notify Architect before installation whenever head room of less than 7-feet 6-inches will result. Coordinate with work of other DIVISIONS to achieve proper head room as specified in this DIVISION.
 4. Provide bases, piers, metal frames and backings, hangers and supports for the fixtures and systems furnished under this DIVISION.
 5. Expansion and Contraction: Make adequate provisions, whether those provisions are shown on Drawings or not.
 6. Cleaning and Closing: Inspect all piping, ductwork, and equipment before placing; clean interior before closing. Close all piping and ductwork at end of each day's work.
 7. Cleaning and Closing: Inspect all piping, and equipment before placing; clean interior before closing. Close all piping at end of each day's work.
- D. Sleeves, Chases, and Concrete Inserts:
1. Cutting and Patching: In accordance with SECTION 017329: "CUTTING AND PATCHING".
 2. Provide, to cause no delay, all required sleeves, chases, inserts, anchor bolts, etc., and be responsible for correct location, installation of same.
 3. Locating and sizing of openings for ductwork through walls, etc., under this DIVISION. Framing of openings provided by respective DIVISIONS in whose work opening is made.
 4. Penetrations of fire or smoke rated walls, partitions, and floors:
 - a. Pack space between piping or duct and sleeve or opening with materials approved by Underwriters Laboratories for use in through-penetration fire stop systems. Materials, methods, and installation shall be in accordance with UL approved listings and shall be designed to act as a firestop as well as a cold smoke, noxious gas, and water sealant. Submit UL listings for all such systems to be used.
 - b. Through-penetrations of fire rated walls shall be protected by an approved through-penetration firestop system installed as tested in accordance with ASTM E814 or UL1479, and shall have an F rating of not less than the required fire-resistance rating of the wall penetrated.

- c. Through penetrations of horizontal assemblies that are not contained inside fire-rated shafts shall be protected by an approved through-penetration firestop system installed as tested in accordance with ASTM E814 or UL1479, and shall have an F and T rating of not less than 1 hour and not less than the required fire-resistance rating of the floor penetrated.
 - (1) Floor penetrations contained and located within the cavity of a wall above or below the floor do not require a through-penetration firestop system with a T rating.
 - 5. Pipe Sleeves: Where not otherwise indicated or specified, sleeves through outside walls, floors or roof slabs shall be zinc coated steel pipe conforming to ASTM A53. Sleeves through inside partitions shall be zinc coated sheet steel not less than 0.0217-inches thick conforming to ASTM A653.
- E. Cutting and Repairing:
 - 1. Do all cutting, repairing, including structural reinforcing, necessary for Work under this DIVISION.
 - 2. Do no cutting or patching without Architect's review. Repair damage done by this cutting equal to original condition in Architect's opinion.
 - 3. Assume responsibility for all damage to any part of premises or Work of other DIVISIONS, caused by leaks or breaks in piping or equipment furnished and/or installed under this DIVISION during construction and guarantee period. TESTING AND ADJUSTING
- F. Do not start or operate any equipment until the unit as well as all services connected thereto have been supported and seismically braced. Services connected to equipment includes ductwork and its in-line components, wiring, or other in-line components.
- G. Furnish all labor and test equipment required under this DIVISION and in accordance with SECTION 230593 and as follows.
- H. Clean and purge equipment and piping before each test.
- I. Test various Mechanical systems in portions as work progresses. Any system or portion previously tested shall become part of any repeated test when it becomes part of distribution or collection system.
- J. Repair leaks by remaking with new material. Makeshift leak stopping methods are not acceptable.
- K. Should any piece of equipment or material fail in any of the tests, immediately remove, replace with new; retest system.
- L. Maintain test pressures for periods stated, or as directed without loss in pressure, except that due to change in temperature or atmospheric pressure during test.

- M. Perform all tests in accordance with the requirements and under supervision of authorities having jurisdiction.
- N. Field Dynamic Balancing:
 - 1. All fans, blowers and exhausters greater than one (1) horsepower, and all flexible coupled pumps regardless of horsepower, shall be dynamically balanced in the field by a company specializing in machine balancing. Provide a written report on completion of balancing indicating final condition of each piece of equipment.
 - 2. See specification Section 230548, "NOISE, VIBRATION, AND SEISMIC CONTROL" for additional requirements.
- O. Air Pre-balancing Requirements:
 - 1. Complete and test all systems early enough to enable completion of air and water balancing prior to Owner move in.
 - 2. Complete or perform the following Work prior to commencement of the balancing procedure:
 - a. Testing of all systems.
 - b. Prior to the start of balancing, complete all punch list items that will affect balancing of the system.
 - c. Install all dampers and other balancing devices shown and specified and check to be sure they are properly installed, indexed, and in good working order.
 - d. Schedule the Work of all other trades to eliminate system shutdown for any reason once balancing is started.
 - e. Schedule the Work of other trades to assure uninterrupted access to mechanical equipment rooms as well as conditioned spaces.
 - f. Provide labor and material necessary to perform any system revisions required to allow completion of balancing.
 - g. Align all drives.
 - h. Set sheaves to provide indicated capacities at specified static pressures.
 - i. Set all manual dampers to 100-percent open position.
 - j. Remove all adjustable pitch pulleys from the motor shaft; the shaft and pulley threads shall be cleaned, lightly oiled; and the pulley remounted, aligned, and properly adjusted.

- k. Drill 3/8-inch diameter holes in low velocity ductwork with burrs removed, for temperature, pressure, and velocity readings; and provide holes in drive guards that will permit tachometer readings without removing guards. Locate as specified hereinafter and as directed. Install a replaceable rubber plug in each hole.
 - l. Clean interior of all plenums, casings, and ducts; and install temporary and final filters before starting any systems.
 - m. Place all systems in automatic operation.
 - n. Notify the Architect prior to start of tests to enable balancing to be scheduled.
- 3. Drill test holes in the following locations:
 - a. Each side of each filter, fan, coil, and multi-blade damper; 12-inches O.C. for traverse readings in all main ducts and as directed in the field. Provide at least ten (10) extra plugs to the Owner.
- 4. When all the above testing and adjusting Work has been completed, submit a written statement to the Architect, stating that all the testing and pre-balancing requirements have been met. Final Balancing shall not begin until the certificate has been approved by the Architect.
- P. At completion of Work, provide written certification that all systems are functioning properly without defects.

3.3 CLEANING AND PAINTING

- A. Refinish Work supplied with final finish under this DIVISION if damaged to satisfaction of Architect.
- B. Matte black paint finish ducts behind grilles and diffusers where duct is visible.
- C. Thoroughly clean all equipment, piping and all other materials under this DIVISION free from all rust, scale, and all other dirt before covering or painting is done, or the systems put in operation. Leave in condition satisfactory to the Architect.
- D. Protect all finished surfaces of fixtures with heavy paper pasted thereon, or by other means, throughout the period of construction.
- E. Cleaning Ductwork:
 - 1. Clean ductwork inside and out before grilles are installed and before fans are operated. The Contractor shall meet the performance requirements and utilize the evaluation criteria of NADCA Standard ACR 2006, Assessment, Cleaning and Restoration of HVAC Systems.

- F. At all times keep the premises free from accumulation of waste material and debris caused by his employees. At the completion of the project, remove refuse from within and around the building. All tools, scaffolding and surplus materials shall also be removed, leaving the site of his Work broom clean.
- G. Completely cover all motors and other moving machinery to keep free of dirt and water during construction. Using Visqueen EcoMembrane or other 100% post-use low density polyethylene sheet membrane material, effectively cap all openings into ducts and pipes to keep foreign matter out during construction.
- H. Lubricate all equipment at completion of Work. Furnish Owner with a written lubrication schedule for all equipment.
- I. Properly prepare Work under this DIVISION to be finished painted under SECTION 099100, "PAINTING".
 - 1. All exposed work which in general includes piping, ductwork, insulation, metal items, equipment and supports shall be painted except that polished aluminum, stainless steel, chrome plate and other finely finished materials shall not be painted unless otherwise noted.
 - 2. Unless otherwise noted all finish colors shall be selected by the Architect.
 - 3. Materials previously shop prime coated by the manufacturer and which have been scuffed or otherwise damaged shall be touched up with the same materials used for priming. Prime coats shall be of a lighter tint than final coats.

3.4 SIGNS, LABELS AND IDENTIFICATION FOR PIPING, VALVES AND EQUIPMENT

- A. Signs and Labels:
 - 1. Fasten a red-headed tack to each T-bar suspended ceiling pushout tile at any equipment, component or control devices, requiring maintenance or access.
 - 2. A printed sign shall be posted at water treating equipment stating, "USE NO CHROMATES".
 - 3. Post a printed sign at each automatically started equipment stating, "WARNING THIS MACHINE IS AUTOMATICALLY CONTROLLED AND MAY START AT ANY TIME".

3.5 EQUIPMENT IDENTIFICATION

- A. Properly identify each piece of equipment and its controls using engraved laminated plastic descriptive nameplates, attached to equipment and controls using round head brass machine screws, pop rivets or contact cement. Cardholders in any form not acceptable.
- B. All equipment identification shall include the year the equipment was installed.

END OF SECTION

SECTION 23 0500

BASIC MATERIALS AND METHODS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. The requirements of this SECTION apply to all Work of this DIVISION, where applicable. The materials, equipment and methods herein are generally common to the various SECTIONS of this DIVISION of the Specification. Materials that apply to only one SECTION are generally included in that SECTION. Where items specified in other SECTIONS of this DIVISION conflict with requirements of this SECTION, the former shall take precedence.

1.2 QUALITY ASSURANCE

- A. Equipment and Accessories
 - 1. Supply all equipment and all accessories new, free from defects.
 - 2. All items of a given type shall be the product of the same manufacturer.
 - 3. Electrical Equipment: Listed by U.L. and bearing their label.
- B. Reference Standards: Refer to individual Mechanical SECTIONS for additional reference standards.
 - 1. ANSI/ASME - B31.9 Building Services Piping
 - 2. ANSI B2.1 - Pipe Threads
 - 3. ASTM D1557 - Test Methods for Moisture Density Relationships of Soil and Soil Aggregate Mixtures.
 - 4. ASTM D2235 - Solvent Cement for ABS Plastic Pipe and Fittings.
 - 5. ASTM D2564 - Polyvinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.
 - 6. ASTM D2657 - Heat-Joining Polyolefin Pipe and Fittings.
 - 7. ASTM F493 - Solvent Cements for Chlorinated Poly(vinyl chloride) Plastic Pipe and Fittings.
 - 8. AWWA C209-83 - Cold applied tape coatings for exterior of connections and fittings for steel water pipe lines.
 - 9. AWWA C214-83 - Tape Coating Systems for exterior of steel water pipe lines.

10. AWWA C510-17 Double Check Valve Backflow Prevention Assembly.
11. AWWA C511-17 Reduced-Pressure Principle Backflow Prevention Assembly
12. ASC - Adhesive and Sealant Council.
13. Copper Development Association - Copper Tube Handbook.
14. NEMA-MG1 National Electrical Manufacturer's Association, Motor and Generator Standards.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Access Doors in Ceilings or Walls:

1. Furnish under this DIVISION where shown, or required by Regulatory Agencies and for access to all concealed valves, shock absorbers, unions, fire dampers, etc., even though access doors are not shown for Mechanical Work. Mark each door to establish its location and deliver doors for installation under SECTION 083100. Access doors shall be as specified in SECTION 083100.
2. Unless otherwise shown or designated, access doors for reaching valves, traps, air vents, duct access doors, and handholes and cleanouts set in walls shall be 12" x 12" for reaching small items within wrist reach of walls, or 24" x 24" for larger items, or items at greater distances than wrist reach, or at ceilings. All ceiling access door locations shall be coordinated with Architectural Reflected Ceiling Plan.
3. Access doors are not required in T-bar suspended pushout ceilings or accessible tile ceilings.
4. For any access door not specifically shown on reflected ceiling plans or Architectural elevations, obtain the Architect's approval of the location, size and type.
5. Access doors shall be Milcor, Bilco, or equal.
 - a. Style A for acoustic tile. Size of this unit must exactly fit single or multiple acoustic tiles.
 - b. Style K for plaster surfaces.
 - c. Style M for masonry, tile, wall board and other non-plastered surfaces.
 - d. U.L. 1 hour B label for one-hour fire rated surfaces.

- B. Piping Schedules:
 - 1. Refer to individual Mechanical SECTIONS for general information, materials, and execution of the proper piping for each system.
- C. Escutcheon: Beaton, Corbin, or equal.
- D. Pipe Hangers: See schedule on Drawings, and individual mechanical specification SECTIONS; see also SECTION 230548: NOISE, VIBRATION, AND SEISMIC CONTROL.
- E. Adhesives and Sealants:
 - 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 Tables 5.504.4.1 and 5.540.4.2 of the 2016 California Green Building Standards Code. Such products shall also comply with the Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride, methylene chloride, perchloroethylene and trichloroethylene), except for aerosol products meeting the requirements of paragraph 5.504.4.1.2 of the 2016 California Green Building Standards Code.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Installation of Piping:
 - 1. Definition of "PIPING": The term "piping" as used in Drawings or these Specifications, means all pipe, fittings, nipples, valves, unions, etc., as may be required for a complete, functional system.
 - 2. The general layout of piping on the drawings indicates branch runouts terminated at individual or groups of fixtures or equipment. The piping shall be considered continuous and finally connected to all fixtures and equipment.
 - 3. Run all pipes in the approximate locations shown. Sizes are given on the Drawings. Unless otherwise shown, lines shall be installed in furred spaces. Offset piping wherever necessary to obtain headroom. In all cases, install pipe lines to conform to actual conditions such as offsetting to clear structural members, lights, ducts, etc. Run all piping true to line and grade. The finished work shall present a neat and workmanlike appearance. Unless otherwise noted, minimum pipe size is 1/2" for all piping systems.
 - 4. Accurately cut pipe and work into place without springing or forcing, except when cold springing is required.

5. Install pipe lines free from traps, air pockets, sags and bends. Arrange water piping for draining at low points and provide vent valve at high points. Drain valves shall be accessible.
6. Wherever changes in size of pipes occur, the changes shall be made with reducing fittings, as the use of bushings will not be permitted.
7. Securely fasten all piping and equipment in the building to the building construction. Secure branch piping runouts in partitions to steel partition members with tie wire. Provide pipe taping separation between steel and copper.
8. Make branch takeoffs with reducing tees or with line size tee and reducers, except that branches less than half diameter of main may be made with forged branch welding outlet fittings.
9. Piping in any partitions, through plates, studs, etc. shall have sufficient clearance from structure to allow for expansion, contraction of piping. No bare piping should touch wood, concrete, etc., any time.
10. All pipes piercing roof membranes shall be flashed water-tight. Hot pipes shall be fitted with a welded cowl with air space between cowl and flashed curb to allow for any expansion.
11. Provide all piping passing through finished floors, ceilings, partitions, or walls exposed to view with chromium-plated escutcheons in bathrooms, prime coated elsewhere. Fit escutcheons for insulated pipe over insulation.
12. Pipe penetrations at Fire and Smoke rated walls and floors: As specified under SECTION 230100: GENERAL REQUIREMENTS.
13. Pipe penetrations of exterior foundation walls or slabs on grade are to be sealed using Thunderline Link Seal, Calpico, or equal.
14. Cut copper tubing with copper tube cutters, ream and size with sizing tools, and thoroughly clean before application of flux or solder.
15. Install pipe shields at all hangers on suspended insulated piping as follows:
 - a. All insulated lines use PSI Model A1000, or Superstrut 791-H.
 - b. Use Model A3000 and A2000 or extra heavy bottom jacket when pipe hangers span greater than 10 feet and for all pipe roller applications.
 - c. Use high density blown polyurethane inserts at seismically-braced hangers.
16. Unless otherwise indicated, drains from all equipment and piping having drain connection, where shown or required, shall be run to the nearest adequately sized clear water waste receptacle.

- B. Flexible Connections: See SECTION 230548: NOISE, VIBRATION AND SEISMIC CONTROL.
- C. Piping Joints:
 - 1. Brazed and Soldered Joints:
 - a. Brazed joints and soldered joints shall be in accordance with ANSI/ASME B31.9-1982 with preparation, techniques and procedures in accordance with the Copper Tube Handbook publication of the Copper Development Association. Brazing materials shall be as specified in the various Sections of these specifications.
 - b. Soldered joints in domestic water systems shall be lead free.

3.2 FIELD QUALITY CONTROL

- A. Brazing and Soldering:
 - 1. Brazing and soldering procedure qualification shall conform to ANSI B31.1. Brazing procedure for joints shall be as outlined in the Copper Tube Handbook published by the Copper Development Association.
 - 2. Soldering, soldering preparation and procedures for joints shall be in accordance with ANSI B31.1 and as outlined in the Copper Tube Handbook published by the Copper Development Association.
- B. Inspection, Examination and Testing of Pipe Joints shall be in accordance with Chapter VI of ANSI/ASME B31.9-1982 and SECTION 230593: TESTS AND BALANCING.

END OF SECTION

SECTION 23 0513

MOTOR AND MOTOR CONTROLLERS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all motors and motor controllers furnished as part of a factory fabricated unit, variable frequency drives controlling motors provided with mechanical equipment, and to raceways, conductors, terminal enclosures that are part of a factory wired unit.
- B. Where customary practices of a manufacturer differ from requirements specified in this section and other referenced sections, notification shall be provided to the Construction Manager and Engineer of all differences. If the customary practice can be shown to be equal to the specified materials and methods and no increase in contract amount results, consideration will be given to accepting the customary practice as a substitution. Equality shall be determined by the Engineer.
- C. Special purpose motors such as refrigerant cooled, explosion proof, part winding, 2 speed and low voltage motors are specified in the section which describes the equipment of which they are a part.
- D. Motor Controllers, starters, breakers, and disconnects:
 - 1. Where supplied as part of or controlling factory fabricated equipment, motor controllers, variable speed drives, starters, breakers and disconnect switches shall comply with requirements of Division 26. Raceways, outlet boxes, wire and cable, electrical equipment enclosures shall conform to requirements of Division 26.

1.2 QUALITY ASSURANCE

- A. Motors shall bear a nameplate listing the information required by NEC Article 430-7. The nameplate shall be of stainless steel or other corrosion resistant material and data shall be permanently stamped with all letters and numbers legible. Required coatings shall not cover nameplate.
- B. Where multiple motors or other electrical devices are factory wired to a common terminal enclosure a nameplate shall be provided meeting the requirements of NEC Article 430-7 and it shall be secured to the equipment adjacent to the terminal enclosure. A multiple motor nameplate shall be provided even though individual motor nameplates may be provided and visible whenever two or more motors may operate simultaneously.
- C. Reference Standards:
 - 1. NEMA STD MG-1-2016

2. UL Listed
3. Efficiency per IEEE Standard 112, Test Method B

1.3 SUBMITTALS

- A. Speed/Torque Curves for motors over 10 h.p.
- B. Statement that motors are suitable for operation with PWM/IGBT variable frequency drive and that warranty is not affected by such application.
- C. Compliance to IEEE 519 – harmonic analysis for the jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD). The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5% of load served. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFDs shall include a minimum of 5% impedance reactors.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Motors:
 1. Siemens
 2. A.O. Smith
 3. General Electric
 4. Marathon Electric
 5. Westinghouse
 6. Gould Inc.
 7. Or approved equal
- B. Motor Controllers:
 1. Cutler-Hammer (Westinghouse)
 2. Square D
 3. Allen-Bradley
 4. General Electric
 5. Or approved equal

C. Variable Frequency Drives:

1. ABB
2. Yasakawa
3. Danfoss Graham
4. Allen Bradley
5. Or approved equal

2.2 MATERIALS

A. Motors and Motor Controllers

1. Integral and motors, 1/2 hp and greater.
 - a. Conform to NEMA Standard MG-1 Table 12-11 and ANSI C50 Standard.
 - b. NEMA design B with Class F insulation, continuous duty. Provide premium efficiency motors with the following minimum efficiencies:

<u>HP</u>	<u>GUARANTEED MIN EFF (%)</u>
1	82.5
1-1/2	84.0
2	84.0
3	87.5
5	87.5
7-1/2	89.5
10	89.5
15	91.0
20	91.0
25	92.4

2. Motor enclosure to be TEFC unless otherwise stated.
3. Motors to be 3 phase squirrel cage induction type rated at 60 cycles and voltage listed herein.
 - a. Motor Voltage Ratings (Dual and tri voltage rated motors are not acceptable):
 - (1) For distribution voltage of 208 volts, motors shall have rating of 200 volts.
 - (2) For distribution voltage of 240 volts, motors shall have rating of 230 volts.
4. Verify and coordinate voltage and frequency of all motors with Division 26.

5. Exterior motors to be epoxy coated.
6. Motors shall have a 1.15 service factor.
7. Motors shall be provided with embedded thermal overload protection.
8. Directly coupled motors shall be capable of operating with axial thrust generated by driven equipment without reduction in bearing service life.
9. Where indicated to be supplied from variable frequency drives, motor shall be suitable for such a supply and shall include grounded shaft to reduce shaft to frame potential to less than 3 volts.
10. Motor speed to be 1800 rpm unless otherwise scheduled.
11. Bearings to be ball or roller with inner and outer shaft seals.
12. Fractional HP motors, less than ½ HP. Single-phase, squirrel cage induction motors, split-phase, capacitor or shaded pole, as shown on schedules, rated at 115V, 60 cycles with built-in overload protection.
13. Motor Controllers
 - a. For factory packaged equipment provide motor controllers complying with Division 26 and requirements of section in which equipment is described.
 - b. Where 120V control circuit is required for operation of control devices, provide transformer within enclosure.
 - c. Enclosures to be NEMA 1 for indoor locations, NEMA 4 for outdoor locations and NEMA 9 for hazardous applications.

B. Variable Frequency Drives (VFD)

1. UL listed as a complete assembly and built in compliance with the latest standards of ANSI, IEEE, NEMA and the NEC.
2. Pulse Width Modulated design converting the fixed utility voltage and frequency to a variable voltage and frequency output via a two step operation. VFDs utilizing a third power section are not acceptable. Efficiency shall exceed 97% at 100% speed and load. Line side displacement power factor shall exceed 0.95 regardless of speed and load. Rated for 110% current, for one minute for variable torque loads.
3. Operating Criteria:
 - a. Incoming 3-phase, 480 volt AC power, 10%, 60Hz.
 - b. Humidity 0 to 90% (noncondensing and noncorrosive).
 - c. Altitude 0 to 3,300 feet above sea level.
 - d. Ambient temperature 0 to 40 deg C.

4. Ratings for VFDs:
 - a. Unit shall allow continuous motor operation at a service factor of 1.15.
 - b. Variable torque application.
5. Interfaces:
 - a. Run relay with an isolated set of form C contacts.
 - b. Power on or up to speed contacts (form C-selectable).
 - c. Trip contacts (form C).
 - d. VFD will accept an external trip contact and indicate this on the display.
 - e. Dedicated terminal blocks for interface with maintained remote start contact contacts.
 - f. Speed reference interface with a differential amplifier input 4-20 ma DC signal.
 - g. Dedicated terminal blocks for interface with remote life-safety controls (e.g. fire/smoke detectors). This input signal shall stop the motor controlled by the VFD even if the controller is in the bypass position.
 - h. Output signal proportional to output frequency 4-20mADC.
 - i. Output signal proportional to output current 4-20mADC.
 - j. Provide communications interface as required by the Building Management System.
6. Protective features:
 - a. Molded case line motor circuit protector disconnect for each motor served by the VFD.
 - b. Short circuit current rating of 100,000 RMS symmetrical amperes.
 - c. Electronic instantaneous overcurrent protection
 - d. Undervoltage protection
 - e. DC bus overvoltage protection
 - f. Able to withstand output line-to-line short circuits without component failure
 - g. Status indication via an eight character LED

- h. Display of the following protective functions:
 - (1) Undervoltage
 - (2) Overcurrent
 - (3) DC Bus Overvoltage
 - (4) Controller Overtemperature
 - (5) Overload
 - (6) Overload Warning
 - (7) Overfrequency
 - (8) Phase Loss
 - i. Overload capability shall be 110% of the inverter rating for one minute
 - j. Line reactors for all units
 - k. Selectable auto restart (for source related faults only or multiple attempt restarts)
 - l. VFD will catch a motor spinning in the forward direction upon starting
 - m. Upon loss of the input signal (4-20mA) the drive will stop, trip or go to preset speed
 - n. 2 second power ridethrough
7. Adjustable controls:
- a. Minimum frequency (4-60 Hz)
 - b. Maximum frequency (40-120 Hz)
 - c. Three preset speed (2-60 Hz) initiated by Contact closures
 - d. Two acceleration rates (2-300 seconds)
 - e. Two deceleration rates (2-300 seconds)
 - f. Minimum speed dwell time (0-16 seconds)
 - g. Voltage boost (0-50 volts) for starting torque control
 - h. V/Hz linear or reduced for motor noise reduction
 - i. Carrier frequency adjustment (10%) for motor noise reduction

- j. Current limit (70-120%)
 - k. Critical Frequency avoidance (3 bands with 10 Hz adjustable widths)
- 8. Door mounted operator controls and status indication:
 - a. Run/stop selection and LED indication
 - b. Speed control selection and LED indication
 - c. Manual/Auto selector switch
 - d. Manual speed adjustment
 - e. Frequency meter
 - f. Motor RPM
 - g. Ammeter
 - h. Output voltage
 - i. Elapsed time meter
- 9. The keypad shall have a 40 character, English words, LCD display. The reverse button and the programming functions may be locked out if desired.
- 10. Additional features:
 - a. Output contactor to provide electrical output isolation when the VFD is not running.
 - b. Three-contactor bypass on all VFDs, except for direct driven fan motors where the design speed of the fan is less than 1760 rpm, which includes an output contactor electrically and mechanically interlocked with a bypass contactor, run relay including control logic, status lights and a motor overcurrent relay. Size heaters appropriate to motor nameplate data. The complete bypass system and Inverter-Off-Bypass selector switch shall be packaged in the VFD's enclosure.
 - c. Factory-wired with NEMA Class 2C wiring with control terminals at top.
 - d. Enclosure: Fabricated of formed steel reinforced with angle iron. Unit starter doors: fully flanged along front edges and with integral door interlocked disconnect. Multiple unit structures: complete with 4 inch channel iron sill (flat side down) and lifting angle. Provide 1/4 inch x 2 ground bus entire length of control centers. Minimum depth 19 inches. Provide grounding lugs as required to suit cable connections.

- (1) NEMA 1 for interior applications for units up to 3 HP and NEMA 12 for interior applications for 5 HP and larger.
 - (2) NEMA 4 for exterior applications.
 - (3) NEMA 4X for hazardous applications.
 - e. Finish inside with two (2) coats of epoxy exterior paint after suitable metal preparation, or equivalent manufacturer's standard exterior paint after suitable metal preparation. Finish exterior with electronically applied catalyzed epoxy paint, manufacturer's standard color combination.
 - f. Provide gaskets for all cubicle doors. Relay compartments to have steel mounting plate for attachment of devices.
 - g. Provide a Fireman's Switch for supply and return/exhaust fans used in smoke management systems.
 - h. Provide units with a minimum of 5% impedance reactors.
11. Factory testing:
- a. All printed circuit boards shall be burned in at elevated temperature for at least 24 hours.
 - b. Test the completed controller for 24 hours at full load.
 - c. Perform operational testing of complete assembly for proper operation.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Motors and MCCs:
- 1. In finished areas, mount motor protection switch flush and install suitable cover plates.
 - 2. Install heaters correlated with full load current of motors provided.
 - 3. Set overload devices to suit motors provided in accordance with NEC.
 - 4. For VFD driven motors.
 - a. Service disconnects shall not be located between the VFD and the motor, unless they are interlocked to disable the VFD when the disconnect is opened.
 - b. Use symmetric motor cable between the VFD and motor, with low inductance shield or conduit, and with all joints joined with bonding straps.

- c. Use cable connectors with 360 degree connections to the armor/conduit at both ends of motor cable. Verify electrical path from inverter cabinet entry plate to armor/conduit to motor terminal box.
- d. Install auxiliary high frequency bonding connections for potential equalization between: motor frame and connected machinery, motor baseplate and building steel, motor frame and building steel, and motor frame and motor terminal box.

B. Testing:

- 1. Field test for variable frequency drives
 - a. Performed by VFD manufacturer's engineering field service engineer.
 - b. Inspect for physical damage, proper anchorage and grounding.
 - c. Inspect for compliance with drawings and specifications.
 - d. Compare overload heater rating with motor full-load current rating to verify proper sizing. (Adjust as necessary if power factor correction capacitors are connected on load side of heaters.)
 - e. Check tightness of bolted connections using calibrated torque wrench.
 - f. Measure insulation resistance of each starter section phase-to-phase and phase-to-ground with the starter contacts closed, the protective device open, and the solid state controller isolated. Test voltage shall be in accordance with Table 10.2 of NETA STD-ATS-2001.
 - g. Measure insulation resistance of each control circuit with respect to ground. Refer to Table 7.1.1 and Section 7.16.2 of NETA STD-ATS-2001.
 - h. Test molded-case breakers per Section 7.6.1.1 of NETA STD-ATS-2001.
 - i. Verify continuity of ground (resistance < 2 ohms) between:
 - (1) VFD frame and building steel.
 - (2) VFD frame and VFD-motor cable conduit.
 - (3) VFD frame and motor frame.
 - (4) Motor frame and connected machinery.
 - (5) Motor frame and building steel.

2. Start-up and operation check-out and calibration
 - a. Performed by VFD manufacturer's engineering field service engineer.
 - b. Perform and comply with manufacturer's recommended procedure, including but not limited to:
 - (1) Safety checks
 - (2) Check wiring from controller to motor for proper installation and rotation of motor.
 - (3) Controller checks
 - (4) Wiring is properly routed and terminated
 - (5) Power fuses and control fuses are properly in place
 - (6) Make all power off preliminary adjustments
 - (7) Make all power on preliminary adjustments including:
 - (a) Set boost
 - (b) Set minimum frequency
 - (c) Set maximum frequency
 - (d) Set motor acceleration
 - (e) Set motor deceleration
 - (f) Calibrate V/Hz at 7.67V/Hz
 - (g) Lock out reverse functions
 - (8) Calibrate process follow. Coordinate with the Controls Contractor. Make all connections in the controller terminal board, Coordinate stop-start inputs.
 - (9) Verify motor restarts when commanded upon restoration of power after a power failure.
 - (10) Verify that motor restarts when commanded upon resetting of any interlocked fire alarm.

END OF SECTION

SECTION 23 0529

SUPPORT AND ANCHORS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. Work included in this Section: Materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Pipe Hangers and Supports
 - 2. Duct Hangers and Supports
 - 3. Equipment Anchors

1.2 RELATED WORK AND REQUIREMENTS

- A. Section 230100: General Requirements
- B. Section 232113: HVAC Pipe and Pipe Fittings
- C. Section 230548: Noise, Vibration and Seismic Control
- D. Section 233100: Ductwork

1.3 QUALITY ASSURANCE

- A. Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:
 - 1. Pipe Supports: ANSI B31.1, Power Piping.
 - 2. California Code of Regulations, Title 24, Building Standards.
 - a. Part 2, California Building Code (CBC).
 - b. Part 4, California Mechanical Code (CMC).
 - c. Part 5, California Plumbing Code (CPC).
- B. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.
- C. All items of a given type shall be the products of the same manufacturer.

1.4 SUBMITTALS

- A. Submit the following:

1. Shop Drawings showing attachments to structure.
2. Calculations showing deflections of trapeze hangers or other multiple pipe supports.
3. Details of upper hanger attachments for duct and pipe supports with calculations stamped and signed by a Structural Engineer registered in the State of California.
4. Include structural calculations when required by Section 230548 Noise, Vibration and Seismic Control.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Hangers Supports and Miscellaneous Attachment Accessories:

1. Easton's B-line
2. Superstrut
3. Unistrut
4. Or equal

2.2 PIPE HANGERS AND SUPPORTS

A. Where pipe supports are not shown but are required to avoid excessive pipe deflections, provide in accordance with schedule and to meet seismic code requirements. Pipe supports shall be similar in construction to those detailed on the Drawings for similar applications.

B. Spacing:

1. Piping not otherwise indicated:

a. Maximum spacing for horizontal piping:

Type of Pipe	Size	Maximum Spacing	Hanger Rod Size (inch)
Steel	1-1/2 in and smaller	7 ft	3/8
	2 in. to 4 inches	10 ft	1/2
	5 inches and larger	12 ft	5/8
Brass or Copper	3/4 in. and smaller	5 ft	3/8
	1 - 1-1/4 in.	6 ft	3/8
	1-1/2 - 3 in.	8 ft	1/2
	4 in. and larger	10 ft	5/8

PVC	3/4 in and smaller	3 ft	3/8
	1 - 1-1/2 in.	4 ft	3/8
	2 - 3 in.	4 ft	1/2
	4 in. and larger	4 ft	5/8

C. Supports

1. Provide additional supports:
 - a. At changes in direction.
2. Other piping support spacing shall be as scheduled on Drawing or as required by manufacturer or referenced standard.

D. Pipe Bracing shall be provided as required by other Sections of this Division.

E. Fastening: Non-metallic Pipes shall be anchored for limiting expansion where shown or required by means of non-metallic clamps or other approved means, fastened to the pipe by approved means and rigidly attached to the building construction.

F. Multiple pipes shall be attached to zinc coated steel channels using zinc coated clips or pipe clamps with zinc coated steel nuts and bolts, channel nut springs to be 18-8 stainless steel. For external supports use hot dipped galvanized or baked epoxy coated steel channels and angles.

G. Single pipe hanger to be zinc coated steel Clevis type with spacer bar and nuts and rod. Similar to B-Line Fig. B3100.

H. Struts, mounting brackets, channels, structural box sections, etc. shall be galvanized steel with zinc rich touch up of cut edges.

I. Riser clamps at each floor:

1. Non metallic pipes shall be supported with solvent welded collar above loose pipe clamp.
2. Galvanized steel riser clamp for steel pipes. Similar Eaton's B-line B3373C.
3. Plastic coated steel riser clamp for copper pipe. Similar Eaton's B-line B3373CTC.

2.3 STRUCTURAL ANCHORS

A. Beam Clips: B-Line Fig. B3060 side angle clips, Superstrut, or equal.

B. Beam Clamps: B-Line Fig. B3050 or B3055, Tolco, Superstrut, or equal.

C. Maximum load safety factors:

1. Static loads: 5

2. Vibratory loads: 8

3. Shock loads: 10

2.4 PIPE SHIELDS

- A. Copper pipe bearing on metal surface, including hangers, use minimum 1/16 inches PVC separation strip, or approved cushion strip. Minimum length 12 inches. Where pipe bears on wood or PVC, no shield is required.

2.5 SUPPLEMENTARY SUPPORTS

- A. Where support spacing is more frequent than distance between structural members provide steel angles, channels or beams sized to provide a deflection less than 1/240 of span when fully loaded, to transfer pipe support loads to structural members.
- B. Where deflection of center of trapeze support exceed 1/240 of distance between hanger rods provide additional hanger rods.
- C. Where multiple risers are supported within shafts provide steel angles, channels, or beams, sized to provide a deflection of less than 1/240 of span when fully loaded, to transfer loads to the concrete floor slab. Anchor supplemental supports to the slab, and provide resilient element where required by other Sections of this Division.
- D. Hot dip galvanize all supports exposed to weather.

2.6 DUCT HANGERS AND SUPPORTS

- A. See Section 233100 Ductwork.

PART 3 – EXECUTION

3.1 PIPE HANGERS, SUPPORTS AND GUIDES

- A. General:
 - 1. Ensure adequate support for pipe and contents.
 - 2. Prevent vibration or swaying.
 - 3. Provide for expansion and contraction.
 - 4. Supports of wire, rope, wood, chain, strap perforated bar or any other makeshift device not permitted.
 - 5. Comply with applicable requirements at ANSI B31.1.0 and B31.2 for piping.
 - 6. Support piping independently so that equipment is not stressed by piping weight or expansion.

7. See other Sections of this Division for hangers, guides, anchors and supports requiring vibration isolation units.
 8. Hangers and supports shall have minimum safety factor of 5, based on ultimate tensile or compressive strength, as applicable, of material used.
- B. Horizontal piping, except as noted:
1. Trapeze hangers:
 - a. Provide individual guides for pipes on trapezes.
 - b. Where rods are unequally loaded, design for maximum load at both ends.
 - c. Deflection of channel not to exceed 1/240th of span.
 2. Threaded rods:
 - a. 2 in vertical adjustment with 2 nuts each end for positioning and locking.
 - b. Size as indicated hereinbefore.
 - c. For double rod hangers: 1 size smaller than scheduled.
 3. Adjust trapeze and individual hanger rods so as to equalize loads on successive hangers.
 4. Plastic Piping Supports: All horizontal plastic piping shall be supported on continuous trough supports, with hangar spacing and rod sizes same as specified for metallic piping above. Trough shall be galvanized steel, "V" shaped, "U" shaped, or semi-circular shaped. "V" or "U" shaped troughs shall have blocking at hangers to prevent rotation. Troughs shall be sized for a maximum deflection of 1/360 under actual load, with "S" equal to 25,000 psi and "E" equal to 29,000,000 psi.
- C. Install Cushion strip pipe isolators between steel hangers and:
1. Uninsulated copper tubing.
 2. Wherever any pipe requires sound and vibration isolation.
- 3.2 ATTACHMENT TO STRUCTURE
- A. Concrete and CMU
1. Install attachments with expansion shields. Shot in anchors may not be used.

- B. Side Wall Supports:
 - 1. Stud Walls
 - a. Toggle bolts.
 - b. Lag screws into wood backing.
- C. Wood Beams and Roof Decks;
 - 1. Through-bolts for roof mounted ducts, pipe and equipment. Provide weatherproofing of penetration where exposed to outdoors.
 - 2. Beam clamps or beam clips for suspended ducts, pipe and equipment.
- D. Steel Beams:
 - 1. Beam clamps with retaining straps, in lieu of the specified beam clamps, shall not be used without a substitution request.

END OF SECTION

SECTION 23 0548

NOISE, VIBRATION, AND SEISMIC CONTROL

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Provide complete systems including design, materials, equipment and installation for vibration isolation and seismic restraints for equipment, piping and ductwork.
- B. The work of this Section includes, but is not limited to:
 - 1. Seismic Restraints.
 - 2. Vibration Isolators.
 - 3. Flexible Pipe Connections.
 - 4. Field Dynamic Balancing.

1.2 WORK INCLUDED

- A. Objective: It is the objective of this specification to provide the necessary design for the avoidance of excessive noise or vibration in the building due to the operation of machinery or equipment, and/or due to interconnected piping, ductwork or conduit.
- B. Description of Work: Furnish, install, assemble, set up, test (hereinafter "provide") the following systems and equipment in accordance with the Contract Documents.
 - 1. Isolation of mechanical equipment including but not limited to fans, package air conditioning units, refrigeration compressors, cooling towers, evaporative condensers and pumps, including bases.
 - 2. Isolation for ductwork and piping (including all piping connected to vibrating equipment).
 - 3. Inspection of installation of vibration isolation to equipment.
 - 4. Provision of all Motion Restraints required by applicable codes for noise and vibration control equipment/systems specified herein.
 - 5. Coordination of Airtight Installation requirements at Mechanical Rooms and/or Drywall Duct Enclosures.
 - 6. Dynamic balancing of equipment.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Concrete: Division 3.
- B. Thermal and Moisture Protection: Division 7.
- C. Finishes: Division 9.
- D. Section 230529 Support and Anchors.
- E. Electrical: Division 26.

1.4 QUALITY ASSURANCE**A. General:**

- 1. Anchor, support, and brace all equipment and systems to resist seismic forces as specified hereinafter.
- 2. Comply with CCR 2016 California Building Codes.
- 3. Where anchorage support and bracing for various manufactured and fabricated items and systems are detailed and scheduled on the drawings, provide as shown.
- 4. For anchorage, support and bracing not fully detailed, provide in accordance with OSHPD Certified systems or submit details of anchors, supports and bracings complete with calculations. Details and calculation shall be signed and stamped by a Structural Engineer licensed in the state having jurisdiction over the project.

B. Reference Standards:

- 1. Standards: Provide equipment in accordance with the latest edition and revisions of all applicable standards and specifications of all appropriate agencies including, but not limited to, the following:
 - a. AHRI - Air Conditioning Heating and Refrigeration Institute
 - (1) AHRI 260-2012 Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment.
 - (2) AHRI 270-2015 Standard for Sound Performance Rating of Outdoor Unitary Equipment.
 - (3) AHRI 275-2010 Standard for Application of Outdoor Unitary Equipment A-Weighted Sound Power Ratings.
 - (4) AHRI 280-2011 Standard for Requirements for the Qualification of Reverberation Rooms in the 63 Hz Octave Band.
 - (5) AHRI 300-2008 Standard for Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment.

- (6) AHRI 350-2015 Standard for Sound Performance Rating of Non-Ducted Indoor Air-conditioning and Heat Pump Equipment.
 - (7) AHRI 370-2015 Standard for Sound Performance Rating of Large Outdoor Refrigerating and Air-conditioning Equipment.
 - (8) AHRI 530-2011 Standard for Rating of Sound and Vibration for Refrigerant Compressors.
 - (9) AHRI 575-2008 Standard for Method of Measuring Machinery Sound Within an Equipment Space.
 - (10) AHRI 885-2008 Standard for Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.
- b. ASCE - American Society of Civil Engineers
- (1) Standard 7-10 – Minimum Design Loads for Buildings and Other Structures
 - (a) Chapter 13 – Seismic Design Requirements for Non-Structural Components
- c. ASTM - American Society for Testing and Materials
- (1) Specification A123/A123M-01a Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - (2) Test Method ASTM D471-98e1 Standard Test Method for Rubber Property-Effect of Liquids.
 - (3) Test Method ASTM D2240-02 - Standard Test Method for Rubber Property- Durometer Hardness.
 - (4) Test Method ASTM E84-01 - Surface Burning Characteristics of Building Materials.
- d. ASA - Acoustical Society of America/ANSI
- (1) ANSI S12.2-2008 Criteria for Evaluating Room Noise
 - (2) ANSI S12.11-2003 Method for the Measurement of Noise and Vibration of Small Air-Moving Devices
 - (3) ANSI S12.18-1994 (R1999) Outdoor Measurement of Sound Pressure Level

- (4) ANSI S12.31-1990 (R2001) Precision Methods for the Determination of Sound Power Levels of Broad-Band Noise Sources in Reverberation Rooms
- (5) ANSI S12.36-1990 (R1997) Survey Methods for the Determination of Sound Power Levels of Noise Sources
- (6) ANSI S12.54-2011 (ISO 3744:2010) Determination of sound power levels of noise sources using sound pressure - Engineering method in an essentially free field over a reflecting plane
- e. AMCA - Air Movement and Control Association International, Inc.
 - (1) AMCA Standard 300-08, Reverberant Room Method for Sound Testing of Fans
 - (2) AMCA Standard 320-08, Laboratory Methods of Sound Testing Fans Using Sound Intensity
 - (3) ANSI/AMCA Standard 330-97 (ANSI/ASHRAE 68-99), Laboratory Method of Testing to Determine the Sound Power in a Duct
- f. AWS - American Welding Society, Inc.
 - (1) AWS D1.1 - 2002 Structural Welding Code - Steel
- g. ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers
 - (1) 1999 HVAC Applications Manual, Chapter 46
- h. SMACNA - Sheet Metal & Air Conditioning Contractor's National Association, Inc.
 - (1) Rectangular Industrial Duct Construction Standards 2nd edition, 2004
 - (2) Round Industrial Duct Construction Standards, 2nd edition, 1999
 - (3) HVAC Duct Construction Standards - Metal & Flexible, 3rd edition, 2005, with Addenda
 - (4) Architectural Sheet Metal Manual, 6th edition, 2003
 - (5) Seismic Restraint Manual: Guidelines for Mechanical Systems, 3rd edition, 2008.

- C. Codes: Perform installation in accordance with all applicable international, federal, state, county, municipal and local codes and regulations, including but not limited to Chapters 16 and 17 of the California Building Code.
- D. Conflicts: Present any conflicts between codes, regulations, specifications and/or requirements at least thirty (30) days prior to the commencement of the scheduled work.
- E. Schedules: See contents of this Section for specific specifications and schedules of vibration isolators, frames and static deflections. Also see equipment support schedule on the drawings.
- F. Product Suppliers: All vibration isolation devices, equipment bases and frames for equipment and piping furnished under this Division shall be designed and furnished by no more than two different isolator manufacturers and no single vibrating element shall be isolated by the products of more than one isolator manufacturer.
- G. Supervision: The installation of all vibration isolation units, and associated hangers and bases shall be under the direct supervision of the vibration isolation manufacturer's representative.

1.5 COORDINATION

- A. Coordinate with all trades and Electrical Division for installation of Vibration Isolation. Coordinate with Concrete trade for equipment inertia bases. Coordinate Work of this Section with all other impacted trades.
- B. Unit Noise Levels
 - 1. Coordinate these requirements with other Division 23 Equipment submittals.
 - a. Submit manufacturer data obtained in an AMCA or NVLAP approved acoustical testing facility for the submitted unit tested at the static pressures and CFM's proposed for this project
 - (1) Test to be conducted according to the relevant laboratory standards for equipment submitted, using the appropriate procedures listed in 1.03 Quality Assurance above.
 - (a) Exception: Manufacturers may extrapolate data from other similar units operating at brake horsepower and CFM within 20% of the values scheduled for this Project.
 - b. Maximum HVAC Equipment Sound Power Levels
 - (1) HVAC equipment casing radiated, inlet and discharge sound power levels (PWL), in dB re. 10⁻¹² watts shall not be more than the scheduled:

(2) The following variances will be accepted for equipment otherwise satisfying the maximum noise criteria above:

(a) 2 dB variance in each of not more than 4 octave bands.

(b) 4 dB variance in a single octave band.

1.6 SUBMITTALS

A. Descriptive Data - Submit the following:

1. Catalog cuts and data sheets on specific vibration isolators to be utilized showing compliance with the specifications and schedules herein. Include load versus deflection curves.
2. An itemized list showing the items of equipment, piping, etc., to be isolated, the isolator type and model number selected, isolator loading and deflection, wire diameter and number of coils in springs, and references to specific shop drawings showing frame construction where specified.
3. Written approval of the frame design to be used, obtained from the equipment manufacturer.

B. Seismic Bracing

1. Where pre-approved bracing systems will be employed, submittals shall include:
 - a. Approval identification number.
 - b. System component brochure describing components used and detailed installation instruction.
 - c. Loads to be transmitted to structure at anchor point.
2. Where anchorage, support and bracing are not fully detailed on the drawings and pre-approved systems are not used, Contractor shall submit designs and calculations of proposed systems. Submittals shall include:
 - a. Detailed sketches showing system to be installed, stamped and signed by a California registered Structural Engineer.
 - b. Written instructions from the vibration isolation manufacturer as to the proper installation and adjustment of vibration isolation devices, including hangers and bases; alternatively, the equipment may be installed by the vibration isolation manufacturer.

- c. For each Motion Restraint, a stress analysis prepared by a Structural Engineer licensed to practice in the State of project jurisdiction.
 - (1) Provide sufficient detail to permit architect and authorities having jurisdiction to verify compliance with all applicable Codes and these specifications.
 - (2) For vibration isolation used with floor of roof mounted equipment over 400 pounds or suspended equipment over 20 pounds, provide calculations for:
 - (a) shear
 - (b) pull-up
 - (c) primary overturning
 - (d) secondary overturning
 - d. A certification in the calculation cover sheet stating:
 - (1) "These calculations demonstrate that the system detailed complies with the requirements of Chapter 16 of the California Building Code."
 - 3. An itemized list of all items of equipment to be fitted with flexible piping and/or duct connections.
 - a. Flexible piping and/or duct submittals shall contain all information and calculations to demonstrate conformance and suitability for the equipment operating conditions including but not limited to pressure, temperature, capacity, mounting, maintenance, etc.
 - b. Submittals shall also include independent acoustical test data demonstrating at least 20 dB attenuation of vibration accelerations at typical blade passage frequencies.
 - C. Certified acoustic test data for terminal units. Provide maximum casing radiated and discharge noise PWL and SPL in accordance with the specified procedures. Provide acoustical test data for in duct insertion loss.
 - D. Shop Drawings - Submit the following and secure approvals prior to fabrication:
 - 1. Drawings showing equipment frame construction for each machine, including dimensions, structural member sizes, support point locations, etc.
 - 2. Drawings showing methods for suspensions, support, guides, etc., for piping and ductwork, etc.

3. Drawings showing methods, for isolation of ducts, pipes, etc., piercing walls, slabs, beams, etc.
 4. Drawing showing methods numbers and details of Motion Restraints and anchors for equipment, frames, isolators, piping, ductwork, etc., including calculations as above.
 5. Details for concrete and steel bases including anchor bolt locations.
 6. Specific details of restraints including anchor bolts for mounting and maximum loading at each location, showing compliance with Code and coordination with the Project Architectural, Structural and Mechanical Documents.
 7. Details of flexible piping and duct connections for all typical conditions listed in the schedule provided above.
- E. Seismic Qualification Requirements Certificate of Compliance: Submit certificates of compliance for all applicable equipment as required by the California Building Code, Chapter 17, paragraph 1708.5.
- F. Anchorages and Supports
1. Where Contractor-proposed substitutions change the weight, size, configuration or other aspects of systems and equipment that will affect the performance of anchorages and/or supports, the Contractor shall submit calculations for proposed anchors and supports, and install them as shown in these calculations. The calculations shall include the same certification and engineer's stamp as required above for seismic bracing.
 2. Where contractor-proposed substitutions are claimed to have no effect on anchors and supports detailed on the Contract Documents, Contractor shall submit information on sizes, weights, center of gravity and other relevant information to demonstrate this fact.
 3. Contractor shall submit details and calculations for all embedded inserts, drilled inserts and other fasteners for attachments of suspended components showing the load-carrying capacity of each device calculated in accordance with Chapter 16 of the California Building Code. The calculations shall include the same certification and engineer's stamp as required above for seismic bracing.
 4. For all anchorages and supports not detailed on the Contract Documents, Contractor shall submit details and calculations. The calculations shall include the same certification and engineer's stamp as required above for seismic bracing.

PART 2 – PRODUCTS

2.1 GENERAL PROPERTIES

- A. Deflection: Vibration isolators shall have either known undeflected heights or other markings so that, after adjustment, when carrying their load, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.
- B. Range: Isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range 60 percent above the design deflection.
- C. Ratio: Ratio of lateral to vertical stiffness shall not be less than 1.0 or greater than 1.3.
- D. Nested: Unless specifically noted, nested spring designs shall not be permitted.
- E. Uniformity: Vertical natural frequency for each support point, based upon the load per isolator and isolator stiffness, shall not differ by more than +/- 10 percent.
- F. Isolation: Wave motion through the isolator shall be reduced to the following extent: Isolation above the primary vertical system resonance frequency shall follow the theoretically predicted isolation curve for single degree of freedom systems within 10% up to 50 dB or greater at all frequencies above 150 Hz.
- G. Protection: Isolators installed outdoors shall be designed for such exposure suitable to the Project conditions.
 - 1. Springs shall be coated in neoprene or PVC. Spring housings shall be hot dip galvanized.
 - 2. All neoprene mountings shall have a Shore-A hardness of 30 to 50, after minimum aging of 20 days or corresponding oven aging.
- H. Internal Isolation: Where vibration isolators and associated equipment frames have been specified herein for "package" air handling units which are available with "internal" isolation; the contractor shall comply with the following:
 - 1. Provide neoprene mounts for the "internal" isolation supplied by the air handling unit manufacturer. Such mounts shall be of 30 to 60 durometer neoprene and shall have a static deflection no greater than 0.25 times the scheduled static deflections.
 - 2. "Internal" isolation in lieu of the specified vibration isolators and scheduled equipment frames is unacceptable. Where internal isolation is provided, in addition to the specified isolation, same shall be removed or made ineffective.

2.2 ACCEPTABLE MANUFACTURERS**A. Bracing Systems:**

1. Bline
2. Super Strut
3. ISAT
4. Or equal

B. Vibration Isolators:

1. Mason Industries
2. Peabody Kinetics
3. M.W. Sausse & Co.
4. Or equal

2.3 ISOLATOR DESCRIPTION**A. Application Cross-Reference:** For application and the specific static deflection requirements of the isolators described below, refer to schedules and references elsewhere herein.

1. Type MS: Bare spring type equipped with leveling bolts and with two layers of ribbed or waffled neoprene pad separated by a 1/16" galvanized steel plate under the base plate.
2. Type MSL: Bare spring type with two layers of ribbed neoprene pad with 1/16" galvanized steel separator between layers under the base plate. Provide limit stops to prohibit spring extension if the load is removed. These stops shall serve as rigid blocking during erections so that the installed and operating heights shall be the same. Provide a maximum of 1/4" clearance around restraining bolts and between the limit stops and the housing so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation.
3. Type HS: Suspension hangers having a steel frame and spring element in series with a 1 inch thick neoprene pad with integral grommet. The design static deflection under load shall be as shown on the schedule. The isolator shall be designed so hanger rod may be misaligned 15 degrees relative to the vertical without touching integral grommet inset in hanger box frame.
4. Type HD: Spring hangers, load transfer. Same as Type HS with washer and nut assembly and indicator for load transfer and deflection readout.

5. Type HN: Suspension hangers having a neoprene isolator unit having a minimum static deflection range of 0.25" to 0.5" designed to preclude contact of hanger rods with frame at up to 15 degree misalignment.
6. Type MN: Neoprene isolator unit having a minimum static deflection range of 0.25" to 0.5".
7. Type NSP: Neoprene pad. Waffled or ribbed. Typically 5/16 to 2" thick. Durometer of 50 maximum. Static deflection typically 0.05". Nominal design 40 durometer for 0.05" static deflection under 60 psi load. Provide steel load distribution plates. Size of pad to be selected by isolator supplier based on load per point.
8. Type MND: Neoprene Mount, Deep Displacement. A machinery mount with a neoprene diagonal lattice structure located between steel base and support plates. Suitable for loads from 300 to 4000 lbs and for driving frequencies as low as 6 Hz. Capable of providing static deflections from 5/8" to 1" with lateral stability.
9. Corrosion Protection: Steel parts of vibration isolators and seismic snubbers, except springs, shall be hot dipped galvanized in accordance with ASTM A123. Where steel parts are exposed to the weather, galvanized coating shall be at least 2 ounces of zinc per square foot of surface. Springs shall be neoprene coated.

2.4 EQUIPMENT FRAMES

- A. General Properties: Mounting frames and/or brackets shall be provided to carry the load of the equipment without stressing or causing mechanical distortion of the equipment. Each piece of equipment shall be supported at least four points by vibration isolators and restrained at least four locations by Motion Restraint.
 1. Rigid Steel (SB): Construction:
 - a. Rectangular with a minimum of four pieces of welded, wide flange or channel structural steel with welded height saving brackets to accept the isolators. Additional frame members shall be provided as necessary to support pumps, motors, etc.
 - b. The section depth of the frame members shall be greater than 1/10 of the length of the longest frame member, and shall be constant in all four perimeter frame pieces. Provide height saving brackets at all mounting locations to maintain a 1 inch clearance below the base.
 2. Floating Concrete Bases (CB): Construction:
 - a. Provide rectangular steel concrete pouring forms for floating concrete bases, with a minimum of four pieces of welded, wide flange or channel structural steel with welded or integral height saving brackets to accept the isolators and to maintain a 1 inch

clearance below the base. Additional frame members shall be provided as necessary to support pumps, motors, etc. Forms shall include minimum concrete reinforcing consisting of 2 inch bars welded in place on 6 inch centers running both ways in a layer 1.5 inch above the bottom. Provide forms with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured.

- b. The section depth of the frame members shall be greater than 1/12 of the length of the longest frame member, but not less than 6", and shall be constant in all four perimeter frame pieces.
3. Integrated Roof mounted Spring and Frame (IRSF): The integrated roof mounted spring and frame assembly shall consist of a rectangular angle iron equipment frame supported by a type MS isolator on a steel channel roof perimeter. This assembly integrates with the roof insulation and canting to provide a weather tight seal with cover plates removable for isolator inspection. The IRSF shall provide integral motion restraint and shall be available in stock modular construction components.

2.5 EQUIVALENT VIBRATION ISOLATORS AND EQUIPMENT FRAMES

A. Isolators

1. Acceptable subject to 2.03 above:

Type	Description	Mason Industries	Vibrex/ Sause	Lord Mechanical Products	Kinetics	Amber Booth	Vibration Mountings & Controls
MS	Spring Mount	SLF*	RMSG *	B	FDS*	SW*	ADC*
MSL	Spring Mount with Limit Stop	SLR C series	RMLS -EQ	--	FLS	CT	AWR
	Under 1.5" S.D. and under 200 pounds load per isol.	SLR A series	RMUJ -EQ- SH	B	FLS	CT	AWR
HS	Spring Hanger	30N*	HXA*	B	SRH*	BSRA *	SH*
HD	Spring Hanger	PC30N *	HXA- PC	--	--	--	
HN	Neoprene Hanger	HD*	HSS*	--	RH*	HRD*	RHD*
MN	Neoprene Mount	ND*	DD*	--	RD*	RVD*	RD*
MND	Neoprene Mount, Deep Deflection*	--	--	Lattice Mount	--	--	--
NSP	Neoprene	W, WM*	R*		NPS*	SP- NR*	Shear- flex

*Unrestrained isolation systems require separate Motion Restraint as specified below.

B. Frames and Curbs

1. Acceptable subject to 2.04 above:

Type	Description	Mason Industries	Vibrex/ Sause	Kinetics	Amber Booth	Vibration Mountings & Controls
SB	Rigid Steel Base	MSL/WFSL	RMSB	SFB	B	WFB-AC
CB	Floating Concrete Base	BMK/KSL	RMSBI			
IRSF	Integrated Roof Mount	RSC	VIC-EQ	ESR	B	B

2.6 MOTION RESTRAINTS

- A. Objective: Provide motion restraining devices at all vibration isolated piping and equipment. Design restraints to comply with applicable Code in Project Jurisdiction.
- B. General properties: Restraints shall permit adjustment during installation to insure sufficient clearance between vibration isolated element and rigid restraining device. Restraints at base supported equipment shall include resilient neoprene pads at all potential contact areas between isolated equipment and rigid restraining element.
- C. Equipment, equipment bases and concrete inertia bases shall be restrained against excessive movement during a seismic event by the use of resilient snubbers designed to resist forces in accordance with Title 24 requirements. The steel members of the snubbers shall be designed to yield but not fail under these design conditions. Calculations by a Registered Professional Engineer, or certified tests reports from a nationally recognized independent test laboratory shall be submitted which verify the capacity of each snubber.
- D. Restraint Description
 1. Restraining devices at base supported vibration isolated equipment shall be as manufactured by Mason Industries, type Z-1011 or equal by Vibrex, Amber Booth or Kinetics.
 2. Coordinate restraint bolt locations with the structural and mechanical drawings and conditions.

3. Restraints at suspended piping and equipment shall consist of stainless steel cables together with neoprene snubbers arranged to achieve the required all directional restraint and sized to resist the forces defined. Shop Drawings shall indicate proposed method for achieving vertical restraint for ceiling suspended piping. Cables shall have sufficient slack to avoid short circuiting the vibration isolators.
4. Snubbers shall be welded steel, and shall be attached to the supporting structure in a manner consistent with anticipated loads. Such attachments shall meet current State Building Codes.
5. Snubbers shall be placed around equipment to limit lateral or vertical movement at each snubber to one-quarter inch (1/4"). A minimum of four (4) snubbers shall be installed around each piece of resiliently supported equipment.
6. Snubbers shall include resilient pads to cushion any impact, and shall be installed so as to be out of contact during equipment operation.

2.7 VIBRATION ISOLATOR APPLICATION AND SCHEDULES - EQUIPMENT

- A. General: The isolator type scheduled shall be furnished and installed for the following mechanical equipment in accordance with Part 3 herein, loaded to yield the specified deflection per the schedule below at each isolator. The contractor shall verify that the dead load deflection of the structure at each isolator location is less than 0.25 times the isolator static deflections scheduled herein. In the event that the dead load deflection of the structure at any isolator location is greater than 0.25 times the scheduled isolator static deflection, the contractor shall increase the static deflection of such isolators to be at least 4.0 times the dead load deflection of the structure.
- B. Application Schedule: See also equipment schedule on drawings.

Equipment Designation	Isolation Type	Frame Type	Minimum Static Deflection (inches)	Mounting Notes
HP-1	NSP			
HR-1	MN/NSP			
EF-1	HS/HD	-	1 to 2	
ERV-1&2	HS/HD		1 to 2	

2.8 PIPING AND DUCT RESILIENT SUPPORT AND SUSPENSION

- A. Execution Cross-Reference: Refer elsewhere in this Section for the requirements of Resilient Penetrations and Flexible Connections. Refer to Part 3 for the extent of the resilient piping support cited below.

1. At horizontal suspended pipe 2" and smaller connected to vibrating equipment over 2 HP provide Type HS isolator or floor supported Type MSL isolator with a minimum 1.0 inch static deflection. At horizontal suspended piping larger than 2" provide type HD isolator or floor supported Type MSL isolator with a minimum of 1-1/2" static deflection.
 2. At vertical riser pipe supports supporting piping attached to vibrating equipment over 1/2 hp and piping over 1.0" O.D., provide Type MS isolators selected for a minimum static deflection of 1.0".
 3. At pipe anchors for piping attached to vibrating equipment provide Types MN or HN to avoid direct contact of piping with building.
 4. Pipe sway braces where required and attached to vibrating equipment shall utilize neoprene elements of 40 durometer maximum and of 3/8" minimum thickness, Type MN shall be used where such braces are required to accommodate both tension and compression forces.
- B. High Velocity Ductwork: At ducts with air velocities greater than 1600 FPM provide Type MSL if roof/floor supported, or Type HS if suspended. Penetrations of shaft assemblies by such ductwork shall not be "rigid" as described elsewhere in this Section.
- C. Vane Axial Fans: At vane axial fans operating against a static of 3" w.g. or greater provide neoprene/spring thrust snubbers, type WBI or WBD by Mason or equal by Sausse.

2.9 FLEXIBLE DUCT CONNECTIONS

- A. Fabric: Flexible connection fabric shall be a noncombustible water-proof, airtight, glass fabric, one side coated with Neoprene, weight 20 ounce per square yard. For ducts operating at over 100 deg F and for acid resistant applications, flexible fabric shall be 30 ounce Neoprene coated glass fabric. All fabric shall meet the applicable Code of the project jurisdiction. See Section 233100: Ductwork" for additional material and installation requirements.
- B. Acceptable Manufacturers:
1. Vent Fabrics, Inc.
 2. Duro-Dyne
 3. Advance Elastomeric Systems
 4. O equal, as specified elsewhere in this Division.

2.10 RESILIENT PENETRATIONS

A. For piping or ductwork, (Field Fabricated Method):

1. Sleeves: Sleeves of appropriate gage galvanized sheet metal shall be formed to at least the thickness of the penetrated construction and 3/4" to 1" larger in each cross-sectional dimension than the penetrating element.
 - a. Acceptable:
 - (1) Century-Line Sleeves by Thunderline Corporation
 - (2) Custom by Contractor
2. Batt: Glass fiber of batt or mineral wool, 1 to 3 lb/cu ft density.
 - a. Acceptable Manufacturers
 - (1) Certain-Teed
 - (2) Johns Manville
 - (3) Owens-Corning
3. Acoustical Sealant:
 - a. Acceptable Manufacturers:
 - (1) DAP
 - (2) Pecora
 - (3) Tremco
 - (4) U.S. Gypsum
4. Firestop Sealant:
 - a. Where duct and piping penetrate sound isolation partitions or walls around mechanical rooms, the penetration shall have a maximum clearance of 3/4-inch on all sides and shall be packed with glass fiber and caulked airtight on both sides with acoustically rated sealant, or equal. Acoustic sealant shall be fire rated to meet UL designs for applicable fire rated wall assemblies. For smoke or fire rated partitions see other Sections of this Division.
 - b. Fully hardened firestop caulk shall develop a Shore A hardness of no greater than 35.

- c. Acceptable, subject to approval for intended application by Authorities Having Jurisdiction:
 - (1) G.E. Pensil 100 Firestop Sealant
 - (2) Tremco Fyre-Sil Silicone Fire-stop Construction Sealant
- B. For piping penetrations (Factory Fabricated Component Method):
 - 1. A factory fabricated sleeve assembly with outer sleeve of sheet metal and inner resilient liner of moisture and vermin resisting felt neoprene, glass fiber or foam rubber 2 to 3/4" thick and bonded to the sheet metal sleeve. Sleeve inside diameter shall be equal to outside diameter of penetrating element. Sleeve length shall be at least equal to the thickness of the penetrated construction. Sleeve shall be set and caulked airtight in penetrated construction and clamped tightly around penetrating element.
 - 2. Acceptable:
 - a. Mason Type SWS
 - b. Peabody Type PS-1-D
 - c. Potter Roemer PR-Isolator
 - d. Stoneman Engineering Trisolator
 - 3. Where required, a fire rated factory fabricated sleeve and inner resilient liner of solid rubber links may be substituted for the preceding when installed in strict accordance with the manufacturer's instructions.
 - a. Acceptable, subject to by Authorities Having Jurisdiction:
 - (1) Link Seal by ThunderLine Corp.

PART 3 – EXECUTION

3.1 INSTALLATION/APPLICATION/PERFORMANCE/ERECTION

- A. Seismic Restraint Systems: Maintain equipment, piping, ductwork in a captive position. Do not short circuit vibration systems or transmit objectionable vibration or noise. Structural bases shall be reinforced as required to prevent flexure, misalignment of drive and driven unit or stress transferal into equipment.
- B. Vibration Isolation: Mechanical and associated electrical machinery, piping and ductwork shall be mounted on vibration isolators and seismic snubbers as indicated or specified and required to minimize transmission of vibrations and structure borne noise to the building structure or spaces. All mechanical equipment, unless otherwise noted, shall be isolated from the structure by means of resilient vibration and noise isolators.

1. Rotating and reciprocating machinery shall be balanced statically and dynamically.
- C. After installation and before equipment start-up an authorized representative of the manufacturer shall visit the site, and shall inspect each isolator and certify in writing that each is installed in accordance with the manufacturer's instructions. Make all adjustments and corrections required by the manufacturer's representative to enable this certification.
- D. Ductwork Seismic Restraints:
1. Support and brace all ductwork not otherwise detailed on the Contract Drawings in accordance with ISAT or equivalent.
 2. Diffuser Bracing: For suspended type ceilings, ceiling mounted air terminals or services shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners. In addition, two No. 12 gauge slack wires shall be connected from diffusers to the structure above. Connect wire to diffusers at diagonally opposite corners.
 3. Support and seismically brace all duct mounted devices including but not limited to VAV/CAV terminal boxes, fan powered boxes, coils, and sound attenuators. Where permitted by the authority having jurisdiction, seismic bracing of duct mounted devices weighing less than 75 lbs may be omitted provided, where appropriate, piping connection to these devices is made with flexible connection. Where bracing for duct mounted devices has been omitted as indicated herein, the weight of devices shall be added to the weight of the ductwork in calculating the required seismic bracing of ductwork.
- E. Piping mounted on roof or floor slab: Attach all support points to roof structural member and provide seismic bracing of all piping at an interval of not more than 40 feet.

3.2 FIELD QUALITY CONTROL

- A. Testing and Inspection: See SECTION 014523.
1. Special Inspections as defined in CBC Chapter 17, paragraph 1705.12.6, shall be provided as required.
- B. Field Dynamic Balancing:
1. Dynamic balancing of certain critical rotating equipment is required.
 - a. Maximum Permissible Machinery Vibration Levels:
 - (1) Mechanical balance of rotating equipment as specified shall be field tested with final drives and couplings in place and with the units in normal operation.

- b. Overall vibration amplitude 0.003-inch maximum peak-to-peak, for frequencies below 10 cycles/second (600 rpm) and 0.1-inch/second maximum peak velocity for frequencies above 10 cycles/second (600 rpm).
- c. Take measurements on bearing housings (not end caps) or other heavy structural element directly connected to bearing housing at both ends of each unit.
- d. Pulley runout in radial and axial directions shall be less than 0.001-inch.
- e. Correct and retest equipment exceeding the limits for compliance.

3.3 INSPECTION OF CONDITIONS

- A. Examine related Work and surfaces before starting Work of this Section. Report to the Architect, in writing, conditions which will prevent proper provision of this work. Beginning the Work of this Section without reporting unsuitable conditions to the Architect constitutes acceptance of such conditions by Contractor. Perform any required removal, repair, or replacement of this Work caused by unsuitable conditions at no additional cost to the Owner.

3.4 GENERAL INSTALLATION REQUIREMENTS

- A. Stress: Installation or use of vibration isolators must not cause any change of position of equipment or piping which would result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, equipment and piping shall be maintained in a rigid position during installation. The load shall not be transferred to the isolator until the installation is complete and under full operational load.
- B. Prior Approval: The Contractor shall not install any equipment, duct or piping which makes rigid contact with the "building" unless it is approved in this specification or by the Architect. "Building" includes, but is not limited to slabs, beams, columns, walls, partitions, ceilings, studs, ceiling framing and suspension systems.
- C. Rigid Contact: Prior to installation, bring to the Architect's attention any conflicts between trades which will result in unavoidable rigid contact at equipment or piping or ducts, as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- D. Discrepancies: Prior to installation, the Contractor shall bring to the Architect's attention any discrepancies between the specifications and field conditions or changes required due to specific equipment selection. Corrective work necessitated by discrepancies after installation shall be at the Contractor's expense.

- E. Protection: Isolators exposed to the outdoors during construction shall either be designed for such exposure or shall be protected by suitable means.
- F. Access: The Contractor shall obtain inspection and approval from the Architect of any installation to be covered or enclosed, prior to such closure.
- G. Instructions: The Contractor shall obtain written instructions from the vibration isolation manufacturer as to the proper installation and adjustment of vibration isolation devices; alternatively, the equipment may be installed by the vibration isolation manufacturer.
- H. Defective Installations: Correct, at no additional cost to the Owner, all installations which are deemed defective in workmanship or materials by the Architect or Consultant.

3.5 EQUIPMENT ISOLATORS

- A. Structural Frames: Machines to be isolated shall be supported by a structural steel frame, Type RS, or Type IRSF frames as described herein.
- B. Brackets: Brackets shall be provided as required to accommodate the isolator and provide a mechanical stop. The vertical position and size of the bracket shall be submitted by the isolator manufacturer.
- C. Clearance: Operating clearance between the bracket and the pad or floor shall be 3/8". The minimum operating clearance between the frame and the housekeeping pad or floor shall be 1", for rigid steel and 2" for concrete inertia base.
- D. Shims: Frame shall be placed in position and the brackets supported temporarily by 3/8" shims prior to the installation of the machine or isolators.
- E. Support: Isolators shall be installed without raising the machine and frame assembly.
- F. Adjustment: After the entire system installation is completed and under full operation load, the isolator shall be adjusted so that the load is transferred from the shims to the isolator. When all isolators are properly adjusted, the shims should be barely free and shall be removed. Thereafter, the shims should be used as a gauge to check that the 3/8" clearance is maintained so that the system will remain free of stress.
- G. Roof curbs: Installation of Type IRSF shall be in strict conformance with the manufacturer's instructions.

3.6 INSTALLATION REQUIREMENTS, MOTION RESTRAINTS

- A. Inspection: All installations shall be inspected and approved by a Civil or Structural Engineer licensed in the Project jurisdiction for adequate motion restraint and to assure that such does not short-circuit vibration isolators during normal operation. Adjustments, as reasonably required, shall be made by the Contractor at no expense to the Owner.

Such inspector shall be provided by the Contractor, and the Engineers shall certify the installation in writing.

3.7 PIPING AND DUCT RESILIENT SUPPORT AND SUSPENSION

- A. Applies: Pipes included under this Section of the Specifications are refrigeration and all pressurized water piping including that connected to vibrating equipment.
- B. Does Not Apply: Piping not included is compressed air and fire standpipe and sprinkler piping.
- C. Extent: Pipes and ducts connected to vibrating equipment shall be resiliently supported or suspended for a distance of 30 feet from such equipment. Refer to Part 2 for products. All connections to such equipment shall include flexible connections specified elsewhere in this Section in minimum lengths conforming to the recommendations in Table 35, Chapter 42, ASHRAE 1991 HVAC Applications.
- D. Spring Hangers:
 - 1. Suspension Isolators shall be installed with the isolator hanger box as close as possible to the structure. Such isolators shall be suspended from substantial structural members, not from slab diaphragms unless specifically approved.
 - 2. Hanger rods shall be aligned to clear the hanger box.

3.8 INSTALLATION REQUIREMENTS, FLEXIBLE DUCT CONNECTIONS

- A. Alignment: Align sheet metal duct with fan or fan casing opening in all three dimensions prior to installation of flexible connection, so that duct opening nearly coincides and are almost equally spaced from one another all around. Do not install flexible connection until above requirements are met.
- B. Free motion: Fans or fan casings and ducts shall be able to move 1" in any direction relative to each other without short-circuiting metal to metal or stretching taut the flexible connection.

3.9 INSTALLATION REQUIREMENTS, FLEXIBLE PIPING CONNECTIONS

- A. Application: Flexible piping connections shall be installed within 10 feet of all vibrating equipment, or prior to penetration of the building, whichever is shorter, on all piping connected to such equipment.
- B. Placement: Flexible piping connections shall be located such that their length is at right angles to the principal direction of movement and thus such that the movement of the equipment does not alternately place the connection into tension and compression.
- C. Length: Flexible piping connectors shall be installed in accordance with the manufacturer's recommended procedures and in lengths complying with Table 28, Chapter 52, ASHRAE 1995 Applications Handbook.

- D. Braided metal hose: Where permitted as a substitution, shall be installed in pairs, one in the vertical plane and one in the horizontal plane at each location that a single flexible piping connection is required in this section.

3.10 INSTALLATION REQUIREMENTS, RESILIENT PENETRATIONS

- A. Application: Penetrations included in this Section of the Specifications include all piping and ducts connected to vibrating equipment within 30 feet of such equipment.
- B. Alternate A for round or rectangular penetrations:
 - 1. Cut a clean opening in the penetrated construction very nearly the size of the sleeve for each penetrating element. Provide lintels above, relief structure below and vertical framing between and to the sides, as required. Provide the above, escutcheon plates and such related construction as is necessary to make the penetrated structure as solid and massive near the penetrations as the surrounding construction.
 - 2. Set the metal sleeve into the penetrated construction in an airtight manner around its outer periphery, using grout, dry packing, plaster or drywall compound full depth and all around - but only to a maximum width of 2" - or the requirements of the above paragraph shall not have been satisfied.
 - 3. Pack annular opening with glass fiber between metal sleeve and penetrating element full depth, all around to a firm degree of compaction. Leave a 2" deep annular opening free at each end of the metal sleeve; fill this fully with sealant.
- C. Alternate B for round penetrations: Observe requirements above, except that use of sealant at sleeve ends is not required. In lieu of sealant, clamp factory fabricated sleeve assemblies specified in Part 2 tightly around penetrating elements, using built-in or field supplied clamping devices. Apply clamping of sleeves to penetrating services before sealing of sleeves to penetrated constructions. Refer to manufacturer's instructions for installation of fire rated rubber link systems.

3.11 EQUIPMENT ROOM/PLENUM REQUIREMENTS

- A. Airtight Enclosure: All mechanical rooms, plenums, duct shafts and drywall duct enclosures shall be constructed airtight. This means that every precaution shall be taken to maintain construction completely airtight around a room so designated. Construction joints, duct penetrations, electrical boxes, frames, supports, cabinets, doors, access panels, fixtures, etc., all shall be built or installed in such a manner as to prevent sound transmission through any construction enclosing a room horizontally or vertically. Appropriate lintels, frames, blocking, escutcheons, grouting, gaskets, packing, caulking, taping, filling, etc., all shall be employed to prevent sound transmission. Refer to requirements of this Section for Resilient Penetrations.

- B. Discrepancies: All work under this section is to comply with the above. Report to architect any construction conditions which arise which might compromise compliance with this requirement.

3.12 REQUIRED HVAC AMBIENT NOISE CRITERION

- A. Criteria: The ambient noise levels resulting from HVAC equipment shall not exceed the noise criterion (NC levels) scheduled below.
- B. Contract Documents: The noise criterion scheduled herein have been utilized to determine the sizing of the sound traps and amount of acoustical lining of ductwork required to meet this criteria.
- C. Field Design: Where field alterations are made to the design, main duct and branch duct velocities shall be sufficient to provide noise attenuation to the noise criteria scheduled herein.

1. NOISE CRITERIA

AREA	NC CRITERION
Showroom	NC-35
Demonstration Kitchen	NC-35 to NC-40
Service Desks	NC-35
Open Plan Offices	NC-35
Private Offices and Conference Rooms	NC-30
Medium and Large Meeting Rooms	NC-30
Corridors	NC-40
Tech Services/Sorting and Closed Shelving, and Storage	NC-40
MDF, Utility & Restroom	NC-40

END OF SECTION

SECTION 23 0593

TESTS AND BALANCING

PART 1 – GENERAL

1.1 QUALITY ASSURANCE

A. Applicator (Erector) Qualifications:

1. System balancing shall be done by a firm regularly engaged and specializing in the field of air and water balancing. Testing and balancing shall be performed in complete accordance with the National Standards for Total System Balance, as published by the Associated Air Balance Council (AABC). The Contractor must be AABC certified. National Environmental Balancing Bureau (NEBB) Certified contractors may perform test and balance work, provided they furnish the same Performance Guarantee as described on page v of the 2002 AABC National Standards. Contractor shall issue such performance guarantee within 30 days of receiving a contract, or 14 calendar days prior to commencing work, whichever is sooner.
2. The Tests and Balancing firm must have experience in projects of similar type and scope and shall submit a list of names and qualifications of all personnel proposed to do this Work. A detailed description of the procedures and the instrumentation employed shall accompany the personnel list. Only experienced personnel and rational orderly procedures will be accepted.
3. The Tests and Balancing Contractor shall contract directly with the General Contractor and shall not be a sub-contractor to the Mechanical Sub-contractor.
4. The final balance report shall be certified by a registered Professional Engineer. Submit the qualifications of the supervisor and engineering technician for review. Personnel shall have past experience of such nature that qualifies them for balancing of these systems.

B. The Mechanical sub-contractor shall cooperate with the Balancing sub-contractor in the following manner:

1. Performance of pre-balancing requirements of SECTION 230100: GENERAL REQUIREMENTS.
2. Provide under his contract for at least one sheave and drive belt change per fan and for a reasonable number of additional dampers and devices required by Par. 3.03.I.2.
3. Inform HVAC Tests and Balancing Contractor of any major changes made to mechanical systems during construction.

4. Perform pressure testing of piping systems as specified herein.
- C. Requirements of Regulatory Agencies:
 1. Air balance between and within rooms in accordance with CCR Title 24, Part 4, Chapter 4.
 2. California Code of Regulations, Title 24, Part 5, California Plumbing Code.
- D. Referenced Standards:
 1. AABC - Associated Air Balance Council.
 - a. National Standards for Total System Balance.
 2. American Society of Mechanical Engineers.
 - a. ASME/ANSI B31.9 Building Services Piping.
 3. SMACNA - Sheet Metal and Air Conditioning Contractors National Association.

1.2 SUBMITTALS

- A. Shop Drawings and Product Data:
 1. Submit procedure to be followed for air and water balancing, including:
 - a. Detailed procedures.
 - b. Agenda for this project.
 - c. Report forms.
 - d. Project performance guarantee.
- B. Test Reports:
 1. Submit six copies of the balance report typed in final form.
 2. Submit six copies of balancing drawings (see Par. 3.03.1.6.).
 3. Submit a written report as necessary, describing any component, i.e., fan drive, damper, pump, valve, etc., which does not function properly.
 4. Submit air and water balance reports at least two weeks prior to the start date of the final punch list process.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Products and Materials as specified in Part 3 of this Section and related Sections.

PART 3 – EXECUTION

3.1 AIR BALANCING

- A. Study the Specifications and Drawings and prepare schedule to inspect equipment of air and water systems.
- B. Make field inspection prior to closing in portions of systems to be balanced. Verify that all work, fittings, dampers, balancing devices, etc., are properly fabricated and installed as specified or shown and that proper balancing can be done.

3.2 PREPARATION

- A. Prepare test and balancing procedures schedule, test record forms and technical information about the air and water systems necessary to balance Work.

3.3 INSTALLATION/APPLICATION/PERFORMANCE/ERECTION

- A. Test and Balance Service:
 - 1. The test and balance services shall be performed upon completion of the air handling and water systems and after completion of general operating tests described under Prebalancing Requirements in SECTION 230100: GENERAL REQUIREMENTS, and after the Work specified above.
 - 2. Upon completion of installation of air systems and after completion of prebalancing requirements, complete the balance tests, analysis and balance of the air systems.
 - 3. Recommend adjustments and/or corrections to equipment and air and water systems necessary for proper balancing and submit to the Architect.
- B. Performances and Capacity Checks: Readings shall be taken as shown, specified and as required to demonstrate that the following equipment is operating in accordance with the manufacturer's published ratings:
 - 1. Supply, return and exhaust fans.
 - 2. Air inlets and outlets: Air inlets and outlets of 200-cfm or less shall be balanced to within 10-percent of design; all other air system readings within 5-percent of design.
- C. Temperature readings shall be accurate to within 1/2-deg F.
- D. Pressure readings shall be accurate to within 0.01-inch W.G. for air systems.
- E. Where changes are made to existing supply or exhaust duct systems, it is the intent of the design, in addition to balancing the new work, to restore all existing branches of the system to the conditions measured and recorded under the Air Prebalancing paragraphs of Section 230100. To do this, the following work is required.

1. After the modification work is completed, measure the available cfm at the point of connection to the existing system. If it is not sufficient to achieve the air quantities shown in the design documents, notify the Architect who will issue instructions how to proceed.
2. After measurements indicate that adequate air quantities are available, balance the new work to the design documents.
3. After completing balancing of the new work, restore all existing branches to the air quantities measured and recorded in accordance with applicable paragraphs of Section 230100. If there are not enough dampers installed to achieve this, add the necessary balancing dampers.

F. Recorded Data:

1. All readings, measurements, and observations shall be recorded on AABC or equivalent printed data sheets and tabulated with appropriate calculations. Recorded data shall include the following:

a. Fan Performance Data:

	ACTUAL	SPECIFIED
CFM	_____	_____
RPM	_____	_____
SP+	_____	_____
SP-	_____	_____
TSP	_____	_____
Amperage	_____	_____
Voltage	_____	_____
Outside Air	_____	_____
CFM	_____	_____
Return Air	_____	_____
CFM	_____	_____
Outlet Data:		
Total CFM of		
Outlets	_____	_____
Traverse Total	_____	_____

- b. Air velocities, entering and leaving air temperatures.
- c. Main and branch duct velocities and static pressures.
- d. Velocities specified and actual, air volume factors, design and calculated air volumes of supply, return, and exhaust air outlets, size of outlets.

- e. Room temperatures.
 - f. Air balancing drawings - See Par. 3.03.I.6.
- G. Spot Checking: After the Balancing Contractor has submitted his records of final readings and measurements for all systems, the Architect may make spot checks of each system. If spot-check measurements differ materially from those submitted, the Architect will direct that the systems concerned be completely re-balanced in the presence of the Inspector and that new data be submitted. All systems shall be completely balanced and preliminary balance reports shall be submitted no later than the actual date of completion of balancing.
- H. Air Balancing:
 - 1. Air balancing procedures, methods and data recording and reporting shall be in accordance with the applicable portions of AABC National Standards, and as specified herein.
 - 2. Provide additional dampers and pressure plates where required to facilitate balancing and to prevent damper, grille and diffuser noise. All this Work shall be done at no increase in the Contract Amount.
 - 3. Make adjustments at all diffusers and grilles to prevent drafts at the occupant level in the space. Portions of the diffusers and grilles shall be blanked behind these units as directed or required or blades shall be redirected in order to prevent or remove drafts.
 - 4. As part of the air balancing procedure, positive or negative pressure relationships between supply and exhaust CFM shall be achieved in spaces where required by code.
 - 5. All other rooms which are both supplied and exhausted shall be in balance (no difference between supply and exhaust), unless otherwise shown or specified.
 - 6. The Tests and Balancing Contractor shall obtain at his expense a set of reproducible prints of screened architectural reflected ceiling plans. The Tests and Balancing Contractor shall show in each room, using appropriate uniform symbols, the following information:
 - a. A unique number next to each register, grille, or diffuser, keyed to the corresponding measurement in the written report.
 - b. Supply air (cfm) as a positive number.
 - c. If the room is negative to adjacent spaces, the amount (cfm) obtained from adjacent spaces, as a positive number. The drawing shall also show the origin of this infiltrated air, usually as a directional arrow through a door or other opening.
 - d. Return air (cfm) as a negative number.

- e. If the room is positive to adjacent spaces, the amount (cfm) leaving the room, as a negative number. The drawing shall also show the destination of this exfiltrated air, usually as a directional arrow through a door or other opening.
 - f. Exhaust air (cfm) as a negative number.
 - g. A symbol indicating the pressure relationship of the room to adjacent spaces:
 - (1) E if the room is equal in pressure to adjacent spaces.
 - (2) P if the room is positive to adjacent spaces.
 - (3) N if the room is negative to adjacent spaces.
 - h. Please note that the positive and negative numbers must add up to zero. The infiltrated and exfiltrated air for each space shall be accounted for in each adjacent space. In other words, air exfiltrated from room #1 shall show as infiltration in the adjacent room #2.
- 7. Where fans with VFD's are used, fan speeds may be adjusted to obtain scheduled flow. On completion of balancing, drive sheaves shall be changed to restore VFD to 57mhz at 100% design flow.
 - 8. Establish duct static pressure setpoints for all variable volume systems, provide this information to the controls contractor, and record this information in the Balancing Report. The setpoints shall be the lowest value possible to achieve the design CFMs.
 - 9. Provide means of adding false resistance at filter banks to simulate dirty filter pressure drops. For systems without VFDs on fans and duct static pressure controls, balance for filter loading at midpoint between clean and dirty filter pressure drops. Testing of Fire and Smoke Dampers:
 - 10. Test all fire and smoke dampers for proper operation. Test in accordance with local Fire Marshal requirements. Provide documentation of testing indicating date of test, individuals present during testing, and pass or fail for each damper and/or duct detector. System testing shall not be complete until record indicates that all dampers and/or duct detectors have passed the test.

END OF SECTION

SECTION 23 0700

INSULATION

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Provide complete systems of insulation for piping, ducts, boiler stacks and breeching, and mechanical equipment as specified.
- B. Related work specified elsewhere: This section does not include acoustic or thermal duct liner where indicated on the drawings to be applied to the interior side of ductwork or plenums. See SECTION 233100, "DUCTWORK".
- C. The intent of these Specifications is that all hot and chilled equipment, piping and other items noted be insulated. The Contractor shall carefully advise himself of the extent of all the factory insulated packaged equipment where piping and miscellaneous parts will be furnished without insulation. Provide insulation as required for all packaged equipment requiring insulation, whether furnished with equipment or not.
- D. Piping:
 - 1. Insulate all refrigeration lines where refrigerant temperatures are below 60 degrees F, including fittings, flanges, unions, and valves, except stems and operators. Insulate condensate drain lines.
- E. Ducts, Plenums, and Casings:
 - 1. Insulate heating, and air conditioning supply ducts, from the outside air intake to the room outlets. Insulate flexible runouts, plenums, casings, and air handlers. Install rigid insulation on exposed ducts in interior and outside locations. Use flexible blanket insulation on concealed interior ducts and on exposed round or oval ducts.
 - 2. Insulation shall be continuous through walls and floors except at fire dampers.
- F. Non-Insulated Ductwork, Casings, Plenums, and Housings:
 - 1. Where acoustic or thermal duct liner is indicated on the drawings.
 - 2. Return Air Ductwork: Exposed in air-conditioned spaces, Above suspended ceiling in air-conditioned spaces, or in duct shafts.
 - 3. Exhaust Ductwork.
- G. Non-insulated Equipment:
 - 1. Exhaust fans and fans handling unconditioned air.

H. Definitions:

1. Finished Spaces: Habitation or occupancy spaces where surfaces are plastered, paneled, or otherwise treated to provide a pleasing appearance.
2. Unfinished Spaces: Storage or work areas where appearance is not a factor; unexcavated spaces, crawl spaces, etc.
3. Concealed Spaces: Spaces between a ceiling and floor construction above; between double walls or furred-in areas; pipe and duct shafts, etc.
4. Exposed: Open to view inside the building (including interstitial spaces). For example, pipe run through a room, and not covered by other construction, is exposed.
5. Outside or exterior: Open to view beyond the exterior side of walls; above the roof; unexcavated or crawl spaces, above or beneath pier floors; in tunnels or exposed on all sides in trenches connected or not connected to an exterior portion of a building.

1.2 QUALITY ASSURANCE

A. Reference Standards:

1. ASTM American Society for Testing and Materials.
 - a. B 209 Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. C 195 Mineral Fiber Thermal Insulating Cement.
 - c. C 449 Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - d. C 533 Calcium Silicate Block and Pipe Thermal Insulation.
 - e. C 547 Mineral Fiber Preformed Pipe Insulation.
 - f. C 553 Mineral Fiber Blanket and Felt Insulation (Industrial Type).
 - g. C 612 Mineral Fiber Block and Board Thermal Insulation.
 - h. E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
2. CCR California Code of Regulations, Title 24
 - a. Part 6, California Energy Code.
 - b. Part 4, California Mechanical Code (CMC).

3. Federal Specifications (Fed. Spec.):
 - a. L-P-535E Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) and Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
 - b. L-T-80B Tape, Pressure-Sensitive Adhesive (Aluminum Backed).
 - c. HH-B-100B Barrier Material Vapor (For Pipe, Duct and Equipment Thermal, Insulation).
 - d. HH-I-573B Insulation, Thermal, Flexible Unicellular Sheet and Pipe Covering.
4. UL Underwriters Laboratory, Inc.

1.3 SUBMITTALS

- A. Product Data:
 1. Submit manufacturer's data on the following:
 - a. Insulation Materials.
 - b. Jackets and casings.
 - c. Adhesives, mastics and coatings.
 - d. Fastening Devices.
 - e. Vapor Barriers.
 - f. Material Safety Data Sheets (MSDS) shall be submitted for all insulation materials including adhesives, cements and finishing materials.
 - g. Proof of California Quality Standards Certification.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Manufacturer's Stamp or Label: Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to the project site for use must have the manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material. Insulation packages and containers shall be marked "asbestos-free."
- B. All insulation materials subject to regulation under CCR Title 24, Part 6, shall meet the requirements of Section 123 and 124, and Table 123-A, and shall be so certified. Submit proof of certification.

- C. Fire Resistance: Insulation, adhesives, vapor-barrier materials, and other accessories, except as specified herein, shall be noncombustible. Materials shall not have a flame-spread rating more than 25 and a smoke-developed rating not more than 50 in accordance with UBC Standard 42-1, except for flexible unicellular insulation which, in thickness greater than 1/2-inch, may have a smoke-developed rating not to exceed 100.
- D. Materials Tests: Test factory-applied materials assembled. Field-applied materials may be tested individually. UL label, or satisfactory certified test report from an approved testing laboratory, will be required to show that fire hazard ratings for materials proposed for use do not exceed those specified. Flame-proofing treatments subject to deterioration due to effects of moisture or high humidity are not acceptable.
- E. Piping Insulation:
 - 1. Flexible unicellular: Fed. Spec. HH-I-573B, for temperature range from -40 degrees to +180 degrees F.
 - a. Use for refrigeration piping and elsewhere where specified.
 - b. Minimum Density: 5.5 lbs./cu.ft.
 - c. Thermal Conductivity: 0.28 K factor at 75 degree F.
 - d. Rubatex, Armaflex, or equal.
- F. Ductwork, casings, housings, plenums, breeching and equipment insulation: Shall conform with the referenced publications. Temperature ranges and densities in pcf shall be as specified.
 - 1. Fiberglass Duct Wrap: Fiberglass blanket with foil reinforced kraft (FRK) paper vapor barrier; 250 degrees F. maximum; 0.24 Btu/in/hr/sq.ft./degree F. at 75 degree F. mean temperature with 25% compression. Owens Corning Type ASW with FRK facing; Certain-Teed or equal.
 - 2. Flexible Mineral-Fiber Blanket: ASTM C 553, Type I (flexible resilient), up to 1000 degrees F, 0.28 Btu/in/hr/sq.ft./degree F. at 100 degree F. mean temperature. Owens Corning TIW Type I; Certain-Teed or equal.
 - 3. Rigid Mineral-Fiber: ASTM C 612, board type, to 450 degrees F, 3 pcf, foil reinforced kraft facing or all-service jacket facing. Owens Corning Type 703 with FRK jacket; Certain-Teed or equal.
 - 4. Mineral Fiber Block: ASTM C 612, semi rigid, bonded fiberglass fibers, 850 degrees F. maximum; 3.0 pcf; 0.23 Btu/in/hr/sq.ft./degree F. at 75 degree F. mean temperature. Owens Corning Insul-Quick; Certain-Teed or equal.

- G. Insulation Jackets:
1. Vapor-Barrier Material: HH-B-100, Type I. Material shall be resistant to flame and moisture penetration and not support mold growth. Provide foil reinforced kraft facing in concealed locations. Provide vapor-barrier material all service jacket on insulation in exposed locations with a white surface suitable for painting without sizing. Lamtec 70JASJ or approved equal.
 2. Aluminum Jackets: ASTM B 209, Temper H14, 0.016 inch thick, smooth. Do not use on calcium silicate surfaces or surfaces above 200 degrees F operating temperature. Pabco-Childers Aluminum Roll Jacketing for straight piping and Pabco-Childers Sure-Fit for elbows, or approved equal. Secure in place with Childers Fabstraps, Pabco Pab-Bands, or approved equal.
 3. Weatherproof: Aluminum jacket, ASTM B 209, minimum 0.016-inch thick, moisture barrier adhered to inside face. Fabricate and install jacketing with a continuous modified Pittsburgh Z-Lock on the longitudinal seam. Seal each butted section of jacketing with a butt strap containing high temperature sealant and secure with Childers Lock-On, Pabco Z-Lock, or approved equal.
 4. PVC Jackets: (limited to indoor piping only). Fed. Spec. L-P-535, Composition A, Type II, Grade GU. One-piece premolded plastic covers for fittings, flanges, and valves. Zeston, Speedline, or approved equal.
- H. Removable/Reuseable Insulation: Shall be one or two piece design with silicone coated fiberglass cloth liners, minimum of 1/2-inch thick fiberglass insulation, and a weather barrier of teflon coated fiberglass. Sewing thread shall be teflon coated fiberglass. Quilting pins shall be used to prevent shifting of insulation. Covers shall have rain flaps and straps with stainless steel double buckles or Velcro fasteners. Johnson Energy Products, Accessible Products Co., or approved equal.
- I. Adhesives, Sealants, Coatings and Compounds: Shall be compatible with materials to which applied and suitable for the service. Shall comply with South Coast Air Quality Management District VOC regulations (SCAQMD Rule #1168, effective date of July 1, 2005, rule amendment date of January 7, 2005).
1. Vapor-seal and Fiberglass Insulation Adhesive: Foster Quick Tack 85-60 or approved equal, ASTM C 916, Type II. U.L. Label. Adhesive shall meet California Dept of Public Health (CDPH) Standard Method Ver. 1.1, 2010 Small Scale Environmental Chamber Test for VOCs. for CA Specification 01350.
 2. Lagging Adhesive: Fosters 30-36 or equal, U.L. Label
 3. Insulation Cement: ASTM C 195, mineral fiber, thermal conductivity 0.85 max. at 200 degrees F mean when tested per ASTM C 177. Fibrex, Pabco, or approved equal

4. Vapor Barrier Coating: Foster 30-65, Childers CP-34 or approved equal, U.L. Label, (indoor only above 60 degrees F). Permeance shall be 0.03 perms or less at 45 mils dry as tested by ASTM E96. Coating shall meet California Dept of Public Health (CDPH) Standard Method Ver. 1.1, 2010 Small Scale Environmental Chamber Test for VOCs. for CA Specification 01350.
 5. Weather Barrier Breather Mastic: Childers Vi Cryl CP-10/CP-11, Foster Weatherite 46-50, Eco Mastic 55-50 or approved equal
 6. Reinforcing Mesh: Childers Chil Glas #10; Foster Mast a Fab or approved equal.
 7. Metal Jacketing Sealant: Childers CP-76; Foster 95-44 Tite-fit 30-35, or approved equal, U.L. Label, (indoor only above 60 degrees F).
 8. Adhesive for Flexible Unicellular insulation: Rubatex R-373, Armstrong 520 or approved equal.
- J. Accessories:
1. Staples: Corrosion-resistant outside-clinch type. Bostitch, Duo-Fast or approved equal.
 2. Insulation Bands: ¾-inch wide; 0.018-inch stainless-steel or 0.020-inch aluminum. Band-It, Houdaille, or approved equal.
 3. Bands for Metal Jackets: 3/8-inch minimum width; 0.018-inch stainless-steel or 0.020-inch aluminum. Pabco-Childers or approved equal.
 4. Wire: Minimum 16-gauge stainless steel or copper-clad annealed steel wire.
 5. Anchor Pins: Anchor pins, clips and speed washers; AGM Industries, Accessible Products, or approved equal.
 6. Aluminum-Foil-Backed Pressure Sensitive Adhesive Tape: Fed. Spec. L-T-80, 50 degrees F max. and limited to use on insulation with factory-applied jacket with aluminum foil facing. Venture Tape, Compac Corp. or approved equal.
 7. Vapor-Barrier Material Tape: Fed. Spec. HH-B-100, Type I, pressure sensitive adhesive backed, Lamtec 70JASJ, Ideal Tape Co. or equal.
 8. Glass Cloth and Tape: Childers No. 10, J.P. Stevens Glass-Tex, open weave, white color cloth.

PART 3 – EXECUTION

3.1 INSTALLATION/APPLICATION/ERECTOR

A. General:

1. During the installation and when putting insulated systems into service, the contractor shall observe all instructions, recommendations, and Cautions issued or published by the insulation materials manufacturers.
 2. Preparation: Do not apply insulation until surfaces to be covered have been leak tested, have had rust and scale removed, and have been cleaned, dried, and inspected.
 3. Application: Insulation shall be clean and dry when installed and kept dry during finish application. Wetted insulation will not be approved for installation. Install materials neatly with smooth and even surfaces with jackets drawn tight and smoothly cemented down on longitudinal and end laps. Scrap pieces shall not be used where a full-length section will fit. All surface finishes shall be extended to protect all surfaces, ends, and raw edges of insulation. Coatings and adhesives shall be applied at the manufacturer's recommended coverage per gallon.
 4. Name Plates and Access Plates: Do not insulate name plates or ASME labels. Bevel insulation around name plates and ASME stamps.
 5. Calcium Silicate: Do not install on aluminum surfaces.
- B. Piping:
1. Provide insulation of thickness specified for the applicable temperature and service in accordance with California Energy Code. Installed insulation thickness shall exceed required code thickness by 10% (minimum).
 2. Where vapor barrier jacket on piping with liquid of less than 60 deg F is stapled or punctured, the jacket shall be brush-coated with vapor-barrier coating. Adhesive or coating is not required on hot piping jackets when staples are used.
 3. Finish for Outdoor Locations: Weatherproof aluminum jacket. Coat all seams with metal jacketing sealant to prevent water entry.
 4. Flexible Unicellular Insulation: Temperature range minus 30 to plus 220 degrees F. Flexible unicellular insulation shall not be used in pipe chases and fire walls, nor penetrate fire walls. Use an adhesive recommended by insulation manufacturer and apply in accordance with manufacturer's published instructions. Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Vapor seal unicellular insulation to piping in accordance with manufacturer's instructions. Do not apply unicellular insulation in multiple layers.
 5. At Pipe Hangers:
 - a. Insulation protection saddles and shields are specified in SECTION 230500, "BASIC MATERIALS AND METHODS". Tape all butt joints where insulation butts against hanger shield. On hot piping, apply 3-inch wide canvas strip dipped in lagging adhesive

over butt joints.

b. Embed no hangers in insulation.

C. Ductwork, Casings, Plenums:

1. Where ducts run in groups too close to be individually insulated and finished, completely fill all spaces between ducts with rigid or flexible insulating material and insulate the group of ducts as one duct.
2. Where ducts cannot be insulated after erection, insulate prior to installation.
3. Access Plates and Doors: On internally insulated ducts, plenums, and casings, continue insulation on access plates and doors. Bevel insulation around access plates and doors. For externally insulated ducts provide duct access doors as per 233100 Ductwork and terminate the covering neatly at the ends around the access door using channels and vapor barrier taping.
4. Rigid Insulation: Use in Mechanical Rooms and exposed locations. Secure rigid insulation by impaling over pins or anchors located not more than 3 inches from edge of boards and spaced on not more than 18-inch centers; secure with washers and clips. Spot-weld anchor pins or attach with an approved waterproof adhesive especially designed for use on metal surfaces. Each pin or anchor shall be capable of supporting a 20-pound load. Protruding ends of clips shall be cut off flush after clips are secured and sealed with aluminum backed pressure sensitive tape and coated with vapor barrier coating. Apply insulation with joints tightly butted. Where vapor barrier is specified, all joints, breaks, punctures, and voids shall be filled with vapor barrier coating and covered with vapor seal material identical to that surrounding.
5. Flexible Duct Wrap Insulation: Use in all concealed locations. Apply over clean, dry sheet metal ductwork that has been sealed air-tight at all seams and joints. Install to allow maximum fullness at corners (avoid excessive compression). Minimum thickness at corners is 1-inch. Butt insulation tightly at joints; vapor barrier facing shall be overlapped a minimum of 2-inches. Staple all seams approximately 6-inches on center with outward clinching staples, then seal with a foil vapor barrier tape, and vapor barrier coating. When ducts are over 24-inches in width, the duct wrap shall be additionally secured to the bottom of rectangular ducts with mechanical fasteners spaced on 18-inch centers, maximum, to prevent sagging of insulation. Seal penetration of facing to provide a vapor tight system.
6. Insulation Thickness:
 - a. Fibrous glass blanket, foil-scrim-kraft facing. Thickness: 1-1/2 inches for concealed ductwork, 2-inch where required by the California Energy Code, including but not limited to:
 - (1) Outdoors;

- (2) In space between the roof and an insulated ceiling;
 - (3) Unconditioned spaces.
 - b. Fibrous glass board, 3-pound density, foil-scrim-kraft facing, vapor sealed. For ductwork plenums and casings exposed to view:
 - (1) Match sizes of reinforcing and connecting angles. Verify sizes of angles in field: Minimum 1-inch thick.
 - (2) In General:
 - (a) To 42-Inches Wide: 1-inch.
 - (b) 43-Inches Wide and Over: 1-1/2-inches.
- D. Equipment:
 - 1. Equipment Insulation Thicknesses:
 - a. Mineral fiber block: 1-1/2 inch minimum.
 - b. Flexible unicellular: 3/4-inch.
 - c. The specified insulation thicknesses for equipment shall be increased where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface.
- E. Insulation Finish:
 - 1. Provide Fed. Spec. HH-B-100, Type I, vapor barrier covering for piping and ducts. Vapor barrier surfaces shall be suitable for painting.
 - 2. Cold Piping, Ducts and Equipment:
 - a. Insulation on pipe, Fittings, flanges, elbows, and irregular surfaces shall be finished the same as hot piping with special care taken to seal all joints including butts to ensure a continuous vapor barrier. On insulated cold fittings and valves, coat the insulation with vapor barrier coating and reinforcing mesh to prevent moisture ingress.
 - 3. Insulated piping exposed to weather shall be provided with weatherproof aluminum jacket; seamed to insulation with aluminum or stainless steel bands. Coat all seams with metal jacketing sealant to prevent water entry.
 - 4. Insulated Ducts Exposed to Weather. Provide:
 - a. 2-inch internal lining (see 233100, DUCTWORK).

END OF SECTION

SECTION 23 3100

DUCTWORK

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. Work includes air distribution and collection system including appurtenances.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 230100: General Requirements.
- B. Section 230500: Basic Materials and Methods.
- C. Section 230529: Supports and Anchors.
- D. Section 230548: Noise, Vibration, and Seismic Control.
- E. Section 230913: Building Management System.
- F. Section 230593: Testing & Balancing.

1.3 QUALITY ASSURANCE

- A. Design Criteria: Contribution to noise level not to exceed NC 33 except in service and equipment spaces.
- B. Flexible Fabric Connector Material and Flexible Duct: Shall meet the requirements of NFPA Standards Nos. 90A and 90B.
- C. Flexible Fibrous glass duct liner: shall comply with NFPA 90A/90B and ASTM C1071.
- D. Fire Dampers: Approved and listed by California State Fire Marshal.
- E. Flexible Ducts: Underwriter's Lab. 181 Class 1.
- F. Combination Fire and Smoke Dampers: Leakage rated per UL 555S and approved by the California State Fire Marshal.
- G. Referenced Standards - The latest editions of specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this section where cited below:
 - 1. Adhesive and Seal Council - ASC - 7100C Standard for Adhesives for Duct Liner.
 - 2. CCR - California Code of Regulations, Title 24, Part 4, California Mechanical Code:

- a. Chapter 6, Duct Systems.
- b. Standard 6-2, Galvanized Sheet Metal
- c. Standard 6-6, Standard for Metal Ducts
- 3. SMACNA - Sheet Metal and Air Conditioning Contractors National Association:
 - a. HVAC Duct Construction Standards, Metal and Flexible, Third Edition, 2005 with Addendums.
 - b. Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems, Fourth Edition, 1992.
 - c. HVAC Systems Testing Adjusting and Balancing.
 - d. HVAC Air Duct Leakage Test Manual 1st Edition.
- 4. NFPA - National Fire Protection Association:
 - a. NFPA 90A, Installation of Air Conditioning and Ventilating Systems
 - b. NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
 - c. NFPA 96, Ventilation Control and Fire Protection of Commercial Cooking Operations.

1.4 SUBMITTALS

- A. Submit large-scale drawings in accordance with the requirements of Section 01300, "SUBMITTALS" and as follows:
 - 1. Fully coordinated 1/4-inch scale dimensioned duct layout drawings of all mechanical rooms, riser elevations, and floor plans, giving complete dimensions for location, elevation, and clearance, showing work of all other Sections and Divisions. Layout drawing shall be prepared with architectural floor plan and ceiling grid background indicating room numbers, ceiling heights, location and elevations of structural components, light fixtures, all piping and other equipment.
- B. Method of attachment of duct hangers to building construction.
- C. Product Data: Submit duct material, shape, gauge, type of joints and duct reinforcing for each size range, for joints, method of fabrication and reinforcing. Submit acoustic lining, duct access doors, duct fitting construction detail, duct sealant, flexible connection and plenum construction detail. Submit manufacturer's catalog data sheets for air distribution and other devices.
- D. Sample round welded duct fitting.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Sheet Metal:

1. Black or Galvanized Steel as specified:
 - a. Per California Mechanical Code (CMC) Section 602.
 - b. Cold rolled steel sheets, lock forming quality meeting ASTM A-924 A-653/A-653M.
 - c. Where paint is to be applied, prepare galvanized steel surfaces per ASTM D2092.
2. Stainless Steel Sheets, ANSI Type 316 (type 316L for welded applications), 2B finish.
3. Lead Sheets: Federal Specification QQ-L-301a, Grade C., 6 millimeters thick.
4. Aluminum sheets: ASTM B209, maximum 0.4 percent copper. Provide mill-finish commercial sheets; 16,000 pounds per square inch minimum strength.

B. 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, with two (2) removable nuts each end for positioning and locking rod in place. Unless galvanized or cadmium plated, provide a shop coat of red lead or zinc chromate primer paint.

C. Miscellaneous Fasteners and Upper Hanger Attachments:

1. Sheet Metal Screws: Zinc coated, with organometallic polymer thermoset corrosion resistant coating similar to Climaseal by ITW Buildex.
2. Machine Bolts and Nuts: Galvanized or cadmium plated steel.
3. Concrete Inserts: Steel or malleable iron of the continuously slotted type of Universal inserts.
4. Welding Studs: DSM Products, capacitor discharge, low carbon steel, copper flashed.
5. Self-Drilled Expanding Fastener: Phillips type.
6. Expansion Shields: per Section 230529.

7. Electrically operated tools for installing welded studs and fasteners shall be listed by a nationally recognized test agency.

- D. Flexible Duct Liner: Fibrous glass duct liner, acrylic surface treatment on air side. Manville Permacote Linacoustic (no known equal). Liner for round ducts shall be performed round fiber glass, Manville Permacote Spiracoustic (no known equal). Coat duct liners with an EPA registered fungicide that prevents the growth of mold, fungus or bacterial. When tested in accordance with ASTM C1338, UL 181 or ASTM G21 there shall be no growth of mold, fungal or bacterial.

1. Except where shown otherwise duct liner shall be 1" thickness.
2. Minimum sound-absorption coefficients (ASTM C423 Mounting Type A) for sound-absorbing duct lining material for rectangular ducts:

	Octave Band Center Frequency, HZ					
	125	250	500	1000	2000	4000
1" thickness lining, 2.0-3.0 pcf density	.09	.31	.67	.91	1.01	.98
1.5" thickness lining, 2.0-3.0 pcf density	.21	.53	.90	1.03	1.01	1.00
2" thickness lining, 2.0-3.0 pcf density	.20	.57	1.02	1.03	1.02	1.03

3. Minimum sound-absorption coefficients (ASTM C423 Mounting Type A) for sound-absorbing duct lining material for round ducts:

	Octave Band Center Frequency, HZ					
	125	250	500	1000	2000	4000
1" thickness lining, 2.0-30 pcf density	.05	.21	.71	1.01	1.07	1.04
1.5" thickness lining, 2.0-3.0 pcf density	.10	.39	1.02	1.08	1.04	1.00

- E. Flexible Connections - Fabric:

1. Provide UL listed Glass fabric weighing a minimum of 24-ounces per square yard coated on both sides with DuPont Hypalon inorganic elastomeric material, suitable for indoor/outdoor use, similar to "Durolon" as manufactured by Duro Dyne Corporation.
2. Fabric and metal shall be joined by means of a double lock seam of pre-fabricated, pre-assembled fabric connectors with minimum No. 24 USS gauge metal edges similar to "Metal-Fab" as manufactured by Duro Dyne Corporation or approved equal, with double-lock gripping fingers of metal-to-fabrics similar to "Grip-Loc" as manufactured by Duro Dyne Corporation, or approved equal.

F. Flexible Duct:

1. Provide duct of dual element construction consisting of a corrosion resistant galvanized steel support spiral, mechanically locked to reinforced coated glass fabric, conforming to California Mechanical Code/Uniform Mechanical Code Standard 6-5, Class 1.
2. Factory insulate the flexible duct with fiberglass insulation with an R value of not less than 4.2 at a mean temperature of 75 deg. F. Provide an internal impervious liner to separate the insulation material from conditioned air stream.
3. Cover the insulation with a fire retardant metalized vapor barrier jacket reinforced with crosshatched scrim having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E96.
4. Flexible ductwork shall have internal working pressure rating of 6 in.wg. positive and 2 in.wg. negative, be rated for 4000 fpm and a temperature range of -20 deg F to 250 deg F.
5. Acoustical insertion loss of a 10 foot length of straight flexible duct, when tested in accordance with ASTM E477 at a velocity of 2500 fpm shall be not less than:

Octave Band	2	3	4	5	6	7
Hz	125	250	500	1000	2000	4000
6" dia	7	31	40	38	40	27
8" dia	13	29	36	35	38	22
12" dia	21	28	29	33	26	12

6. The self generated sound power levels (LW) dB re 10-12 Watt of a 10 foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed:

Octave Band	2	3	4	5	6	7
Hz	125	250	500	1000	2000	4000
6" dia	42	31	23	18	17	21
8" dia	41	34	27	19	18	21
12" dia	54	45	38	31	28	23

2.2 FABRICATION AND MANUFACTURER

- A. Ducts, plenums, flashings, and other duct appurtenances shall be fabricated of prime galvanized steel and shall conform to the construction standards of the CMC Chapter 6 and Appendix A, and in accordance with current SMACNA Duct Construction Standards and SMACNA pressure classification and seal classes listed for ductwork systems involved.

1. Rectangular ductwork:
 - a. ± 1 inch WG Class with Seal Class C: Supply air ductwork downstream of terminal boxes.
 - b. ± 2 inches WG Class with Seal Class B: Return air ductwork and general exhaust ductwork not used for smoke exhaust.
 - c. ± 3 inches WG Class with Seal Class A: Constant volume or variable volume supply air ductwork.
 - d. ± 4 inches WG Class with Seal with Seal Class A: Return and exhaust air ductworks used for smoke exhaust.
 - e. ± 5 inches WG Class with Seal Class A: Hazardous exhaust systems for hoods and safety cabinets.
2. Gauge reduction permitted for cross broken ducts. Beaded ducts permitted only if approved by enforcing agency and any duct with wall vibration exceeding .05 inches during operation is retrofitted with stiffening angle.
- B. Round and flat oval ducts shall be used where shown. Round duct transverse joints shall be beaded sleeve, up to 24" diameter and bolted angle rings or "Spiralmate" formed angle and closing ring, secured to duct with screws, for ducts greater than 24" diameter.
- C. Longitudinal joints shall be Pittsburg lock. Button punch snap locks may be used if sealed by injection of Ductmate 5511M Sealant into the button punch snaplock seam. No "S" slip or drive slip transverse joints shall be used. Transverse joints shall be pocket locks. "Ductmate" system joints may be used in lieu of pocket locks.
- D. Round and Oval Ductwork
 1. SMACNA Pressure Classification positive or negative 2 in. w.g., with Seal Class B, for general use.
 2. SMACNA Pressure Classification negative 4 in. w.g., with Seal Class A, for ductwork used in smoke exhaust ductwork.
 3. Factory or shop fabricate interlocking spiral lockseam duct, without external standing rib upstream of volume control boxes, with external rib downstream of boxes and for single branches of return air duct system.
 4. Prefabricated Fittings:
 - a. Site fabricated fittings and saddle taps not permitted.
 - b. Same manufacturer as duct.

- c. Continuously welded seams, except downstream of pressure regulating volume control dampers where spot welds on 1" centers are allowed.
- d. Die stamped elbows for 8 inches or smaller. Optionally to 12-inches diameter.
- e. Elbows larger than 8 inches.
 - (1) 2 gores - less than 35 degrees.
 - (2) 3 gores - 36 degrees through 71 degrees.
 - (3) 5 gores - over 71 degrees.
- f. "Spin-in" round taps into rectangular ducts to be conical with welded seams.
- g. Tee and cross fittings to have conical branches.
- 5. Not acceptable:
 - a. Corrugated or flexible metal duct.
 - b. Duct or fittings not of quality equal to sample.
 - c. "Spin-in" round taps connecting to rectangular ducts except where branch flow is less than 15% of flow in rectangular duct.
 - d. Adjustable elbows.
 - e. Site fabricated fittings and saddle taps.

2.3 REGISTERS AND GRILLES

A. Acceptable Manufacturers

- 1. Titus
- 2. EH Price
- 3. Nailor
- 4. Krueger

B. Grilles and Registers: (See Schedule on Drawings)

- 1. Unless otherwise shown or specified, fabricate all grille and register faces and frames of steel or aluminum with a factory-applied finish as follows:
 - a. For installation in gypsum board, hard plaster or acoustic plaster ceilings specified to be painted, finish shall be a factory-applied white baked enamel.

- b. For installation in walls, specified to be painted, finish shall be factory applied white baked enamel.
 - c. For acoustic tile ceilings, provide factory applied white baked enamel.
- 2. Provide frames for each grille and register except as follows:
 - a. Grilles and registers installed directly in exposed uninsulated ductwork.
 - b. Grilles or registers specifically designed for installation in suspended lay-in tile ceilings or suspended combination lay-in and splined tile grid ceilings.
- 3. Supply Grilles except where otherwise scheduled: Provide adjustable, double-deflection type, consisting of a heavy formed face, with rear bars or vanes installed in a No. 20-gauge frame of the same material as the bars or vanes. Install face bars and rear bars or vanes on nominal 0.75-inch centers, individually adjustable and front pivoting to any desired setting.
- 4. Exhaust Grilles except where otherwise scheduled: Provide 35-degree or 45-degree fixed single deflection type, consisting of a heavy formed face with horizontal face bars on nominal 0.75-inch centers, installed in a No. 20-gauge frame of the same material as the bars.
- 5. Supply Registers: Provide assembly consisting of a register face and damper assembly. Provide register face of the adjustable double deflection type consisting of a heavy formed face, with rear bars or vanes installed in a No. 20-gauge frame, of the same material as the bars or vanes, with the face and rear bars or vanes on nominal 0.75-inch centers; individually adjustable and front pivoting to any desired setting. Provide damper assembly of the opposed multiblade type consisting of a frame, blades and a key operated movement of the locking type, with the operator projecting through the frame. Provide operators which are removable or permanently secured in place, as directed. Damper may be omitted on individual branches with remote duct damper.
- 6. Exhaust Registers: Provide complete assembly consisting of a register face and a damper assembly. Provide register face of 35-degree fixed single deflection type, consisting of a heavy formed face with horizontal face bars on nominal 0.75-inch centers, installed in a frame of the same material as the bars. Provide damper assembly of the opposed multi-blade type consisting of a frame, blades and a key operated movement of the locking type, with the operator projecting through the frame. Provide operators which are removable or permanently secured in place, as directed. Damper may be omitted on individual branches with remote duct damper.

- C. Frames for Registers and Grilles:
 - 1. Provide frames fabricated from a minimum of No. 20-gauge extruded aluminum, to match the material and finish of the grille or register face required to be installed in same, with interlocked and mechanically staked corner joints. Furnish frames complete with felt or sponge rubber gaskets, except when they are used as plaster stops on all four sides.
- D. Air Diffusers:
 - 1. Provide diffusers of the circular, square, rectangular, or linear type as scheduled. Do not use neck or duct connection sizes shown to size diffusers.
 - 2. Ceiling diffusers shall be of the high-induction type with removable core and trim. Finish same as grilles and registers.
 - 3. Provide all branch ducts to grilles and diffusers complete with volume dampers. Where it is not possible to install volume dampers in ducts, provide grilles and diffusers fitted with opposed blade, key-operated dampers located directly behind the grille or diffuser. Furnish 2 keys for each type of operator.
 - 4. Grilles and diffusers shall be constructed so that the connection to the duct may be taped from the inside when outside is inaccessible.
 - 5. All ceiling grilles and diffusers shall be located as shown on drawings.
 - 6. Where substitutions are offered, diffusers shall be sized for the air quantities and location shown and shall provide a maximum air velocity of 50 feet per minute at a level of six feet or less above the floor without exceeding noise level of specified diffuser.
 - 7. Ceiling plaque registers will not be acceptable as a substitution unless these units are specifically shown or specified.
 - 8. Circular, Square, and Rectangular Diffusers: Provide diffusers complete with a volume control damper except where outlet has an individual remote duct damper; and an adjustable equalizing grid. Fabricate the volume control damper and equalizing grid from same material and with the same finish as the diffuser. Diffuser shall have specially designed outer rings or rims with contours of sufficient depth below the ceiling line to minimize smudging.
 - 9. Linear diffusers to have borders of the type scheduled so as to coordinate with architectural finish.
- E. Provide concealed mounting of all grilles, registers and diffusers.
- F. Finishes and finish colors of all exposed items shall be selected by the architect unless otherwise noted.

2.4 DUCTWORK ACCESSORIES

A. Dampers:

1. Manual Volume Dampers:

- a. In rectangular branch 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. In rectangular branch ducts 9-inches high or less, provide single-blade dampers with frames of minimum 4-1/2 inch x 12-gauge material, or 3-inch wide x 22 gauge with folded angle or flange minimum 2 inch high. Fabricate all damper blades, axles, and frames of the same material as the ductwork in which they are to be installed. Blades: 16-gauge minimum. Blades to close against bead or flange or provided with edge seal. Blades in multiblade dampers: 8-inches wide maximum.
- b. In round or flat oval branches damper blade to be minimum 12 gauge to 18" major axis, 10 gauge for larger than 18", frame to be minimum 18 gauge channel, axles to be minimum 2" diameter plated steel. Flat oval dampers with major axis greater than 36 to have center mullion. Dampers to be similar to Ruskin CDR25, CD025 or United McGill SOSVH or SRSVH Type 2.

2. Duct Damper Hardware: Hardware shall be similar to Ventfabrics "Ventlock" as follows:

- a. Uninsulated Duct Dampers above accessible ceilings:
 - (1) Shaft lengths up to 18-inches:
 - (a) No. 635, 3/8-inch Dial Regulator with No. 607 gasketed end bearing.
 - (2) Shaft lengths 19-inches to 48-inches:
 - (a) No. 641, 1/2 inch Self-locking Regulator and No. 607 gasketed end bearing.
- b. Insulated Duct Dampers above accessible ceilings:
 - (1) Shaft lengths up to 18-inches:
 - (a) No. 637, 3/8-inch Dial Regulator with No. 607 gasketed end bearing.
 - (2) Shaft lengths 19-inches to 48-inches:
 - (a) No. 644, 1/2 inch Self-locking Regulator with No. 607 gasketed end bearing.

- c. Insulated and Uninsulated Duct Dampers above inaccessible ceilings: Install same rod sizes and end bearings for shaft lengths indicated in 2.4.B.1 and 2.4.B.2 above. Install No. 680 miter gear with No. 677 Concealed Damper Regulator. Regulator cover plate shall be natural zinc, prime painted to match ceiling color finish; install flush with ceiling. Submit installation details showing attachment to ceiling support structure. Alternately, a Bowden Remote Cable Controls model 270-275 by Young Regulator Company (no known equal) may be used.
- d. U-Bolt Blade Fasteners, if used, shall be: No. 615, spaced at 12-inches on-centers maximum.
- e. Provide all couplings, joints, screws, rods, linkages, etc., to complete the installation.
- f. On round and flat oval ducts bearings to be mounted on flat surface raised from duct curvature, bracket to be attached with minimum of four screws.

B. Turning Vane Assemblies:

- 1. Fabricate vane assemblies of the same material as the ductwork in which installed. Provide individual vanes of the hollow airfoil type, rigidly connected to vane rails, with the rails screwed into the duct fitting. Turning vanes on square elbows shall have 4 inch radius and installed on 3.5 inch centers. Vane length not to exceed 36-inches.
- 2. Turning vanes shall not be used in exhaust ducts.

C. 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 of the self-conforming type, of width as required by the particular flange.

D. Duct Tape and Sealants:

- 1. Hardcast CCWI-181 or Hardcast Aluma-Grip AFT-701.
- 2. Foster 32-19
- 3. Childers CP-146

E. Duct Access Doors:

1. Provide access doors with a minimum size of 20 inches by 14 inches. Provide larger size where required for access. In ducts with maximum dimension less than 14 inches, provide bolted flanged section for a section of ductwork with a minimum length of 20 inches.
2. Fabricate of the same material, finish and gauge as the ductwork in which installed, unless otherwise shown.
3. In uninsulated ducts provide folded edges on all four sides of door panels, lapping 1-inch over the outside surface of the duct, on each of the four edges of the duct opening. Provide each door with a continuous hinge and with two (2) casement fasteners for doors over 16 inches high.
4. In insulated ducts provide hollow metal doors of thickness to match insulation, fabricated from a minimum of No. 20-gauge sheet. Design lock edge of doors with a bevel of 1/8-inch in 1-inch and fill the interior hollow space with insulation, thermally equivalent to the ductwork insulation. Lap the inner face of the door over the duct opening, a minimum of 1/4-inch on all four edges of the free duct opening. Frame the duct opening for each door with a continuous 1-inch x 1-inch x 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. Provide each door with a continuous hinge and a surface type latch with inside striker for contracting inside of door framing, so as to provide a compression fit. Provide doors over 16 inches high with a minimum of two latches. Provide all doors with 3/4 inch wide sponge rubber or felt gasket, around all four sides of duct opening.
5. Provide Ruskin ADH series for 24"x24" and smaller access doors for flat ductwork, Ruskin series GPAD for larger then 24"x24" access doors and Ruskin series ADR for round ductwork.
6. Access points shall be permanently identified on the exterior by a label with letters not less than 2 inch in height per CMC Section 605.5.

F. Duct Access Door Hardware:

1. Butt Hinges: Provide galvanized steel with brass pins, approximately 2-inches x 1-1/2-inches wide for doors under 25 inches high and 3-inches x 2-inches wide for doors over 24 inches high.
2. Casement Fasteners: Steel or cast aluminum with galvanized or aluminized finish.
3. Door Latches: Ventfabrics, Inc. Ventlock 100 series for 24"x24" and smaller access doors, and Ventfabrics, Inc. Ventlock 260 series or Duro Dyne Corp. SP Series for larger than 24"x24" access doors.

- G. Fire Dampers and Combination Fire and Smoke Dampers:
1. All fire dampers and combination fire and smoke dampers shall conform to California Mechanical Code Chapter 6, Section 605, and be listed by the Office of the State Fire Marshal.
 2. Submit substantiation of California State Fire Marshal listing and installation details.
 3. Dampers operating with blades closing in any direction other than by gravity pull shall be assisted in closing by a heat resistant, reel-type stainless steel spring.
 4. Fire-damper installation is required for all ductwork which penetrates fire rated walls, floors and ceilings. Every effort has been made to show all fire dampers on the Mechanical Drawings. The Architectural Drawings indicate by symbol all such fire rated partitions. The Contractor shall verify all locations and provide fire dampers which are required but not shown on the Mechanical Drawings at no increase in the Contract Sum. Installation shall conform in all respects to the requirements of the State Fire Marshal.
 5. All fire dampers and combination fire and smoke dampers shall be rated to close against air flow at 3000 feet per minute at 4" wg pressure.
 6. Fire Dampers Inside Ducts:
 - a. Vertical and/or horizontal type dampers for installation in one or two-hour fire resistive construction shall be the folded blade type.
 - b. All fire dampers shall be mounted in a sleeve by the manufacturer, of the gauge for which it is approved.
 - c. Provide 100-percent free area dampers where fire dampers are shown, Ruskin, Air Balance, or equal, in folded blade type; Style B for rectangular ducts, Style LR for round ducts.
 7. Combination Fire and Smoke Dampers:
 - a. Combination Fire & Smoke Dampers shall be Ruskin manufacture, FSD-60 series, or equal.
 - b. Conform to UL 555S, Class 1.
 - c. Installed in factory fabricated wall sleeve.
 - d. Rectangular dampers to have hollow airfoil blades.
 - e. Actuator shall meet the following requirements:
 - (1) 120 VAC rated for 350 degree F operation, factory installed.

- (2) Sized for 125% of the required torque based on the damper size, direct coupled.
- (3) The damper assembly shall be tested for a minimum of 20,000 cycles and shall be 99% reliable when cycled once a year. Damper assemblies requiring more frequent cycling are not acceptable.

PART 3 – EXECUTION

3.1 DUCT INSTALLATION - GENERAL

- A. Installation of ducts shall conform to requirements of CMC Chapter 6, Section 603.
- B. Elbows:
 - 1. Use radius elbows in rectangular ducts unless otherwise indicated. Centerline radius shall be a minimum of 150% of duct width.
 - 2. Where space does not permit duct radius specified above, install short radius or square elbow with vanes per SMACNA duct construction standards.
 - 3. Do not use turning vanes in Grease and vapor exhausts; Fume hood exhaust; Breeching; Toilet exhaust ducts; any gravity ductwork; Clothes dryer exhaust or Hoistway vent.
 - 4. For 2 inch water gauge or above pressure class ductwork, spot weld turning vanes to duct.
- C. Install ductwork to provide maximum headroom. Properly seam, brace, stiffen, support, and render ducts mechanically airtight. Adjust ducts to suit local conditions and if necessary to accomplish this, dimensions may be changed but only after review by the Architect. Cross-sectional area shall be maintained.
- D. If beading is substituted for crossbreaking transverse reinforcing must be increased such that no panel deflection exceeds +/-5 mils, when system is operating. Beading to be at right angles to air flow.
- E. 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.
- F. Joints and Seams: Tape all plenum joints and all duct transverse joints and field formed seams air tight in accordance with CMC Chapter 6, Section 602.3. Tape shall be extended a minimum of one-inch beyond joint or seam opening. Apply tape internally in large supply plenums and externally in large exhaust plenums. Tape shall also be applied at duct connection to diffusers and grilles, and at all longitudinal button lock seams.

- G. All seams and joints in ductwork exposed to the weather shall be waterproofed by application of Foster 32-19, Childers CP-146, Hardcast CCWI-181 or Hardcast Aluma-Grip AFT-701.
- H. Where internal insulation is applied, duct sizes as shown on the Drawings shall be inside clear dimensions.
- I. Install ductwork exposed to the weather with double-sloped roof, and arrange duct support elements, to promote drainage of precipitation and prevent standing water.
- J. Notify Architect where duct dimension field changes are required in order to conform with the building structure or to avoid interfering with other trades.
- K. Provide access doors, whether indicated on the drawings or not, at the following locations:
 - 1. Fire dampers
 - 2. Smoke dampers
 - 3. Combination fire and smoke dampers
 - 4. Direct drive fans (motor and/or bearing side)
 - 5. Backdraft dampers
 - 6. Duct-mounted smoke detectors, sprinkler heads, and heat detectors
 - 7. Inlet side of sound attenuators
 - 8. All controls, sensing, processing, transmitting and actuating devices
 - 9. Duct drains
 - 10. Where access is required to assemble duct mounted devices.

3.2 HANGERS FOR DUCTS (SEE ALSO SECTION 230529 AND 230548)

- A. Install hangers for ducts as specified in the CMC Chapter 6, Section 603.3,
- B. and as follows:
 - 1. For rectangular ducts up to 42 inches wide, supported from overhead construction, extend band hangers down over each side of the duct and turn under bottom of duct a minimum of 2 inches. Secure hanger to duct with three sheet metal screws, one in the bottom and two in the side of the duct.
 - 2. Support rectangular ducts larger than 42 inches wide with trapeze hangers or Tie Reinforcement as per SMANCA standards.
 - 3. For round and flat oval ducts, see drawings for arrangement, size hangers and braces as for rectangular ducts.

3.3 UPPER HANGER ATTACHMENTS**A. General:**

1. Metallic fasteners installed with electrically operated tools may be used as upper hanger attachments, with the following exceptions:
 - a. Do not support a load, in excess of 250 pounds from any single anchor.
 - b. At areas with non-structural lightweight fill use Superstrut C-475 concrete insert welded to deck. Do not support a load in excess of 200 pounds from any single insert.

3.4 ADJUSTMENT AND CLEANING

- A. Clean ductwork inside and out before grilles are installed and before fans are operated.

3.5 DUCT LINER

- A. Install in accordance with SMACNA standards for the application of duct liner and the following.
 1. All portions of duct designated to receive duct liner shall be completely covered with liner. Transverse joints shall be neatly butted and there shall be no interruptions or gaps. The black coated side of the liner shall face the air stream. Duct liner shall be adhered to the sheet metal with 100 percent coverage of adhesive, and all leading edges and all transverse joints coated with adhesive in accordance with ASC-7001C, Foster 85-60, Childers CP-127 or approved equal.
 2. Liner shall be additionally secured in accordance with SMACNA standards with mechanical fasteners which shall compress the duct liner sufficiently to hold it in place. Cut duct liner to assure overlapped and compressed longitudinal corner joints.
 3. Provide continuous sheetmetal edge protection nosings at entering and leaving edges of lined duct sections and all joints.
 4. Where duct liner is shown on drawings for ductwork exposed to outdoor temperatures, lining thickness shall be not less than 2 inch thick.
 5. Provide 2 inch thick duct liner on all supply air and return air ductwork exposed to outdoor temperatures.

3.6 FLEXIBLE FABRIC CONNECTORS

- A. Make ductwork connections to air handling equipment with flexible fabric connectors. Install connectors so as to have sufficient slack to prevent vibration transmission.

- B. Secure fabric connectors to fans, casings and ducts as follows:
 - 1. Secure round connectors with No. 12 USS gauge x 1 inch wide galvanized steel draw bands. Secure bands with bolts and nuts.
 - 2. Secure rectangular connectors with 1 inch x 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.
- C. Fabric connectors may be factory pre-fabricated, pre-assembled units, with minimum No. 24 gauge metal edges, secured to fabric with double lock seams.
- D. Do not paint fabric connectors.
- E. Fabric connectors exposed to weather shall have a sheet metal shield to protect them from sunlight fastened to one edge of the connection.

3.7 FLEXIBLE DUCT

- A. Flexible Air Duct installation shall be in accordance with CMC Chapter 6, and length shall not exceed 10 ft. and angular deflection shall not exceed 135 degree with each turn not exceeding 90 degrees, or the minimum inside radius of one duct diameter, and not more than two bends per flexible duct.

3.8 DAMPER HARDWARE

- A. Provide all couplings, joints, screws, rods, linkages, etc., to complete the installation.

3.9 SCHEDULE

- A. See Air Distribution Device Schedule for type, size and code numbers of air outlets.

3.10 MISCELLANEOUS INSTALLATIONS

- A. Locate and install the following equipment and materials specified in other Sections of this Division. Comply with manufacturer's installation instructions, code requirements, UL listing and the requirements of local authorities.
 - 1. Backdraft and balancing dampers
 - 2. Fire, smoke, and fire/smoke dampers
 - 3. Control dampers, automatic louver dampers
 - 4. Filters
 - 5. Sound traps
 - 6. Air monitors and flow measuring devices

7. Access doors: allow for adequate length of duct to install access door for all dampers.
8. Smoke detectors, flow switches, controls and fire alarm devices
9. Pressure, temperature, humidity sensors/transmitters

END OF SECTION

SECTION 23 3400

FANS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The work of this section shall include, Centrifugal Fans and Roof Exhaust fans.

1.2 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on the elevation above sea level at the project site or as noted on the schedule.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 230100: General Requirements.
- B. Section 230500: Basic Materials and Methods.
- C. Section 230513: Motors and Motor Controllers.
- D. Section 230529: Supports and Anchors.
- E. Section 230548: Noise, Vibration, And Seismic Control.
- F. Section 230913: Building Management System.
- G. Section 230593: Testing & Balancing.
- H. Section 230800: Commissioning.

1.4 QUALITY ASSURANCE

- A. Applicator (Erector) Qualifications: All fans required under this SECTION, shall be the products of a single manufacturer.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

- A. Fan ratings shall be approved by AMCA, and shall be based upon tests performed in strict accordance with the Test Code adopted jointly by AMCA (Standard 210) and ASHRAE. Each fan shall bear, near the manufacturer's nameplate, the seal authorized by AMCA indicating that ratings are certified.
- B. AMCA Air Moving and Conditioning Association.
 - 1. Standard 210 - "Test Code for Air Moving Devices".
 - 2. Standard 300 - "Relevant Room Method for Sound Testing of Fans".

3. Standard 301 - "Method for Calculating Fan Sound Ratings from Laboratory Test Data".
4. Standard 2401 - "Fan Dimensions".
5. Standard 2408 - "Class I, II or III Construction".

1.6 SUBMITTALS

- A. Number and Form as required is SECTION 230100.
- B. Shop Drawings and Product Data: Submit manufacturer's catalog sheets, brochures, performance charts, standard schematic drawings, wiring diagrams, specifications, and installation instructions. 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. Submittals 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 gages and finishes, including color charts.
 5. Dampers, including housings, linkages, and operators.
- C. 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.
- D. Operating load at each support and weight of heaviest removable item.
- E. Operation and Maintenance Data: Furnish installation, maintenance, and operating instruction manuals, complete with parts list.
- F. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 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 gages and finishes, including color charts.

5. Dampers, including housings, linkages, and operators.

1.7 QUALITY ASSURANCE

- A. Fans shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL705) and bear the AMCA certified ratings seal for sound and air performance.
- B. 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.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- E. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions. Lift and support units with manufacturer's designated lifting or supporting points.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Fans:
 1. Loren Cook
 2. Greenheck
 3. Or approved equal

2.2 GENERAL - ALL FANS

- A. Provide fan motors in accordance with SECTION 230513: Motors & Motor Controllers. For motors in the airstream, provide TEFC type motors, unless more stringent requirements are indicated in SECTION 230513.

- B. Size motor to drive its respective fan when the fan is operating at a speed 5 percent in excess of that required to meet the scheduled fan performance. For belt driven motors include drive losses in motor selection. Drive losses used in calculations shall not be less than "Medium" as defined in AMCA publication 230-90 "Estimated Belt Drive Loss" and shall be High for high speed fans. Do not select motors within the service factor for this range.
- C. Bearings: Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy-duty regreasable ball or roller type in a cast iron pillow block housing and selected for a minimum AFBMA L50 life in excess of 200,000 hours at maximum cataloged operating speed. Provide copper lubrication leads, for lubrication of internal motors and bearings, extending to a capped termination point external to the fan casing.
- D. On fans driven by belt drive provide standard "V-groove" type oil resistant, nonsparking, and nonstatic belts with cast iron sheaves suitable for the service intended. Fan sheaves shall be non-adjustable type with removable machined bushings. Provide adjustable pitch type motor sheaves with double locking feature, to 10 percent above and below the rated fan speed. Dynamically balance sheaves with over three grooves. Provide at least two belts and sheaves each capable of carrying the entire load with one belt broken.
- E. Provide pre-formed expanded metal and sheet metal belt guards at the fan and motor shafts, for all exposed sheaves and belts. Guard shall comply with OSHA and SMACNA requirements; 0.1046 inch thick, $\frac{3}{4}$ inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short-circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
- F. Use AMCA Type A spark resistant construction for all fans handling flammable, and use explosion proof motors.
- G. Electrically ground all fans and drives.
- H. Provided threaded drain plugs at fan housing low points.
- I. Completely house fan assemblies exposed to weather in weatherproof enclosures including motor and drive.
- J. Provide fans used to exhaust grease laden vapors with motor drive and bearings completely external of air stream, and fan housings continuously welded inside and outside.
- K. Provide gasketed access doors to permit routine maintenance and inspection of motor and internal components. Inside surface of access door shall be flush with the inside surface of the fan housing.
- L. Statically and dynamically balance fan wheels/impellers at the factory and certify balance. Design all vertically mounted fans to withstand the vertical thrust loads.

- M. Provide housings with integral inlet and discharge flanges, complete with bolt holes for flexible or hard duct connections. Shop fabricate any companion flanges required for connections to sound attenuators. Companion flanges shall be rolled angles matched to both fan housing and sound attenuators.
- N. Where specified, provide parallel vane prerotation vortex vanes at the fan inlet for variable volume control. Vanes shall be steel blades supported at both ends with two permanently lubricated bearings. Variable mechanism shall terminate in single control lever with control shaft for double width fans. Furnish and install all necessary linkages and accessories required for automatic control.
- O. Coating: All steel fan components shall be coated with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint shall exceed 1,000 hour salt spray under ASTM B117 test method.

2.3 CEILING-MOUNTED VENTILATORS

- A. Description: Fans shall be ceiling, wall or inline mounted, direct driven, centrifugal exhaust fan.
- B. Construction: The fan housing shall be minimum 20 gauge galvanized steel and acoustically insulated. Blower and motor assembly shall be mounted to a minimum 14 gauge reinforcing channel and be easily removable for servicing. Motor to be mounted on vibration isolators. The outlet duct collar shall include a reinforced aluminum damper with continuous aluminum hinge rod and nylon bushings. Discharge position shall be convertible from right angle to straight through by moving interchangeable panels.
- C. Fan Wheel: Wheels shall be centrifugal forward curved type, constructed of galvanized steel. Wheel shall be balanced in accordance with AMCA Standard 204-96.
- D. Grille: A powder painted white steel grille provided as standard.
- E. Electrical Requirements: Thermal overload protection and receptacle for motor disconnect plug.
- F. Accessories:
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
 - 2. Manufacturer's standard roof jack or wall cap as required or shown on the drawings.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install fans in accordance with manufacturers' recommendations and as shown on drawings. Follow SMACNA and AMCA recommendations for fan installations, belt guards, duct connections, etc.
- B. Install fans and motors with proper support and vibration isolation as specified in SECTION 230548: Noise, Vibration and Seismic Control.
- C. Install units with adequate clearances for service and maintenance.
- D. Make final duct connections with flexible connectors. Provide sufficient separation of ductwork, plenum panels, or air handling unit casings from fan assembly to prevent metal-to-metal contact due to start-up torque or operating under specified isolator deflections.
- E. Provide sufficient clearances around fans for access and servicing of components. Install fans such that tachometer openings, access doors, motors, belts, lubrication lines, electrical connections, etc. are readily accessible and not obstructed by other installations or structures.
- F. 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 and UL 486B.

3.2 FIELD QUALITY CONTROL

- A. Equipment Startup Checks:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connection to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Verify lubrication for bearings and other moving parts.
 - 6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 7. Disable automatic temperature-control operators.

- B. Starting Procedures:
 - 1. Energize motor and adjust fan to indicated rpm.
 - 2. Measure and record motor voltage and amperage.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Shut unit down and reconnect automatic temperature-control operators.
- F. Refer to Section 230593: Testing, and Balancing for testing, adjusting, and balancing procedures.
- G. Replace fan and motor pulleys as required to achieve design airflow.

3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension and check drive alignment and lubricate bearings.

3.4 CLEANING

- A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris.
- B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

END OF SECTION

SECTION 23 4000

AIR FILTERS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. The work of this section shall include, but is not limited to, the following:

1. Air filters, filter housing and gauges.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230519: Instrumentation

B. Section 230913: Building Management Systems (BMS)

1.3 QUALITY ASSURANCE

A. Reference Standards:

1. ASHRAE Standards 52.1-1992 and 52.2-2007.
2. Underwriter's Laboratory: U.L. 900.
3. CCR Title 24, 2016 Edition:
 - a. Part 4 (California Mechanical Code)
 - b. Part 12 (Referenced Standards Code), Chapter 12-71

B. Design Criteria:

1. Air flow not to exceed rated capacity at specified efficiency.
2. Initial and final resistance not to exceed scheduled values.

1.4 SUBMITTALS

- A. Product Data: Submit for all items in accordance with requirements of SECTION 230100, GENERAL REQUIREMENTS.
- B. Submit manufacturer's name and catalog data, installation data, capacities and pressure drop.
- C. Materials of Construction.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Ship equipment in its original packages Perform all handling and shipping in accordance with manufacturer's recommendations.

- B. Provide protective coverings at the factory to prevent damage to the units or entrance of foreign matter during shipping or construction.

PART 2 – PRODUCTS**2.1 ACCEPTABLE MANUFACTURERS**

- A. Filters:
 - 1. Camfil Farr.
 - 2. American Air Filter.
 - 3. Eco-Air.
- B. Miscellaneous:
 - 1. Air Filter Gauges – Dwyer, Ashcroft, or approved equal.

2.2 MATERIALS

- A. Filter Cartridges:
 - 1. Filters:
 - a. Provide replaceable, factory-assembled filters with microfine glass laminated to a reinforcing backing to form a uniform lofted media blanket. The media blanket shall be formed into uniform radial pleats and supported by a non-metallic stiffened media backing. The media shall be mechanically and chemically bonded to the inside periphery of the enclosing frame to prevent air bypass.
 - b. Construct the non-metallic enclosing frame of multiple laminate layers that shall be resistant to high humidity and maintain a rigid and durable enclosure.
 - c. Filter shall be capable of withstanding 10" w.g. air pressure without failure.
 - d. Provide 2 inch deep filter as manufactured by Camfil Farr Riga-Flo or equal, MERV 8 efficiency as per ASHRAE Standard 52.2-2007 and 30-35% dust spot efficiency as per ASHRAE Standard 52.1-1992, U.L. Class 1 listed.
 - e. Initial pressure drop shall not exceed 0.65-inch WG at 500-fpm face velocity. Final pressure drop shall not exceed 1.5 inch WG.
 - 2. Spare Cartridges:
 - a. Install new filter cartridges immediately prior to acceptance. In addition, furnish one (1) additional complete set of new filter cartridges for each filter bank on completion and acceptance of the Work.

PART 3 – EXECUTION

3.1 INSTALLATION/APPLICATION/PERFORMANCE/ERECTION

- A. Joints between holding frames of filters and enclosures shall be gasketed, caulked, and sealed against any air leakage.
- B. Filter gauges to be installed across each filter bank, mounted where directed.

3.2 FIELD QUALITY CONTROL

- A. Filter cartridges shall be capable of easily being loaded or unloaded through side access doors. Maintain necessary clearance for changing filters.

3.3 ADJUSTMENT AND CLEANING

- A. Supply fans shall not be operated unless filters are installed, including prefilters. When the final pressure drop of the prefilters reaches .5-inch wg during construction, replace them with a new set.
- B. Deliver the spare set to the Owner at the time of acceptance.

3.4 SCHEDULE

- A. See air filter schedule on Drawings for additional filter model numbers, air quantity, and sizing data.

END OF SECTION

SECTION 23 7213

AIR TO AIR ENERGY CORE VENTILATOR FOR OUTDOOR OR INDOOR INSTALLATION

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes Air-to-Air Energy Core Ventilators for indoor installation.
- B. Related sections include the following:
 - 1. Section 22 00 00: Scope of Work
 - 2. Section 22 01 00: General Provisions
 - 3. Section 22 07 00: Insulation
 - 4. Section 22 10 00: Plumbing
 - 5. Section 23 09 00: Controls and Instrumentation
 - 6. Section 23 00 00: Electrical

1.2 SUBMITTALS

- A. Product Data: For each type or model include the following:
 - 1. Blowers shall be AMCA certified for airflow.
 - 2. Energy core performance data for both summer and winter operation.
 - 3. Motor ratings, electrical characteristics and motor and fan accessories.
 - 4. Material types and gauges of all component pieces and assemblies.
 - 5. Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
 - 6. Estimated gross weight of each installed unit.
 - 7. Installation, Operating and Maintenance manual (IOM) for each model.
 - 8. Remote Control Panel description to include all functions
 - 9. Color chart including a palette of available standard paint finishes.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain unit with all appurtenant components or accessories from a single manufacturer.

- B. For the actual fabrication, installation and testing of work under this section, use only thoroughly trained and experienced workers completely familiar with the items required and with the manufacturer's current recommended methods of installation.
- C. Product Options: Drawings must indicate size, profiles and dimensional requirements of Energy Recovery Units and are to be based on the specific system indicated. Refer to Division 1 Section "Product Requirements".
- D. Certifications:
 - 1. Entire unit shall be ETL Certified per U.L. 1812 and bear an ETL sticker.
 - 2. Energy Core shall be AHRI Certified per Standard 1060.

1.4 COORDINATION

- A. Coordinate size and location of all building penetrations required for installation of each unit and associated plumbing and electrical systems.
- B. Coordinate sequencing of construction of associated HVAC, electrical supply

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: Two sets of MERV 8 filters for each unit.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers:
 - 1. Greenheck
 - 2. Renewaire
 - 3. Daikin
 - 4. Or equal.

2.2 MANUFACTURED UNITS

- A. Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, energy core, motorized intake damper, motorized return damper, sensors, filter assembly for intake and exhaust air, supply air blower assembly, exhaust air blower assembly and an electrical control center. All specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection.

2.3 CABINET

- A. Materials: Formed single wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
 - 1. Outside casing: Pre-painted components as supplied by the factory shall have polyester urethane paint on 18 gauge G60 galvanized steel. Components that receive a painted finish shall be of 18 gauge type A60 galvanized steel and shall be painted with a baked industrial enamel finish.
 - 2. 24 gauge, galvanized (G90) steel. Direct drive motor provided with a fabricated belly band for motor support.
- B. Access doors shall be hinged.
- C. Shall have factory-installed duct flanges on all duct openings.
- D. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
 - 1. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
 - a. Thickness: 1 inch (25 mm)
 - b. Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
 - c. Location and application: Full coverage of entire cabinet exterior to include walls, roof and floor of unit. Insulation shall be of semi-rigid type and installed between inner and outer shells of all cabinet exterior components.
- E. Energy Core: Energy core shall be of total enthalpy and shall be removable from the cabinet. The core shall consist of a galvanized steel framework (designed to produce laminar air flow through the core) and an energy core as specified. The core media shall be a corrugated hydroscopic resin in a galvanized steel framework and can be removable for servicing. The energy core is to have a five year warranty. Performance criteria are to be as specified in AHRI Standard 1060.
- F. Supply Air and Exhaust Air blower assemblies: Blower assemblies consist of an electric motor and a direct driven blower. Assembly shall be mounted on heavy gauge galvanized rails and further mounted on 1.125 inch thick neoprene vibration isolators.
- G. Control panel /connections: Energy Core Ventilator shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections
- H. Frost control: None.
- I. Economizer Control: None

- J. Motorized dampers / Return Air, Intake Air: Motorized dampers of low leakage type shall be factory installed.
- K. Sensors are considered to be part of various optional operational modes or device controllers and are to be factory supplied and installed.

2.4 BLOWER

- A. Blower section construction, Supply Air and Exhaust Air: Direct drive motor and blower shall be assembled with neoprene vibration isolation devices.
- B. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
- C. Centrifugal blower housing: Formed and reinforced steel panels to make curved scroll housing with shaped cutoff.
- D. Forward curved blower (fan) wheels: Galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow. Mechanically attached to shaft with set screws.
- E. Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".
- F. Exhaust Only Operation: The exhaust blower will run continuously while the supply blower is off.

2.5 MOTORS

- A. General: Blower motors greater than $\frac{3}{4}$ horsepower shall be "NEMA Premium™" unless otherwise indicated. Minimum compliance with EPAct minimum energy-efficiency standards for single speed ODP and TEFC enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts. Electric motors of ten horsepower or less shall be supplied with an adjustable drive pulley. Comply with requirements in Division 23 05 13, matched with fan load.
- B. Motors shall be 60 cycle, 1 phase 115 volts

2.6 UNIT CONTROLS:

- A. This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.
- B. Remote Interface: Contractor shall provide and install a Remote Interface that functions as a remote indicator of owner-selected operating parameters and also permits remote inputting of new operating parameters. Each remote panel shall have a large LCD user interface screen similar in form and function to the screen on the DDC. Installed location of room display shall be as indicated on the plans..

1. Operating protocol: The network interface shall be factory-programmed for BACnet for monitoring of the unit's status.
- C. Variable Frequency Drive (VFD): unit shall have factory installed variable frequency drives for modulation of the blower motors The VFDs shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.
- D. Sensors
 1. Room Temperature Sensors
 2. Dirty Filter Sensor
 3. CO2 Sensor
 4. Temperature Sensors- OAI, EAD, RAI, OAD.
 5. Current Sensor- OAF-A, EF-A.

2.7 FILTERS

- A. MERV 8 disposable pleated filters shall be provided in the intake air stream and MERV 8 filters in the exhaust air stream.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance.
- B. Examine roughing-in of electrical and HVAC services to verify actual location and compliance with unit requirements.
- C. Proceed with installation only after all unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.

3.3 CONNECTIONS

- A. In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
 1. Duct installation and connection requirements are specified in Division 23 of this document.
 2. Electrical installation requirements are specified in Division 26 of this document.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A/E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

3.5 START-UP SERVICE

- A. Engage a factory authorized service representative to perform startup service. Clean entire unit and install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting, and Balancing" and comply with provisions therein.

3.6 DEMONSTRATION AND TRAINING:

- A. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

END OF SECTION

SECTION 23 74 16

SMALL CAPACITY PACKAGED ROOFTOP AIR CONDITIONING UNITS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. The work of this section shall include Packaged Rooftop Air Conditioning Units.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 230100: General Requirements.
- B. Section 230500: Basic Materials and Methods.
- C. Section 230513: Motors and Motor Controllers.
- D. Section 230529: Supports and Anchors.
- E. Section 230519: Instrumentation.
- F. Section 230548: Noise, Vibration, and Seismic Control.
- G. Section 230700: Insulation.
- H. Section 234000: Filters.
- I. Section 230913: Building Management System.
- J. Section 230593: Testing & Balancing.
- K. Section 230800: Commissioning.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

- A. Unit meets Title 24 Part 6 -2016 or ASHRAE 90.1-2016 and IECC-2015 minimum efficiency requirements.
- B. Units are ENERGY STAR* certified (except for 04 single phase models).
- C. Unit shall be rated in accordance with AHRI Standards 210/240 and 340/360.
- D. Unit shall be designed to conform to ASHRAE 15.
- E. Unit shall be UL-tested and certified in accordance with ANSI Z21.47 Standards and UL or ETL-listed and certified under Canadian standards as a total package for safety requirements.
- F. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

- G. Unit internal insulation linings shall be resistant to mold growth in accordance with “mold growth and humidity” test in ASTM C1338, G21, and UL 181 or comparable test method. Air stream surfaces shall be evaluated in accordance with the “Erosion Test” in UL 181, as part of ASTM C1071.
- H. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
- I. Roof curb shall be designed to conform to NRCA Standards.
- J. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory, and must be available upon request.
- K. Unit shall be designed in accordance with UL Standard 1995, including tested to withstand rain.
- L. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 mph.
- M. Unit shake tested to assurance level 1, ASTM D4169 to ensure shipping reliability.
- N. High Efficiency Motors listed shall meet section 313 of the Energy Independence and Security Act of 2007 (EISA 2007).
- O. California Administrative Code - Title 24 establishes the minimum efficiency requirements for HVAC equipment installed in new buildings in the State of California.

1.4 SUBMITTALS

- A. Number and Form as required is SECTION 230100.
- B. Submit drawings indicating components, dimensions, weights and loadings, required clearances, and location and size of field connections.
- C. Submit product data indicating rated capacities, fan curves, roof mounting frames and curbs, accessories, service clearances and electrical requirements.
- D. Submit manufacturer's installation instructions.

1.5 HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Leave factory shipping covers in place until installation.

1.6 WARRANTY

- A. Provide a full warranty for one year from Substantial Completion.

- B. Provide five year extended warranty for compressors including materials only.
- C. Provide five year limited warranty for heat exchanger including materials only.

1.7 REGULATORY REQUIREMENTS

- A. Unit shall conform to UL 1995/CSA 22.2 #236 for construction of packaged air conditioner and shall have UL/CSA label affixed to the unit.
 - 1. In the event the unit is not UL approved, the manufacturer shall, at his expense, provide for a field inspection by a UL representative to verify conformance to UL standards. If necessary, perform required modifications to the unit to comply with UL as directed by the UL representative, at no additional expense to the Owner.

1.8 EXTRA MATERIALS

- A. Provide one set of extra filters.
- B. Furnish one complete set per applicable motor of fan motor drive belts.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. APPROVED MANUFACTURERS
 - 1. Daikin Rebel (Basis of Design)
 - 2. Carrier
 - 3. Or approved equal.
- B. Note – all manufacturers that are not the Basis of Design, must demonstrate that:
 - 1. The required turndown can be accomplished, if necessary with a bypass damper arrangement. Contractor is responsible for including this in the price and showing that this will fit in the space provided.
 - 2. They meet the specified acoustical performance, if necessary with additional sound treatment included in the price. This includes external unit vibration isolation if the compressors and fans are not internally spring isolated.
 - 3. That the energy efficiency of the units is equivalent.
 - 4. That other specification requirements are acceptable to the owner/engineer.

2.2 GENERAL UNIT DESCRIPTION

- A. Provide packaged rooftops air conditioning units as specified on the drawings and herein specified. Cooling capacity ratings shall be based upon ARI Standard 360. Unit shall consist of insulated weather tight casing with compressors, air cooled condenser coil, condenser fans, evaporator coil, minimum 5:1 turndown gas-heat output and airflow, filters, variable speed supply

and exhaust fans capable of 5:1 turndown, high efficiency motors and drives and BACnet compatible unit mounted controller capable of SZVAV, controlling space pressure, tracking and maintaining minimum OSA and operating in a trim and response sequence to maintain duct static pressure for the units feeding multiple zones

- B. Provide factory manufactured single piece construction units. Package units shall be constructed for installation on a full perimeter curb. Installation shall meet the requirement of DSA with earthquake hold down brackets. Factory test units to include the operation of all fans, compressors, heat exchangers, and control sequences. Unit shall be tested, piped, internally wired and fully charged with R-410A refrigerant.
- C. Affix labels, decals, and tags to aid in the service of the unit and indicate caution areas.

2.3 UNIT CASING

- A. Cabinet: shall be double-wall construction for all panels including the floor panels. Equipment shall have an underfloor liner. Insulation shall be 1" thick with a minimum R value of 7.0 and shall be a 2-part injected foam. Unit cabinet shall be designed to operate at a TSP of 5.0". Exterior surface shall be documented to withstand a minimum 750-hour salt spray test in accordance with ASTM B117.
- B. Service access doors shall be provided on the fan section, return fan section, filter section, control panel section and heating section in order to provide service access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and be secured by a latch system. Removable access doors secured by multiple fasteners are not acceptable.
- C. Electrical; unit wiring shall comply with NEC requirements and all applicable UL Standards. All wiring and electrical components provided with the unit shall be numbered, color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired, weatherproof control panel. Unit to have a single point power block for main power wiring. Each compressor and condenser fan shall be furnished with contractors and inherent thermal overload protection. A GFI receptacle shall be factory provided, mounted and wired that is field powered. A single non-fused disconnect shall be factory installed, mounted internally and operated by an externally mounted handle.

2.4 AIR FILTERS

- A. Refer to SECTION 234000 for Air Filter requirements. Unit shall have side access filter frames for a 2" MERV 8 and a 4" MERV 13 filter. Provide one set of construction filters with unit and a second set at turnover to the SCC facilities

2.5 FANS

- A. Provide direct drive SWSI, airfoil supply and exhaust fans of Class II construction with aluminum, precision balanced wheels. Fan and motor shall be mounted on a slide out assembly for servicing and maintenance. Mount fan motor and fan on a common base assembly and isolate from unit with double deflection rubber-in-shear isolators. Provide thrust restraint isolation on the fan housing/fan board to assure smooth fan startup transition and operation. For fans greater than 8 hp or 22" diameter shall be internally isolated on 1" deflection, spring isolators and include removable shipping tie downs.
- B. Supply and exhaust fan motors shall operate as variable speed controlled by the rooftop unit controller. Motors shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. Motors shall be variable speed EC type or driven by a VFD. The motor shall have phase failure protection, preventing the motor from operation in the event of a loss of phase. Motors shall be premium efficiency and capable of airflow modulation from 20% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

2.6 VARIABLE FREQUENCY DRIVE

- A. If variable frequency drives are required for variable speed fan operation they shall be factory installed and tested not field retrofitted.

2.7 GAS FIRED HEATING SECTION

- A. Provide gas-fired heating section as a completely assembled and factory-installed heating system integral to unit, UL approved specifically for outdoor applications for use downstream from refrigerant cooling coils. Provide threaded gas piping connection through side or bottom of unit. Field installed gas heating is not acceptable.
- B. Heating section shall be factory fire-tested prior to shipment.
- C. Gas Burner shall operate on induced draft fan to maintain a negative pressure in the heat exchanger tubes for removal of flue gas. Burner safety controls: each burner module shall have two flame roll-out safety protection switches and a high temperature limit switch that will shut the gas valve off upon detection of improper burner manifold operation. The induced draft fan shall have an airflow safety switch that will prevent the heating module from turning on in the event of no airflow in the flue chamber.
- D. The heating module shall be tubular design with in-shot gas burners.
- E. Gas heaters shall be constructed of stainless steel suitable for condensing environments. The heater shall provide full modulation with a turn-down ratio of at least 5-to-1 and be controlled and monitored by the unit's factory provided and installed DDC system.

2.8 EVAPORATOR COIL SECTION

- A. Provide heavy duty aluminum plate fins mechanically bonded to internally enhanced copper tubes. Evaporator coil shall be interlaced to maintain active coil face area at part load conditions. Row split coils are not acceptable.
- B. Provide an electronic controlled expansion valve for each refrigerant circuit. Factory pressure and leak test coil at 300 psi.
- C. Provide doubled sloped stainless-steel drain pan for positive drainage of condensate from the unit casing.

2.9 CONDENSER SECTION

- A. Provide heavy duty aluminum fins mechanically bonded to copper tubes. Factory leak test coil under 450 psi pressure.
- B. Provide sub-cooling circuit(s) integral with condenser coils to maximize efficiency and prevent premature flashing of liquid refrigerant, to a gaseous state, ahead of the expansion valve.
- C. Provide vertical discharge, direct drive composite condenser fans with low noise fan blade design. Fan motor shall be EC typed and variable speed to maintain proper head pressure control from 0 – 125 F ambient. Fans shall be statically and dynamically balanced. Motors shall be permanently lubricated, with built-in current and thermal overload protection and weather tight slinger over motor bearings.
- D. Provide factory-installed coil guards around perimeter of condensing section to protect the condenser coils, refrigerant piping and control components.

2.10 REFRIGERATION SYSTEM

- A. The unit shall have scroll compressors. One of the compressors shall be an inverter driven compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain discharge air temperature.
- B. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All the above devices shall be an input to the unit controller and the values be displayed at the unit controller.
- C. Cooling capacity shall be capable of discharge air control from 100% to 10% without hot-gas.
- D. Compressors shall have isolation allowing the compressor(s) to be isolated from the refrigeration circuit

2.11 OUTDOOR AIR SECTION

- A. Unit shall be provided with an outdoor air economizer section. The economizer section shall include outdoor, return, and exhaust air dampers. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be parallel blade design. Damper blades shall be gasketed with side seals to provide an air leakage rate of 1.5 cfm / square foot of damper area at 1" differential pressure in accordance with testing defined in AMCA 500. A barometric exhaust damper shall be provided to exhaust air out of the back of the unit. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges. Control of the dampers shall be by a factory installed, direct coupled actuator.

Damper actuator shall be of the modulating, spring return type. A dry bulb OSA and return air sensor shall be used to determine the availability of "free" cooling, the outdoor air dampers shall modulate in response to the unit's temperature control system. The unit shall include Economizer diagnostics meeting the requirements of Title 24.

- B. Provide a factory mounted airflow monitoring station to maintain minimum outside airflow rate through ventilation control module. Provide a control signal to the BMS for calculation of minimum outside air quantity for VAV systems as well as tracking and recording of outside air flow quantity.

2.12 ROOF CURB

- A. Roof curb shall be welded construction of minimum 14-gauge steel providing full perimeter support under the entire unit, as well a cross member at the intersection of the condenser section and the air handling section. Provide gasket at the cross member described above and at the sloped sheet metal piece such that air or water may not leak into the air handling or condenser sections of the roof curb. Curb shall be designed to allow the contractor to install duct prior to setting the unit. Curb shall be coordinated with electrical wiring for internal mounted disconnect.

2.13 DDC MICROPROCESSOR CONTROLS

- A. General - Provide a factory-installed, programmed and run-tested, stand-alone, microprocessor control system suitable for VAV control as required. The system shall consist of temperature and pressure (thermistor and transducer) sensors, printed circuit boards, and a unit-mounted Operator Interface Panel. The microprocessor shall be equipped with on-board diagnostics to indicate that all hardware, software, and all interconnected wiring and sensors are in proper operating condition. The microprocessor's memory shall be non-volatile EEPROM type, requiring no battery or capacitive backup to maintain all data during a power loss.

- B. The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted. The user interaction with the display shall provide the following information at a minimum; Return air temperature, Discharge air temperature, Outdoor air temperature, Space air temperature, Compressor suction temperature and pressure, Compressor head pressure and temperature, Expansion valve position, Condenser fan speed, Inverter compressor speed, Dirty filter indication, Airflow verification, Cooling status, Control temperature (Changeover), VAV box output status., Cooling status/capacity, Unit status, All time schedules, Active alarms with time and date, Previous alarms with time and date, Optimal start, Supply fan and exhaust fan speed, System operating hours, Cooling, Individual compressor, Heating, Economizer, Tenant override
- C. To increase the efficiency of the cooling system the DDC controller shall include a discharge air temperature reset program for part load operating conditions. The discharge air temperature shall be controlled between a minimum and a maximum discharge air temperature (DAT) based on one of the following inputs: Airflow Outside air temperature; Space temperature; Return air temperature; External signal of 1-5 vdc; External signal of 0-20 mA; Network signal
- D. Provide for field installation by installing contractor, supply duct static pressure sensor, building static pressure sensor and zone CO2 sensor (where applicable),
- E. Provide each unit with BACnet communication card per unit

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that proper power supply is available.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount units on factory built roof mounting frame providing watertight enclosure to protect ductwork. Install roof mounting curb level.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer shall furnish a factory trained service engineer without additional charge to start the unit(s). Package rooftop unitary manufacturers shall maintain service capabilities no more than 100 miles from the jobsite.

1. The manufacturer shall furnish complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

END OF SECTION

SECTION 23 8175

VARIABLE REFRIGERANT VOLUME SYSTEM

PART 1 – GENERAL

1.1 SYSTEM DESCRIPTION

- A. Provide a variable capacity, heat pump air conditioning Variable Refrigerant Volume type split system. The system shall consist of multiple evaporators using DDC control, connected to a single condenser unit or multiple condenser units but not to exceed what is permitted by local code. The condenser shall be air cooled, as per schedules, direct expansion (DX), heat pump air-conditioning system, variable speed driven compressor multi zone split system, using R410A or 407c refrigerant.
- B. The condensing unit shall be interconnected to indoor units as scheduled in accordance with the manufacturers engineering data book detailing each available indoor unit.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 230100: General Requirements.
- B. Section 230500: Basic Materials and Methods.
- C. Section 230513: Motors and Motor Controllers.
- D. Section 232113: HVAC Pipe and Pipe Fittings.
- E. Section 230523: Valves.
- F. Section 230529: Supports and Anchors.
- G. Section 230519: Instrumentation.
- H. Section 230548: Noise, Vibration, and Seismic Control.
- I. Section 230700: Insulation.
- J. Section 230913: Building Management System.
- K. Section 230593: Testing & Balancing.

1.3 QUALITY ASSURANCE

- A. Unit shall be UL listed.
- B. Referenced Standards - The latest editions of specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this section where cited below:

1. Adhesive and Seal Council - ASC - 7100C Standard for Adhesives for Duct Liner.
2. NFPA - National Fire Protection Association:
 - a. NFPA 90A, Installation of Air-Conditioning and Ventilating Systems
 - b. NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems
3. ASTM A924 – General Requirements for Steel Sheet, Metallic-Coated by Hot Dip Process
4. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated Galvanized
5. ASTM D2092 - Standard Guide for Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting
6. ASTM B209 – Specification for Aluminum and Aluminum Alloy Sheet and Plate
7. ASTM C423 – Sound Absorption and Sound Absorption Coefficients by the Heat Transfer Properties of Horizontal Pipe Insulation.
8. ANSI Type 316

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle units per unit manufacturer's recommendations.

1.5 SUBMITTALS

- A. Number and Form as required in DIVISION 1, GENERAL REQUIREMENTS and Section 230100: General Requirements.
- B. Shop Drawings and Product Data: Submit manufacturer's catalog sheets, brochures, performance charts, standard schematic drawings, wiring diagrams, specifications, and installation instructions. Submittal data for all fans shall include fan curves for a family of curves at differing speeds and shall include scheduled operating point. Curves shall be correct for air density of operation. Submittals 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 gages and finishes, including color charts.

5. Dampers, including housings, linkages, and operators, if applicable.
6. Submit drawings indicating components, dimensions, weights and loadings, required clearances, and location and size of field connections.
- C. 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.
- D. Operating load at each support and weight of heaviest removable item.
- E. Operation and Maintenance Data: Furnish installation, maintenance, and operating instruction manuals, complete with parts list.
- F. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 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 gages and finishes, including color charts.
 5. Dampers, including housings, linkages, and operators, if applicable.
 6. Submit manufacturer's installation instructions.

1.6 WARRANTY

- A. Warrant the entire unit against defects in materials and workmanship for a period of one (1) year from date of Substantial Completion. Provide six (6) years parts warranty for the compressor.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. LG
- B. Daikin.
- C. Mitsubishi.
- D. Or approved equal.

2.2 VARIABLE REFRIGERANT VOLUME SYSTEM

- A. General: Indoor, direct-expansion, Ducted or Ductless Fan Coil Units. The Fan Coil Unit shall be shipped complete with cooling coil, fan, fan motor, piping connectors, electrical controls, solid-state electromechanical control system, and applicable mounting / hanging brackets.
- B. Condensing Unit:
 - 1. The Condensing Unit shall be available as a Standard unit configurable to either Heat Pump application as required by connection of the applicable Pipe work and components.
 - 2. The Condensing unit shall be a factory assembled unit with frameless casing structure.
 - 3. The cabinet shall be made from rust proof mild steel panels coated with an electro-painted oven baked enamel finish.
 - 4. The Condensing 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 compressor, motors, condenser coil, electronic expansion valve, solenoid valves, 4 way valve, distribution headers, capillaries, filters, shut off valves, oil separator, service ports, liquid receivers and accumulators.
 - 5. The connection ratio of indoor units to condensing unit shall be 50% as a maximum lower limit to 130% as a minimum upper limit.
 - 6. Air Cooled Condensing Unit
 - a. The sound pressure dB (A) at rated conditions shall be a value of 63 decibels at 3 feet from the front of the unit, or less.
 - b. The system shall automatically restart operation after a power failure and shall not cause any settings to be lost, without the need for reprogramming.
 - c. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
 - d. 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, 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.

- e. Oil recovery cycle shall be automatic.
 - f. The condensing unit shall be completely weather proof and corrosion resistant. Equip condensing units with DC inverter driven propeller type, direct-drive fan with external static pressure capability of not less than 0.12 in.wc. pressure, vertical discharge configuration, the fan motor shall have inherent protection and permanently lubricated bearings and be provided with a fan guard to prevent contact with moving parts. Condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond. The coil shall be complete with corrosion treatment of an acrylic resin or amino-alkyd type. Unit shall be capable of operation in Cooling Mode or Heating Mode within Outdoor temperature of 23 - 109 F and 0 - 60 F respectively.
- 7. Each condensing unit shall have a 240VAC, .3mA-.5A control circuit output for water pump or isolation valve operation. This circuit shall be configured at commissioning to operate based on system or compressor operation.
 - 8. Each condensing unit shall incorporate a normally open, 15VDC and 1.0mA rated contacts for integration of a mandatory flow proving device.
- C. Compressor:
- 1. Compressor shall be variable speed controlled capable of changing speed to follow the variations in total heating or cooling load as determined by the suction gas pressure as measured in the condensing unit. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity shall be controlled to eliminate deviation from target value.
 - 2. The inverter driver compressor in each condensing unit shall be of highly efficient reluctance DC (digitally commutated), hermetically sealed scroll type "G-type".
 - 3. Neodymium magnets shall be adopted in the rotor construction.
 - 4. The capacity control range shall be 23% to 100%, with 22 individual capacity steps at minimum for a Single Module System. The capacity control range shall be 11% to 100% for a Dual Module System and 8% to 100% for a Triple Module System.
 - 5. Equip each compressor with a crankcase heater, high pressure safety switch, and internal thermal overload protector, and an oil separator together with an oil balancing circuit.

6. In the case of multiple condenser modules, conjoined operation hours of the compressors shall be balanced by means of the Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle or every 8 hours.

D. Indoor Units

1. General:

- a. Provide indoor units with a fan, heat exchanger with condensate drain pan and an electronic proportional expansion valve which shall be controlled via computerized control which constantly, and assesses the status of the return air temperature, refrigerant inlet and outlet temperature.
- b. During the cooling operation the electronic expansion valve shall control the degree of refrigerant superheat at the evaporator outlet. During the heating operation it shall control the degree of refrigerant sub cooling at the condenser outlet.
- c. Complete the indoor unit printed circuit board with power input fusing, address switches for a variety of operation controls, emergency operation switch and fault/operation indication LED's. Fan motors shall be thermally protected.
- d. The indoor unit casing shall be fully insulated and sealed to prevent condensation. The insulation shall conform to local regulations.
- e. Indoor Room Temperature range shall be 68 to 74 deg F DB in cooling mode, and 69 to 78 deg F DB in heating mode.
- f. The indoor unit shall be separately powered with 208 to 230/1/60HZ.
- g. The coil shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
- h. Indoor unit and refrigerant pipes shall be charged with dehydrated air prior to shipment from the factory.
- i. The indoor unit shall be affixed with factory supplied hanging brackets for ceiling, wall or floor installation.

E. Controls:

1. General:

- a. Controls shall consist of a solid-state electromechanical control system which shall control space temperature and determine optimum fan speed. The temperature control range shall cover from 60 F to 90 F. The unit shall have the following specifications as a minimum.
- b. From each circuit board, the electrical voltage shall be 16 volts DC.

2. Individual zone controller- wired but without timer:
 - a. Provide a wired remote controller capable of controlling 1 group of maximum of 16 fan coil units and able to function as described herein:
 - b. The controller shall be suitable for wiring length of not less than 1,640 feet.
 - c. The controller shall have a self-diagnosis function that constantly monitors the system for malfunctions (total of 80 components).
 - d. The controller shall be able to immediately display fault location and condition.
 - e. An LCD digital display shall allow the temperature to be set in 1°F units.
 - f. The controller shall be equipped with a thermostat sensor in the remote controller making possible more comfortable room temperature control.
 - g. The controller shall monitor room temperature and preset temperature by microcomputer and can select cool/heat operation mode automatically (heat recovery outdoor unit only).
 - h. The controller shall allow the user to select cool / heat / fan operation mode with indoor remote controller of choice without using the cool / heat selector.
 - i. The following functions shall be provided: -
 - (1) OPERATION:
 - (a) Start/Stop
 - (b) Operation Mode
 - (c) Temperature Setting
 - (d) 60°F – 90°F Set Point Range
 - (e) Fan Speed
 - (2) MONITORING:
 - (a) Status.
 - (b) Malfunction Flashing.
 - (c) Malfunction Content
 - (d) Operation Mode

- (e) Temperature Setting
 - (f) Permit/Prohibit Selection
 - (g) Fan Speed
- (3) CONTROL MANAGEMENT:
 - (a) Field Setting Mode
 - (b) Group Setting
 - (c) Auto Re-Start
- F. Filters: Filters for Ceiling Concealed Ducted units shall be Field Supplied. Provide a Field Constructed Filter Rack.
- G. Electrical Requirements: Unit shall operate on power supply as specified on the equipment schedule. Power and control connections shall have terminal block connections.
- H. BACnet Gateway:
 - 1. Manufacturer's BACnet Gateway must be provided for each Water Cooled Condensing Unit.
 - 2. Provide a standalone BACnet Gateway hardware, Unit Manufacturer should provide all necessary hardware including but not limited to Centralized Controller, Desktop Computer with Software, and Lifetime License to allow for Connection via BACnet over IP for each Condensing Unit Location.
 - 3. BACnet Gateway shall be able to control minimum 128 indoor unit groups as standard (with the option of control of 256 indoor unit groups (and shall be able to control/monitor) as follows as a minimum. Devices that do not provide at least the following points list will not be acceptable:
 - a. OPERATION:
 - (1) Start/Stop.
 - (2) Operation Mode.
 - (3) Temperature Setting.
 - (4) Fan Speed.
 - (5) Filter Sign Reset.
 - (6) Airflow Direction
 - (7) Communication Status

- (8) Forced System Off
- (9) On/Off Restriction
- (10) Mode Restriction
- (11) Setpoint Restriction
- (12) Forced Temperature Control Enable/Disable
- b. MONITORING:
 - (1) On/Off Status
 - (2) Error Status Report
 - (3) Error Code Report
 - (4) Filter Sign Report
 - (5) Operation Mode Status Report
 - (6) Airflow Direction Status
 - (7) Temperature Setting
 - (8) Room Temperature Report
 - (9) Fan Speed
 - (10) Expansion Valve Status
 - (11) Compressor Status
 - (12) Fan Status
 - (13) On/Off Restriction Status
 - (14) Mode Restriction Status
 - (15) Setpoint Restriction Status
 - (16) Forced Temperature Control Enable/Disable Status
- 4. The controller shall have be suitable for wiring length of not less than 1,640feet.

PART 3 – EXECUTION**3.1 INSTALLATION**

- A. Install fan coil units in accordance with manufacturer's recommendations and as shown on drawings.

Follow SMACNA and AMCA recommendations for fan installations, belt guards, duct connections, etc.

- B. Install fans and motors with proper support and vibration isolation as specified in SECTION 230548: Noise, Vibration and Seismic Control.
- C. Install units with adequate clearances for service and maintenance.
- D. Make final duct connections with flexible connectors as described in specification SECTION 233100: Ductwork. Provide sufficient separation of ductwork, plenum panels, or air handling unit casings from fan assembly to prevent metal-to-metal contact due to start-up torque or operating under specified isolator deflections.
- E. Provide sufficient clearances around units for access and servicing of components. Install fans such that tachometer openings, access doors, motors, belts, lubrication lines, electrical connections, etc. are readily accessible and not obstructed by other installations or structures.
- F. 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 and UL 486B.
- G. Refrigerant Piping: The system shall be capable of refrigerant piping up to 390 linear feet or 459 equivalent feet, a total combined length of 980 feet of piping between the condensing and indoor units, with maximum 165 feet vertical difference, without any oil traps or additional equipment. In case where the condensing unit is located below the indoor unit, the vertical difference shall be not less than 131 feet. The units shall be capable of operation with vertical distance between indoor units of not less than 49 ft.
- H. Liquid, discharge, and suction lines must be individually insulated between the condensing and indoor units.
- I. Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit then to the branch selector box and outdoor unit. Control wiring shall run from the indoor unit terminal block to the specific controller for that unit.
- J. The wire shall be a 2-core stranded, non-shielded cable, size AWG18-2 or AWG 16-2, meeting manufacturer requirements.
- K. Refrigerant piping shall be sized by the unit manufacturer.

3.2 FIELD QUALITY CONTROL

- A. Equipment Startup Checks:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connection to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

3. Verify that cleaning and adjusting are complete.
 4. Verify lubrication for bearings and other moving parts.
 5. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 6. Disable automatic temperature-control operators.
- B. Starting Procedures:
1. Energize motor and adjust fan to indicated rpm.
 2. Measure and record motor voltage and amperage.
 3. Follow Manufacturer's Commissioning Guide for Equipment Startup, and Controls Configuration.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper phase or motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Complete Manufacturer's commissioning report and submit copy to manufacturer for record keeping and future service support.
- F. Refer to Section 230593 "Testing, and Balancing" for testing, adjusting, and balancing procedures.
- 3.3 ADJUSTING
- A. Adjust damper linkages for proper damper operation.
- 3.4 CLEANING
- A. On completion of installation, internally clean system according to manufacturer's written instructions. Remove foreign material and construction debris.
- B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

END OF SECTION

SECTION 25 0000

CONTROL – GENERAL CONDITIONS

PART 1 – GENERAL**1.1 DESCRIPTION**

- A. Provide complete system of temperature controls including connections to existing stand-alone data gathering and control panels as shown and specified herein. The System shall consist of networked or stand-alone controllers, performing in concert to provide the proper operation of the HVAC equipment.

1.2 WORK INCLUDED

- A. The work under this Section of the specifications includes all labor, materials, equipment and services to provide fully operational Control System in strict accordance with these specifications and the Contract Drawings and subject to the terms and conditions of the Contract. The work in general consists of, but is not limited to, the following:
1. Provide all necessary hardware and software to meet the systems functional specifications. This shall include all required system devices, wiring, etc. in order to integrate equipment furnished by other manufacturers which are intended to be an integral part of the overall building control system (where their integration is shown on the contract drawings or included in the project specifications). The work shall also include analysis of integration issues, and identification of measures and modifications required to provide a complete and functional system; all such required measures and modifications shall be provided under this Division of work.
 2. Prepare individual hardware layouts, interconnection drawings, and software configuration (if needed) from project design data.
 3. Prepare a complete point list based on the requirements of this specification and control drawings.
 4. Implement the detailed design for all control objects, based on control descriptions, sequence of operation, system point list in the construction documents.
 5. Complete electrical installation including wiring, raceways and power wiring, except as noted.
 6. Complete operating and maintenance manuals and 20 hours of field training for system operator's and maintenance personnel after acceptance of the system.

7. System commissioning (including point-to-point verification, functional testing, and trend logs).
8. Full documentation for all software and equipment provided.
9. Project management for managing system installation including, but not limited to: Design installation, equipment delivery, coordination with other trades, labor management, commissioning and acceptance testing.
10. Complete electrical installation including control wiring, raceways and power wiring, including but not limited to:
 - a. Wiring of thermostats.
 - b. Interlock wiring where shown or specified.
 - c. Power wiring from designated Division 26 outlets to control components that require power.
11. Provide spare parts as noted in this specification.
12. Warranty of system including all associated materials, labor, and services for period of one year from the date of final acceptance.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 230100: Mechanical General Requirements
- B. Section 251000A: Control Devices
- C. Section 251000B: Direct Digital Control Systems
- D. Section 251000C: Electric and Electronic Control Systems
- E. Section 259000: Sequence of Operations
- F. Division 26: Electrical

1.4 SUBMITTALS

- A. General:
 1. Indicate with bid known substitutions and deviations from requirements of Contract Documents. Substitutions shall be submitted in accordance with the requirements of 230100.
- B. Product Data:
 1. Provide technical bulletins and catalog data for all equipment and system components. Clearly identify, by use of symbol or tag number, the service of each item. All irrelevant information shall be marked out leaving only pertinent data.

C. Shop Drawings:

1. Provide all drawings in AutoCad release 2010 compatible format. Shop drawing submittals shall include sufficient data to indicate complete compliance with Contract Documents. Submissions in form of drawings, brochures, bulletins, catalog data, and/or narrative descriptions. As a minimum requirement submit:
 - a. Symbol and abbreviation lists.
 - b. System block diagram showing quantity and location of controller and other major System Components.
 - c. Control diagrams for all systems controlled. Controls shall be shown on system flow diagrams.
 - d. Interfaces (software and hardware) with equipment provided in other sections of specifications.
 - e. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
 - f. Narrative description of operation for each system, enumerating and describing the function of each component. Include alarm and emergency sequences, and equipment interlocks.
 - g. Detailed bill of materials.
 - h. Valve and Damper Schedule: Provide identification numbers, location, system, dimensions and performance data.
 - i. Device mounting details. Include as a minimum:
 - (1) Sensing elements in ducts or casings.
 - (2) Sensing elements in piping.
 - (3) Variable volume pressure sensor.
 - j. Other information as requested herein.
 - k. Drawings shall be submitted in 11"x 17" (ANSI B) size.

D. Samples:

1. Space temperature sensors.
2. All devices mounted on finished surfaces.

E. Quality Control Submittals:

1. UL listing compliance certificates for equipment.
2. Final calibration, commissioning and testing reports at completion of project.

1.5 OWNER'S MANUALS

A. General:

1. Submit copies (hard copy and electronic media) of owner's manuals for review. Refer to Section 230100.
2. Update manuals with modifications made to system during guarantee period. Provide replacement pages or supplements in quantity stated above.
3. On the first page of each manual identify with project name, manual title, owner's name, engineer's name, contractor's name, address and service phone number, and person who prepared manual.

B. One hardcopy of operating manual to serve as backup and reference manual for all aspects of the system. As a minimum include the following:

1. Control flow diagrams.
2. Sequence of operation for automatic and manual operating modes. The sequences shall cross reference the system point names.
3. Description of manual override operation of control points.
4. System manufacturer's complete operating manuals.
5. Complete as-built installation drawings for each system. Provide all drawings in AutoCad release 2008 compatible format. Drawings shall be on CD-ROM.
6. Overall system electrical power supply scheme indicating source of electrical power for each system component. Indicate which components are on emergency power and indicate all battery backup provisions.
7. Overall system shielding and grounding scheme indicating all major components and ground paths.
8. Photographs and drawings showing installation details and locations of equipment.
9. Charts showing normal operating conditions at significant points such as electrical test points.

10. Routine preventive maintenance procedures, corrective diagnostic troubleshooting procedures, and calibration procedures.
11. Parts lists with manufacturer's catalog numbers and ordering information.
12. Lists of ordinary and special tools, operating materials supplies and test equipment recommended for operation and servicing.
13. Manufacturer's operating set up, maintenance and catalog literature for each piece of equipment.
14. Maintenance and repair instructions.
15. Recommended spare parts.

1.6 QUALITY ASSURANCE

- A. Comply with all current governing codes, ordinances and regulations, as well as with requirements of NFPA, UL and all other applicable codes.
- B. Qualifications:
 1. Submit written resumes of key personnel proposed on the project.
 2. The following minimum qualifications are required from the Controls contractor:
 - a. Have comprehensive local service and trained support personnel capable of giving instruction and provide emergency maintenance on the system. Including all software, firmware and hardware components.
 - b. Have access to local supplies of essential expendable and spare parts.
 - c. Have a proven record of successful local installation and maintenance of control systems for a minimum period of 4 years. Provide list of all local installations with Owner contact names and phone numbers.

1.7 COMMISSIONING RESPONSIBILITIES

- A. Construction and Acceptance Phases
 1. Include the cost of commissioning (Cx) in the contract price.
 2. In each purchase order or subcontract written, include requirements for submittal data, Cx documentation, O&M data and operator training.
 3. Attend a Cx scoping meeting and meetings necessary to facilitate the Cx process.
 4. Provide functional testing procedures.

5. Contractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
6. Perform, clearly document, and submit all completed startup and system operational checkout procedures.
7. Address current punch list items before the commencement of functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.
8. Provide skilled technicians to execute starting of equipment and to execute the functional performance 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.
9. Provide skilled technicians to perform functional performance testing.
10. Correct deficiencies.
11. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
12. During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning.
13. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
14. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranties.
15. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications.
16. Control Drawings Submittal
 - a. The control drawings shall have a key to all abbreviations.
 - b. The control drawings shall contain graphic schematic depictions of the systems and each component.
 - c. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 - d. Provide a full points list

17. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls as-built drawings submittal.
18. Assist and cooperate with the TAB contractor in the following manner:
 - a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB.
 - b. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.
19. Execute all control system trend logs required to demonstrate performance and stability of control systems. Trend data will be required in electronic format, specifically in a Microsoft Excel compatible format (ASCII text, comma delineated, .xls, etc.).
20. List and clearly identify on the as-built duct and piping drawings the locations of all sensors.

1.8 TRAINING

- A. Training will consist of the following:
 1. Hardware orientation
 2. Software generation and documentation
 3. Network diagnostics and trouble shooting
 4. Remote panel operations
 5. Central station operations
 6. System Maintenance
- B. The contractor will furnish all training manuals, materials and information necessary for understanding and implementing proper system operation procedures.
- C. Training of facilities personnel will be conducted in phases by a factory trained instructor who is employed by an accredited training institution, and principal duties are training. All certification of instructor qualifications and all training schedule shall be submitted by the contractor at the time of bid.

PART 2 – PRODUCTS

2.1 NOT USED

PART 3 – EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. All electrical work performed in the installation of the control system as described in this specification shall be per the National Electrical Code (NEC) and per applicable state and local codes. Where exposed, conduit shall be run parallel to building lines properly supported and sized at a maximum of 40% fill. In no cases shall field installed conduit smaller than ½" trade size be allowed. Where conductors are concealed, cable rated for use in return air plenums shall be used.

3.2 WIRING

- A. All control and interlock wiring shall comply with national and local electrical codes and Division 26 of this specification. Where the requirements of this section differ with those in Division 26, the requirements of this section shall take precedence.
- B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC and Division 16 requirements.
- C. All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.
- D. Where NEC Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:
 - 1. Circuits meet NEC Class 2 (current limited) requirements (low voltage power circuits shall be suffused when required to meet Class 2 current limit).
 - 2. All cables shall be UL listed for application (e.g. cables used in ceiling plenums shall be UL listed specifically for that purpose).
- E. All wiring in mechanical, electrical, or service rooms — or where subject to mechanical damage — shall be installed in raceway.
- F. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- G. Do not install wiring in raceway containing tubing.
- H. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it, and neatly tied at 10-foot maximum intervals. Such bundled cable shall be fastened to the structure, using specified fasteners, at 5 ft intervals or more often to achieve a neat and workmanlike result.

- I. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
- J. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
- K. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- L. Maximum allowable voltage for control wiring shall be 120 volt. If only higher voltages are available, the Contractor shall provide step-down transformers.
- M. All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.
- N. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with other sections of this specification and local codes..
- O. Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer's recommendation and NEC requirements, except as noted elsewhere.
- P. Include one pull string in each raceway 1 inch or larger.
- Q. Use coded conductors throughout with different colored conductors.
- R. Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.
- S. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6 inches from high-temperature equipment (over 104 degrees F).
- T. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- U. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.
- V. The Contractor shall terminate all control and/or interlock wiring, and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

- W. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 feet in length and shall be supported at each end. Flexible metal raceway less than ½ inch electrical trade size shall not be used. In areas exposed to moisture — including chiller and boiler rooms — liquid tight, flexible metal raceways shall be used.
- X. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (per code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.
- Y. Independently support all control wiring.
- Z. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.

3.3 CLEANING

- A. This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.
- B. At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.
- C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.4 PROTECTION

- A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.
- B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.5 FIELD QUALITY CONTROL

- A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.

- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.
- C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.6 OWNER TRAINING

- A. The Contractor shall provide five (5) copies of an operator's manual describing all operating and routine maintenance service procedures to be used with the temperature control system supplied. Contractor shall instruct the owner's designated representatives in these procedures during the startup and test period. The duration of the instruction period shall be no less than 20 hours, during normal working hours.

3.7 CALIBRATION AND ADJUSTMENTS

- A. After completion of the installation, perform final calibrations and adjustments of the equipment provided under this Contract. Adjust and validate all sensors, valves, dampers, relays, controllers, etc.

3.8 TECHNICAL SUPPORT

- A. Contractor shall be available to respond to system failure within four (4) hours of notification between the hours of 7 a.m. and 10 p.m.

3.9 FUNCTIONAL TESTING

- A. The following test procedures shall be completed.
 - 1. Contractor shall provide qualified test personnel who will be familiar with the equipment and software used for this contract.
 - 2. Test personnel shall be responsible for conducting tests without harm to persons working in the building and without damage to any installed equipment, materials or finishes.
 - 3. The Owner and Owner's Representatives shall observe the test activities.
 - 4. Contractor shall provide all test instruments and shall demonstrate recent calibration.
 - 5. Contractor shall notify Owner in writing a minimum of 15 working days prior to start of any test.
- B. Satisfactory operation of the following shall be demonstrated.
 - 1. Communication between all points and controllers and between controllers and operator station.

2. Correct response to forced sensor deviation.

3.10 ACCEPTANCE PROCEDURE

- A. Upon completion of the calibration, Contractor shall startup the system and perform all necessary testing and run diagnostic tests to ensure proper operation. An acceptance test in the presence of the Owner's representative or engineer shall be performed.
- B. The system installation shall be complete in all respects and tested for proper operation prior to acceptance testing by the owner's authorized representative. A letter shall be submitted to the Owner requesting systems acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing will commence at a mutually agreeable time within 14 calendar days of the request. When the system has been deemed satisfactory in whole or in part by the owner's representative, the system will be accepted for beneficial use which will start the warranty period for the commissioned portion.
- C. During acceptance testing provide services of a fully qualified building automation technician who is knowledgeable of the project.
- D. Warranty will commence upon successful completion of the acceptance tests to the Owner's satisfaction.
- E. Controls Contractor shall provide assistance to Mechanical Contractor during system balancing as described in Section 230593.

END OF SECTION

SECTION 25 1000A

BUILDING MANAGEMENT SYSTEM (BMS)

PART 1 – GENERAL**1.1 DESCRIPTION**

- A. The Building management System (BMS) operating system shall utilize the BACnet data communication protocol outlined in ANSI/ASHRAE Standard 135-1995.
- B. Provide a “native” BACnet-based system, including a Microsoft Windows XP Professional operator’s terminal, based on a distributed logic control system. The operator’s terminal, all DDC controllers, and control devices shall communicate using the protocols and standards as defined by ANSI/ASHRAE Standard 135-1995. Operator terminal workstations and DDC controllers shall be “native” BACnet devices; “native” in this context shall mean that BACnet is used o as the internal data communications protocol within all BMS devices, or that translators, or “gateways,” for converting proprietary data communications protocols to BACnet communications shall be internal to the BMS manufacturer’s devices, shall be manufactured by or under license to the BMS manufacturer, and shall provide BACnet-based interoperability of all devices as specified herein. Functionality of any “gateways” provided to achieve this interoperability shall be the responsibility of the BMS manufacturer (except where gateways are furnished as part of an HVAC manufacturer’s equipment where controls are an integral part of the equipment: e.g. chillers). Where “gateways” are utilized, the BMS manufacturer shall provide all firmware upgrades as necessary to achieve the specified level of interoperability.

1.2 WORK INCLUDED

- A. The work under this Section of the specifications includes all labor, materials, equipment and services to provide fully operational BUILDING MANAGEMENT SYSTEM (BMS) in strict accordance with these specifications and the Contract Drawings and subject to the terms and conditions of the Contract. The work in general consists of, but is not limited to, the following:
 - 1. Provide all necessary BACnet-compliant hardware and software to meet the systems functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for every controller in the BMS system.
 - 2. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
 - 3. Prepare a complete point list based on the requirements of this specification and control drawings.

4. Implement the detailed design for all system-standard analog and binary objects, distributed control and system databases, graphic displays, logs, and management reports based on control descriptions, sequence of operation, system point list in the construction.
5. Remote portable field service interface computer units with converter (if required) as specified.
6. A dedicated fully compliant Ethernet LAN including electric isolation from electrical interference.
7. A network of stand alone Direct Digital Control (DDC) controllers, unitary controllers, and terminal controllers including sensors, and control actuator devices.
8. Complete electrical installation including wiring, raceways and power wiring, except as noted.
9. Software required to effect a complete and operational BMS as specified herein.
10. Complete operating and maintenance manuals and 80 hours of field training for system operator's and maintenance personnel after acceptance of the system.
11. System commissioning (including point-to-point verification, functional testing, and trend logs).
12. Full documentation for all software and equipment provided.
13. Project management for managing system installation including, but not limited to: Design installation, equipment delivery, coordination with other trades, labor management, commissioning and acceptance testing.
14. Modems for communication to remote PC's.
15. Miscellaneous control wiring including, but not limited to:
 - a. Wiring of thermostats.
 - b. Interlock wiring where shown or specified.
 - c. Power wiring from designated Division 26 outlets to BMS components that require power.
16. Provide spare parts as noted in this specification.
17. Warranty of system including all associated materials, labor, and services for period of one year from the date of final acceptance.

B. Qualifications:

1. Submit written resumes of key personnel proposed on the project.
2. The following minimum qualifications are required from the BMS contractor:
 - a. Have comprehensive local service and trained support personnel capable of giving instruction and provide emergency maintenance on the system. Including all software, firmware and hardware components.
 - b. Have access to local supplies of essential expendable and spare parts.
 - c. Have a proven record of successful local installation and maintenance of native BACnet-based BMS systems for a minimum period of 4 years. Provide list of all local installations with Owner contact names and phone numbers.
 - d. Have installed a system with similar size and BMS BACnet architecture as the current project.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 230100: Mechanical General Requirements
- B. Division 26: Electrical.

1.4 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Provide the following items furnished under this Section but installed under other sections:
 1. Automatic Control Valves.
 2. Automatic Control Dampers.
 3. Thermowells.
 4. Liquid Flow Sensor -Transmitters.
 5. Liquid Flow Switches.
 6. VAV (CAV) Box terminal controllers.
- B. Designated circuits shall be furnished by Division 26 from the distribution panelboards for BMS power. Power wiring from the designated power outlets shown on Division 2 6 drawings, to BMS components shall be within the work scope of this section.

- C. Supervise and coordinate the installation of equipment, instruments and materials furnished under this Section but installed under other Divisions of the specifications. All equipment and instruments shall be installed in strict accordance with the manufacturer's published installation instructions.

1.5 SYSTEM DESCRIPTION

A. System Configuration:

1. The BUILDING MANAGEMENT SYSTEM (BMS) shall perform both monitoring and control of HVAC, utilities, and electrical equipment for building management energy conservation, and environmental control in accordance with the sequence of operation and specification.
2. BMS operator's terminal personal computer to provide for overall building data acquisition and transfer, report generation, historical data storage and retrieval, and operator interface.
3. The Direct Digital Controllers (DDC) to perform remote data acquisition and process control. DDC panels shall be locally mounted completely self-contained, field programmable, real-time microprocessor based BACnet DDC controllers capable of stand alone operation.

B. Design and Performance Criteria:

1. Expansion Capability:
 - a. The system shall have an initial capacity of not less 200% of the points specified with no hardware changes except addition of DDCs and extension of the LAN.
 - b. System shall be modular, to allow change of function and operation in the field by plug-in module equipment and software change to expand system capacity on full on-line basis.
2. Response Time:
 - a. Time between occurrence of alarm, status change or change of value and its processing, display or printout shall not exceed 5 seconds irrespective of other system activities.
 - b. Time between an operator's command and the associated system output shall not exceed the following times irrespective of other system activities.
 - (1) Point Command (Start Stop, Setpoint, etc): 5 seconds
 - (2) Log Request: 10 seconds
 - (3) Graphics Request: 8 seconds

- (4) Program or Database Modification: 60 seconds
- c. Provide stable control of all connected systems with a closed loop control accuracy not to exceed:
 - (1) Temperature: ± 2 degree Fahrenheit.
 - (2) Air Pressure: ± 5 percent
 - (3) Fluid Pressure: ± 2 psig.
 - (4) Flow: ± 2 percent of sensor span.
- d. Environmental Conditions:
 - (1) The DDCs, Field Equipment Panels, and other equipment shall operate under ambient environmental conditions of 35 degree to 122 degree F dry bulb and 10% to 95% relative humidity, noncondensing as a minimum. Sensors and control elements shall operate under the ambient environmental temperature, pressure, humidity, and vibration conditions encountered for the installed location.
 - (2) Other equipment, such as CRTs and printers, shall, unless designated otherwise, operate properly under ambient environmental conditions of 50 degree to 104 degree F and a relative humidity of 20% to 80%.
- e. Materials and Equipment:
 - (1) Where multiple units of the same type are required, the units shall be products of a single manufacturer. However, the component parts of the system need not be the products of a single manufacturer. Each major component of equipment shall be labeled with the manufacturer's name, address, model and serial number.
 - (2) All systems and components shall have been thoroughly tested and proven in actual use.

1.6 SUBMITTALS

A. General:

- 1. Indicate with bid known substitutions and deviations from requirements of Contract Documents. Substitutions shall be submitted in accordance with the requirements of 230100.

B. Product Data:

1. Provide technical bulletins and catalog data for all equipment and system components. Clearly identify, by use of symbol or tag number, the service of each item. All irrelevant information shall be marked out leaving only pertinent data.

C. Shop Drawings:

1. Provide all drawings in AutoCad release 14 compatible format. Shop drawing submittals shall include sufficient data to indicate complete compliance with Contract Documents. Submissions in form of drawings, brochures, bulletins, catalog data, and/or narrative descriptions. As a minimum requirement submit:
 - a. Symbol and abbreviation lists.
 - b. System block diagram showing quantity and location of DDCs, unitary and terminal controller and other major System Components.
 - c. Control diagrams for all systems controlled. Controls shall be shown on system flow diagrams.
 - d. Interfaces (software and hardware) with equipment provided in other sections of specifications.
 - e. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
 - f. Narrative description of operation for each system, enumerating and describing the function of each component. Include alarm and emergency sequences, and equipment interlocks.
 - g. Complete input output point schedule. Identify point function, type and location.
 - h. Spare capacity provisions.
 - i. Detailed bill of materials.
 - j. Valve and Damper Schedule: Provide identification numbers, location, system, dimensions and performance data.
 - k. Device mounting details. Include as a minimum:
 - (1) Sensing elements in ducts or casings.
 - (2) Sensing elements in piping.
 - (3) Variable volume pressure sensor.

- I. Other information as requested herein.
- m. Drawings shall be submitted in 11"x 17" (ANSI B) size.
- n. Complete point list, including all data points obtained through BACnet interface to major equipment furnished in other sections of this specification.

D. Programming:

- 1. Point identification code.
- 2. System advisory messages, printouts, logging formats.
- 3. Drawings of system graphics showing monitored points.
- 4. Software flow charts for application and DDC programs.
- 5. Person machine interface program, include commands, alarm annunciation, logs and programming capabilities.
- 6. Description of system operation under failure conditions.

E. Samples:

- 1. Space temperature sensors.
- 2. All devices mounted on finished surfaces.

F. Quality Control Submittals:

- 1. UL listing compliance certificates for equipment.
- 2. Final calibration, commissioning and testing reports, and trend logs at completion of project.

1.7 OWNER'S MANUALS

A. General:

- 1. Submit copies (hard copy and electronic media) of owner's manuals for review. Refer to Section 230100.
- 2. Update manuals with modifications made to system during guarantee period. Provide replacement pages or supplements in quantity stated above.
- 3. On the first page of each manual identify with project name, manual title, owner's name, engineer's name, contractor's name, address and service phone number, and person who prepared manual.

- B. One hardcopy of operating manual to serve as backup and reference manual for all aspects of the system. As a minimum include the following:
1. Control flow diagrams.
 2. Sequence of operation for automatic and manual operating modes. The sequences shall cross reference the system point names.
 3. Description of manual override operation of control points.
 4. System manufacturer's complete operating manuals.
 5. Complete as-built installation drawings for each system. Provide all drawings in AutoCad release 14 compatible format. Drawings shall be on CD-ROM.
 6. Overall system electrical power supply scheme indicating source of electrical power for each system component. Indicate which components are on emergency power and indicate all battery backup provisions.
 7. Overall system shielding and grounding scheme indicating all major components and ground paths.
 8. Photographs and drawings showing installation details and locations of equipment.
 9. Charts showing normal operating conditions at significant points such as electrical test points.
 10. Routine preventive maintenance procedures, corrective diagnostic troubleshooting procedures, and calibration procedures.
 11. Parts lists with manufacturer's catalog numbers and ordering information.
 12. Lists of ordinary and special tools, operating materials supplies and test equipment recommended for operation and servicing.
 13. Manufacturer's operating set up, maintenance and catalog literature for each piece of equipment.
 14. Maintenance and repair instructions.
 15. Recommended spare parts.
- C. Provide 1 hard copy of Programming Manual to serve as backup and reference manual for all aspects of system programming. As a minimum include the following:
1. Complete programming manuals, and reference guides.

2. Details of any special software packages and compilers supplied with system.
3. Information required for independent programming of system.
4. Documentation on application and DDC programs: Flow charts, equations, parameters.
5. Point schedule; include all points, real and virtual.
6. Software troubleshooting procedures.

1.8 QUALITY ASSURANCE

- A. Comply with all current governing codes, ordinances and regulations, as well as with requirements of NFPA, UL and all other applicable codes.

1.9 MAINTENANCE

- A. Submit an alternate price to perform complete preventative and emergency maintenance of the BMS for a period of one (1) year after Owner acceptance of the system in accordance with the Subcontractor's recommended standards and schedule. This price shall be itemized, to show material. costs and labor costs. This price shall be based upon work being executed during normal working hours but shall include separate emergency callout provisions. Prices submitted should be based upon current price lists and labor rates, details of which shall be included with the bid and should be broken out into three categories:
 1. Computer hardware and associated equipment.
 2. Field equipment including DDCs, sensors and final control elements.
 3. Software.
- B. The preventative maintenance contract may be renewed annually, at the option of the Owner, up to a total term of 10 years. The annual price shall be negotiated 3 months in advance of annual contract expiry and shall be at the mutual agreement of both parties. Variation in annual prices shall reflect only changes in material and labor costs as substantiated by Federal Guideline Consumer Price Indexes.

PART 2 – PRODUCTS**2.1 ACCEPTABLE MANUFACTURERS OF BMS SYSTEM**

- A. Alerton BACtalk (with web access)
- B. Automatic Logic Inc. Web CTRL
- C. Delta

2.2 OPERATOR WORKSTATION (OWS)

- A. BACnet Conformance - See Paragraph 2.4 B.
- B. Provide two operator workstations (complete with required hardware and software): one located in building, one located remotely.
- C. Refer to section 22.2, BACnet Functional Groups, in the ANSI/ASHRAE 135-1995 BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- D. Standard BACnet object types supported shall include as a minimum: Calendar, Command, Device, Event Enrollment, File and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- E. Displays:
 - 1. Operator's terminal shall display all data associated with project as called out on drawings and/or object type list supplied. Operator's terminal software shall accept Windows BITMAP (*.bmp) format graphic files for display purposes. Graphic files shall be created using AutoCAD drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's terminal shall display all data using graphic representations of all mechanical equipment.
 - 2. System shall be capable of displaying graphic file, text, and dynamic object data together on each display. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. All information on any display shall be dynamically updated without any action by the user. Terminal shall allow user to change all field-resident BMS functions associated with the project, such as set points, weekly schedules, exception schedules, etc. from any screen no matter if that screen shows all text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.
 - 3. Contractor shall generate displays for all systems, graphic equipment, and points for this project. All displays shall be generated and customized in such a manner by the local control system supplier that they fit the project as specified. Displays shall use standard English for labeling and readout. Systems requiring factory programming for graphics or DDC logic are specifically prohibited. All graphics and DDC programming shall be supported locally by the installing contractor without factory dependency or assistance.

4. Binary objects shall be displayed as ON/OFF/NULL or with customized text. Text shall be justified left, right or center as selected by the user. Also, allow binary objects to be displayed as individual change-of-state bitmap objects on the display screen such that they overlay the system graphic. Each binary object displayed in this manner shall be assigned up to three bitmap files for display when the point is ON, OFF or in alarm. For binary outputs, toggle the objects commanded status when the bitmap is selected with the system mouse. Similarly, allow the terminal operator to toggle the objects status by selecting with the mouse a picture of a switch or light, for example, which then displays a different picture (such as an ON/switch or lighted lamp). Additionally, allow binary objects to be displayed as an animated graphic.
5. Animated graphic objects shall be displayed as a sequence of multiple bitmaps to simulate motion. For example: when a pump is in the OFF condition, display a stationary picture of the pump. When the operator selects the pump picture with the mouse, the represented objects status is toggled and the picture of the pumps impeller rotates in a time-based animation. The operator shall be able to click on an animated graphical object or switch it from the OFF position to ON, or ON to OFF. Allow operator to change bitmap file assignment and also create new and original bitmaps online. System shall be supplied with a library of standard bitmaps, which may be used unaltered or modified by the operator. Systems that do not allow customization or creation of new bitmap objects by the operator (or with third-party software) shall not be allowed.
6. Analog objects shall be displayed with operator modifiable units. Analog input objects may also be displayed as individual bitmap items on the display screen as an overlay to the system graphic. Each analog input object may be assigned to a minimum of five bitmap files, each with high/low limits for automatic selection and display of the bitmaps. As an example, a graphic representation of a thermometer would rise and fall in response to either the room temperature or its deviation from the controlling set point. Analog output objects, when selected with the mouse, shall be displayed as a prompted dialog (text only) box. Selection for display type shall be individual for each object. Analog object values may be changed by selecting either the Aincrease or Adecrease arrow in the analog object spinner box without using the keypad. Pressing the button on the right side of the analog object spinner box allows direct entry of an analog value and accesses various menus where the analog value may be used, such as trendlogs.
7. Analog objects may also be assigned to an area of a system graphic, where the color of the defined area would change based on the analog objects value. For example, an area of a floor-plan graphic served by a single control zone would change color with respect to the temperature of the zone or its deviation from set point.

All editing and area assignment shall be created or modified online using simple icon tools.

8. A customized menu label shall be used for display selection. Menu items on a display shall allow penetration to lower level displays or additional menus. Dynamic point information and menu label push buttons may be mixed on the same display to allow sub-displays to exist for each item. Each display may be protected from viewing unless operator has appropriate security level. A separate security level may be assigned to each display and system object.
9. A mouse shall be used to move the pointer arrow to the desired item for selection of new display or to allow the operator to make changes to object data.
10. Displays may be modified on site or via modem remote communications.
11. Display resolution shall be limited by the CRT hardware and Windows- software driver only.
12. Entire BMS shall operate without dependency on the operator's terminal.

F. Password Protection:

1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator's terminal functions unless user is logged on. This includes displays as outlined above.
2. Each operator's terminal shall provide security for 200 users minimum. Each user shall have an individual User ID, User Name and Password. Entries are alphanumeric characters only and are case sensitive (except for User ID). User ID shall be 0-8 characters, User Name shall be 0-29 characters, and Password shall be 4-8 characters long. Each system user shall be allowed individual assignment of only those control functions and menu items to which that user requires access. All passwords, user names, and access assignments shall be adjustable online at the operator's terminal. Each user shall also have a set security level, which defines access to displays and individual objects the user may control. System shall include 10 separate and distinct security levels for assignment to users.

G. Display of Scheduling Object Information:

1. BACnet exception schedules (non-normal schedules, such as holidays or special events) shall display all dates that are an exception to the weekly schedules. These specialty schedules shall be displayed at the operator's terminal in a format similar to the weekly schedules, again allowing easy data entry.

Exception schedule data is entered by the following methods: date entries (one day entries), date-to-date (a range or span of days), and by weekday (for example, a given day of a given week each month). User shall be able to scroll easily through the months for each year as a minimum.

2. At the operator's terminal, the system user shall be able to change all information for a given weekly or exception schedule if logged on with the
3. Alarm Indication:
4. Operator's terminal shall provide audible, visual, and printed means of alarm indication. The alarm dialog box shall always become the top analog box regardless of the application(s), currently running (such as a word processor). Printout of alarms shall be sent to the assigned terminal and port.
5. System shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal. Each entry shall include a description of the event-initiating object generating the alarm, time and date of alarm occurrence, time and date of object state return to normal, and time and date of alarm acknowledgment.
6. Alarm messages shall be in English and shall be entered either at the operator's terminal or via remote communication.

H. Trend log Information:

1. System shall periodically gather historically recorded selected samples of object data stored in the field equipment (DDC Controllers, field controllers) and archive the information on the operator's terminal (server) hard disk. Archived files shall be appended with new sample data, allowing samples to be accumulated over several years. Systems that write over archived data shall not be allowed, unless limited file size is specified. Samples may be viewed at the operator's terminal in a Trend log. Logged data shall be stored in spreadsheet format. Operator shall be able to scroll through all Trend log data. System shall automatically open archive files as needed to display archived data when operator scrolls through the data vertically. All Trend log information shall be displayed in standard engineering units.
2. Software shall be included that is capable of graphing the trend logged object data. Software shall be capable of creating two-axis (x,y) graphs that display up to six object types at the same time in different colors. Graphs shall show object type value relative to time.
3. Operator shall be able to change trend log setup information as well. This includes the information to be logged as well as the interval at which it is to be logged. All input, output, and value object types in the system may be logged. All operations shall be password protected.

Setup and viewing may be accessed directly from any and all graphics object is displayed on.

I. Energy Log Information:

1. System shall be capable of periodically gathering energy log data stored in the field equipment and archive the information on the operator terminal's hard disk. Archive files shall be appended with the new data, allowing data to be accumulated over several years. Systems that write over archived data shall not be allowed unless limited file size is specified. System shall automatically open archive files as needed to display archived data when operator scrolls through the data. Display all energy log information in standard engineering units.
2. System software shall be provided that is capable of graphing the energy log data. Software shall be capable of creating two-axis (x, y) graph that show recorded data, relative to time. All data shall be stored in comma- delimited file format for direct use by third-party spreadsheet or other database programs. Operation of system shall not be affected by this operation. In other words, it shall stay completely online.
3. Operator shall be able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. All meters monitored by the system may be logged. All operations shall be password protected.

J. Configuration/Setup:

1. Provide means for operator to display and change system configuration. This shall include, but not be limited to, system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed, etc. Items shall be modified using understandable terminology with simple mouse/cursor key movements.

K. Programming Tools:

1. Operator's terminal shall include programming tools for all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from different types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.
2. User shall be able to pick graphical function block from menu and place on screen. Programming tools shall place lines connecting appropriate function blocks together automatically. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.

3. Programming tools shall include a test mode. Test mode shall show user real-time data on top of graphical display of selected function blocks. Data shall be updated real-time with no interaction by the user. Function blocks shall be animated to show status of data inputs and outputs. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.

L. OWS Hardware:

1. Provide operator's workstation. Operator's workstation shall include the following as a minimum:
 - a. IBM Compatible PC (computer) capable of utilizing PCI bus cards.
 - b. Intel Pentium IV processor +/- 3000 MHz (or higher).
 - c. 2000 MB RAM on motherboard.
 - d. One 250 MB "ZIP" Drive, One DVD-RW drive.
 - e. Hard disk drive with a minimum of 300 GB free space.
 - f. Microsoft Windows XP Professional.
 - g. Monitor 22" EPA Energy Star compliant, 1280 x 1024, 85 MHz, non-interlaced flat panel monitor. Dot pitch: 0.26 millimeters maximum, Low emission, MPR II, Displayable colors: 256 minimum. Bus mouse compatible with Windows- XP. PCI video card with 256 MB RAM.
 - h. Keyboard: 101-key typewriter-like keyboard with special function keys "F1" through "F12" and numeric keyboard. Keys to have tactile feedback. Include rubber wrist rest pad. Microsoft or equal.
 - i. US Robotics V90 Compliant Modem.
 - j. Hewlett Packard or approved equal type color printer. 5 pages per min in color mode.
 - k. Microsoft Office Suite: including Access, Excel, Word (latest release at time of submittal).
 - l. Uninterruptible Power Supply (UPS): Provide a portable UPS capable of maintaining operation of the PC and all peripherals for 30 minutes in the event of a failure of the normal power supply. UPS shall provide instantaneous backup power during blackouts and brownouts, lightning and surge protection tested to UL 1449, and network-grade line conditioning and two EMI/AFI filters. UPS shall be hot-swappable with user replaceable batteries while the entire system continues to

operate. Assemble console equipment in a console configuration that allows operator access to all console equipment from one position.

m. Two 10/100/1000 Base T network interface cards; mouse.

M. Web Access: Provide software, hardware, and network connections required to provide authorized access to the facility's BMS through any standard web browser interface such as Internet Explorer™ or Netscape Navigator™. Interface shall allow access to entire system including but not limited to dynamic graphical views, scheduling, trending, point commands, and setpoint adjustments.

2.3 FIELD OPERATOR'S TERMINAL

- A. Provide one portable field operator's terminal to allow local programming, control and monitoring at each controller. Provide one additional field operator's terminal for each Non-native BACnet LAN and for each type of gateway as required to provide field programming.
- B. The portable field operator terminal shall meet the following requirements:
 - 1. Integral keyboard with ASCII character set.
 - 2. Output display on CRT, or LCD screen with minimum concurrent display of 20 characters.
 - 3. Powered by rechargeable battery. Provide extra set batteries adequate for minimum of 3 hours of operation.
 - 4. Capable of monitor and change any control loop setpoints at all controllers units. Weight not to exceed seven pounds.

2.4 DDC CONTROLLER

- A. General:
 - 1. DDC controller shall provide battery-backed real-time (hardware) clock functions. It shall also provide communications via BACnet standard protocols to all field controllers. DDC controller shall interface with operator terminal(s) via BACnet protocols for information display.
 - 2. DDC Controller shall incorporate the functions of a 3-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet), master slave token passing (MS/TP), and point-to-point (PTP) or modem ports and may have capability to function as a 4-way router with the addition of plug-in modules.
 - 3. DDC Controller shall be capable of deciding strategies for the system based on information from any objects in the system regardless if the object is directly monitored by the controller or by another controller.

The program that implements these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed control strategies that cannot be modified by field personnel on-site or downloaded via remote communications are not acceptable. Changing control strategies via firmware changes is also unacceptable. Program execution at DDC Controller shall be a minimum of once per second.

4. Programming can be object-oriented using control program blocks. Documentation in flowchart form for all programming shall be provided as part of the final system as-built documentation. Samples of flowchart documentation shall be included in submittals. All flowcharts shall be generated and automatically downloaded to controller. No re-entry of database information shall be necessary.
5. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator's terminal, field computer, or modem.
6. Controller shall have a minimum of 2 MB battery-backed static RAM, expandable to 4 MB, along with 64K of EPROM. Battery shall retain static RAM memory and clock functions for a minimum of 1 year. Battery shall be a field-replaceable lithium type.
7. DDC Controller may include display for network setup and monitoring. Display shall be backlit LCD with 2-line by 20-character display and 8-key keypad for operator entry of data.

B. BACnet Conformance:

1. DDC Controller shall as a minimum support, MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. DDC Controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Clock Functional Group.
 - b. Hand Held Workstation Functional Group.
 - c. Personal Computer Workstation Functional Group
 - d. Event Initiation Functional Group
 - e. Event Response Functional Group
 - f. COV Event Initiation Functional Group
 - g. Files Functional Group

- h. Reinitialize Functional Group
 - i. Device Communications Functional Group
 - j. Time Master Functional Group
 - 2. Refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 - 3. Standard BACnet object types supported shall include as a minimum: Analog Value, Binary Value, Calendar, Command, Device, File, Group, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Remote Communications:
- 1. Provide all functions that will allow remote communications via internal modem to off-site locations. Include modem along with all cabling necessary for installation.
 - 2. Provide Windows™ software for off-site computer that allows operator to view and change all information associated with system on color graphic displays. Operator shall be able to change all parameters in this section from off-site location including all programming of DDC Controllers and all programmable Unitary controllers including all terminal unit controllers.
 - 3. DDC Controller shall have capability to call out alarm conditions automatically. Alarm message and site description shall be sent to off- site computer or serial printer. If desired, controller may also send encoded message to digital pager. All DDC Controllers connected to the LAN shall be capable of calling out alarm messages through one shared modem connected to one or more of the DDC Controllers on the local LAN.
 - 4. DDC Controller shall have capability to call a minimum of 10 different phone numbers. Numbers called may be controlled by type of alarm, time schedule, holiday schedule, or other selectable program parameters.
 - 5. DDC Controller and supplied modem shall be capable of modem-to-modem baud rates of 32 Kbps (V90 standard) minimum over standard voice-grade phone lines.

D. Schedules:

1. Each DDC Controller shall support a minimum of 100 BACnet Schedule Objects and 100 BACnet Calendar Objects.
2. Each schedule object (Weekly or Exception) shall be capable of performing an optimum start. Optimum start calculation shall be based on outside air temperature, zone air temperature, deviation from zones, daytime heating and cooling set points, and individual zone adaptive heating and cooling coefficients that are adjusted each day based on performance parameters of the individual zone.

E. Logging Capabilities:

1. Each DDC Controller shall log as a minimum 1 50-user selectable object types with a minimum of 100 samples per object with standard memory configuration. Logging shall be expandable (user defined), with additional memory in DDC Controller. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's terminal. Start of sampling may be by one of the following: Selectable log beginning and ending by using BACnet Calendar and Schedule Objects.
2. Object change of value (all types of analog objects) Object change of state (all types of binary objects)
3. Logs may be viewed both on-site or off-site via remote communication.
4. DDC Controller shall periodically upload trended data to operator's terminal for long term archiving if desired.
5. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

F. Alarm Generation:

1. Object change of values and change of states may be identified as alarm conditions. When such conditions exist, the DDC Controller identifies each alarm through BACnet Get Alarm Summary Service. This summary of active alarms is presented to and displayed at the operator's terminal for system user action. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
2. Each alarm may be dialed out as noted in paragraph above.
3. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications.

G. Enclosure:

1. Provide wall mounted steel cabinet with full front hinged door, locking handle with key and non-glare baked enamel finish. Each DDC control panel shall contain a plastic encased control diagram showing associated controls.
2. Provide the manufacturer's standard enclosure except if location requires additional protection due to potential vandalism, environmental conditions or any other reason. Take all necessary precautions to protect the DDC controller and related components, including:
 - a. Using suitable NEMA enclosure.
 - b. Heavy duty locks.
 - c. Provisions to drain of condensation or water passing through conduits.

2.5 ROUTER, CONVERTER, REPEATER

- A.** Routing functions shall be performed using only BACnet standard protocols as defined by ANSI/ASHRAE Standard 135-1995. The converter interconnects a standard computer serial port with an MS/TP LAN. Repeater functions shall be handled by a device designed to selectively interconnect four portions of MS/TP LAN as a minimum.
1. **ROUTERS:** The router shall perform the BACnet definition functions of interconnecting two or more BACnet LANs together, forming a BACnet internetwork. The router shall have optional plug-on boards permitting the following BACnet communication methods:
 - a. The router shall have the routing functionality of interconnecting BACnet Ethernet and/or ARCNET high-speed LAN to BACnet MS/TP LAN and one or more PTP LANs.
 - b. The router shall have capability of interconnecting BACnet Ethernet high-speed LAN to BACnet ARCNET high-speed LAN.
 - c. BACnet PTP (RS-232 point-to-point) communication shall be available on the DDC Controller by including a modem. The PTP/modem option shall operate under the BACnet half router communication protocol.
 - d. BACnet messages may be routed to all LANs installed on the router at the same time with no operator intervention.
 2. **CONVERTER:** A converter shall be provided if required to interface the portable field service computer from its serial port (RS-232) to the BACnet MS/TP LAN (RS-485).

3. REPEATERS: BACnet repeaters shall provide selective interconnection to 4 segments of MS/TP LAN as a minimum. The repeater shall be an active device, containing logic capable of detecting and repeating signals from one MS/TP LAN segment to all other segments. Repeaters shall permit additional nodes to be added to the MS/TP LAN, up to a maximum of 254 nodes.

2.6 UNITARY CONTROLLERS

- A. Provide one or more Unitary controller for each air handler/fan system, and hydronic system, that adequately covers all objects listed in point summary list. Controllers may interface to DDC Controller via MS/TP LAN using BACnet protocol. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable.
- B. BACnet Conformance:
 1. BACnet Unitary controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as native BACnet devices. Unitary controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
 2. Refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Unitary controllers shall include universal inputs with 10-bit resolution that accept 3K and 10K thermistors, 0-10 VDC, 0-5 VDC, 4-20 mA and dry contact signals. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs shall be switch selectable as either 0-10VDC or 0-20mA. Software shall include scaling features for analog outputs. Unitary controller shall include 24VDC voltage supply for use as power supply to external sensors.
- D. All program sequences shall be stored on board Unitary controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and capable of multiple PID loops for control of multiple devices.

All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator's terminal.

- E. Programming of Unitary controller shall be completely modifiable in the field over installed LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Unitary controller shall be programmed using programming tools as described in operator's terminal section. All programming tools shall be provided as part of system. Provide documentation in flowchart form of all programming as part of the final system as-built documentation. Include samples of flowchart documentation in submittals.
- F. Unitary controller shall include software scheduling functions on board without depending on any external device. Scheduling shall be via a BACnet schedule object for seven-day-of-the-week scheduling. Controller shall include interface capability for optional plug-in hardware clock with battery back up. Provide optional hardware clock as shown on object list given in drawing set.

2.7 SENSORS AND CONTROL DEVICES

A. General:

- 1. Provide sensors and control devices as indicated on mechanical plans, control flow diagrams and as required to meet specified performance. Where performance specifications exceed capabilities of hardware specified, performance governs. The installation of such devices shall be the responsibility of the contractor.
- 2. Equip analog sensors with industry standard 4 to 20 mA transmitters with built-in circuit protection against reverse polarity and supply voltage transients. The transmitters to be matched to the sensing element and compatible with the DDC controller.
- 3. All sensor/transmitters assemblies shall be factory calibrated.
- 4. The sensor range and type to be suitable to the application.
- 5. Minimum contact rating of relays and switches shall be 5 amp 110 volts resistive.

B. Dampers

- 1. The Controls System supplier shall provide all automatic control dampers not specified to be supplied integral to the HVAC equipment. Controls supplier shall review the integral dampers provided with equipment and shall state that they are adequate for the proper functioning of the control system.

2. All proportional dampers shall be opposed blade type. Two position dampers may be opposed or parallel blade type.
3. Damper frames shall be .125 thickness 5"x1" aluminum hat channel. Aluminum airfoil blade width shall not exceed 8 inches. Dampers and seals shall be suitable for temperature ranges of □50 to 250 deg F. Where shown as low profile frames shall be 5"x.5" channel. Shafts shall be ½ hexagonal plated steel.
4. Low Leakage Dampers. Low leakage dampers shall be furnished. Field replaceable edge and end seals will be installed along the top, bottom, and side of the frame an each blade. Seals and bearings shall be suitable for temperature ranges form 40 to 200 deg F. Leakage shall not exceed 6 CFM/sq. ft. at 4" W.G. differential.
5. Dampers shall be Ruskin, Model CD50, "or equal".
6. Refer to Section 233100 of this Division for Smoke dampers and combination smoke/fire dampers end switches. Smoke detectors are furnished under Division 26, installed under this Division. Wiring to BMS under Division 25, to Fire Alarm System under Division 26. If isolation or conversion of the signal from these switches to allow communication of damper status is needed, it shall be included in the work of this section.

C. Electronic Actuators

1. General: Actuators shall be of the magnetic or electric type with linear or rotary actuation for proportional modulating, or 2-position control as required by the application. Electronic actuators shall use an overload-proof synchronous motor or an electric motor with end switches to de-energize the motor at the end of the stroke limits. Control voltage shall be 24VAC, 0-20VDC, 0-10VDC, or 4-20mA as required. Modulating actuators shall be equipped with an analog feed-back point which shall be arranged to provide a positive position indication to the system operator integrated into the control loop algorithm. All damper applications with outdoor air openings shall be provided with spring return to the closed position. Direct coupled actuator torque ratings shall be 125% of the requirements of the application. Linkage coupled actuator torque ratings shall be 200% of requirements of application. All valve and damper actuators on air handlers shall be provided with spring return to the closed position. All valve and damper actuators on air handling shall be provided with a means to manually override control signals and manually position the actuators. Manual positioning of AHU actuators shall not be dependent on the presence of normal control signals. Manual overrides shall be local to the room/area in which the air handler(s) is located. Provide a local indication of the normal (under control) and manually overridden AHU actuator positions.

2. Damper Actuators: Shall be proportional modulating or 2-position as required by the application and shall provide a indication of damper position. Provide AHU modulating actuators with a manual override of control signals to allow manual positioning of the actuator. Provide adjustable travel stops for each damper actuator. Actuator shall be sized to close damper at a differential pressure of 4" w.g.

D. Temperature Sensors

1. Temperature sensors shall be Resistance Temperature Detector (RTD) or Thermistor as dictated by the requirements of this specification.
2. Duct sensors shall be rigid or averaging as specified in the sequence of operations. Averaging sensor shall be a minimum of 5 feet in length.
3. Immersion sensors shall be provided with a separable stainless steel well.
4. Space sensors shall be equipped with setpoint adjustment and/or override switch as specified on the plans or in the sequence of operations.
5. Accuracies shall be ± 1 degree F for standard applications. Where high accuracy is required, accuracies shall be $\pm .2$ degree F.

E. Static Pressure Sensors

1. Duct static pressure sensors shall be differential pressure type. The sensor range shall be closely matched to the system static pressure, $\pm .5$ to .5 inches, ± 1 to 1 inches, 0 to 2.5 inches.
2. Underfloor static pressure sensors shall use a strain gauge transducer to provide a 4-20 m. amp signal. Range shall be 0.0 to 0.25 in H2O. Similar to Dwyer 603A-1.
3. Sensor accuracy shall be plus or minus 2% of the sensing range.

F. Carbon Dioxide Sensors:

1. Sensor shall use non-dispersive infrared technology, with sensor protected by membrane filter that is permeable to CO2. Signal processor shall automatically compensate for drift and shall be self-testing and shall not need recalibration more frequently than once per year.
 - a. Operating range to be 0-2000 part per million CO2.
 - b. Output signal to be 1-10 VDC linear within operating range.
 - c. Shall be suitable for duct mounting.

- d. Response time not to exceed 30 seconds.
- e. Accuracy to be + /-100 ppm.
- f. Repeatability better than + /-20 ppm.
- g. Shall be listed as meeting FCC Part 15.
- h. Similar to Johnson Controls CDS-2000.

G. Fan Inlet Airflow Traverse Probe.

- 1. Provide on the indicated fans, airflow traverse probes mounted in the fan inlets capable of continuously measuring the air handling capacity (air volume) of the respective centrifugal fans.
- 2. The fan inlet airflow traverse probes shall contain 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. Sensors shall not protrude beyond the surface of the probe, nor be adversely affected by particle contamination normally present in building system airflows.
- 3. The fan inlet airflow traverse probes shall have symmetrical averaging signal takeoffs, and shall be of aluminum construction with hard anodized finish copper construction with galvanized steel mounting hardware.
- 4. The fan inlet airflow traverse probes shall not significantly impact fan performance or contribute to fan generated noise levels. The probes shall be 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.
- 5. The fan inlet airflow traverse probes shall be the VOLU-probe/FI as manufactured by Air Monitor Corporation, Santa Rosa, California, or equal.
- 6. Furnish probe to fan manufacture for factory mounting.

H. Air Flow Transmitter

- 1. The transmitter shall be capable of receiving flow signals (total and static pressure) from an airflow station or probe array and produce dual outputs linear and scaled for air volume, velocity differential pressure, etc.

2. The transmitter shall contain an integral multi-line digital display for use during the configuration and calibration process, and to display one transmitter output during normal operating mode. All transmitter configuration, parameter setting, zero and span calibration in the on-board microprocessor via input pushbuttons.
3. The transmitter will be available in multiple natural spans covering the range of 0.05 IN w.c. to 10.0 IN w.c. with an accuracy of 0.1% of natural span. The transmitter shall be furnished with a transducer automatic zeroing circuit and be capable of maintaining linear output signals on applications requiring 10 to 1 velocity (100 to 1 pressure) turndown.
4. The transmitter shall be capable of having its operating span electronically selected without having to perform recalibration involving an external pressure source.
5. The transmitter will provide the means of managing a system for automatic high pressure purge of the airflow station or probe array, with user selectable purge frequency and duration, while maintaining the last transmitter output during the purge cycle.
6. The transmitter shall be VELTRON II as manufactured by Air Monitor Corporation, Santa Rosa, California, or equal.

PART 3 – EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. All electrical work performed in the installation of the control system as described in this specification shall be per the National Electrical Code (NEC) and per applicable state and local codes. Where exposed, conduit shall be run parallel to building lines properly supported and sized at a maximum of 40% fill. In no cases shall field installed conduit smaller than ½" trade size be allowed. Where conductors are concealed, cable rated for use in return air plenums shall be used.

3.2 OWNER TRAINING

- A. The Contractor shall provide five (5) copies of an operator's manual describing all operating and routine maintenance service procedures to be used with the temperature control system supplied. Contractor shall instruct the owner's designated representatives in these procedures during the startup and test period. The duration of the instruction period shall be no less than 80 hours, during normal working hours.

3.3 CALIBRATION AND ADJUSTMENTS

- A. After completion of the installation, perform final calibrations and adjustments of the equipment provided under this Contract. Adjust and validate all sensors, valves, dampers, relays, controllers, etc.

3.4 TECHNICAL SUPPORT

- A. Contractor shall supply and install any software changes issued during the warranty period.
- B. Contractor shall be available to respond to system failure within four (4) hours of notification between the hours of 7 a.m. and 10 p.m.

3.5 FUNCTIONAL TESTING

- A. The following test procedures shall be completed.
 - 1. Contractor shall provide qualified test personnel who will be familiar with the equipment and software used for this contract.
 - 2. Test personnel shall be responsible for conducting tests without harm to persons working in the building and without damage to any installed equipment, materials or finishes.
 - 3. The Owner and Owner's Representatives shall observe the test activities.
 - 4. Contractor shall provide all test instruments and shall demonstrate recent calibration.
 - 5. Contractor shall notify Owner in writing a minimum of 15 working days prior to start of any test.
- B. Satisfactory operation of the following shall be demonstrated.
 - 1. Communication between all points and controllers and between controllers and operator station.
 - 2. Correct response to forced sensor deviation.

3.6 ACCEPTANCE PROCEDURE

- A. Upon completion of the calibration, Contractor shall startup the system and perform all necessary testing and run diagnostic tests to ensure proper operation. Contractor shall be responsible for generating all software and entering all databases necessary to perform the sequence of control and specified software routines. An acceptance test in the presence of the Owner's representative or engineer shall be performed.
- B. Provide trend logs for all system points necessary to demonstrate proper functioning of the BMS. Trend logs shall indicate stable operation of the mechanical systems at the design parameters for 5 consecutive days. Any deviation during this period shall require beginning the 5 day period over again. Submit trend logs in tabular and graphical format.
- C. Warranty will commence upon successful completion of the trend logging and acceptance tests to the Owner's satisfaction.

- D. Controls Contractor shall provide assistance to Mechanical Contractor during system balancing as described in Section 230593.

END OF SECTION

SECTION 25 3000

BUILDING MANAGEMENT SYSTEMS - FIELD DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. General: The control system field devices shall include, but not limited to the following:
 - 1. Sensors
 - 2. Thermostats
 - 3. Switches
 - 4. Relays
 - 5. Actuators
 - 6. Dampers
- B. Refer to Section 251000A: General Requirements.
- C. Refer to Section 251000B: Overall System Accuracy.

PART 2 – PRODUCTS

2.1 FIELD CONTROL DEVICES

- A. Temperature Sensors
 - 1. Temperature sensors shall be Resistance Temperature Device (RTD) or Thermistor.
 - 2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 5 feet in length.
 - 3. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
 - 4. Space sensors shall be equipped with set-point adjustment, override switch, display, and/or communication port as shown on the drawings.
 - 5. Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.2 deg F.

B. Humidity Sensors

1. Duct and room sensors shall have a sensing range of 20% to 80% with accuracy of $\pm 5\%$ R.H.
2. Duct sensors shall be provided with a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% R.H. It shall be suitable for ambient conditions of -40 deg F to 170 deg F.
4. Humidity sensor's drift shall not exceed 1% of full scale per year.

C. Static Pressure Sensors

1. Sensor shall have linear output signal. Zero and span shall be field-adjustable.
2. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
3. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
4. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.

D. Low Limit Thermostats

1. Safety low limit thermostats shall be vapor pressure type with an element 6m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any one foot section.
2. Low limit shall be manual reset only.

E. Indoor Air Quality Sensors

1. Indoor air quality sensors shall measure both total percentage VOCs and CO₂ in PPM. Sensors shall be duct or space mounted.

F. Flow Switches

1. Flow-proving switches shall be either paddle or differential pressure type, as shown.

2. Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 1 Type enclosure unless otherwise specified:
3. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 Type enclosure, with scale range and differential suitable for intended application, or as specified.
4. Current sensing relays may be used for flow sensing or terminal devices.

G. Relays

1. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.

H. Transformers and Power Supplies

1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
3. Unit shall operate between 0 deg C and 50 deg C.
4. Unit shall be UL recognized.

I. Current Switches

1. Current-operated switches shall be self-powered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

J. Motorized Dampers

1. Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.

2. Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.
3. Damper shaft bearings shall be as recommended by manufacturer for application.
4. All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
5. All leakage testing and pressure ratings will be based on AMCA Publication 500.
6. Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.
7. Control dampers shall be parallel or opposed blade type as scheduled on drawings

K. Electronic Damper / Valve Actuators.

1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
3. All rotary spring return actuators shall be capable of both clockwise and counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
5. All 24 VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 W for DC applications. Actuators operating on 120 VAC or 230 VAC shall not required more than 11 VA.
6. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
7. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.

8. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
9. Actuators shall be Underwriters Laboratories Standard 873 listed.
10. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.

L. Local Control Panels

1. All indoor control cabinets shall be fully enclosed NEMA 1 Type construction with [hinged door], key-lock latch, and removable sub-panels. A single key shall be common to all field panels and sub-panels.
2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control termination's for field connection shall be individually identified per control drawings.
3. Provide on/off power switch with over-current protection and main air gauge for control power sources to each local panel.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment is installable as shown, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

3.2 GENERAL WORKMANSHIP

- A. Install equipment, piping, wiring/conduit parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.

- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.3 WIRING: SEE 250000.

3.4 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequate for the environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
- E. Install duct static pressure tap with tube end facing directly down-stream of air flow.
- F. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- G. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.
- H. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.
- I. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

3.5 ACTUATORS

- A. Mount and link control damper actuators per manufacturer's instructions.
- B. To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately 5 deg open position, manually close the damper, and then tighten the linkage.
- C. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
- D. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

3.6 WARNING LABELS

- A. Affix plastic labels on each starter and equipment automatically controlled through the Control System. Label shall indicate the following:

CAUTION
This equipment is operating under
automatic control and may start at any
time without warning.

3.7 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling, including that within factory fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.
- B. Permanently label or code each point of field terminal strips to show the instrument or item served.
- C. Identify control panels with minimum 1-cm letters on laminated plastic nameplates.
- D. Identify all other control components with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

3.8 CONTROLLERS

- A. Provide a separate Controller for each major piece of HVAC equipment. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.
- B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.
- C. Future use of spare capacity shall require providing the field device, field wiring, points database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

3.9 PROGRAMMING

- A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory free for future use.
- B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.

C. Software Programming

1. Provide programming for the system as per specifications and adhere to the strategy algorithms provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

D. Operators' Interface

1. **Standard Graphics.** Provide graphics for each major piece of equipment and floor plan in the building. This includes each Chiller, Air Handler, VAV Terminal, Fan Coil, Boiler, and Cooling Tower. These standard graphics shall show all points dynamically as specified in the points list.
2. The controls contractor shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.
3. As part of this execution phase, the controls contractor will perform a complete test of the operator interface. Test duration shall be a minimum of [16] hours on-site. Tests shall be made in the presence of the Owner or Owner's representative.

- E. Demonstration:** A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of 16 hours on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection, and permits acceptance of the delivered system for on-line operation.

3.10 CLEANING

- A.** This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.
- B.** At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.

- C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.11 PROTECTION

- A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.
- B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.12 TRAINING

- A. Provide a minimum of 2 classroom training sessions, 8 hours each, throughout the contract period for personnel designated by the Owner.
- B. Train the designated staff of Owner's representative and Owner to enable them to proficiently operate the system; create, modify and delete programming; add, remove and modify physical points for the system; add additional panels when required.
- C. These objectives will be divided into three logical groupings; participants may attend one or more of these, depending on level of knowledge required:
 - 1. Day-to-day Operators
 - 2. System Troubleshooter
 - 3. System Manager: parts
- D. Provide course outline and materials as per Part 1 of this Section. The instructor(s) shall provide one copy of training material per student.
- E. The instructor(s) shall be factory-trained instructors experienced in presenting this material.
- F. Classroom training shall be done using a network of working controllers representative of the installed hardware or at the customer's site.

3.13 FIELD QUALITY CONTROL

- A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.

- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.
- C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.14 ACCEPTANCE

- A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

END OF SECTION

SECTION 26 0100

ELECTRICAL GENERAL REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Comply with the requirements of DIVISION 01.
- B. The requirements of this SECTION apply to all work of this DIVISION.
- C. 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 the Contract Amount.

1.2 QUALITY ASSURANCE

- A. Related Work Specified Elsewhere:
 - 1. Refer to DIVISION 23 for all electrical wiring and equipment furnished under mechanical division but installed and connected under this division.
 - 2. Refer to DIVISIONS 10, 11, 12 and 14 for all electrical wiring and equipment furnished under architectural division but installed or connected under this division.
- B. Examination of the Site:
 - 1. Visit the site prior to bidding. If any of extra work due to discrepancies or omissions on the drawings if such omissions or discrepancies have been revealed by examination before bidding, the Contractor should report the discrepancy to the Architect a minimum of three days prior to receipt of bids. If additional work is required due to omissions and discrepancies after the contract for the work is signed and if such omissions or discrepancies would have been revealed by a visit to the site before receipt of bids, then the corrective additional work shall be performed at no additional cost to the Owner.
- C. Requirements of Regulatory Agencies:
 - 1. Standards Compliance: When materials or equipment must conform to the standards of organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), American Society of Mechanical Engineers (ASME), American Gas Association (AGA), American Refrigeration Institute (ARI), and Underwriters' Laboratories (UL), proof of such conformance shall be submitted to the Architect for approval.

If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization, which is competent to perform acceptable testing and is approved by the Architect. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.

2. Any specific reference in these Specifications to codes, rules, regulations, standards, manufacturer's instructions or requirements of regulatory agencies shall mean the latest printed edition of each in effect at date of submission of Bid, unless the Document is shown dated.
3. Perform the work in conformance with the applicable requirements of all regulatory agencies, including, but not limited to the following:
 - a. National Electrical Code.
 - b. Uniform Plumbing Code.
 - c. Uniform Building Code
 - d. California Code of Regulations (CCR).
 - (1) Title 8, Division 1, Chapter 3.2 - California Occupational Safety and Health Regulations (CAL/OSHA).
 - (2) Title 8, Division 1, Chapter 4 - Safety Orders.
 - (3) Title 24, Building Standards.
 - (4) Part 2 - California Building Code
 - (5) Part 3 - California Electric Code
 - (6) Part 4 - California Mechanical Code
 - (7) Part 5 - California Plumbing Code
 - (8) Acceptance Requirements of California Energy Code, including but not limited to:
 - (a) Testing of lighting control systems including all associated wiring devices and control components.
 - (b) Reviewing plans and specification to ensure conform to the Acceptance Requirements

- (c) Perform construction inspection prior to testing to ensure that the equipment installed is capable of complying with the requirements of the Standards, the equipment is installed correctly and calibrated.
 - (d) Undertake all required Acceptance Requirement procedures and identify all performance deficiencies, ensuring that they are corrected. Document the results of the Acceptance Requirement procedures on the Acceptance Test forms and indicate satisfactory completion by signing the Certificate of Acceptance.
- 4. Nothing in the Drawings or Specifications shall be construed to permit Work not conforming to applicable laws, ordinances, rules, regulations.
- 5. When Drawings or Specifications exceed requirements of applicable laws, ordinances, rules, regulations, Drawings and Specifications take precedence.
- 6. It is not the intent of Drawings or Specifications to repeat requirements of codes except where necessary for completeness or clarity.
- 7. Work herein shall comply with all applicable requirements of CCR Title 8, Division 1, as they apply to this project, both in reference to Contractor's operations in performing his work and also in construction result to be accomplished. Where an omission or a conflict appears between OSHA requirements and the Drawings and Specifications, OSHA requirements shall take precedence.
- D. When there is an ambiguity or discrepancy between Drawings and Specifications the more stringent requirement of the two shall be provided.
- E. Licenses, Permits and Fees
 - 1. Provide, procure and pay for all permits, licenses, fees, etc., required to carry on and complete the Mechanical Work. Contact all applicable utility authorities and include in bid all fees, charged by any such authorities.
- F. Operating and Maintenance Instruction:
 - 1. Furnish the services of competent instructors who will give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the equipment or system specified. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The number of man-days (8 hours) of instruction furnished shall be two.

1.3 SUBMITTALS**A. General**

1. Submit shop drawings, catalog data, supplemental data, for all materials, equipment in all Sections of this DIVISION in accordance with the requirements of SECTION 013300, "Submittal Procedures" and as specified hereinafter.
2. Four weeks after award of the Contract, or earlier it deemed appropriate by the Architect, submit a schedule of all submittals with the date for each equipment submittal or shop drawing submittal clearly indicated.
3. Forward all submittals to Architect, together, at one time. Individual or incomplete submittals are not acceptable. Six (6) copies are required.
4. Submittals shall have been reviewed and stamped by the General Contractor in accordance with the requirements of the GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION. Submittals not so stamped will be returned without review.
5. The contractor shall allow for adequate time for submittal review by the engineer. In general, the contractor shall allow for a minimum of 15 working days from the day the general contractor sends the submittal to the architect to the day the architect returns the submittal to the general contractor. Additional time shall be allowed for large or complex submittals.
6. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment. Words "as specified" are not sufficient identification.
7. Identify each submittal item by reference to Specification SECTION Paragraph in which item is specified or drawing and detail number.
8. Organize submittals in same sequence as they appear in specification sections, articles, or paragraphs.

B. Indexing:

1. Submittals shall be indexed according to specification DIVISION and SECTION number and paragraph to identify each item. Sporadic submittals, incomplete data, or unidentified data, or data not showing features to coordinate item with other work will not be accepted.

C. Binders: Prepare submittal material in accordance with the following:

1. Insert all literature in standard three (3) ring binders for 8-1/2 x 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 one binder "No. 1 Architect's Copy" and another "No. 2 Engineers Copy". Both these binders shall contain original manufacturer's literature.
 3. Reference each item to the appropriate contract drawing sheet detail and to specification section and paragraph, and to the Mark Numbers appearing on the equipment schedule.
 4. Provide an index with each binder. This index shall follow the same sequence as the project Specifications.
- D. Submittal literature, Drawings and wiring diagrams shall be specifically applicable to this project and shall not contain extraneous material. The literature shall be clearly marked to indicate the proposed item and any accessories or options to be furnished. Submittals shall include, but not be limited to the following:
1. Floor boxes
 2. Supports and Anchors
 3. Electrical equipment, including but not limited to; transformers, switchboards, panelboards, motor control centers or control panels, electrical cabinets, multi-outlet assemblies, wiring devices, motor control disconnects and controllers, transient voltage surge suppressors, and lighting fixtures
 4. Overcurrent protective device coordination study, voltage drop and short circuit analysis
- E. Re-submittals shall respond to comments made on the original submittal and shall be marked with a re-submittal number and dated. Re-submittals not in conformance with these requirements will be returned without review.
- F. Shop Drawings: (Also see Division 01 requirements)
1. Submit shop drawings for lighting and audio-visual devices and equipment. Do not begin fabrication until shop drawings have been coordinated with all trades and have been reviewed and accepted by the Architect.
 2. Drawings shall be a minimum of 8-1/2 inches by 14 inches in size, with a minimum scale of 1/8 inch per foot, except as specified otherwise. Drawings shall include floor plans, sectional views, wiring diagrams, and installation details of equipment; and equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, coordination plans with piping, ductwork, and other items that must be shown to assure a coordinated installation. Equipment and conduit routing layouts and Electrical Room layouts shall be drawn at a minimum scale of 1/4 inch per foot. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment.

Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

3. The Architect's review of Shop Drawings is not intended to verify dimensions or quantities, or to coordinate items shown on these Drawings. Architect will review them for general conformance with design concept of the project and general compliance with the information given in the contract requirements of the plans and Specifications. Contractor is responsible for dimensions, which shall be confirmed and correlated at the job site, for fabrication processes and techniques of construction, for coordination of his work with that of all other trades and the satisfactory performance of his work.

G. Record Drawings

1. Installation drawings shall be drawn at the site by the Contractor on reproducible paper and shall be fully coordinated for interferences by all trades. The Contractor shall maintain at the jobsite a complete set of prints of the installation drawings for all mechanical work. These prints shall be kept up to date by recording all changes daily. The progress of the work shall be clearly, neatly and accurately designated, coloring in the various pipes, ducts and equipments as they are erected. This process shall incorporate all changes to the original drawings including formal change orders or other instructions issued by the Architect. Principal dimensions of all concealed work shall be recorded including inverts of buried conduits and height to underside of conduit racks or cable trays.
2. These marked up prints will be used as a guide for determining the progress of the work installed. They will be inspected monthly by the Architect and shall be corrected immediately if found either inaccurate or incomplete.
3. Prior to final acceptance of the Work of this Division, submit properly certified Record Drawings to the Architect for review and make changes, corrections, or additions as the Architect may require. After the Architect's review and any required Contractor revisions, deliver the Record Drawings to the Owner on electronic media in AutoCAD format. The Architect and Engineer do not assume any responsibility for the accuracy or completeness of the Record Drawings.

H. Operating & Maintenance Manuals:

1. Furnish an operation and maintenance manual for each item of equipment. Furnish three copies of the manual bound in hardback binders or an approved equivalent. Furnish one complete manual prior to the time that equipment tests are performed, and furnish the remaining manuals before the contract is completed. Inscribe the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the name and location of the equipment or the building, the name of the Contractor, and the contract number. The manual shall include the names, addresses, and telephone numbers of each subcontractor installing equipment, and of the local representatives for

each item of equipment. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start-up, operation and shutdown; description of the function of each principal item of equipment; the procedure for starting; the procedure for operating; shutdown instructions; installation instructions; maintenance instructions; lubrication schedule including type, grade, temperature range, and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. The parts lists for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the project site. The manual shall be complete in all respects for equipment, controls, accessories, and associated appurtenances provided.

2. Submit a DVD disk containing all Operations and Maintenance data in Adobe "pdf" format. Also include an index of Internet web site addresses Section No. and title, equipment name, Web site address for the O&M manual of the equipment, and the O&M Manual filename.
 - I. Letters from manufacturers certifying their supervision of equipment installation and start-up procedures.
 - J. Three (3) copies of certification signed by Owner's representative, attesting to their receipt of instructions required by paragraph "Operation and Maintenance Instruction" of this Section.

1.4 PRODUCT DELIVERY AND STORAGE

- A. Identify materials and equipment delivered to site to permit check against approved materials list, reviewed shop Drawings.
- B. Protect from loss or damage. Replace lost or damaged material and equipment with new at no increase in the Contract Amount.

1.5 DRAWINGS AND COORDINATION WITH OTHER WORK

- A. Contract Drawings:
 1. For purposes of clarity, legibility, the Contract Drawings are essentially diagrammatic to extent that many offsets, bends, unions, special fittings are not shown. Exact locations of items are not indicated, unless specifically dimensioned.
 2. Exact routing of conduit, surface raceway, etc., shall be governed by structural conditions, obstructions. Contractor shall make use of data in

Contract Documents. Architect reserves right, at no increase in price, to make any reasonable change in location of mechanical items, exposed at ceiling and/or on walls, to group them into orderly relationships and/or increase their utility. Verify Architect's requirements in this regard prior to roughing-in.

3. In addition to the Shop Drawings called for under SUBMITTALS the Contractor shall prepare large scale layout drawings showing location of equipment, piping and duct runs, and all other elements of mechanical systems provided under this DIVISION. Include sections of congested areas to show relative position and spacing of affected elements.
 4. Refer to the mechanical "M" and "P" series drawings and specifications, (Divisions 23 and 22 respectively) for the service voltage, power feed, control and interlock wiring for equipment specified under those sections. Review the documents to verify that the electrical services (power, control, interlock, etc.) provided are adequate and compatible with the equipment requirements. Include the cost to furnish and install the additional electrical services, if it is required over and above what is indicated on the mechanical "M" or "P" series drawings and in Division 26, such as additional control interlock conductors, larger feeder, or separate 120V control power source.
 - a. Prior to proceeding with the installation of any additional electrical work, submit detailed drawings indicating the exact scope of additional electrical work to the Architect for review and approval.
 5. Obtain and provide templates, information, and instructions to other DIVISIONS to properly locate holes and openings to be cut or provided for electrical Work.
 6. Not all offsets in surface raceway or conduit are shown. Decide which item to offset or relocate.
- B. Coordination:
1. Work out all "tight" conditions involving Work under this DIVISION and Work in other DIVISIONS in advance of installation.
 2. Maintain minimum 1 inch clearance from adjacent work, including piping, ductwork, insulation, etc. except as noted or approved.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for two years prior to bid opening.

The two year use shall include applications of equipment and materials under similar circumstances and of similar size.

- B. Alternative Service Record: Products having less than a two-year field service record may be acceptable on approval of the Architect if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.
- C. Service Support: Major equipment items shall be supported by service organizations. The Contractor shall submit a certified list of qualified permanent service organizations for support of the equipment, which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- D. Identify materials, equipment by manufacturer's name, nameplate data. Remove unidentified materials, equipment from site.
- E. 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.
- F. 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 and meets acceptance.
- G. Equipment Guarding
 - 1. Equipment Safety:
 - a. High-temperature equipment and conduit (transformers, dimmer panels, etc.) so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of a type as specified herein. Items such as catwalks, ladders, and guardrails shall be provided where required for safe operation and maintenance of equipment.
- H. Equipment or material damaged during transportation, installation or operation is considered as totally damaged. Replace with new. Variance with this permitted only with written acceptance.
- I. Provide an authorized representative to constantly supervise work of this DIVISION, check all materials prior to installation for conformance with Drawings and Specifications.
- J. Equipment shall be as described in the respective SECTIONS of THIS DIVISION and as shown.

2.2 SUBSTITUTIONS

- A. Where more than one specific name is used, it is to be understood that the name mentioned first represents the manufacturer whose equipment has been used as the basis of design. All other names mentioned are to be considered substitutions within the meaning of this paragraph, and no additional cost to the Owner shall accrue due to any revisions, additions or deletions required to make

substituted equipment perform in accordance with the plans and specifications.

- B. Any redesign necessitated by substitutions shall be provided by the Contractor and shall be subject to review and approval by the Architect.
- C. Substitutions will not be considered if they are indicated or implied on Shop Drawings or Project Data Submittal without the formal request required by Division 01.

PART 3 – EXECUTION

3.1 DEMOLITION

- A. Remove all conduit, fixtures, equipment, etc., where shown or otherwise indicated to be removed. Cap conduit at mains or source.

3.2 INSTALLATION

- A. Manufacturer's Recommendations

- 1. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material or equipment being installed, printed copies of these recommendations shall be furnished prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- 2. Provide complete systems in accordance with manufacturers' requirements.
- 3. Where dimensions or specific installation and operating instructions of equipment are not provided in the Drawings or Specifications, perform the Work according to approved manufacturer's specifications and recommendations. Any material and work required under this heading shall be supplied at no additional cost to the Owner.
- 4. Assemble equipment which is required to be field assembled, under the direct supervision of the manufacturer's agent. Prior to the final acceptance submit letters from the manufacturers that this has been done.

- B. 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 failure on part of Contractor to foresee means of bringing in or installing equipment into position inside building.

- C. Conduit and channel support Systems:

- 1. Worked into complete, integrated arrangement with like elements to make work neat appearing, finished.

2. Run concealed, except as shown or noted otherwise; where exposed, run parallel with walls or structural elements; vertical runs plumb; horizontal runs parallel with structure and level or uniformly pitched as appropriate.
3. Install with adequate passageways free from obstructions, as high as practicable to maintain adequate head room, as shown or as required. Notify Architect before installation whenever head room of less than 7-feet 6-inches will result. Coordinate with work of other DIVISIONS to achieve proper head room as specified in this DIVISION.
4. Provide bases, piers, metal frames and backings, hangers and supports for the fixtures and systems furnished under this DIVISION.
5. Expansion and Contraction: Make adequate provisions, whether those provisions are shown on Drawings or not.
6. Cleaning and Closing: Inspect all conduit and surface raceway, and equipment before placing; clean interior before closing. Close all piping and ductwork at end of each day's work.

D. Sleeves, Chases, and Concrete Inserts:

1. Provide, to cause no delay, all required sleeves, chases, inserts, anchor bolts, etc., and be responsible for correct location, installation of same.
2. Locating and sizing of openings for conduit or raceways through walls, etc., under this DIVISION. Framing of openings provided by respective DIVISIONS in whose work opening is made.
3. Penetrations of fire or smoke rated walls, partitions, and floors:
 - a. Pack space between conduit or cables and sleeve or opening with materials approved by Underwriters Laboratories for use in through-penetration fire stop systems. Materials, methods, and installation shall be in accordance with UL approved listings and shall be designed to act as a firestop as well as a cold smoke, noxious gas, and water sealant. Submit UL listings for all such systems to be used.
4. Conduit Sleeves: Where not otherwise indicated or specified, sleeves through outside walls, floors or roof slabs shall be zinc-coated steel pipe conforming to ASTM A53. Sleeves through inside partitions shall be zinc-coated sheet steel not less than 0.0217-inches thick conforming to ASTM A653.

E. Cutting and Repairing:

1. Do all cutting, repairing, including structural reinforcing, necessary for Work under this DIVISION.
2. Do no cutting or patching without Architect's review. Repair damage done by this cutting equal to original condition in Architect's opinion.

3. Assume responsibility for all damage to any part of premises or Work of other DIVISIONS, caused by leaks or breaks in piping or equipment furnished and/or installed under this DIVISION during construction and guarantee period.

3.3 TESTING AND OPERATIONAL CHECK

- A. Furnish all labor and test equipment required under this DIVISION and as follows.
- B. Clean equipment and conduit before each test.
- C. Test various Electrical systems in portions as work progresses. Any system or portion previously tested shall become part of any repeated test when it becomes part of distribution system.
- D. Should any piece of equipment or material fail in any of the tests, immediately remove, replace with new; retest system.
- E. Maintain test pressures for periods stated, or as directed without loss in pressure, except that due to change in temperature or atmospheric pressure during test.
- F. Perform all tests in accordance with the requirements and under supervision of authorities having jurisdiction.
 - a. All equipment shall be tested in the field by a company specializing in the specific equipment. Provide a written report upon completion of testing indicating final condition and setting(s) of each piece of equipment.

3.4 FIELD TESTING – GENERAL

- A. Tests:
 1. Perform as specified in individual sections and as required by authorities having jurisdiction.
 2. Duration as noted.
 3. Provide testing in accordance with NETA requirements.
- B. Provide required labor, material, equipment, instruments, and connections.
 1. Provide adequate number of technicians thoroughly familiar with systems to be tested to manage test procedures and assignments.
 2. Provide calibrated instruments, tools, and equipment for verification and adjustment, including adequate number of portable two-way radio communication equipment.
- C. Pay for restoring or replacing damaged work due to tests.
- D. Conducted by installer and equipment manufacturer or by approved testing agency where stated.

- E. Preliminary Tests: After work is completed, conduct preliminary tests to verify that installations are properly adjusted and free from defects.
- F. Final Tests: After completion of preliminary tests, conduct final tests to cover total systems throughout building. Tests to prove continuity and proper operation of entire installation of each system.
- G. Preparations:
 - 1. Give 14 days written notice before final tests. Coordinate dates and times with Owner.
 - 2. At time of notice, submit for review charts, lists, and schedules listing each circuit and item in each system for recording of values and check-off during tests.
- H. Submit test results in accordance with submittal requirements.
- I. In addition to specific systems testing described elsewhere include the following tests:
 - 1. Insulation resistance.
 - 2. Circuit continuity:
 - 3. Test all feeder and branch circuits for continuity.
 - 4. Test all neutrals for improper grounds.
 - 5. Test motors for proper rotation and operation.
 - 6. Alarm systems: Test failure and trouble modes for proper system response. See other sections.
 - 7. Circuit numbering verification: Select at random basis branch circuit breakers. Cycle on-off to verify panel directory matches actual load controlled.
- J. Approved Testing Agency: Electro Test Inc. Power Systems Inc., or approved equal.

3.5 CLEANING AND PAINTING

- A. Refinish Work supplied with final finish under this DIVISION if damaged to satisfaction of Architect.
- B. thoroughly clean all equipment, conduits and all other materials under this DIVISION free from all rust, scale, and all other dirt before covering or painting is done, or the systems put in operation. Leave in condition satisfactory to the Architect.
- C. Protect all finished surfaces of fixtures with heavy paper pasted thereon, or by other means, throughout the period of construction.

- D. At all times keep the premises free from accumulation of waste material and debris caused by his employees. At the completion of the project, remove refuse from within and around the building. All tools, scaffolding and surplus materials shall also be removed, leaving the site of his Work broom clean.
- E. Completely cover all electrical equipment to keep free of dirt and water during construction. Using visqueen, or other suitable material, effectively cap all openings into equipment to keep foreign matter out during construction.
- F. Torque and paint bolt heads in all equipment at completion of Work. Furnish Owner with a written torque schedule for all equipment.
- G. Properly prepare Work under this DIVISION to be finished painted
 - 1. All exposed work which in general includes conduit, surface raceway, channel supports, metal items, equipment and supports shall be painted except that polished aluminum, stainless steel, chrome plate and other finely finished materials shall not be painted unless otherwise noted.
 - 2. Unless otherwise noted all finish colors shall be selected by the Architect.
 - 3. Materials previously shop prime coated by the manufacturer and which have been scuffed or otherwise damaged shall be touched up with the same materials used for priming. Prime coats shall be of a lighter tint than final coats.

3.6 SIGNS, LABELS AND IDENTIFICATION

- A. Signs and Labels:
 - 1. Fasten a red-headed tack to each T-bar suspended ceiling pushout tile at any equipment, component or control devices, requiring maintenance or access.
 - 2. A printed sign shall be posted at alarm equipment. Provide proposed wording prior to fabrication.
 - 3. A printed sign shall be posted at each automatically started equipment stating, "WARNING THIS MACHINE IS AUTOMATICALLY CONTROLLED AND MAY START AT ANY TIME".
- B. Conduit Identification:
 - 1. Identify and color-code all conduit including conduit in furred ceiling spaces. Identification shall be as specified herein.
 - 2. Plastic Markers: Seton Setmark, or equal, for concealed locations or if located in electrical rooms; or Seton Opticode, or equal, for exposed conduits in public areas, with wording as selected by the Architect. Each marker must show approved color-coded background, proper color of legend in relation to background color, approved legend letter size, and approved marker length.

3. Location for Conduit Identification:
 - a. Adjacent to each panel or junction box fitting
 - b. At each branch and riser take-off.
 - c. At each conduit passage through wall, floor and ceiling construction.
 - d. On all horizontal runs spaced 25-feet maximum but not less than one per room.

3.7 EQUIPMENT IDENTIFICATION

- A. Properly identify each piece of equipment and its controls using engraved laminated plastic descriptive nameplates, attached to equipment and controls using round head brass machine screws or pop rivets. Cardholders in any form are not acceptable. Equipment nameplates shall be as shown on drawings.
- B. Wiring devices shall be provided with engraved nameplates indicating the panel and circuit number. Text color shall be black unless directed otherwise by Architect. Text height shall be minimum 1/8" high.

3.8 SEISMIC REQUIREMENTS

- A. Contractor shall engage and pay for services of a California Registered Structural Engineer for the purpose of design and follow-up field verification of seismic anchoring for:
 1. Distribution panels and switchboards.
 2. Typical panelboards (wall mounted).
 3. Typical multiple conduit racks and tray supports.
- B. Details shall be submitted to the Architect for records only. Design shall be in accordance with UBC, Chapter 23, Section 2312. Verify with Structural Engineer.

END OF SECTION

SECTION 26 0519

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. Refer to 260100, Basic Electrical Requirements
- B. All materials shall bear the listing label of Underwriters Laboratories.

1.2 SUBMITTALS

- A. Manufacturers' product data sheets.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. AFC Cable Systems
- B. Allied Wire and Cable
- C. American Insulated Wire
- D. Cerro Wire
- E. General Cable
- F. Prysmian
- G. Pyrotenax
- H. Southwire

2.2 CONDUCTORS

- A. All conductors shall be solid or stranded copper and installed as identified and specified.
- B. All wire sizes shown on the Drawings are copper.

2.3 INSULATION

- A. Type THHN, THWN, XHHW (75 degrees C): Type XHHW shall be used in below grade and damp locations.
- B. Type AF (150°C) Fixture Wire: Minimum size No. 14, stranded, high temperature wire shall be used for field wired tap-off connections to lighting fixture where operating temperature exceeds 90°C.

- C. Special types of wiring such as coaxial cables, microphone cable and other multi-conductor cables shall be as specified elsewhere and as indicated.
- D. Type MC (90°C): Use for branch circuit wiring from ceiling junction box to switch or receptacle (not permitted for branch circuit homeruns). The conductors shall be color coded to match coding as described herein. Fittings for connection of Type MC cable to boxes, cabinets, etc., shall be fitting type E.T.P. Series AMC or acceptable equivalent.

2.4 IDENTIFICATION

- A. Color code all wiring throughout including branch circuits, feeders, multiconductor cables, fire alarm system, equipment ground conductors, etc., as specified hereinafter and as indicated.

<u>Phase</u>	<u>120/208 Volts</u>	<u>277/480 Volts</u>
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	White
Ground	Green	Green
Isolated Ground	Green/Yellow Stripe	

- B. Switch legs for local wall switches shall be same color as phase wires.
- C. Colored insulation in sizes up through No. 8. Conductors No. 6 and larger shall have black insulation but phase color coded with 1/2 inch band of colored tape, at all junction boxes, pull boxes, wireways, and terminations.
- D. Main and feeder cables shall be tagged in all pull boxes, wireway, and wiring gutters of panels. Tags shall be of fireproof, nonconductive material, approved by Architect.
- E. Maintain the same phase, neutral and ground color from circuit breaker or switch to last device.

2.5 PULL CORD

- A. Branch and System Raceways: Provide 300 lbs strength (minimum) polypropylene rope.
- B. Feeder Raceways: Provide 1/4 inch (minimum) polypropylene rope.
- C. Both ends of all pull cords shall be identified by means of labels or tags, reading "PULL CORD" and shall be numbered to refer to the same pull cord at each end.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. All conductors shall be solid or stranded for branch circuit lighting and receptacle wiring. Use stranded conductors for branch circuit wiring to motors or vibrating equipment.
- B. A complete system of conductors shall be installed in the raceway system throughout the building for all feeder and branch circuits, etc.
- C. All conductors shall be continuous from outlet to outlet and no splices shall be made except within outlet or junction boxes. Junction boxes may be utilized where required. At least 6 inches of wire shall be left at outlet boxes for connecting fixtures and devices.
- D. No wire smaller than No. 12 gauge shall be used, except for signal or control systems, or where otherwise indicated. No. 10 wire shall be used for 120 volt branch circuit runs exceeding 70 feet, and 160 feet for 277 volt, for all exit light wiring, and elsewhere when noted on the plans.
- E. Parallel Feeders: Each phase wire and neutral wire of each parallel run shall be the same length.
- F. Wires entering switchboards, panelboards, and disconnects shall be of sufficient length for proper termination without splicing within the equipment enclosure. Any wires installed that require splicing for terminating shall be removed and replaced with ones of the proper length. Wires shall be trained and supported in a neat and workmanlike manner.
- G. Wiring Bundles or Harnesses:
 - 1. Multiple wires in bundles or harnesses terminating in control panels, switchboards, panelboards, etc., shall be bundled, trained, and laced to achieve a neat and workmanlike appearance.
 - 2. Surplus wire protruding from the harness for termination shall be trimmed to the proper length. Do not fold and stuff surplus wires into wiring gutters.
 - 3. Wires exiting the bundle or harness shall be carefully trained at a 90° angle to the termination point.
- H. Phase Rotation:
 - 1. The Contractor shall check with the power company serving the facility to determine that the phase rotation on the primary side of the building service transformer is clockwise, A-B-C, left-to-right. Coordinate phase rotation between power company and emergency engine-generators.
 - 2. This phase rotation shall be maintained throughout the facility including wiring for switchboards, substations, panelboards, motor control centers, and transformers (both primary and secondary).

3. Prior to Final Closeout of the Project, the Contractor shall furnish a certificate to the Architect stating the above has been accomplished.
- I. All wire shall be brought to the job in unbroken packages and shall bear the date of manufacturing and shall not be older than 12 months.
- J. Type MC cable shall be installed in compliance with NEC Article 300. Support for MC cable shall be within 6 feet of every outlet box, junction box, cabinet, or fitting. Maximum distance between horizontal supports shall be 6 feet.

3.2 CONNECTIONS

- A. Connections to circuit breakers, switches, and similar equipment provided with lugs or connectors may be used without additional lugs or connectors; where equipment is provided without terminating devices. Contractor shall provide appropriate devices which are listed and manufactured for such application.
- B. Splices:
 1. No. 8 and smaller wire shall be Scotchlock or approved equal, pressure type solderless connectors with insulator.
 2. No. 6 and larger wire shall be Burndy, Type QPX, or approved equal, solderless lugs and clamp-type connector.
 - a. Uninsulated solderless connectors shall be insulated as follows: Wrap with two complete thicknesses of varnish cambric followed by 6 complete wraps of Scotch 33 or equal, followed by 1 complete wrap of Scotch 2200.
- C. Control Wires:
 1. Control wires shall terminate into a terminal block or lug connection. Wires shall be stripped to the proper length and a ring or tongue crimp-on terminal lug installed.
 2. Do not wrap bare wires around bolt heads for termination.
 3. Stranded wires terminating into terminal blocks or lugs and secured by means of a set screw shall have the wire end tinned with solder to achieve a positive connection and anneal the strands together.
- D. Conductors subject to moisture. Use 3M Scotchcast splicing kits for power signal or control conductor splices.

3.3 LUBRICATION

- A. Where lubrication is required for pulling conductors or cables, it shall be a compound specifically prepared for cable pulling and shall not contain petroleum or other products which will have a deteriorating effect on the cable insulation.

END OF SECTION

SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL**1.1 WORK INCLUDED**

A. The electrical grounding work shall include, but not necessarily be limited to, the following as defined in Article 250 of NEC:

1. Electrical circuit and system grounding:
 - a. Service supplied AC systems.
 - b. Separately derived AC systems including transformers, UPS systems, power conditioners, standby or emergency generators, etc.
2. Electrical enclosure and raceway grounding.
3. Equipment grounding.
4. Bonding.

B. Equipotential grounding of building structure.

C. Zero Signal Reference Grid for computer/data processing rooms.

1.2 REFERENCED STANDARDS

A. In addition to NFPA No. 70-NEC, and NFPA No. 101 - Life Safety Code conform to the following standards, latest edition:

1. UL Standard 467 - Electrical Grounding and Bonding Equipment.
2. UL Standard 1053 - Ground-Fault Sensing and Relaying Equipment.
3. IEEE Standard 142.
4. Federal Information Processing Standard (FIPS) No. 94.

B. Where drawings or specifications require a more stringent material or method than the above mentioned standards conform to the drawings and/or specifications.

PART 2 – PRODUCTS**2.1 GROUND RODS**

A. Copper clad steel rod conforming or exceeding requirements of UL Standard No. 467. Rod shall be 3/4" diameter, 10' in length.

- B. In corrosive soil locations: Stainless steel (302) or stainless steel jacketed steel rod conforming or exceeding requirements of UL Standard No. 467 (ANSI C-33.8) as manufactured by Teledyne Metals Forming Company, Elkhart, Indiana. Rod shall be 3/4" diameter 10' in length.

2.2 CONDUCTORS FOR GROUNDING

- A. In raceways installed with circuit conductors: Size and insulation shall be as specified in this section or on drawings.
- B. Grounding electrode conductors: Medium hard drawn, stranded copper. Minimum size: #4 AWG.
- C. Bonding conductors: NEC Article 250, Part G.

2.3 GROUND CONNECTIONS

- A. Below Grade: Exothermic welding method, Cadweld or equal.
- B. Above Grade or in Manholes: Compression type connectors, T&B, Burndy or Anderson.

2.4 HARDWARE

- A. Bolts, nuts, and washers shall be bronze, cadmium plated steel, or other non-corrosive material, approved for the purpose.

2.5 WATERPROOF SEALANT

- A. Use Kearney "Aqua Seal" mastic sealant on all below grade clamp or compression type connections.

PART 3 – EXECUTION

3.1 GROUNDING ELECTRODE SYSTEM

- A. Grounding electrode system shall consist of the following electrodes:
 - 1. Metal underground water pipe.
 - 2. Building structural metal columns grounded as detailed on drawings.
 - 3. Concrete-encased electrodes (UFER Ground) as detailed on drawings.
 - 4. Ground rods.
- B. The above grounding electrodes shall be connected together to form a grounding electrode system. See drawings for additional details.

3.2 CIRCUIT AND SYSTEM GROUNDING

- A. Direct-current systems and service-supplied and separately derived alternating-current systems shall be grounded in accordance with NEC 250-3 to 250-26 inclusive.
- B. Ground conductor shall be copper and shall be in accordance with NEC 250-94.

3.3 ELECTRICAL EQUIPMENT GROUNDING

- A. Ground non-current carrying metal parts of electrical equipment enclosures, frames, conductor raceways or cable trays to provide a low impedance path for line-to-ground fault current and to bond all non-current carrying metal parts together. Install a ground conductor in each raceway system in addition to conductors shown.

Equipment ground conductor shall be electrically and mechanically continuous from the electrical circuit source to the equipment to be grounded. Size ground conductors per NEC 250-95 unless larger conductors are shown on drawings.

- B. Grounding conductors shall be identified with green insulation. Where green insulation is not available, on larger sizes, black insulation shall be used and suitably identified with green tape at each junction box or device enclosure.
- C. Install metal raceway couplings, fittings and terminations secure and tight to insure good ground continuity. Provide grounding bushing and bonding jumper where metal raceway is not directly attached to equipment metal enclosure and at concentric knock-outs.
- D. Lighting fixtures shall be securely connected to equipment ground conductors. Outdoor lighting standards shall have a factory installed ground lug for terminating the ground wire.
- E. Motors shall be connected to equipment ground conductors with a conduit grounding bushing and with a bolted solderless lug connection on the metal frame.
- F. UFER Ground: Form a continuous ground mat by serpentine bare copper conductor of minimum length 60 feet in the bottom of the structure foundation footing. The maximum resistance of the ground mat shall not exceed 5 ohms under normally dry conditions. If this ground resistance cannot be obtained with the 60 feet of conductor, additional conductor shall be added.
- G. All ground connectors shall be bronze of the clamp type. All clamp accessories such as bolts, nuts, and washers shall also be bronze to assure a permanent corrosion-resistant assembly. Connector shall be as manufactured by Burndy Engineering Company, Ilco Corporation, or approved equal.
- H. All ground cable splices, joints, building structural steel, and connections to ground rods shall be made with an exothermic welding process which shall provide a weld with current-carrying capacity not less than that of the conductors welded. Soldered connections shall not be used.

- I. All ground wire shall be bare, unless otherwise indicated on the Drawings, extra flexible stranded copper cables. Grounding cables installed in earth shall be laid slack.
- J. Neutrals throughout the system shall be solidly grounded.
- K. Lighting and power panelboard shall be grounded by connecting a bare conductor to the grounding stud and to the incoming and outgoing feeder conduits grounding bushings. Each grounding-type bushing shall have the maximum ground wire accommodation available in standard manufacture for the particular conduit size. Connection to the bushing shall be with wire of this maximum size.
- L. The grounding stud of each secondary voltage dry type, 3-phase transformer shall be connected separately to the grounding lug on the panelboard serving the transformer utilizing a ground clamp for such transformers specified below. Connection shall be by means of an insulated conductor run in rigid steel conduit, sized as shown on the Drawings.
- M. The central equipment for the fire protection alarm system shall have its grounding terminal connected to the ground lug on the panelboard serving the system by means of a #6 green coded insulated conductor, run in 3/4 inch rigid steel conduit, utilizing a ground clamp.
- N. Grounding connections to switchboards and distribution panelboards shall be by using a compression type lug bolted directly to the ground bus for each grounding conductor terminated.

3.4 BONDING

- A. Bonding shall be provided to assure electrical continuity and the capacity to conduct safely any fault current likely to be imposed.
- B. Bonding shall be in accordance with NEC Article 250, Part G.

3.5 ISOLATED/INSULATED GROUND FOR ELECTRONIC EQUIPMENT AND/OR INSTRUMENT

- A. Provide a ground grid and insulated conductors into the building where shown to form the Isolated/Insulated Ground System for Electronic Equipment and/or Instrument.
- B. Provide grounding bars, outlets and/or jacks as shown and detailed on drawings.
- C. Isolated Equipment Grounding System Installation
 - 1. The isolated ground receptacle branch circuits shall require a separate neutral and isolated grounding conductor. A single equipment grounding conductor shall also be installed for grounding the raceway system (this conductor can be a common conductor for 2 or 3 branch circuits within the same raceway).

2. The isolated ground receptacle grounding screw shall be grounded by extending an isolated grounding conductor with the circuit conductors to the serving panelboard. At the panelboard connect the isolated grounding conductors to an isolated ground bar (insulated) from the panelboard metal housing. From the isolated ground bar extend a green wire with yellow strip (same size as the equipment grounding wire) back to the equipment grounding terminal of the derived system or service. This conductor shall be routed through the distribution system without connection until it terminates at the derived system or service point

END OF SECTION

SECTION 26 0529

SUPPORTS AND ANCHORS

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. Multi-outlet supports.
- B. Raceway supports.
- C. Conduit supports.

1.2 WORK INCLUDED

- A. Refer to SECTION 260100: Basic Electrical Requirements

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Supports:
 - 1. OZ/Gedney
 - 2. Appleton
 - 3. Thomas and Betts
 - 4. Minerallac
 - 5. Midwest Electric
 - 6. Unistrut
 - 7. B-Line
 - 8. Kindorf
 - 9. Super Strut
 - 10. Erico Products (Caddy)
- B. Anchors:
 - 1. Hilti
 - 2. Red Head
 - 3. Raw Plug
 - 4. Star Expansion

2.2 METAL SURFACE RACEWAYS AND MULTIOUTLET ASSEMBLIES**A. Fasteners and Supports:**

1. Wood: Flat-head wood screw.
2. Dry Wall: Plastic anchor with flat-head wood screw.
3. Plaster: Plastic anchor with flat-head sheet metal screw.
4. Brick, Masonry or Block: Masonry nail.
5. Tile: Toggle bolt.
6. Concrete: Drive pin fastener.

2.3 CONDUIT**A. Single Conduit:**

1. Supported from beam flange:
 - a. Beam Clamp:
 - (1) Appleton No. BH500 for conduit 1 inch and smaller.
 - (2) Appleton No. BH502 for conduit 1-1/4 inches and larger.
 - b. Conduit Hanger: Zinc-plated steel with bolt and nut, Minerallac No. 0-B through 10-B as required.
 - c. Support: Machine screw between clamp and hanger.
2. Supported and suspended from beam flange:
 - a. Beam Clamp:
 - (1) Appleton No. BH500 for conduit 1 inch and smaller.
 - (2) Appleton No. BH502 for conduit 1-1/4 inches and larger.
 - b. Conduit Hanger: Zinc-plated steel with bolt and nut, Minerallac No. 0-B through 10-B as required.
 - c. Rod: Zinc-plated or galvanized steel, threaded, Minerallac.
 - (1) 1/4 inch diameter for conduit 1 inch and smaller.
 - (2) 3/8 inch diameter for conduit 1-1/4 inches and larger.
 - d. Support:
 - (1) Nut on rod on both the inside and outside of the clamp; outside nut to act as locking nut.

- (2) Nut on rod on inside of hanger.
 - 3. Supported from concrete slab or roof:
 - a. Support: One-hole strap, Minerallac MIN-E snap-on clip.
 - b. Concrete Insert: Phillips Redhead, 'J' or 'S' Series.
 - 4. Supported and suspended from concrete slab or roof:
 - a. Conduit Hanger: Zinc-plated steel with bolt and nut, Minerallac No. 0-B through 10-B as required.
 - b. Rod: Zinc-plated or galvanized steel, threaded, Minerallac.
 - (1) 1/4 inch diameter for conduit 1 inch and smaller.
 - (2) 3/8 inch diameter for conduit 1-1/4 inches and larger.
 - c. Support: Nut on rod on inside and outside of hanger.
 - d. Concrete Insert: Phillips Redhead, 'J' or 'S' Series.
 - 5. Supported from concrete, or hollow masonry wall:
 - a. Conduit Hanger: Two-hole heavy-duty strap, Minerallac 200 Series.
 - b. Anchor:
 - (1) Concrete: Phillips Redhead, 'J' or 'S' Series.
 - (2) Masonry Wall: Molly bolt.
 - 6. Supported from damp or outside concrete wall:
 - a. Conduit Hanger: Zinc-plated steel with bolt and nut, Minerallac No. 0-B through 10-B as required.
 - b. Anchor: Phillips Redhead, 'J' or 'S' Series.
- B. Multiple Conduits:
 - 1. Supported from concrete slab or roof:
 - a. Support: One-hole strap, Minerallac MIN-E snap-on clip.
 - b. Concrete Insert: Phillips Redhead, 'J' or 'S' Series.
 - 2. Supported and suspended from concrete slab or roof:
 - a. Conduit Hanger: Unistrut pipe clamp No. P1100 Series for rigid and No. P1200 Series for EMT.

- b. Rods (2 required): 3/8 inch diameter.
- c. Support:
 - (1) Unistrut No. P-1000, length as required.
 - (2) Nut on rod on outside of unistrut and unistrut spring-loaded nut on inside of unistrut.
- d. Concrete Insert: Phillips Redhead, 'J' or 'S' Series.
- 3. Supported from metal deck:
 - a. Conduit Hanger: Zinc-plated steel with bolt and nut, Minerallac No. 0-B through 10-B as required.
 - b. Anchor in Deck: Fender washer with nut.
- 4. Supported from concrete or hollow masonry wall:
 - a. Conduit Hanger: Unistrut pipe clamp No. P1100 Series for rigid and P1200 Series for EMT.
 - b. Support: Unistrut No. P-1000, length as required.
 - c. Anchor:
 - (1) Concrete Insert: Phillips Redhead, 'J' or 'S' Series.
 - (2) Masonry Wall: Molly bolt.

2.4 SUBMITTALS

- A. Manufacturer's product data.

PART 3 – EXECUTION

3.1 CONDUIT SUPPORTS

- A. Support Horizontal Conduit as Follows:
 - 1. Rigid, intermediate conduit and EMT shall be supported no greater than every 10 feet. Flexible conduit and MC cable shall be supported no greater than every 4.5 feet.
- B. Rigid galvanized steel and EMT shall be supported within 3 feet of every outlet box, junction box, cabinet, or fitting. Flexible conduit shall be supported within 1 foot.
- C. Support vertical conduit at every floor with a maximum of 10 feet between supports.
- D. Conduit systems shall be designed for maximizing deflection not greater than 1/8".

3.2 SLEEVES

- A. Provide conduit sleeves for every fire-rated wall or floor where conduit penetrates.

3.3 ANCHORS

- A. Anchors shall be installed using the proper drill bits and power tools.
- B. Anchors shall be installed per the manufacturer's recommendations.

END OF SECTION

SECTION 26 0533

CONDUIT RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 GENERAL REQUIRMENTS

- A. Galvanized rigid steel conduit (GRC).
- B. Plastic coated rigid steel conduit.
- C. Intermediate metal conduit (IMC).
- D. Electrical metallic tubing (EMT).
- E. Nonmetallic conduit.
- F. Flexible metal conduit.
- G. Liquid tight flexible metal conduit.
- H. Outlet boxes.
- I. Junction boxes.
- J. Pull boxes.

1.2 SUBMITTALS

- A. Manufacturer's product data.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - CONDUIT

- A. Conduit (GRC, IMC, EMT):
 - 1. Triangle
 - 2. Wheatland
 - 3. Allied
 - 4. Western
- B. Plastic Coated Rigid Steel:
 - 1. Robroy
- C. Conduit (Nonmetallic):
 - 1. Carlon

2. Anamet]
3. P-W Pipe
- D. Flexible Metal Conduit:
 1. AFC
 2. Anamet
 3. Alflex
- E. Liquid-tight Flexible Metal Conduit:
 1. Anamet
 2. Electri-flex
 3. Wheatland
- F. Fittings:
 1. Crouse-Hinds
 2. Appleton
 3. Steel City
 4. T&B
 5. ETP
 6. Midwest Electric
 7. Oz/Gedney

2.2 ACCEPTABLE MANUFACTURERS - BOXES

- A. Steel:
 1. Steel City
 2. Appleton
 3. Raco
 4. Bowers
 5. Hoffman
 6. Circle AW Products
 7. E.M. Wiegmann

B. Malleable Iron:

1. Appleton
2. Crouse-Hinds
3. Killark
4. Oz/Gendey

2.3 CONDUIT TYPES

A. GRC:

1. Conduit: Standard I.P.S., hot-dipped galvanized or sheradized steel with galvanized threads. Zinc coating.
2. Fittings:
 - a. Threaded galvanized malleable iron or heavy steel water and concrete tight.
 - b. Metallic nylon grounding type insulated bushings with locknuts for all connectors at cabinets, boxes, and gutters.
 - c. Set screw connectors are not acceptable.
 - d. Die-cast fittings shall not be used.
3. Bushings and Locknuts: Malleable iron with sharp, clean cut threads.

B. Plastic-coated Rigid Steel:

1. Conduit:
 - a. Hot-dip galvanized including hot dip galvanized threads.
 - b. Zinc surface prior to plastic coating to be conditioned to provide anchor for the plastic coating.
 - c. Interior and exterior to be coated with lacquer, such as an epoxy acrylic, prior to application of plastic coating.
 - d. Plastic coating to be applied by dip method.
 - e. Plastic coating to be factory applied by same manufacturer who produces the hot dip galvanized conduit.
 - f. Plastic coating to have minimum thickness of 0.040 inches the full length of the pipe except for the threads.

- g. Bond between metal and plastic is to be equal to or greater than the tensile strength of the plastic coating.
 - h. Coupling to be furnished with each length of conduit and have a plastic sleeve extending 1 pipe diameter or 2 inches whichever is less beyond the end of the coupling. Inside diameter of the sleeve to be the same as the outside diameter of the IPS pipe used with it. Wall thickness of the sleeve to be the same as the plastic coating on the pipe.
- 2. Fittings: Coated in the same manner as the conduit.
- C. Intermediate Metal Conduit:
 - 1. Conduit: Hot-dipped galvanized steel with galvanized threads. Zinc coating. Interior coating for easier wire pulling.
 - 2. Fittings:
 - a. Threaded galvanized malleable iron or heavy steel water and concrete tight.
 - b. Metallic nylon grounding type insulated bushing with locknuts for all connectors at cabinets, boxes, and gutters.
 - c. Set screw connectors are not acceptable.
 - d. Die-cast fittings shall not be used.
 - 3. Bushings and Locknuts: Malleable iron with sharp, clean threads.
- D. EMT:
 - 1. Conduit:
 - a. Hot-dip galvanized steel, electrically welded. Exterior zinc coating. Interior coating for easier wire pulling.
 - 2. Fittings:
 - a. Compression Type:
 - (1) Connectors: Steel, nylon insulated, zinc electroplated, raintight, T&B No. 5123, Crouse-Hinds No. MW1650 Series, or approved equal.
 - (2) Couplings: Steel, zinc electroplated, raintight, T&B No. 5120, Crouse-Hinds No. MW660S Series, or approved equal.

- (3) Combination Couplings: Threaded steel, zinc electroplated, T&B No. 530 Series, Crouse-Hinds No. MW690 Series, or approved equal.
 - b. Set-Screw Type for Interior Dry Locations:
 - (1) Connectors: Steel, zinc electroplate, nylon insulated, concrete tight, T&B No. 5031 Series, Crouse-Hinds No. MW1450 Series, or approved equal.
 - (2) Couplings: Steel, zinc electroplate, concrete tight, T&B No. 5030 Series, Crouse-Hinds No. 460 Series, or approved equal.
 - (3) Combination Couplings: Steel, zinc electroplate, concrete tight, T&B No. 480 Series, Crouse-Hinds No. MW420 Series, or approved equal.
 - c. Die cast, pressure cast, or indentor type fittings shall not be used.
 - d. Other applicable fittings as specified for GRC or as approved.
- E. Flexible Metal:
 - 1. Conduit:
 - a. Flexible steel conduit, formed on 1 continuous length of electro-galvanized spirally wound steel strip.
 - b. Not to exceed 6'-0" in length for lay-in fixtures.
 - c. Not to exceed 4'-0" for motors.
 - d. Aluminum flexible conduit shall not be used.
 - 2. Fittings:
 - a. Clamp-type utilizing 1 set screw 3/8 inch through 1 inch size, 2 set screws 1-1/4 inch and larger, galvanized malleable iron or steel with nylon insulated throat.
 - b. O.Z. Gedney KC series or approved equal.
- F. Liquid-tight Flexible Metal:
 - 1. Conduit:

- a. Liquid-tight flexible steel conduit, formed of one continuous length of electro-galvanized spirally wound steel strip, with neoprene jacket. Conduit 1-1/4 inch and smaller, shall contain a built-in continuous copper ground.
 - b. 4'-0" maximum length.
 - 2. Fittings:
 - a. Galvanized malleable iron or steel, liquid-tight with neoprene gaskets, "O" ring and retainer, nylon insulated throats and external grounding lug.
 - b. Appleton No. 4Q-TL series or approved equal.
- G. Rigid Nonmetallic:
 - 1. Conduit:
 - a. Rigid polyvinyl chloride (PVC) Schedule 40 as noted on the Drawings.
 - b. Provide in standard lengths of 10 or 20 feet.
 - 2. Fittings:
 - a. Factory made.
 - b. Horizontal elbows may be rigid nonmetallic.
 - c. Approved couplings for joining plastic to steel shall be used for connection to GRC elbows or raceways.
- H. Metal-Clad Cable

2.4 OUTLET BOXES, JUNCTION AND PULL BOXES - REQUIREMENTS

- A. Boxes must conform to the provisions of Article 370 of the NEC.
- B. Boxes shall be of the proper size to accommodate the quantity of conductors enclosed in the box. Boxes shall not be less than 4 inches square and 1-1/2 inches deep unless otherwise noted.

2.5 CONSTRUCTION

- A. Boxes generally shall be hot-dipped galvanized steel with factory-made knockout openings.
- B. Boxes on exterior surfaces, in floors, on stub-ups above floors, or in wet or damp locations shall be corrosion-resistant cast malleable iron. Boxes shall have threaded hubs for rigid conduit and neoprene gaskets for their covers. Boxes shall be Type FS or FD.

- C. Conduit bodies shall be corrosion-resistant cast malleable iron. Bodies shall have threaded hubs for rigid conduit and neoprene gaskets for their covers.
- D. Conduits terminating in boxes, cabinets, panelboards, etc., with eccentric or concentric knockouts, shall have a grounding bushing installed and bonded to the box by means of a bond wire from the bonding bushing lug to a lug on the enclosure.

2.6 TYPES

A. Outlet Boxes:

- 1. Deep boxes shall be used:
 - a. In walls covered by wainscot or paneling.
 - b. In walls of glazed tile, brick, or other masonry which will not be covered with plaster. The bottom of the box shall be located on the horizontal joint. Box shall be listed for particular application.
- 2. Thru-the-wall-type boxes shall not be used unless specifically called for.
- 3. Boxes shall be nongangable.
- 4. Boxes in concrete shall be of a type to allow the placing of conduit without displacing the reinforcing bars, and shall be of the type approved for concrete use. Boxes installed in poured concrete shall be packed with a material to avoid concrete from entering the box during the pour.
- 5. Lighting fixture outlet boxes shall be equipped with the proper fittings to support and attach a light fixture.
- 6. Light, switch, receptacle, and similar devices shall be provided with approved boxes, suitable for their function.
- 7. Back boxes shall be furnished and installed as required for the equipment and/or systems under this contract.

B. Pull and Junction Boxes:

- 1. Shall be code gauge boxes with screw covers. Boxes shall be rigid under torsional and deflecting forces and shall be provided with angle iron framing where required.
- 2. Shall have a blank cover in unfinished areas and a plaster ring and blank cover in finished areas.
- 3. Shall have their covers accessible. Covers shall be fastened to boxes with machine screws to insure continuous contact all around. Covers for surface-mounted boxes shall line up evenly with the edges of boxes. Covers for flush-mounted boxes shall extend 3/4 inch past boxes all around.

4. Boxes with unused punched out openings shall have the openings filled with factory-made knockout seals.
5. Where 120 volt and 277 volt, or different phases of 277 volt circuits are located in the same outlet box, install partition barriers to limit the voltage to 300 volts to ground, or between adjacent switches. Separate boxes for emergency circuits or lighting switches. On specialty outlets, such as a grounding point, normal and emergency receptacle box, use common box.
6. Feeder pull boxes may be a common box only in parallel runs; combined feeder circuit pull boxes are not allowed.
7. Emergency feeder pull box to be a separate box even for parallel runs.

C. Plaster Rings:

1. Plaster rings shall be installed on all boxes where the boxes are recessed. Plaster rings shall be of a depth to reach the finished surface. Where required, extension rings shall be installed so that the plaster ring is flush with the finished surface.
2. Plaster rings shall be of the number of gangs required to accept the number of devices shown on the Drawings.

PART 3 – EXECUTION

3.1 LOCATIONS

- A. Installed for all wiring, lighting, power, signal, control, communications, alarms, etc.
- B. GRC:
 1. For primary and secondary service and for substation, switchboard, motor controls center, transformer, and panelboard feeders.
 2. Buried in or in contact with earth to be half-lapped with 10-20 mil tape by 3M.
 3. In poured concrete walls, floor, and roof construction, provided a minimum 2 inches cover is maintained.
 4. In all walls up to the first outlet box where fed from rigid conduit in damp locations or locations exposed to the weather.
 5. In exposed locations where subject to mechanical injury, including all mechanical rooms, Central Plant facilities, and fire pump rooms.
 6. All elbows, except that underground plastic conduit elbows may be used in slab and exterior lighting and power.
 7. For hazardous areas.

8. For grounding electrode conductor if exposed overhead, or in or on walls down to equipment.
 9. Elsewhere where indicated on the Drawings.
- C. Plastic-coated Rigid Steel:
1. In earth or encased in concrete.
 2. In industrial waste treatment areas.
- D. IMC:
1. For secondary service and for switchboard, motor control center, transformer, and panelboard feeders.
 2. Buried in or in contact with earth to be half-lapped with 10-20 mil tape by 3M.
 3. In poured concrete walls, floor, and roof construction, provided a minimum 2 inches cover is maintained.
 4. In all walls up to the first outlet box where fed from rigid conduit in damp locations or locations exposed to the weather.
 5. In exposed locations where subject to mechanical injury, including all mechanical rooms, Central Plant facilities and fire pump rooms.
 6. All elbows for underground plastic conduit.
 7. For hazardous areas.
 8. Elsewhere where indicated on the Drawings.
- E. Electrical Metallic Tubing:
1. In stud partitions and hollow masonry walls.
 2. Connection from junction box to lighting fixtures except in accessible ceilings.
 3. Above suspended or accessible ceilings.
 4. Exposed in dry locations where not subjected to mechanical damage.
 5. Furred ceiling spaces.
 6. For secondary service and distribution feeders in dry locations not subjected to mechanical damage.
- F. Flexible Metal:
1. Connections to cabinet unit heaters, suspended unit heaters, fan, and similar small equipment not exposed to moisture.

2. Connections from junction box to lighting fixtures in accessible ceilings.
 3. Final connections to all motor-operated equipment, where not exposed to moisture, and in air streams for built-up air handling units.
 4. Connections from junction box to wiring devices in demountable partitions and cabinet work.
 5. To all terminations to equipment subject to vibration, including transformers.
- G. Liquid-tight Flexible Metal:
1. Final connections to all equipment containing water or other liquid service.
 2. Final connections to motor-operated equipment where exposed to moisture.
- H. Rigid Nonmetallic:
1. In earth or encased in concrete duct banks for primary and secondary service and for [substation], switchboard, motor control centers transformer, and panel feeders. In earth for communication systems services. Branch circuit wiring for slab and exterior lighting and power may be installed in rigid nonmetallic conduit. Horizontal elbows may be rigid nonmetallic, all vertical elbow stub-ups to above grade shall be GRC or concrete encased non-metallic elbows.
 2. In areas subject to severe corrosive influences.
 3. In areas subject to chemicals for which the materials are specifically approved.
 4. For lightning protection downleads.

3.2 SIZES

- A. Minimum size conduit shall be 3/4 inch trade size for branch circuit wiring, signal, and control wiring, except that conduit size shall be increased when branch circuit wiring is increased for voltage drop. Flexible conduit for connection to lay-in fixtures may be 3/8 inch, maximum of 6'-0" long.
- B. Where required size is not called for on Drawings or in Specifications, provide size required from Chapter 9 of the NEC.
- C. Where specific sizes required by Drawings or Specifications are larger than Code requires, larger size shall be installed.
- D. LB condulets for conduits larger than 2 inches I.D. are not to be used unless of the mogul design, and secured to the building structure within 6 inches below and long side of the condulet.

- E. Minimum size conduit shall be 1 inch for communication wiring, except in pharmacy areas where the minimum size shall be 1-1/4 inches.

3.3 INSTALLATION

A. General:

1. Conduit system shall be mechanically and electrically continuous from outlet to outlet and to all cabinets, junction, or pull boxes. Conduit shall enter and be secured to all cabinets and boxes in such a manner that all parts will have electrical continuity.
2. Where panels are installed semiflush, or flush with the walls, empty conduits shall be extended from the panel to an accessible space above. Furnish a minimum of one 3/4 inch conduit for every 3 spare single-pole circuit breakers or spaces or fraction thereof, but never less than 3 conduits. Provide additional conduits where indicated on plan.
3. Raceways Embedded in Floor Slabs:
 - a. Raceways shall not be installed in slab without the approval of the Structural Engineer.
 - b. Raceways shall not interfere with placement of floor slab reinforcement components.
 - c. Install raceways between the upper and the lower layers of reinforcing steel.
 - d. Space raceways not less than 8 inches on centers except where they converge at panels or junction boxes.
 - e. Raceways running parallel to slabs supports, such as beams, columns and structural walls, shall be installed not less than 12 inches from such supporting elements.
 - f. Branch circuit homeruns are not permitted in slab, route branch circuit homeruns above grade exposed in approved areas or above lay-in ceiling spaces.
4. Raceway Above Suspended Ceiling: Install conduit 1'-0" minimum above top of ceiling.

B. Nonmetallic Conduit:

1. Under building slab, install at a minimum 24 inches below slab or at a minimum 8 inches of cover at grade beams or moment frames. Not under building slab install at a minimum of 36 inches below grade unless otherwise noted.
2. Provide code sized copper grounding conductor for entire length of raceway and bond at both ends. Ground wire shall be installed inside of conduit.

3. Conduit joints shall be assembled together with approved couplings to make a watertight joint. Furnish and install expansion fittings on all nonmetallic duct per manufacturer's recommendations.
- C. Rigid Steel Conduits Subject to Corrosion:
1. The following methods of installation will be accepted as meeting the requirements of NEC Section 300-6. Alternate methods will be considered in order to meet local building codes. The installation methods are as follows:
 - a. In Concrete: Galvanized ferrous metal conduit and fittings may be used in concrete above grade and in concrete resting on the ground provided a minimum concrete cover of 2 inches is maintained. Aluminum conduit and fittings are not permitted in concrete.
 - b. In Earth: Ferrous metal conduit installed in earth is to be protected from corrosion with a factory-applied coating or approved field coating. Aluminum conduit and fittings are not permitted.
 - c. In Corrosive and Wet Atmosphere: Ferrous metal used is to withstand the exposure involved.
 2. Field wrapping requirements are as follows:
 - a. Material approval is based on the mil gauge, film material, tensile strength, stretch, adhesion, chemical and physical resistance of film, dielectric strength and electrolytic corrosion. Materials listed in the IAPMO Directory is considered approved material and includes 10, 12, 14, and 20 mil polyvinyl or polyethylene tape.
 - b. Surface Preparation: Oil, grease, rust, scale, moisture, or other foreign material shall be removed by approved paint removers, caustic dips, hand tools, solvents, or other appropriate means. Oil-base solvents shall not be used. Hexane, Toluene, Toluene, Xylol, etc., are acceptable. After cleaning, the pipe is to be kept free of all oil, grease, dirt, and moisture.
 - c. Priming: A coat of primer adhesive is to be applied over cleaned pipe when specified in the manufacturer's directions.

- d. Application of Coating: Tapes must be spirally wrapped so that the wrapping will have no channels that will enable moisture to contact the steel. Tape is to be half-lapped with enough layers to result in a minimum of 40 mil thickness except for 1 inch and smaller conduits where a 20 mil thickness may be used.
- e. Overwrap: When pipe exhibits evidence of damage to the factory coating, it may be overwrapped.
- f. Holiday Detecting: Questionable installations and workmanship, as determined by the Engineer or Building Official, is to be tested by Holiday Test by an approved testing laboratory.

D. Plastic-coated Rigid Steel Conduits:

- 1. All coupling and joining of pipes to be done with a strap wrench.
- 2. All bending is to be done per manufacturer's recommendations.
- 3. All plastic coating that is damaged is to be touched up with touch-up compound provided by the manufacturer, per their recommendations. All screws, bolts, hangars, etc. are also to be touched up.
- 4. After conductors have been installed a nonhardening putty is to be installed in boxes, condulets, etc., to prevent the free flow of corrosive fumes through the inside of the conduit system.

E. Locations:

- 1. All conduits shall be concealed, except in crawl spaces, tunnels, mechanical and electrical equipment rooms, and at connections to surface panels and free-standing equipment, unless otherwise shown on the Drawings.
- 2. Where possible all conduits for wiring within stud or movable partitions shall enter the partition from above.
- 3. Conduits above lay-in grid-type ceilings shall be installed in such a manner that they do not interfere with the "lift-out" feature of the ceiling system. Conduits shall be independently supported from the building structure.
- 4. Exposed conduit and conduit above lay-in ceilings shall be routed in lines parallel to building construction.
- 5. Conduit Runs:
 - a. Conduit runs shall be installed to maintain the following minimum spacing wherever practical.
 - (1) Water and waste piping not less than 3 inches.
 - (2) Steam and condensate lines not less than 12 inches.

- (3) Radiation and reheat lines not less than 6 inches.
 - b. Seal conduit with RTV silicon or other approved seal where conduit leaves heated area and enters unheated area.
 - 6. Coordinate electric conduits and pipes permitted to be embedded in structural concrete work. Cooperate with respective trades to effect the following:
 - a. All reinforcing steel securely anchored in place before installing conduit.
 - b. No steel displaced without approval from Architect.
 - c. No conduit placed over top reinforcing nor under bottom reinforcing.
 - d. Conduit and their fittings not to displace concrete in columns in excess of 4% of total cross-section area of column without approval of Architect.
 - e. Conduit not to be placed closer than 3 diameters on center.
 - f. Maximum size of embedded conduit not to exceed 1 inch.
 - 7. All conduits where located in outside walls, underground construction, damp locations, or exposed to the weather shall have sealant applied to all joints
 - 8. Projections through roofing shall be made watertight by proper flashing; a sheet metal cap and tightening band or storm collar securely fastened to conduits. Flashing shall be by a qualified contractor and satisfactory to Architect.
 - 9. Provide sleeves wherever conduit 1 inch and larger penetrates a fire rated wall or floor.
 - 10. When equipment is mounted on a curb, conduits are to be located inside of curbing.
 - 11. All conduit stubbed up from or through floor slabs for future connections to machines and equipment shall be rigid-type with coupling installed flush with finish floor to permit future conduit removal. For equipment to be installed during this project, bottom of the coupling shall be at the top of the slab. Couplings shall be sealed with a flush, threaded pipe plug.
- F. Elbows, Bends, Expansion Joints:
- 1. Changes in direction shall be made by bends in the pipe wherever possible, and these shall be made smooth and even without flattening or kinking the pipe or flaking the finish. Bends shall be of as long a radius as possible and in no case smaller than the corresponding trade elbow. Long-radius elbows shall be used where necessary.

2. Not more than four 90 degree bends will be allowed in one raceway run. Where more bends are necessary, a conduit body or pull box shall be installed. All bends in 1 inch and smaller metal conduits shall be made with a conduit bender and all larger sizes shall have machine bends. All bends shall be made with the proper equipment as recommended by the manufacturer.
 3. Exposed conduit fittings shall be conduit type for all sharp corners, tees, etc. Use mogul type for conduit 2 inches and larger.
 4. Bushing and Locknuts:
 - a. Where conduits enter boxes, panels, cabinets, etc., they shall be rigidly clamped to the box by locknuts on the outside and inside, and grounding bushing on the inside of the box.
 - b. All conduits shall enter the box squarely.
 - c. Insulated Bushings: Furnish and install insulated bushings as required by Article No. 373-6(c). The use of insulated bushings does not exclude the use of double locknuts to fasten conduit to the box.
 - d. Provide grounding bushings on all feeders, feeder entering and terminating at switchboards, substations, motor control centers, power distribution panels, panelboards, etc. Bond bushings to the ground system by using a continuous No. 6 AWG (minimum) copper bonding jumper.
 5. Provide and install expansion joints at building expansion joints. Expansion joints for feeder conduits shall consist of a sleeve with fittings to provide for telescoping of one of the conduits into sleeve. Movable conduit shall be fitted with insulated bushing joint. Weatherproof shall be made of malleable iron with corrosion-resistant covering. Provide ground bonding jumper around expansion couplings. Expansion joints for branch circuits shall consist of (72 inches minimum) flexible conduit to allow for expansion and contraction.
 6. Open ends of all conduit shall be kept closed with approved conduit seals during the construction of Project.
- G. Supports:
1. General:
 - a. Conduit, which is not buried or embedded in concrete, shall be supported by straps, clamps, or hangers to provide a rigid installation. See Section 260529, SUPPORTS AND ANCHORS, for types of supports.

- b. Conduit shall not be installed on hangers and/or supports installed by other trades for their use.
- c. Conduit shall not be supported from or attached to ceiling wire and/or suspension systems installed for purposes of accommodating other systems within the building.
- d. Conduit shall not be attached to metal or wood studs above the ceiling used for wall construction.
- e. Conduit shall not be supported from other conduit.
- f. Conduits shall be supported at intervals as indicated in Section 1260529 and within 3 feet of any bend and every outlet or junction box, panel, etc. This shall apply to vertical runs as well as horizontal runs.
- g. Power-driven pins or studs shall not be used.

2. Single Runs:

- a. Where conduits are run individually, they shall be supported by approved straps, clamps, and hangers.
- b. No perforated straps or wire hangers of any kind shall be used.
- c. Conduits installed exposed in damp locations shall be provided with clamp backs under each conduit clamp to prevent accumulation of moisture around the conduits.
- d. Open bottom, spring tension, snap-in clamps shall not be used.

3. Multiple Runs:

- a. Where a number of conduits are to be run exposed and parallel one with another, they shall be grouped and supported by trapeze hangers.
- b. Each conduit shall be clamped to the trapeze hanger with conduit clamps.

4. Finish:

- a. All concrete inserts and pipe straps shall be galvanized.
- b. All steel bolts, nuts, washers, rods, trapeze hangers, and screws shall be galvanized or cadmium-plated.

H. Bonding:

- 1. Both ends of nonmetallic conduit shall be securely bonded to the metallic conduit joining it with adapter couplings designed for this purpose.

2. Provide bond wire in all flexible metal conduits.
- I. Pull Cord: A polypropylene pull cord shall be installed in all wiring raceways, which do not have conductors pulled by this contractor.
- J. Color Coding:
1. Provide color bands 1 inch wide for conduits up to 2 inches in diameter and one-half the conduit diameter for larger conduits, applied at panel and pullbox locations, within each room, and 50 feet on center within an area.
 2. Color Banding:
 - a. Normal Power 120/208 Volt: Blue.
 - b. Normal Power 277/480 Volt: Yellow.
 - c. Fire Alarm: Red.
 - d. Telephone: Purple.
 - e. Emergency Call/Room Status System: White.
 - f. Public Address System: Brown.
 - g. CCTV: Rust.
 - h. Computer: Green.
 - i. Emergency Power: Orange.
 3. Paint exposed medium voltage raceways orange with appropriate warning labels, e.g. "15,000 VOLT CABLE".
- K. Underground:
1. All underground conduit, except branch circuit and communication conduits, not under buildings slabs or parking lots shall be encased in a minimum of 3 inches concrete all around. Conduit for branch circuit wiring shall be encased under driveways or roads.
 2. All concrete for primary conduit shall contain a red pigment dye to make it readily noticeable minimum 2500 psi .
 3. For all underground runs of 2 or more conduits, separators, or spacing blocks made of plastic frames placed on not greater than 4 foot centers. They shall be of the interlocking type both horizontally and vertically. Ducts shall be anchored to prevent movement during placement of concrete.
- L. Identification Tape: Before installing the last 12 inches lift of backfill for all primary feeders and for secondary service feeders to the main switch, install polyethylene identification tape full length of duct bank trench.

- M. Responsibility: It shall be the responsibility of the Contractor to consult with the other trades before installing conduits and boxes. Any conflict between the location of conduit and boxes, piping, ductwork, or structural steel supports shall be adjusted before installation. In general large pipe mains, waste, drain, and steam lines, large air ducts and all structural steel shall be given priority. Structural modifications to accommodate equipment installation by this trade shall be approved by the Architect prior to starting actual work.

3.4 STORAGE

- A. Plastic and PVC coated conduit shall be stored on a flat surface and protected from the direct rays of the sun. Conduit found to be damaged by sun rays, in the opinion of the Architect, shall be removed from the Project Site.

3.5 INSTALLATION - BOXES

A. Location:

1. Outlets are only approximately located on the plans and great care must be used in the actual location of outlets by consulting the various detailed Drawings used by other contractors and by securing definite locations from the Architect. Relocation of outlets due to a lack of coordination with other trades will not constitute a reason for additional charges.
2. Outlets shall be flush with finished wall or ceiling as required, or surface mounted when required. Outlets shall be straight and plumb. Receptacles, switches, etc., shown on wood trim, cases, or other fixtures shall have their boxes installed symmetrically on such trim or fixture.
3. Switch boxes shall be located on the lock side of the door regardless of the notation on the Drawings.
4. Pull boxes shall be installed where required to pull cable or wire, but only in finished areas by approval of the Architect. Pull boxes shall be installed on all conduit runs for feeders at intervals of not to exceed 150'-0" or as shown on the Drawings.
5. Pull boxes shall be installed in accessible locations.

B. Fasteners and Supports:

1. Cabinets and boxes shall be secured by means of expansion anchors on hollow masonry; expansion shields and machine screws or standard preset inserts on concrete or solid masonry; machine screws or bolts on metal surfaces and wood screws on wood construction.
2. Wall- and ceiling-mounted outlet boxes shall be supported by bar supports extending from the studs or channels on either side of the box. Do not fasten outlet boxes directly to wall or ceiling where they are of drywall or plaster construction; provide bar supports.

3. Boxes shall be rigidly attached to the structure, independent of any conduit support.
4. Boxes shall not be fastened to ceiling grid or tile unless specifically designed for this purpose and then only by the approval of the Architect. Ceiling grid box supports shall be of the type designed and manufactured for this purpose. Makeshift supports shall not be used.

3.6 IDENTIFICATION

A. Box Covers:

1. Label on outside to identify panel and circuit numbers. Use indelible markers, nonerasing type for boxes not in finished areas.
2. Fire alarm pull and junction boxes shall be painted red.
3. Label feeder pull boxes as to circuit with 2 inches high stencil letters; white letters for normal, red letters for emergency.

3.7 CODING

- #### A.
- Provide electrical box color coding to match conduit system.

END OF SECTION

SECTION 26 0548

VIBRATION ISOLATION AND SEISMIC RESTRAINTS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Provide vibration isolation and seismic restraints in accordance with the Contract Documents.
- B. Provide isolation at electrical connections to rotating or vibrating equipment.
- C. Provide seismic restraints for all electrical equipment.

1.2 QUALITY ASSURANCE

- A. Vibration isolators and seismic restraints shall be of the same manufacturer.

1.3 STANDARDS

- A. SMACNA Guidelines for Restraint of Mechanical Equipment.
- B. Requirements for UBC seismic zone 4.

1.4 SUBMITTALS

- A. Manufacturer's product data sheets and installation instructions for each vibration isolator and seismic restraint.
- B. Plan and elevation diagrams showing equipment, points of attachment, vibration isolators, seismic restraints, mounting methods, and hardware types and sizes.
- C. Seismic restraint calculations. Seismic restraint calculations shall be certified by a Professional Structural or Civil Engineer registered in the State of the project.
- D. Field inspection report.

1.5 FIELD INSPECTION

- A. Upon completion of the installation, the manufacturer's local representative shall field inspect the installation and submit a report verifying the completeness and performance of the installation.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Amber-Booth, Mason Industries, Vibration Eliminator Co., Vibration Mounting & Controls Inc., or Vibrex Vibration Control Systems.
- 2.2 VIBRATION ISOLATION AND SEISMIC RESTRAINTS

- A. General:
 - 1. Devices installed outdoors shall be weatherproof; steel components shall be hot dipped galvanized, hardware shall be cadmium plated, and springs shall be neoprene coated.
 - 2. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load.
 - 3. Springs shall have an additional minimum travel to solid equal to 50% of the rated deflection.

PART 3 – EXECUTION**3.1 GENERAL**

- A. Installation shall be in accordance with seismic restraint calculations and manufacturer's installation instructions.
- B. Verify that mounting methods provide the required vibration isolation and seismic restraint and that there are no vibration short circuits.
- C. Conduit connected to the rotating or vibrating equipment shall be flexible metal conduit or liquid tight flexible conduit.

END OF SECTION

SECTION 26 0923

BUILDING LIGHTING CONTROL SYSTEMS

PART 1 – GENERAL**1.1 SUMMARY**

- A. Scope: This Section includes the following:
 - 1. The work covered in this section is subject to the requirements in the General Conditions of the Specifications. Contractor shall coordinate the work in this section with the trades covered in other sections of the specification to provide a complete and operable system.
 - 2. Extent of lighting control system work is indicated by drawings and by the requirements of this section. It is the intent of this section to provide an integrated, energy saving lighting control system including Lighting Control Panels, Occupancy Sensors, and Daylighting Controls from a single supplier. Contractor is responsible for confirming that the panels and sensors interoperate as a single system.
- B. General Requirements:
- C. The lighting control system shall be programmable and the status readable using a USB connection to a “MS Windows” based computer operating system running the supplier’s software package. Systems which require the computer to stay on-line and connected 24/7 are not acceptable.
- D. One set of any interconnecting cables, adapters and/or software program required to operate, troubleshoot, program, display the status of or interface with the system shall be supplied. Software and cable or adapter costs shall be included in any bid.
- E. The lighting control system manufacturing company shall be regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. Systems must retain their program internally for up to one year including a loss of power. Systems must automatically restore themselves during a power outage to its condition prior to the outage. If any relay, control, switch or sensor shall fail, the remaining portion of the system shall continue operating with only a loss of the failing component. A loss of control input power or control operating system shall cause the lighting relays to fail in the “ON” or “EMERGENCY” position. All relays shall have a way to place the relays in a “manual ON” bypass position for use during troubleshooting or operating system loss. The lighting control system must be able to operate in a simulated fully-operational condition for troubleshooting and programming purpose while the relays are locked in the “ON” position.

- F. The lighting control system must have remote access ability for the factory to access the system and help troubleshoot, program, or alter the system without being on-site. This factory service must be available 24 hours a day, 365 days a year. Normal factory assistance using this connection shall be available after the required warranty period. A modem or similar device that could be connected within 100 feet to a phone line is acceptable. This modem or connection hardware shall be included in the system. If the system requires an internet access point, an empty 3/4" conduit shall be run between the main access point and the designated telecommunication locations.
- G. The lighting control system shall have the capacity of integrating into building management system (BAS) or energy management system (EMS) with the key feature being the ability to, but not limited to monitoring the lighting zones.

1.2 SUBMITTALS

- A. Submit manufacturer's data on lighting control system and components including shop drawings, detailed point to point wiring diagrams, and floor plans showing occupancy and daylighting sensor locations. Provide typical mounting details for occupancy and daylighting sensors for this application.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Lutron "QS" Quantum Total Light Management System.
- B. Comply with NEC, NEMA, and FCC Emission requirements for Class A applications.
- C. UL Approvals: Relay panels and accessory devices are to be UL listed under UL 916 Energy Management Equipment. Configured to order or custom relay panels shall be UL Listed under UL 508, Industrial Control Panels.
- D. Source Limitation: The Lighting Control System Provider shall provide all lighting control components and final commissioning.
- E. Lighting control components shall include all operating elements of the lighting control system. Lighting fixtures, lamps, and passive components such as wire, conduit, and connectors are not included.

PART 2 – PRODUCTS

2.1 LIGHTING CONTROL PANELS

- A. General Requirements
- B. Lighting control panels shall be UL 916 Listed. Lighting control panels controlling emergency circuits shall be ETL listed to UL 924. Emergency source circuits controlled in a normal operation by a relay panel shall fully comply with NEC 700-9(b). Electrical contractor is responsible for verifying compliance.

- C. The lighting control panels shall contain all necessary hardware (transformers, relays, times, fuses, switches, terminals etc.) to control and/or connect to the lighting circuits specified for control. All lighting controls shall be pre-assembled, wired, and tested to operate as a complete integral system and shall provide the lighting control features specified in this section.

- D. Provide lighting control panels in the locations and capacities as indicated on the plans and schedules. Each panel shall be of modular construction and consist of the following components:
 - 1. Enclosure/Tub shall be NEMA 1, NEMA 3R, or NEMA 4 as indicated on the plans, sized to accept an interior with 1-8 relays, 1-24 relays and six (6) four pole contactors, or 1-48 relays with six (6) four pole contactors.

 - 2. Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. The panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.

 - 3. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. The interior construction shall provide total isolation of high voltage (class 1) wiring from low voltage (class 2) wiring within the assembled panel. The interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. The panel interiors shall include the following features:
 - a. Provision for one or two optional control and automation cards.

 - b. Removable, plug-in terminal blocks with screw less connections for all low voltage terminations.

 - c. Individual terminal block, override push button, and LED status light for each relay

 - d. Switch inputs associated with each relay and group channel shall support two or three wire, momentary or maintained contact switches or 24VDC input from occupancy sensors.

 - e. Automatic support for occupancy sensor sequence of operation. Low voltage inputs automatically reconfigure when connected to a Watt Stopper occupancy sensor head. Occupancy sensor shall switch lighting on and off during unoccupied periods but shall not turn lighting off during scheduled occupancy periods.

 - f. Isolated contacts within each relay shall provide true relay state to the electronics. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems.

 - g. Automatic sequenced operation of relays reduces impact on the electrical distribution system when large loads are controlled simultaneously.

- h. Group, channel, and pattern control of relays shall be provided through a simple button-press interface within the panel. Any group of relays can be associated with a channel for direct on/off control or pattern (scene) control via a simple programming sequence using the relay and channel override push buttons and LED displays.
- i. Relay group status for each channel shall be provided through bi-color operation of the LED indicators. Solid red indicates that all relays in the group are on, solid green indicates that the group is in a mixed state, and blinking green indicates that the relays have blink warned and are currently timing out.
- j. Each relay and channel terminal block shall provide a 24V pilot light signal. It shall be possible to configure the system for support for any Class 2 pilot light voltage with the use of an auxiliary power supply.
- k. Single pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:
- l. Electrical:
 - (1) 30 amp ballast at 277V
 - (2) 20 amp tungsten at 120V
 - (3) 1.5 HP motor at 120V
- m. Mechanical:
 - (1) Individually replaceable, ½" KO mounting with removable Class 2 wire harness
 - (2) Actuator on relay housing provides manual override and visual status indication, accessible from Class 2 section of panel
 - (3) Dual line and load terminals each support two #14 – #12 solid or stranded conductors
 - (4) Tested to 300,000 mechanical on/off cycles
 - (5) Isolated low voltage contacts provide for true relay status feedback and pilot light indication.
- n. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.

- E. The Dataline wire will be supplied by the equipment manufacturer and will include the manufacturer's name, catalog number printed on the wire jacket. The contractors, at their own expense will, replace an improper dataline wire.
- F. Panels shall be digitally addressed and support bi-directional communication between each other and other intelligent field devices specified elsewhere.

2.2 RELAY PANELS

- A. System Description Lighting Control Panels shall be UL listed and consist of the following:
 - 1. Enclosure/Tub: NEMA 1, NEMA 3R, or NEMA 4 as indicated on the drawings, sized to accept an interior with 1-8 relays, 1-24 relays and six (6) four pole contactors, or 1-48 relays with six (6) four pole contactors.
 - 2. Cover: Surface or Flush as required, hinged, and lockable and with restricted access to line voltage section.
 - 3. Interior: Barrier included for separation of high voltage (class 1) and low voltage (class 2) wiring. The interior shall include intelligence boards, power supply, mechanically latched control relays and multi-pole contactors. The interiors will include the following features:
 - a. Screwless, removable, plug-in connections for all low voltage terminations.
 - b. Each relay shall be capable of individual ON/OFF control by a low voltage switch and/or occupancy sensor input.
 - c. The system shall monitor true relay status; the relay status will be displayed at the onboard pilot LED and monitored by the system electronics.
 - d. Stagger the ON and OFF sequence of the relays.
 - e. Heavy Duty Relays – Mechanically latching contacts with single moving part design for improved reliability. Relays to have the following characteristics:
 - (1) 30 amp NEMA 410 electronic ballast rated and 20 amp tungsten, rated for 50,000 ON/OFF cycles at full load, Support #12 - #14 AWG solid or stranded wire and rated for 120, and 277 volts; 20 amp NEMA 410 electronic ballast rated and 20 amp tungsten 347 volts.
 - (2) 30 VAC isolated contacts for status feedback and pilot light indication.
 - (3) 14,000 amp short circuit current rating.
 - f. Contactors shall be DIN rail mounted, four pole standard, normally open or normally closed, electrically held with 120 or 277 volt coil

voltage to match panel control power voltage. Contactors shall be compatible with all lighting, ballast and HID loads and be rated for 277 volt 20 amp tungsten and 600 volt 30 amp ballast loads.

4. Power Supply: Multi-voltage transformer assembly with enough power to supply all electronics, occupancy sensors, dataline switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.

2.3 GROUP, CHANNEL AND PATTERN CONTROL

- A. Provide an optional Group Switching card (GS) that allows simple group and pattern configuration at the panel without requiring handheld devices or special programming tools. The GS shall allow any group of relays within the panel to be associated (smartwired) to a channel button using the following procedure:
 1. Press and hold the group pushbutton for several seconds. The group LED and the LEDs for relays currently controlled by that input will begin to flash.
 2. Select the relays to be controlled. The LED for each relay smartwired to the channel selected will be flashing ON/OFF. Press the associated relay control button to add/delete that relay to/from the group.
 3. Press the group pushbutton again. The LEDs will stop flashing and the group pushbutton and associated switch inputs will now control the relays selected.
- B. Group Status: Each group pushbutton shall include an LED status indication. The LED will be ON whenever all of the relays within the group are ON; and shall go OFF when all of the relays within the group go OFF. The LED will be green when in a "mixed" state. Each channel shall also have an associated dry contact closure and pilot contact which tracks the LED operation described above.
- C. Hardware Features
 1. Each GS card will support up to eight groups (channels). The 8-relay and 24-relay panels shall support one GS card; the 48 relay panels will support two cards.
 2. Individual relays may be assigned to more than one channel, and the channel status will be annunciated appropriately.
 3. Each channel shall also have an input for connecting switch or dry contacts for controlling a channel. Inputs shall accept 2 or 3-wire, maintained or momentary inputs, or a 24 VDC signal from occupancy sensor or other voltage signaling device. Groups may be controlled by: an on-board group pushbutton switch, low voltage switch, dataline switch, occupancy sensor, photocell, or time of day.

4. Screwless, removable, plug-in terminals will be provided for all low voltage wiring connections.

2.4 AUTOMATION PANEL NETWORKING AND DATALINE SWITCH SUPPORT

- A. An automation control card provides an Echelon® based network for communications between the intelligent field devices, panels and optional Echelon based Clock, BMS Module, Universal Switch Module and Photocontrol Module.
 1. The modules in multiple panels shall be linked over a single dataline that uses the open digital Echelon/LonTalk® protocol for communications.
 2. The dataline shall extend from the lighting control panel and provide a single communications bus to allow dataline switches and other intelligent field devices to communicate with the panels.
 3. Dataline communications wire shall be 18 AWG, 4 unshielded copper conductors (two independent twisted pairs) meeting Class 2P NEC code requirements. The dataline can be run in a loop, serial, or star configuration.

2.5 EIGHT CHANNEL PHOTOCONTROL MODULE

- A. Provide a single photocell for measuring exterior light levels. The photocell shall connect to a photocontrol module mounted on the DIN rail inside the panel low voltage section and connected to the dataline communications wire. (Section 2.10).
- B. The Photocontrol Module shall integrate seamlessly with either the Network Clock or the BMS Interface Module, replacing the astronomic control function on the clock. The control module shall measure the actual exterior light and display this level in footcandles (fc) on the unit LCD display.
- C. The controller shall have eight individual setpoint adjustments that are available to the lighting control network over the dataline communications wire.
- D. Features
 1. Real time, 2 line LCD display of actual exterior light level up to 200 fc.
 2. Channel set points and parameters programmed via the Network Clock or BMS Interface Module.
 3. Choice of OPERATE or TEST modes, with simulated light level for testing.
 4. Automatic deadband and 5 minute time delay to avoid cycling.

2.6 BUILDING MANAGEMENT SYSTEM INTERFACE

- A. The BMS module shall provide an occupied/unoccupied signal to all networked relay panels by using dry contact closures from any automation system. The module will also provide the blink warning signal, time delay feature and all nec-

essary requirements for ASHRAE 90.1 – 2001, IECC 2003 as well as state and local energy codes required for this project.

- B. The BMS module accepts timing signals from another system, and does not provide its own scheduling; it shall include a unique egress delay option for each group to allow time for occupants to clear the area before lighting is turned OFF.
- C. Features
 - 1. 2 line LCD display with simple data entry for each of eight channels
 - 2. User-selectable intelligent scenarios to handle standard lighting control functions for each channel independently, including:
 - a. Schedule ON / Schedule OFF
 - b. Manual ON / Schedule OFF
 - 3. Automatically detects the presence of the eight channel Photocontrol Module on the dataline and adds the Dark scenarios to the menus, accepting actual light level readings for the following scenarios:
 - a. Dark ON / Dark OFF
 - b. Dark ON / Schedule OFF
 - 4. User-selectable egress delay up to 240 minutes (4 hours) to allow safe exit after channel status changes to Unoccupied.
 - 5. Isolated, single-pole input contact for each channel, user-definable with choice of Occupied = Open or Occupied = Closed.
 - 6. 24 VAC, 1 amp status output contacts, user-definable with choice of closed contact = Any ON, All ON, All OFF, Any OFF.

2.7 OPERATOR'S SOFTWARE

- A. User programming and editing may be conducted both online or offline in a Windows based software application. Data shall be entered through a simple menu-driven user interface.
- B. The software shall simplify integration with other software products by allowing the lighting control manufacturer's components to be embedded into other Windows applications. These features shall include the following:
 - 1. BACNet connectivity with optional WebLink.
 - 2. Drag and Drop interface programming supported throughout the program.

- C. Basic operating software provides the following:
 - 1. Site wiring documentation for all connected relay panels and system components.
 - 2. English descriptions of each relay's circuit designation, circuit description, switch and calculated load.
 - 3. RS232 and TCP/IP Connection to Lighting Control Panel
 - a. Monitor/Control all relays. Software shall show actual relay states, with an optional menu showing how and when the relay state occurred, and when next scheduled to change.
 - b. Simulate all functions.
- D. System Parameters
 - 1. System software to be sized based appropriately for the system – 250, 500, 750 or unlimited relays. Any number of sites may be programmed from a single software package (based on hard drive space).
 - 2. Passwords Matrix Features allowed per site.
 - 3. User defines functions accessible for each password (Document, Program, Initialize, Transfer from PC, Transfer to PC, Control, Simulate/Test).
 - 4. Configure software to automatically contact remote sites using a modem or I/P address.
- E. Other Features
 - 1. Online help brings up a context sensitive help screen.
 - 2. One step menu option to back up all site information to a backup drive.
 - 3. The software shall include Trends and Relay Runtime Analysis that will allow the operator to analyze the operation of specific areas and identify those exceeding normal runtimes. Individual relays may be assigned a kWh weighted value or simply analyzed on a runtime basis. In both cases, the relays may be assigned to logical groups and plotted for the last 30 days or 12 months.
- F. System Design Capability
 - 1. From the lighting control system software database, the software shall be able to automatically create a system single line drawing, panel schedules and specifications that can be exported in DXF format for use in standard CAD drawings.

2.8 CENTRAL PROGRAMMING, MONITORING, AND CONTROL WORK STATION

- A. Desktop Computer work station will provide monitoring, programming and control of the system.
- B. The computer will be a Pentium 4 class personal computer with monitor for enhanced color graphics display. The system shall be shipped complete with all memory, cables, and peripheral devices. The complete system shall be factory tested prior to shipment. The system shall include at a minimum:
 - 1. 3 GHz, Intel Pentium 4 based personal computer
 - 2. 17" SVGA flat panel color monitor
 - 3. 60 GB hard disk
 - 4. 256 MB RAM
 - 5. CD +R/+W drive
 - 6. Lighting control software, WinXP Pro

2.9 DIGITAL DATALINE SWITCHES

- A. Intelligent digital switching shall be provided operating on the dual twisted pair communication wire. Switches shall be available in single, dual, quad, or octal (1-button, 2-button, 4-button, or 8-button) designs. The single, dual, and quad devices shall mount in a standard single-gang box, the octal version in a two-gang box.
 - 1. Each button shall be individually programmable. Programming of buttons shall not require the use of a computer or other programming device. It shall be possible to assign relays or channels to buttons using a simple button press interface. Each button can control any one of the following options:
 - a. Any individual relay in any single panel.
 - b. Any group of relays in any single panel.
 - c. Any group of relays in the system (via network clock, Automation Appliance, or WinControl software package).
 - 2. For applications that require pattern switching, buttons shall function as a scene control using an ON/OFF/Not Controlled pattern of relays instead of the normal All ON/OFF.
 - 3. Switches shall be constructed of non-breakable Lexan on all exposed parts and shall include a matching screwless Lexan wall plate.
 - 4. Individual buttons shall have a removable clear cover to allow standard 9 mm (3/8 inch) labeling tape to be used to identify the controlled loads.

5. Each switch shall use a bi-color LED pilot light for the individual buttons to indicate status of the controlled relay or group of relays. LED indications are Red for All ON, Green for Mixed State (some relays in the group ON and others OFF), and No LED for All OFF.
6. Switch LED pilot lights shall flash green to indicate impending off sweep during the five-minute grace period following blink warning of the lights. Once the button is pressed, the LED will change to Red to acknowledge the occupant's override command to keep lights ON.
7. Multiple dataline switches programmed to control the same relay or relay group shall indicate the same status automatically.
8. Each switch shall also include a locator light illuminating the switch for easy location in the dark.
9. The dual, quad, and octal switches shall all include a single master button that will override all relays controlled by the individual buttons OFF, or Restore them to their original state. Each switch's master button configuration can be altered to perform a Master ON/OFF, OFF Only, or Disabled function if desired.
10. Switches can be configured to follow a "Cleaning" scenario. This specific scenario shall prevent the cleaners from overriding OFF any relays previously turned ON by an occupant.
11. Each switch is available in a Key lock override version. Once a key is inserted, the individual buttons will function for five minutes.

2.10 OCCUPANCY SENSORS AND POWER PACKS

A. Passive infrared sensors shall:

1. Utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion.
2. Provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).
3. Have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.
4. Dual technology sensors shall
5. Be either corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas.
6. Use passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.

B. Ultrasonic sensors shall:

1. Utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air-flow throughout controlled space.
2. Have an ultrasonic operating frequency that is crystal controlled at 25 kHz within $\pm 0.005\%$ tolerance, 32 kHz within $\pm 0.002\%$ tolerance, or 40 kHz $\pm 0.002\%$ tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.
3. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.
4. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
5. When specified, sensors shall utilize SmartSet™ technology or equivalent for automatically adjustable time delay and sensitivity settings.
6. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.
7. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
8. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
9. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable

C. CIRCUIT CONTROL HARDWARE – (POWER PACKS)

1. Control Units - For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to a minimum of two (2) sensors.

2. Relay Contacts shall have ratings of:
 - a. 13A - 120 VAC Tungsten
 - b. 20A - 120 VAC Ballast
 - c. 20A - 277 VAC Ballast
 - d. 20A – 347 VAC Ballast
- D. Control wiring between sensors and control units shall be Class II, 18-20 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.
 1. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.

2.11 EXTERIOR PHOTOCELLS

- A. Photocells to be mounted in location indicated in the plans. Photocells shall produce digital outputs for their readings. Photocells used for exterior lights shall provide multiple trip points from 1 roof mounted unit. All trips points shall be able to be changed remotely via Internet or dial up modem as well as at the lighting control panel. Photocells requiring manual trip point adjustment are not acceptable. Photocells used for interior lighting control shall have multiple settings such as start-point, mid-point, off-point, fade-up, fade-down, etc. All settings shall be remotely accessible and adjustable. The photocell current reading shall be remotely readable at the lighting control panel. Photocells shall be able to be used as inputs for multiple switching or dimming circuit. Systems providing local adjustment only are not acceptable.
- B. Each photocell shall be mounted in the appropriate location for measuring the available daylight. Each photocell will have a separate control/calibration module mounted separately and in an accessible location.
- C. The control module shall:
 1. Have a separate trip point settings. These settings will be entered via easily readable dial switches.
 2. Have a fixed deadband of 10%.
 3. Have a starting delay.
 4. Be suitable for panel mounting.
 5. Be UL listed.

2.12 INTERIOR DAYLIGHTING CONTROL ON/OFF SWITCHING, MULTICHANNEL

- A. The daylighting control module shall be capable of switching any type of lighting ON or OFF in response to light level data. The control module shall be available in one, two or three zone versions.

- B. The photocell is to be mounted remotely from controller. The photocell shall have a range of .2 to 2000 footcandles.
- C. The control module shall:
 - 1. Utilize an external photocell to continuously measure light levels. The photocell shall have a linear response with a 0-20 mA signal. The photocell shall be accurate to +/- 5%. The photocell shall be a low voltage device.
 - 2. Have an adjustable setpoint for each zone.
 - 3. Have an adjustable deadband up to 70% for single and two channel controllers, and 10% fixed for the 3-channel controller.
 - 4. Have an adjustable ON delay of 0-32 seconds, and an adjustable OFF delay of 0-32 minutes.
 - 5. Be suitable for panel mounting on a DIN rail.
 - 6. Be UL listed.

2.13 CORRIDORS, RESTROOMS AND LOBBY OR COMMON AREAS LIGHTING CONTROL

- A. Common areas shall be on at least 3 controlled relays and 4 or more if daylight harvesting is appropriate per Title 24. Multi-stage lighting levels shall be available and installed into the building's system. Subject to the quantity of light fixtures in the area, the switched circuits shall be controllable with all circuits for the designated area available at each fixture's connection point.
- B. Minimum lighting level shall be maintained at intersections of corridors, elevator and exit doors, stairwells and building entry points. These additional wires/switched lines shall be run to each junction box or light fixture in the same-type area to allow graduated lighting levels and daylight harvesting and/or occupancy sensor controls to be incorporated and adjusted for that area. Light fixtures will be initially identified with the appropriate circuit connection out of the three (or four) circuits, but future connection changes and all circuits must be available at each fixture without pulling new wire.
- C. Any restroom shall have a switch at the entrance for public use that triggers the occupied level lighting. Ceiling occupancy sensor(s) shall also trigger, maintain while occupied, and when unoccupied return the lighting to the unoccupied lighting level after 15 minutes. All restrooms and corridors shall have a override switch for maintenance/custodial use within 50 feet of the corridor. A switch in the janitorial closet if within 50 feet of the area is acceptable.

PART 3 – EXECUTION

3.1 SUPPORT SERVICES

- A. System Startup

- B. Manufacturer shall provide a factory authorized technician to confirm proper installation and operation of all system components. The startup requirement is intended to verify:
 - 1. That all occupancy and daylighting sensors are located, installed, and adjusted as intended by the factory and the contract documents.
 - 2. The occupancy sensors and daylighting sensors are operating within the manufacturers specifications.
 - 3. The sensors and relay panels interact as a complete and operational system to meet the design intent.
 - 4. Manufacturer to provide a written statement verifying that the system meets the above requirements.
- C. Training
 - 1. Manufacturer shall provide factory authorized technician to train owner personnel in the operation, programming and maintenance of the lighting control system including all occupancy sensors and daylighting controls.
- D. Documentation
 - 1. Manufacturer shall provide system documentation including:
 - a. Reflected ceiling plans showing each occupancy and daylighting sensor location.
 - b. System one-line showing all panels, number and type of switches and sensors, dataline, telephone override modules, and central PC.
 - c. Drawings for each panel showing hardware configuration and numbering.
 - d. Panel wiring schedules.
 - e. Typical wiring diagrams for each component.
 - 2. The manufacturer will certify that the products will meet the product specifications and local energy codes. If any additional equipment is required to meet the coverage patterns or local energy codes, the manufacturer will provide the additional equipment at no cost to the owner.
- E. Programming
 - 1. Manufacturer shall provide system programming including:
 - a. Wiring documentation.
 - b. Switch operation.

- c. Telephone overrides.
 - d. Operating schedules.
 - 2. These shall be provided on floppy disk compatible with the central PC's Lighting Control Program.
- F. Extended Warranty
 - 1. Manufacturer shall provide a five year extended warranty in addition to a required one year warranty for all system components.

END OF SECTION

SECTION 26 2416

PANELBOARDS

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. Refer to Section 260100, Electrical General Requirements.

1.2 WORK INCLUDED

- A. Panelboards described in this Section shall be dead-front, safety type furnished with thermal-magnetic molded case circuit breakers.
- B. Panelboards shall be for lighting, receptacle and applicable branch circuit and power distribution application. Circuit breakers shall have ratings as scheduled on Drawings.

1.3 RELATED WORK

- A. Section 260526: Grounding and Bonding for Electrical Systems.

1.4 SUBMITTALS

- A. Manufacturer's literature describing the product and shop drawings.
- B. Nameplate identification and circuit breaker or switch layout conforming to engineer's drawing.
- C. Type, electrical ratings, bus bar construction, mounting, circuit breaker, or switch type.

PART 2 – PRODUCTS

2.1 GENERAL CLASSIFICATION

- A. Manufacturers: Eaton Catalog numbers are used to identify type of equipment specified. Equivalent products by Square D or General Electric (G.E.) are acceptable.
- B. Branch Circuit Panels:
 - 120/208 volt: Eaton PRL-1A
 - 277/480 volt: Eaton PRL-1A

2.2 BRANCH CIRCUIT PANELBOARDS

Cabinet: Construct cabinet with code gauge galvanized steel. Provide minimum 20" wide cabinets, and extra wiring space where incoming feed-through.

- A. Doors:
 - 1. Trim for panelboard shall be supplied with a hinged door over all circuit breaker handles. Door in panelboard trim shall not uncover any live parts. Door shall have a semiflush cylinder lock and catch assembly.
- B. Flush mounted panels located adjacent to each other shall have identically sized enclosures and trims.
- C. Finish: Finish exposed parts with one coat of primer and one coat of light grey enamel suitable for overpainting in field if desired.
- D. Bus Bars:
 - 1. Bus Bars shall be silver plated copper sized at 1000 amps per square inch of cross sectional area, or EC grade aluminum sized at 750 amps per square inch. Aluminum bus bars shall be tin plated and solidly bolted utilizing Belleville washers and bolts. Attach circuit breakers to bus in such a way that circuits 1,3, and 5; 2,4, and 6, or any 3 similarly numbered circuits form one three-phase, four-wire circuit.
 - 2. Provide all hardware for future breakers, identified on drawings as SPACES, or for the full length of usable bus, whichever is longer.
 - 3. Provide minimum 1/2 capacity ground bus with full complement of terminals in addition to insulated neutral bus.
 - 4. Panelboards served by K-rated transformers shall have 200% capacity neutral bus.
- E. Circuit Breakers:
 - 1. 120/208 Volt Branch Circuit Panelboards: Quick-make, quick-break, molded case plug-in type designed for 120/208 volt, three phase, four wire service with minimum 10,000 amperes rms short circuit rating.
 - 2. Provide multi-pole units with common trip elements.
 - 3. Breakers shall have center-tripped position in addition of the ON and OFF positions.
 - 4. Provide lockouts for all circuits that should not be inadvertently turned off.
- F. Nameplates: Provide screwed-on (no adhesives) engraved bakelite nameplate identification on outside of each panel showing panel designation voltage and phase in minimum 1/4" high letters.
- G. Circuit Directories: Provide a metal-framed circuit directory welded to inside of inner door, with plastic protector.

2.3 DISTRIBUTION PANELBOARDS

- A. Construction: Code gauge galvanized steel fully flanged for strength and rigidity. Door and trim shall be cold-rolled steel, code gauge. Provide concealed butt hinges and 3-point catch and lock. Provide separately hinged or bolted vertical access doors over lug and wiring spaces.
- B. Finish: Finish all exposed parts with one coat rust inhibitor and two coats of light grey enamel.
- C. Bus Bars: Shall be installed throughout and shall be hard-rolled, electrolytic copper of 98% conductivity designed for a maximum 1000 amperes per square inch, or EC grade aluminum sized at 750 amperes per square inch. Bars shall be factory pre-drilled to accept future field installation of 2 or 3 pole circuit breakers or fused switches in any combination, and shall run full length of breaker or switch space. Brace all bus bars for maximum short circuit rating of circuit breakers, but in no case less than 25,000 amperes symmetrical.
- D. Provide 1/2 capacity ground bus with terminal lugs for each feeder shown. For distribution panelboards served by K-rated transformers provide 200% capacity neutral bus.
- E. Circuit Breaker Type: Thermal magnetic trip, molded case type breakers. Unless otherwise stated on the drawings the minimum interrupting capacity shall be 25,000 amperes symmetrical.
- F. Provide handle locking devices for all circuit breakers and fused switches.
- G. Provide engraved bakelite nameplates with minimum 1/4" high letters screwed to panel front and for each circuit protective device in panel-- adhesives not permitted.

PART 3 – EXECUTION**3.1 INSTALLATION**

- A. Minimum code required clearances around panelboards must be maintained.
- B. Mount panelboards with center of top circuit breaker handle no higher than 6'-6" above finished floor. Mount flush mounted panelboards as indicated on architectural interior elevation drawings.
- C. Provide all necessary blocking, channels and other hardware for securing panelboards to wall, column or other parts of building structure.

END OF SECTION

SECTION 26 2726

WIRING DEVICES

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. Switches.
- B. Dimmers.
- C. Receptacles.
- D. Cover Plates.
- E. Interchangeable Units.
- F. Occupancy Sensors.

1.2 SUBMITTALS

- A. Manufacturer's literature describing product.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Hubbell
- B. Leviton
- C. Pass & Seymour
- D. General Electric
- E. Bryant
- F. Arrow Hart

2.2 SWITCHES

- A. Toggle: Specification grade, AC quiet type, 20 amp, 120/277 volt, No. 1221 Series.
- B. Key Operated: Specification grade, AC quiet type, single pole, 20 amp, 120/277 volt, No. 1221-L Series.
- C. Momentary Contact: Specification grade, 3 position, single pole, double throw, 20 amp, 120/277 volt, No. 1157 Series.

- D. Lighted Handle Pilot Type: Specification grade, AC quiet type, single pole, 20 amp, 120 volt, No. 1221-PLC.
- E. Lighted Handle Locator Type: Specification grade, AC quiet type, single pole, 20 amp, 120 volt, No. 1221-ILC.

2.3 DIMMERS

- A. See Drawings for specific types.

2.4 RECEPTACLES

- A. Uncontrolled Receptacle: Specification grade: Duplex, 2 pole, 3 wire, grounding type, 20 amp, 125 volt, No. 5362 Series.
- B. Completely Controlled Receptacle: Specification grade: Duplex, 2 pole, 3 wire, grounding type, 20 amp, 125 volt, with controlled receptacle marking(s), No. 26362 Series.
- C. Split-Circuit Tab Controlled Receptacle: Specification grade: Duplex, 2 pole, 3 wire, grounding type, 20 amp, 125 volt, with controlled receptacle marking(s), No. 26362 Series CH version. CH version has the split-circuit tab broken at the factory, allowing half of the receptacle to be controlled.
- D. Isolated Ground: Duplex, 2-pole, 3-wire. 20A, 125 volt, No. IG-5362 Series.
- E. Ground Fault Circuit Interrupter: Duplex, 2 pole, 3 wire duplex, grounding type, 20 amp, 125 volt No. GF-8300, No. GF-5362 Series.

2.5 PLATES

- A. Provide high abuse nylon wallplates.
- B. Weatherproof: No. 5205W0, No. 5206WO.
- C. Exposed Boxes: Raised covers or stamped sheet metal.
- D. Mounting Screws: Stainless steel, painted head to match plate finish.
- E. Engraved with 1/4 inch high legend or thermal labels as indicated in 16010.
- F. Plates shall be 1-piece standard size; no oversized or sectional plates.

2.6 COLOR

- A. Devices and plates for normal power services shall be white.
- B. Devices and plates for emergency power services shall be red.
- C. Devices and plates for isolated ground shall be orange.

2.7 INTERCHANGEABLE DEVICES

- A. These devices shall not be used.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Locate all switches, receptacles, etc., as indicated on Architectural Drawings (elevations). Devices located in areas other than janitor's closets, supply rooms, etc., and not indicated on Architectural Drawings shall be located as directed.
- B. Adjust mounting heights of devices in exposed or painted masonry walls so devices are at nearest mortar joint; verify locations with Architect.
- C. In walls with tile, adjust device height so device is either all in tile or all in wall above tile.
- D. Where switches are located adjacent to doors, they shall be installed within 6 inches of door frame on lock side of door.
- E. Verify door switch, wall construction and finish, cabinets, counters, etc., and coordinate device installation.
- F. Locations:
 - 1. Device locations are shown diagrammatically and final locations shall be coordinated with Architect details, elevations, etc. Locations to be symmetrical and with an area, at uniform heights, unless otherwise indicated or directed.
 - 2. Install devices vertically, unless otherwise indicated.
 - 3. Install grounding terminals at top.

3.2 COMMISSIONING

- A. Refer to and 260100, Electrical General Requirements for system commissioning requirements.

END OF SECTION

SECTION 26 2800

LOW VOLTAGE CIRCUIT PROTECTIVE DEVICES

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. Circuit breakers

1.2 SUBMITTALS

- A. Manufacturer's literature describing product.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Circuit Breakers:
 - 1. General Electric
 - 2. Square D
 - 3. Siemens - I.T.E.
 - 4. Eaton Corp. - Cutler-Hammer

2.2 CIRCUIT BREAKERS

- A. Construction:
 - 1. Breaker shall consist of molded case frame, operating mechanism, arc extinguishers, contacts, trip elements, and terminal connectors.
 - 2. Operating mechanism shall be toggle type, quick-make, quick-break, trip free. Handle shall be clearly marked with the rating, and shall indicate the position (ON, OFF or TRIPPED). Multipole breakers shall have common trips. Tandem, duplex, wafer breakers, etc., shall not be used. Tie handles on breakers shall not be used.
 - 3. Trip elements shall be thermal-magnetic with bimetallic elements for overload protection and magnetic elements for short circuit protection.
 - 4. Breakers shall have noninterchangeable trips except in those sizes for which such trips are not manufactured as standard.
 - 5. Circuit-breakers shall bear UL termination temperature rating, and shall be rated not less than 75°C.
 - 6. Individual circuit-breakers interrupting rating shall be indicated for particular equipment in which they are installed.

7. Circuit-breakers, when part of panelboard, shall conform to panelboard's integrated equipment rating.
- B. Ratings:
 1. Circuit breakers shall be furnished with interrupting ratings as indicated on drawings unless otherwise noted.

PART 3 – EXECUTION**3.1 INSTALLATION**

- A. Install fuses so that the labels showing their rating can be read without requiring fuse removal.

3.2 SIZES

- A. Branch circuit overcurrent devices for motor and heating equipment circuits shall be sized for running overload protection per manufacturer's published data, and based upon equipment's nameplate ampere rating for the voltage utilized.

3.3 COORDINATION

- A. Branch circuit overcurrent devices for feeders, branch circuits, motors, and other equipment shall be selected in types and ratings to provide coordinated system of overcurrent protection.

3.4 COMMISSIONING

- A. Refer to Sections 260800, COMMISSIONING OF ELECTRICAL SYSTEMS, and 26050, COMMON WORK RESULTS FOR ELECTRICAL SYSTEMS for system commissioning requirements.

END OF SECTION

SECTION 26 2816**MOTOR AND CIRCUIT DISCONNECTS**

PART 1 – GENERAL**1.1 GENERAL REQUIREMENTS**

- A. Motor disconnects.
- B. Circuit disconnects.

1.2 SUBMITTALS

- A. Manufacturer's literature describing product.

PART 2 – PRODUCTS**2.1 ACCEPTABLE MANUFACTURERS**

- A. Safety Switches and Motor Disconnects:
 - 1. General Electric
 - 2. Square D
 - 3. Siemens - I.T.E.
 - 4. Eaton Corp. - Cutler-Hammer.

2.2 SAFETY SWITCHES

- A. All switches shall be heavy-duty type, externally operated, quick-make, quick-break, rated 600 volts except 208 volt systems where switches rated 240 volts are acceptable with the number of poles and ampacity as noted. All switches for motors shall be HP rated.
- B. Switches shall have NEMA 1 enclosures unless noted otherwise. All switches outside the building shall have NEMA 3R enclosures.
- C. Switches generally shall be nonfused except noted to be fused on the Drawings.

2.3 FRACTIONAL MOTOR SWITCHES

- A. Switches for fractional horsepower, 120 volt, single-phase motors with built-in thermal overload protection shall be a single pole, 15 amp toggle switch unless otherwise noted.

- B. Provide a thermal switch complete with pilot light for all fractional horsepower motors that are not self protected, Square D type as follows:
 - 1. Type KGIA with pilot light and enclosure for equipment in finished or unfinished areas for exposed mounting.
 - 2. Type KSIA, with pilot light mounted on stainless steel plate installed in flush switch box for equipment in finished areas.
 - 3. Type KFIA, with pilot light mounted on 4 inches square box cover, for direct connected equipment in unfinished areas.

PART 3 – EXECUTION**3.1 INSTALLATION**

- A. Disconnecting devices, when not included with electrically operated equipment furnished under other Sections of these Specifications, are provided under this Section.
- B. Switches shall be installed plumb and square to floor and walls.

3.2 COMMISSIONING

- A. Refer to Sections 260800, COMMISSIONING OF ELECTRICAL SYSTEMS, and 260500, COMMON WORK RESULTS FOR ELECTRICAL SYSTEMS for system commissioning requirements.

END OF SECTION

SECTION 26 5000

LUMINAIRES AND ACCESSORIES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Provide luminaires and accessories in accordance with the Contract Documents.

1.2 QUALITY ASSURANCE

- A. Drivers shall be of the same manufacturer for each luminaire type.
- B. Occupancy sensors shall be certified for operation with specific ballasts, drivers and control system utilized in controlled lighting fixtures.
- C. Equipment shall be certified for use in the State of the project and shall meet the State Energy Code and local energy ordinances.
- D. All drivers and ballasts are to be compatible with the lighting control system. See section 26 09 23 for Building Lighting Controls System.

1.3 STANDARDS

- A. Cords: UL 62.
- B. Exit Signs and Emergency Luminaires: NFPA 70 and UL 101 and 924.
- C. Hazardous Locations: UL 506, 844, 1203, and 1225.
- D. Luminaires: UL 57, 676, 1570, 1571, and 1572.
- E. Photometric data: Independent testing laboratory certified.
- F. State Energy Regulations.
- G. Solid State Lighting (LED):
 - 1. American National Standards Institute (ANSI)
 - 2. ANSI C62.41.1-2002 – IEEE Guide on the Surge Environment in Low-Voltage (1000V and less) AC Power Circuits
 - 3. ANSI C62.41.2-2002 – IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000W and less) AC Power Circuits
 - 4. ANSI C82.SSL1 – SSL Drivers (in ANSI development)
 - 5. ANSI C136.31-2001 – American National Standard for Roadway Lighting Equipment – Luminaire Vibration
 - 6. American Society for Testing and Materials International (ASTM)

7. ASTM B117-97 – Standard Practice for Operating Salt Spray (Fog) Apparatus
8. ASTM G53 – Standard Practice for Operating Light and Water Exposure Apparatus (UV – Condensation Type) for Exposure of Nonmetallic Materials
9. Illuminating Engineering Society of North America (IESNA)
10. DG-13-98, Guide for the Selection of Photocontrols for Outdoor Lighting Applications
11. G-1-03, Guidelines for Security Lighting
12. LM-79-08, IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products
13. LM-80-08, IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources
14. RP-33-99, Recommended Practice for Lighting for Exterior Environments
15. TM-15-07 (Revised), Luminaire Classification System for Outdoor Luminaires
16. International Electrotechnical Commission (IEC)

1.4 SUBMITTALS

- A. Manufacturer's product data sheets for each luminaire indicating luminaire type, driver quantity and type, board/diode quantity and type, photometric data, materials, finishes, accessories, voltage, input watts, CFM data, and photographic image of luminaire.
- B. Manufacturer's data sheets for each driver including as applicable the driver type, power factor, input voltage, input watts.
- C. Scaled and dimensioned detail plan and elevation drawings of custom and continuous row type luminaires.
- D. Seismic restraint calculations stamped by a currently registered professional engineer.
- E. Coordination drawings shall be prepared with input from all other disciplines.
- F. All product deviations from the contract documents shall be submitted as a substitution. Failure to comply shall result in rejection and return of the submittal.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Lighting Luminaires: Refer to luminaire schedule on the Drawings.

2.2 LIGHT EMITTING DIODE (LED) LUMINAIRES

- A. Lumens per input watt shall not be less than 50.
- B. R9 values shall not be less than 10 for interior luminaires.
- C. CRI shall not be less than 80 for interior luminaires.
- D. L70 shall not be less than 50,000 hours.
- E. Color temp. of 3500k (indoor) and 4000k (outdoor) within a 4-step MacAdam ellipse.
- F. Dimming performance 10-100% without flicker or noise.
- G. A minimum of five (5) year manufacturer limited warranty shall be required for LED boards and drivers. Or the standard manufacturer's warranty provided this is greater than the five year minimum required.
- H. Power supplies including those integral to drivers shall have a minimum efficiency of 85%.
- I. Drivers shall have a Power Factor of >0.90.
- J. Drivers shall have a Total harmonic Distortion of <20%.

2.3 MATERIALS AND FABRICATION

- A. Luminaires shall be completely factory assembled and wired, and equipped with necessary lampholders, ballasts, wiring, shielding, reflectors, channels, lenses, and other parts necessary to complete the luminaire installation.
- B. Luminaire hardware shall be concealed. Weld exposed metal at joints, fill with weld material, grind smooth, and make free from light leaks. Gasket luminaires with overlapping trim. Weld ballast support studs, socket saddle studs, and reflector support studs to luminaire body; self threading screws are not acceptable. Ventilate ballast compartments and firmly secure ballast to conducting metal surface. Luminaires shall be designed for bottom relamping, unless otherwise noted.
- C. Construct luminaires with a minimum number of joints. Unexposed joints by shall be welded, screwed or bolted; soldered joints are not acceptable. Do not use self tapping methods or rivets for fastening removable parts used to gain access to electrical components requiring service or replacement, or for fastening electrical components or their supports.
- D. Cast or extruded parts of luminaires shall be close grained and free from imperfections or discolorations, rigid, true to pattern, of ample weight and thickness, and properly fitted, filed, ground, and buffed to provide finished surfaces and joints free of imperfections.
- E. Housings for luminaires shall be designed to make electrical components, including the diode boards, easily accessible and replaceable, without removing the luminaire body from its mounting.

2.4 FINISHES

- A. Luminaire finishes shall provide a durable, wear resistant surface. Surfaces shall be chemically cleaned and treated with corrosion inhibiting (phosphating) material to assure positive paint adhesion. Exposed metal surfaces (brass, bronze, aluminum, etc.) and finished castings (except chromium plated or stainless steel parts) shall have an even coat of high grade methacrylate lacquer or transparent epoxy. Anodize exposed aluminum surfaces in a 20 minute bath for corrosion resistance. Sheet steel luminaire housings, and iron and steel parts which have not received phosphating treatment, or which are to be utilized in exterior applications, shall be zinc or cadmium plated, or hot dip zinc galvanized after completion of all forming, welding, and drilling operations.
- B. Screws, bolts, nuts, and other fastening or latching hardware shall be cadmium plated.
- C. Provide luminaires with a high temperature baked enamel coating of selected color and finish, unless otherwise noted. White baked enamel finished surfaces shall have a minimum reflectance of 86%, unless otherwise noted.

2.5 REFLECTORS

- A. Aluminum Reflectors:
 - 1. Reflectors and reflecting cones or baffles shall be as specified on the lighting fixture schedule or shall be fabricated from #12 aluminum reflector sheet, minimum 0.057 inches thick (15 gauge). Material shall be free of tooling marks, spinning lines, and marks or indentation caused by riveting or other assembly techniques. No rivets, springs, or other hardware shall be visible after installation.
 - 2. Reflectors and baffles shall be polished, buffed, and anodized (Alzak) and as noted on the lighting fixture schedule, with finish color as selected by the Architect.
- B. Painted Reflectors:
 - 1. Painted reflectors shall be as specified on the lighting fixture schedule or shall be formed before application of primer and paint. Reflectors and reflector bodies for luminaires with baked white enamel finish shall meet the following requirements and tests:
 - a. After 100 hours of exposure to fade-o-meter, reflectance shall be not less than 86%, and finish shall show no visible color change.
 - b. After 100 hours of exposure to 100% humidity at 100°F, (cook box test) finish shall show no blistering or other degraded effects.
 - c. After 150 hours of exposure to salt spray (20% sodium chloride) shall cause no breakdown of film.

2.6 LENSES, FACEPLATES AND TRIMS

- A. Plastic lenses shall be of virgin methyl methacrylate, unless otherwise indicated. Polystyrene lenses are not acceptable.
- B. Lenses, louvers, and other light diffusing components shall be contained in frames. Lenses shall be removable but positively held within the frames so that hinging or other motion of the frame will not cause the diffusing components to drop out.
- C. Provide ceiling trims for rectangular recessed luminaires with mitered corners, continuously welded and smoothed before shop finishing. Lapping of trim metal is not acceptable.

2.7 LUMINAIRE WIRING

- A. Provide wiring between drivers and diode board of the same or heavier gauge than the leads furnished with the drivers, and having same or higher insulating and heat resisting characteristics. Internal wiring of luminaires shall contain a minimum number of splices. Splices shall be made with suitable mechanical insulated steel spring type connectors.
- B. Wiring channels and wireways shall be free from projections and rough or sharp edges. Provide bushings at points or edges over which conductors pass.

2.8 ACCESSORIES

- A. Where utilized as raceways, luminaires shall be suitable for use as raceways. Provide feed through splice boxes where necessary.
- B. Provide installation and supporting hardware including stems, plates, plaster frames, hangers, and similar items, for support of luminaires for the ceiling construction in which they shall be installed. Provide plaster frames made of non ferrous metal, or of steel that has been suitably rustproofed after fabrication.
- C. Interior luminaires sound ratings lower than A, shall be provided with acoustical mounting pads between luminaire housing and driver to minimize vibration and noise level.
- D. 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.
- E. Attach reflectors to housing by means of safety chains to prevent reflectors from falling. No part of the chain shall be visible after installation.
- F. Provide a ceiling canopy for each stem or connection point. Canopy finish shall match stem finish.
- G. Luminaires installed in air plenums shall be fully enclosed and gasketed and rated for plenum use.
- H. Provide additional feed points in luminaires connected to the emergency power system to accommodate the additional wiring for power and controls.

PART 3 – EXECUTION

3.1 GENERAL

- A. Luminaire locations as indicated on the Drawings are general and approximate. Verify exact location and mounting height of luminaires with the Architect prior to installation. Verify adequacy of clearance with other equipment such as but not limited to ducts, pipes, conduit, cable tray or structural elements. Bring all conflicts to the Architect's attention before proceeding with work.
- B. Verify ceiling construction and furnish appropriate luminaire mounting supports, hardware, trim, and accessories for each luminaire.
- C. Install luminaires in mechanical equipment rooms after ductwork and piping installation. Locate and mount luminaires as indicated on the Drawings unless mechanical equipment prohibits or makes it impractical to do so. In such cases, chain or wall mount luminaires so that equipment requiring service is illuminated.
- D. Luminaires and final installation shall be installed free of light leaks, warps, dents, or other irregularities. Light leaks are not acceptable.
- E. Install reflector cones, aperture plates, lenses, diffusers, louvers, and decorative elements of luminaires after completion of wet work, plastering, painting, and general clean up in the area of the luminaires. Provide final focusing and adjusting of lighting equipment. Focusing and adjusting shall be performed under the Architect's supervision after normal working hours.
- F. Visible hanging devices shall be finished to match the luminaire finish, unless otherwise noted. Suspended fixtures shall hang level and aligned when installed in rows.
- G. Provide fire rated enclosures around recessed luminaires that are installed in fire rated ceilings.
- H. Provide attachment devices, brackets, plaster rings, saddle hanger and tie bars made of formed, rolled, or cast metal shapes with the requisite rigidity and strength to maintain continuous alignment and support of installed luminaires.
- I. Luminaires mounted in suspended ceilings shall be attached to the main runners of the ceiling system with appropriate mounting hardware. Provide independent 45° slack cables from at least two corners of luminaires to structure above.
- J. Provide at least two supports for single luminaires. Where luminaires are continuously mounted in rows, provide supports at maximum intervals of 8 feet, or closer if necessary to prevent visible deflection.
- K. Equipment requiring access for service and maintenance shall be installed so that components requiring access are readily accessible and are provided with any and all access panels necessary to provide access.
- L. Immediately prior to occupancy clean free of all markings and smudges; reflectors, reflector cones, aperture plates, lenses, trim rings, faceplates, louvers, lamps and decorative elements.

- M. Replace burnt out luminaires or replaceable boards where more than 1% of the diodes have failed or components are noisy or defective or are otherwise are non-functioning parts of the complete lighting system.
- N. Luminaires with connected to an emergency source of power shall be connected to unswitched or switched circuits or both as shown on the plans and shall be equipped with any UL 924 listed power transfer devices and labor necessary to provide the operation shown.

END OF SECTION



1' x 4' EZPAN edgelit LED panel lights provide smooth and uniform light edge-to-edge for a clean, modern look. Install in drop ceilings or use optional surface, pendant or recessed (dry wall) mounting kits.

Color: White

Weight: 11.6 lbs

Project:

Type:

Prepared By:

Date:

Driver Info

Type: Constant Current
120V: 0.25A
208V: 0.15A
240V: 0.13A
277V: 0.11A
Input Watts: 30W
Efficiency: N/A

LED Info

Watts: 30W
Color Temp: 4000K (Neutral)
Color Accuracy: 82 CRI
L70 Lifespan: 60,000
Lumens: 3,419
Efficacy: 114 LPW

Technical Specifications

Listings

UL Listing:

Suitable for damp locations

IESNA LM-79 & LM-80 Testing:

RAB LED luminaires and LED components have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80.

DLC Listed:

This product is on the Design Lights Consortium (DLC) Qualified Products List and is eligible for rebates from DLC Member Utilities.
DLC Product Code: PZPV6RAV

LED Characteristics

Note:

All values are typical (tolerance +/- 10%)

Lifespan:

60,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations

LEDs:

Long-life, High efficiency, micro-power, surface mount LEDs

Construction

Maximum Ambient Temperature:

Suitable for use in -30°C (-22°F) to 50°C (122°F)

IC Rating:

Suitable for insulated ceilings

Lens:

Frosted polystyrene

Mounting:

Recessed ceiling

Housing:

Lightweight aluminum housing, steel pan and junction box

Installation:

Standard integral T-bar clips secure the fixture to T-bars and prevent T-system separation

Finish:

Formulated for high-durability and long lasting color

Green Technology:

Mercury and UV-free. RoHS compliant components.

Electrical

Driver:

Constant Current, Class 2, 120-277V, 50/60 Hz, 120V: 0.25A, 208V: 0.15A, 240V: 0.13A, 277V: 0.11A

Dimming Driver:

Driver includes dimming control wiring for 0-10V dimming systems. Requires separate 0-10V DC dimming circuit. Dims as low as 10%.

THD:

9.7% at 120V, 8.3% at 277V

Power Factor:

99.1% at 120V, 96.7% at 277V

Other

Warranty:

RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish. RAB's warranty is subject to all terms and conditions found at

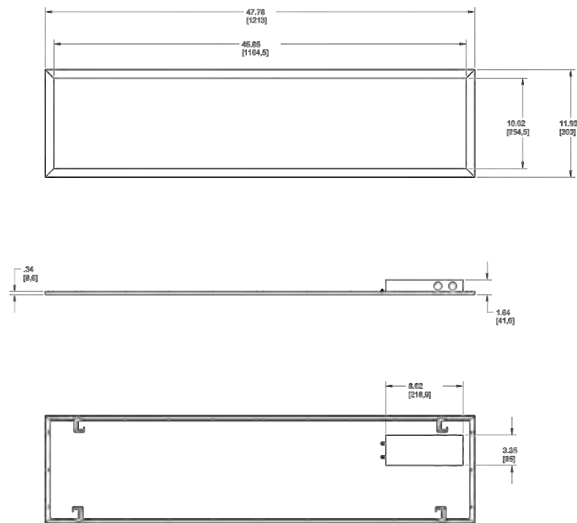
Equivalency :

Equivalent to (4)F32T8 or (4)F28T5

Buy American Act Compliance:

RAB values USA manufacturing! Upon request, RAB may be able to manufacture this product to be compliant with the Buy American Act (BAA). Please contact customer service to request a quote for the product to be made BAA compliant.

Dimensions



Features

- Perfect for shallow plenums
- Even and diffuse ambient illumination, ideal for spaces where glare-free lighting is required
- 0-10V dimmable driver, standard

Ordering Matrix

Family	Size	Wattage	Color Temp	Driver	Options
EZPAN	1X4	30	N	/D10	^
	1X4 = 1' x 4'	17 = 17W 30 = 30W 40 = 40W	Blank = 5000K (Cool) N = 4000K (Neutral) YN = 3500K (Warm Neutral) Y = 3000K (Warm)	/D10 = 0-10V Dimming	Blank = No Option /LC = Lightcloud® Controller /E2 = Emergency Battery 120-277V



1' x 4' EZPAN edgelit LED panel lights provide smooth and uniform light edge-to-edge for a clean, modern look. Install in drop ceilings or use optional surface, pendant or recessed (dry wall) mounting kits.

Color: White

Weight: 11.6 lbs

Project:

Type:

Prepared By:

Date:

Driver Info

Type: Constant Current
120V: 0.25A
208V: 0.15A
240V: 0.13A
277V: 0.11A
Input Watts: 30W
Efficiency: N/A

LED Info

Watts: 30W
Color Temp: 4000K (Neutral)
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DLC Product Code: PZPV6RAV

LED Characteristics

Note:

All values are typical (tolerance +/- 10%)

Lifespan:

60,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations

LEDs:

Long-life, High efficiency, micro-power, surface mount LEDs

Construction

Maximum Ambient Temperature:

Suitable for use in -30°C (-22°F) to 50°C (122°F)

IC Rating:

Suitable for insulated ceilings

Lens:

Frosted polystyrene

Mounting:

Recessed ceiling

Housing:

Lightweight aluminum housing, steel pan and junction box

Installation:

Standard integral T-bar clips secure the fixture to T-bars and prevent T-system separation

Finish:

Formulated for high-durability and long lasting color

Green Technology:

Mercury and UV-free. RoHS compliant components.

Electrical

Driver:

Constant Current, Class 2, 120-277V, 50/60 Hz, 120V: 0.25A, 208V: 0.15A, 240V: 0.13A, 277V: 0.11A

Dimming Driver:

Driver includes dimming control wiring for 0-10V dimming systems. Requires separate 0-10V DC dimming circuit. Dims as low as 10%.

THD:

9.7% at 120V, 8.3% at 277V

Power Factor:

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Other

Warranty:

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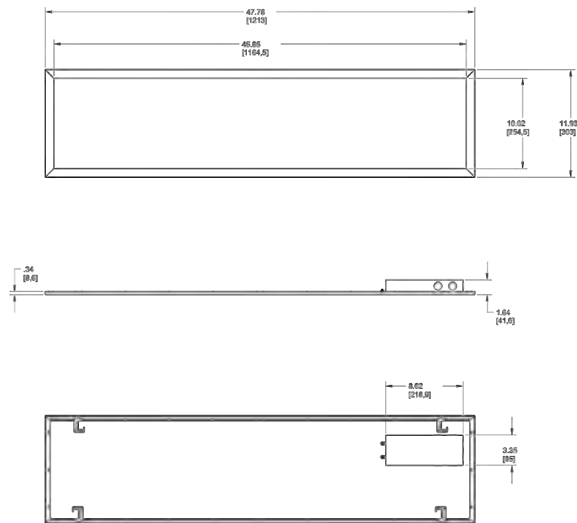
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Equivalent to (4)F32T8 or (4)F28T5

Buy American Act Compliance:

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Dimensions



Features

- Perfect for shallow plenums
- Even and diffuse ambient illumination, ideal for spaces where glare-free lighting is required
- 0-10V dimmable driver, standard

Ordering Matrix

Family	Size	Wattage	Color Temp	Driver	Options
EZPAN	1X4	30	N	/D10	^
	1X4 = 1' x 4'	17 = 17W 30 = 30W 40 = 40W	Blank = 5000K (Cool) N = 4000K (Neutral) YN = 3500K (Warm Neutral) Y = 3000K (Warm)	/D10 = 0-10V Dimming	Blank = No Option /LC = Lightcloud® Controller /E2 = Emergency Battery 120-277V

Embrace

TMSLIGHTING

ESTABLISHED 1923



Features

- Several sizes, output and CCT available for application and design flexibility
- Can be configured with multiple units, at varying height, for higher output and artistic appeal
- Projects a general diffuse pattern with excellent uniformity and coverage
- Surge suppressor protects the internal components
- Optional 0-10V (current sinking) dimming without color shifting
- Cool operation for extended component life

Applications

Embrace complements modern architecture best, in areas where an uplifting appearance is required. Some areas include entertainment venues, lobbies, reception areas, hallways, and meeting areas.

Construction

The body and canopy are formed with high grade steel. The diffuser is formed with acrylic. Available in sizes of 24" (610 mm), 36" (914 mm), 48" (1.219 m), 60" (1.524 m), and 72" (1.829 m) diameter.

LED

Operates with 74W, 112W, 149W, 186W, or 224W Cree™ LED, 80CRI. Specify 3000K, 3500K, or 4000K CCT.

Diffuser

The diffuser is formed with UV-stabilized white acrylic.

Dimming

0-10V current-sinking dimming, with pulse width modulation (PWM), to ensure consistent color through dimming phases.

Note: Use a current-sinking dimming system (by others) with this option. The compatibility of this product is not guaranteed with all control systems.

LED Driver

The LED source is controlled by an advanced, electronic driver that delivers consistent power.

Surge Suppressor

All 120V, 277V, and universal voltage LED luminaires are equipped with an integral, 6kV surge suppressor.

Mounting

Supplied with adjustable aircraft cables with maximum suspension of 120" (3.048 m). Mount on a ceiling, directly to a standard 4" electrical junction box with 3.5" holes c-c.

Follow the installation instructions, and adhere to your local electrical code.

Finish

Available in polyester powder-coated finishes or custom RAL colors. See the Finishes and Diffusers chart.

Compliances

Rated IP20 for use in dry, indoor locations. QPS-C/US, or UL-C/US certified to UL1598 standards. The Consultants Europe (CE) listing is available upon request.



IP20 CE



Embrace

TMSLIGHTING

ESTABLISHED 1923

6050

1 2 3 4 5 6 7

Project: _____
Type: _____
Quantity: _____

Notes:

1 • Diameter

24: 24" (610 mm) dia.
36: 36" (914 mm) dia.
48: 48" (1219 mm) dia.
60: 60" (1524 mm) dia.
72: 72" (1829 mm) dia.

2 • Lamping

74LED: 74W LED (24" dia. only)
112LED: 112W LED (36" dia. only)
149LED: 149W LED (48" dia. only)
186LED: 186W LED (60" dia. only)
224LED: 224W LED (72" dia. only)
Note: All LED sources render at CRI 80.

3 • Voltage

120: 120V
277: 277V

4 • LED CCT (color temp.)

30K: 3000K
35K: 3500K
40K: 4000K

5 • Cord

BC: BLACK DROP CORD
WC: WHITE DROP CORD

6 • Finish

F05: White
F09: Pewter
F15: Matte black
F16: Gloss black
F19: Mirror silver
F24: Melted platinum (textured)
F25: Melted gold (textured)
F26: Melted copper (textured)
F31: Silver metallic
F32: Bronze metallic
F33: Pyrite bronze
RAL: RAL custom color (specify)

7 • Dimming

—: None
DIML: LED dimming (0-10V, current-sinking)
Note: Use a current-sinking dimming system (by others) with this option. The compatibility of this product is not guaranteed with all control systems.

Note: Some options may not be compatible with others. To ensure compatibility, please visit tmslighting.com, on the "configure" page of this luminaire, and use the configuration tool.

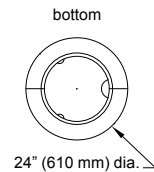
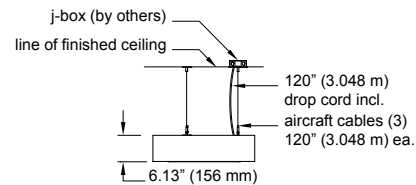


Embrace

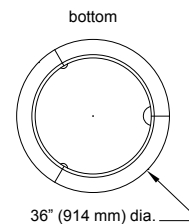
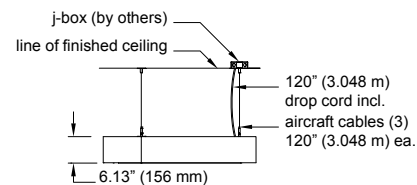
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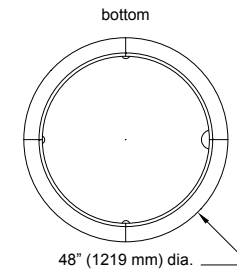
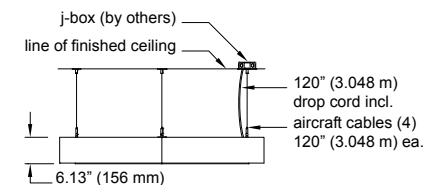
6050-24



6050-36



6050-48



Custom

TMS Lighting can customize this and many of our standard fixtures. The dimensions, lamp types, enclosure and colors could be modified to suit your lighting and architectural requirements. Contact your local representative for more details: <http://tmslighting.com/info/agents>.

Specifications are subject to change without notice.

TMS Lighting Inc.

247A Summerlea Road,
Brampton, Ontario,
Canada. L6T 4E1

Web Site: tmslighting.com

North America: (905) 793-1174

Toll-free: (866) 793-1174

Fax: (905) 793-1175

UK & Europe: 44-1474-250-654

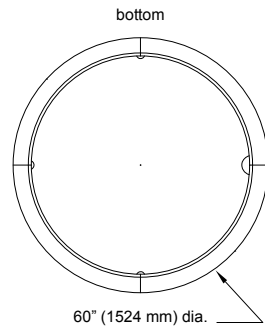
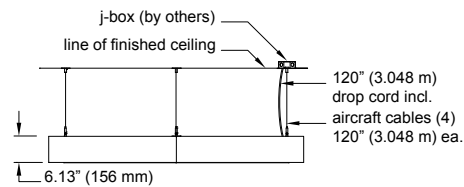


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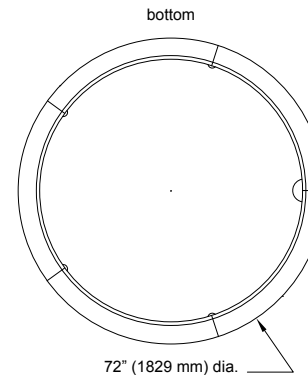
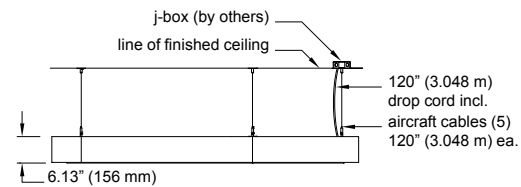
TMSLIGHTING

ESTABLISHED 1923

6050-60



6050-72



Custom

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TMS Lighting Inc.

247A Summerlea Road,
Brampton, Ontario,
Canada. L6T 4E1

Web Site: tmslighting.com

North America: (905) 793-1174

Toll-free: (866) 793-1174

Fax: (905) 793-1175

UK & Europe: 44-1474-250-654

Type LD-1

PHILIPS
LIGHTOLIER

Downlighting

Calculite LED gen 3

4" round downlight,
500 - 3000lm



Calculite LED 4" generation 3 features industry leading visual comfort, excellent uniform illumination over time, and patented installation flexibility.

Complete luminaire = Frame + Engine + Trim + Accessories (optional)

Project: _____
Location: _____
Cat.No: _____
Type: _____
Lamps: _____ Qty: _____
Notes: _____

Frame

example: C4RN

Series	Aperture	Installation	Voltage/ Options
C4	R		
C4 Calculite LED 4" aperture	R Round	N New construction ¹ R Remodeler	— Universal 120 V/277 V (specify for Power Over Ethernet configurations) 3 347 V (not compatible with ELV dimming) EM Emergency ^{1,2} LC Chicago Plenum ¹

Engine

example: C4L15835NZ10U

Series	Lumens	CRI	CCT	Beam	Dimming / Driver	Voltage
C4L						
C4L Calculite LED 4" aperture	05 500lm ³ 10 1000lm 15 1500lm 20 2000lm ⁴ 25 2500lm ⁴ 30 3000lm ⁴	8 80 CRI 9 90 CRI	27 2700 K 30 3000 K 35 3500 K 40 4000 K	N Narrow (43°) M Medium (56°) W Wide (76°)	Z10 0-10 V 1% ³ SOL EidoLED Solo 0-10 V 0.1% D Dali L Lutron LDE1 EcoSystem (fade-to-black) E ELV (120V dimming only) ⁵ P Power over Ethernet (PoE) Only compatible with 1000 (10) to 2500 (25) lumen configurations.	U Universal 120 V/277 V/347 V 1 Universal 120 V/277 V E Ethernet 48 V DC

Trim

example: C4RDLCCP

Series	Aperture	Style	Finish	Flange
C4	R	DL		
C4 Calculite LED 4" aperture	R Round	DL Downlight	BK Black (matte) CL Specular clear WH White (matte)	— White (matte) P Polished F Flangeless
		SL Non-conductive ⁷	WH White (matte)	— White (matte) F Flangeless — Not applicable

Accessories

CA4RFT	Mud-in ring for use with flangeless installations (ordered with a flangeless trim)
CAEM	Field installable EM pack (not compatible with Power over Ethernet configurations)
C4RVPWH	IP65 rated vandal proof matte white accessory that mounts onto a flangeless trim
AMS	ActiLume multi-sensor (optional accessory for Power Over Ethernet configurations)
SWZDT	SpaceWise wireless controller with dwell time functionality ⁶

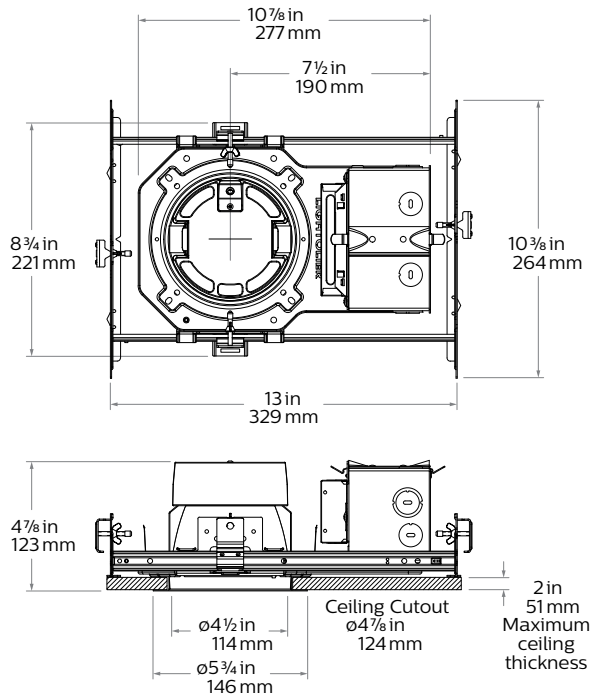
- Emergency (EM) and Chicago Plenum (LC) options are only available with New construction (N) installations.
- Emergency (EM) frame comes with emergency battery pack and ceiling mountable test switch. Reflector mounted test switch requires above ceiling access. For reflector mounted test switch, order emergency frame and add "EM" suffix to reflector (example: C4RDLCCEM).
- The 500lm (05) package is only compatible with 0-10V (Z10) dimming.
- The 2000lm (20), 2500lm (25), and 3000lm (30) packages have marked spacing requirements (see page 3).
- ELV (E) dimming is only compatible with up to 2000lm (20) configurations.
- SpaceWise is compatible with all 0-10V configurations (for details see "SWZDT" spec sheet).
- Non-conductive flush mount lens with pre-installed gasket (matte white non-conductive flange with diffuse lens that is flush with the flange).



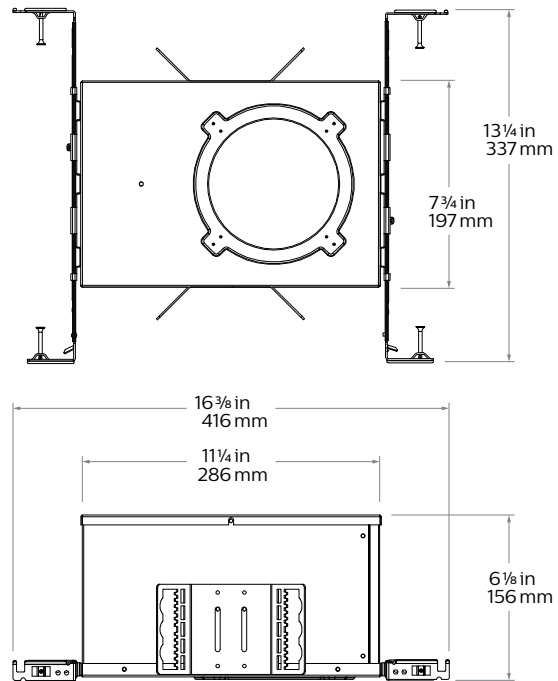
C4RDL Calculite LED generation 3

4" round downlight

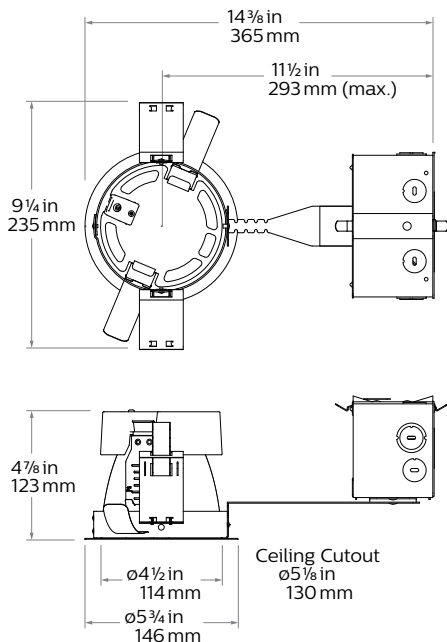
New Construction (N)



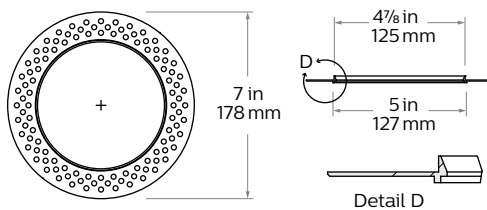
Chicago Plenum (LC)



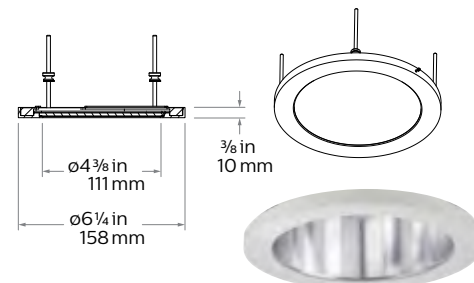
Remodeler (R)



Flangeless mud-in ring (CA4RFT) accessory

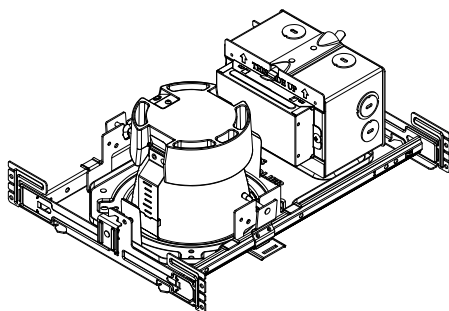


Vandal Proof (VP) accessory



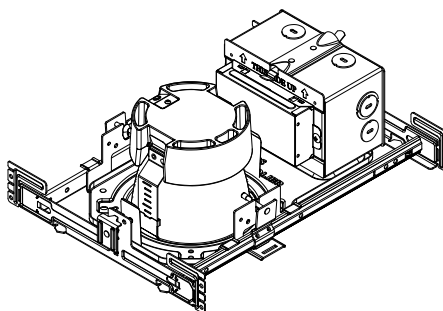
C4RDL Calculite LED generation 3

4" round downlight



Narrow

Light engine	Input volts	Input freq	Input current	Drive current	Input power	THD power	Power factor
C4L05_NZ10U	120V	50/60Hz	0.05	110 mA	6W	<20%	>0.95
	277V		0.03			<20%	>0.90
C4L10_NZ10U	120V	50/60Hz	0.08	230 mA	11W	<15%	>0.95
	277V		0.04			<20%	>0.95
C4L15_NZ10U	120V	50/60Hz	0.12	360 mA	16W	<10%	>0.95
	277V		0.06			<15%	>0.95
C4L20_NZ10U	120V	50/60Hz	0.17	490 mA	21W	<10%	>0.95
	277V		0.08			<15%	>0.95
C4L25_NZ10U	120V	50/60Hz	0.22	640 mA	27W	<10%	>0.95
	277V		0.10			<15%	>0.95
C4L30_NZ10U	120V	50/60Hz	0.27	790 mA	33W	<10%	>0.95
	277V		0.13			<15%	>0.95



Medium/Wide

Light engine	Input volts	Input freq	Input current	Drive current	Input power	THD power	Power factor
C4L05_MZ10U	120V	50/60Hz	0.05	110 mA	6W	<20%	>0.95
	277V		0.03			<20%	>0.90
C4L10_MZ10U	120V	50/60Hz	0.08	230 mA	11W	<15%	>0.95
	277V		0.04			<20%	>0.95
C4L15_MZ10U	120V	50/60Hz	0.12	350 mA	16W	<10%	>0.95
	277V		0.06			<15%	>0.95
C4L20_MZ10U	120V	50/60Hz	0.16	470 mA	21W	<10%	>0.95
	277V		0.08			<15%	>0.95
C4L25_MZ10U	120V	50/60Hz	0.21	610 mA	25W	<10%	>0.95
	277V		0.09			<15%	>0.95
C4L30_MZ10U	120V	50/60Hz	0.26	770 mA	31W	<10%	>0.95
	277V		0.12			<15%	>0.95

Narrow (Power over Ethernet)

Light engine	Input			
	Volts ¹	Voltage ²	Freq	Power
C4L10___NPE	53V	51-54V	DC	160 mA 8.9 W
C4L15___NPE	53V	51-54V	DC	250 mA 13.6 W
C4L20___NPE	53V	51-54V	DC	340 mA 18.5 W
C4L25___NPE	53V	51-54V	DC	460 mA 24.6 W

Medium (Power over Ethernet)

Light engine	Input			
	Volts ¹	Voltage ²	Freq	Power
C4L10___MPE	53V	51-54V	DC	160 mA 8.8 W
C4L15___MPE	53V	51-54V	DC	250 mA 13.4 W
C4L20___MPE	53V	51-54V	DC	320 mA 17.6 W
C4L25___MPE	53V	51-54V	DC	430 mA 23.2 W

Wide (Power over Ethernet)

Light engine	Input			
	Volts ¹	Voltage ²	Freq	Power
C4L10___WPE	53V	51-54V	DC	160 mA 8.8 W
C4L15___WPE	53V	51-54V	DC	250 mA 13.4 W
C4L20___WPE	53V	51-54V	DC	320 mA 17.6 W
C4L25___WPE	53V	51-54V	DC	430 mA 23.2 W

1. Nominal input volts.
2. Preferred volt range.

Marked spacing applications

Light engine	2500lm	3000lm
C4L_Z10U series	—	X
C4L_LU series	X	X
C4L_DU series	—	X

Modules marked with an X require marked spacing:
 - Center-to-center of adjacent luminaires: 24" (610mm)
 - Luminaire center to side building member: 12" (305mm)

Lifetime (TM-21) data

Lumens	Narrow beam	Medium/Wide beam*
500lm	L90 @ 60,000hrs.	L90 @ 60,000hrs.
1000lm		
1500lm		
2000lm	L90 @ 60,000hrs.	L85 @ 60,000hrs.
2500lm		
3000lm*		

* Lutron 3000lm with Medium/Wide beam is L80 @ 60,000hrs.

C4RDL Calculite LED generation 3

4" round downlight

Reflector



Specular clear (CL): Most specular and most efficient finish, delivers maximum photometric performance but can produce a mirror image effect of the interior space.



Comfort clear (CC): Semi-specular finish that softens the light at the source of the reflector and creates a subtle, even luminance from the reflector cone.



Comfort clear diffuse (CD): Slightly diffuse clear finish, that eliminates iridescence and reduces the mirror image effect inherent with specular finishes.



Champagne bronze (CZ): Semi-specular finish that softens light at the source of the reflector while providing a warmer reflector appearance (slightly warmer).



White (WH): (matte) Brightest illuminated aperture and provides the smoothest transition to most ceilings when off (white is only available with a white flange).



Black (BK): (matte) Specular finish that provides the lowest aperture brightness possible and significantly reduces source identification in a ceiling.

Flange



White (-): (matte) Provides the smoothest transition to ceilings when off.



Polished (P): (matches aperture) Produces a continuous look throughout the reflector (aperture matching).



Flangeless (F): (flush-mount) Creates a flush, virtually seamless transition from aperture to ceiling.

Frame-in-kits

New Construction

Galvanized stamped steel for dry or plaster ceilings. Preinstalled telescoping mounting bars from 13" to 24". For 4' distances, use 1/2" EMT, 1-1/2" x 1/2" U or C channel.

Max ceiling thickness is 2" (51 mm). Including PoE frame 4.88" (124 mm).

Patented install Mounting frame

With no driver attached, this versatile frame is independent of driver accommodating a wide range of lumen packages, driver types and CCTs, including 120V and 277V inputs.

Pre-installed mounting bars allow for fast and tool-less installation into T-grid and hat channel ceilings.

Close-cut aperture design eliminates the possibility of undesired gap between ceiling opening and reflector flange.

Separate wiring compartment for wiring frame to building allows inspection prior to light engine installation.

Simple plug-and-play connection between the frame and light engine from below the ceiling eliminates the need for wiring between frame and LED driver, and also saves time during installation and future replacements/upgrades. Plug-and-play receptacle accommodates technology upgrade of light engines and replacements for the life of the building.

Dimming

- Advance 0-10V 1% dimming
- Lutron Hi-lume EcoSystem H Series 1% dimming
- EldoLED ECOdrive Dali 1% dimming
- EldoLED SOLOdrive 0-10V 0.1% dimming
- ELV dimming

Power over Ethernet

Powered via Philips PoE lighting controller: complies with FCC rules per Title 47 part 15 (Class A) for EMI / RFI (conducted & radiated). PoE lighting controller accessible from below ceiling.

Rated life: 60,000 hrs at 70% lumen maintenance based on IES LM-80-08 and TM-21-11.

Optical systems

Comfort throughout the space:

Patented optical system combines primary and secondary optics to provide a true 50° physical cutoff and 45° reflected cutoff virtually eliminating the view of the light source and bright spots in the reflector. A new reflector curve reduces reflector brightness by up to 50% compared to existing products, allowing for the use of higher lumen packages in smaller apertures without creating bright spots in the ceiling.

Quality of light: 2 SDCM ensures color consistency from fixture to fixture and over the luminaire's long lifetime. Proprietary optical grade silicone lens with patterned surface provides soft, even beam diffusion without hotspots or dark rings.

Light Engine

Quick connect power pack comprised of light source and driver allow for easy installation and replacement from below ceiling with no need for additional wiring. This allows for:

- Frame and ceiling installation to be performed while still finalizing details such as lumen packages, CCT and control type.
- Easy replacement of electronics at end of life with minimal wasted material and labor required.
- Ease and upgradability of technology.

Options and Accessories

Flangeless mud-in ring: Use **CA4RFT** for use with flangeless plaster installations.

Sloped ceilings: Compatible with sloped ceiling adapters (see **SCA** spec sheet).

Vandal Proof: Use **C4RVPWH** for an IP65 rated vandal proof matte white accessory. Must be ordered with a flangeless trim.

ENERGY STAR® exceptions

500lm & 90 CRI configurations
Champagne Bronze and Black finishes
347V & Emergency voltage/options
Dali, EldoLED Solo & PoE drivers

Title 24 exceptions

1000lm configurations
Champagne Bronze and Black finishes

Labels and Listings

cULus listed for wet location
ENERGY STAR®, RoHS & CEC Title 24 JA8 certified
CCEA (frames with *LC suffix)
IP65 rated with vandal proof accessory
IBEW Union made (light engines & reflectors)

Warranty

5 year warranty on complete system.

Complete warranty available at: http://images.philips.com/is/content/PhilipsConsumer/PDFDownloads/United%20States/ODLI20150930_003-UPD-en_US-Philips-warranty-indoor-PLS-us.pdf

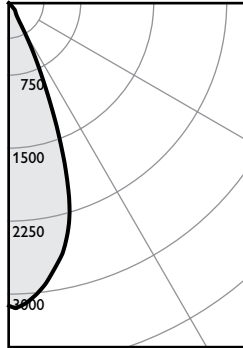


C4RDL Calculite LED generation 3

4" round downlight

Narrow beam, 1500lm Engine, 103.8 lm/W at 14.7W or 112.2 lm/W at 13.6W (Power over Ethernet)

Candela Curve



Frame: **C4RN**
Engine: **C4L15835NZ10U**
Trim: **C4RDLCL**

Output lumens: 1526 lms
Input watts: 14.7 W
CRI: 80 min
CCT¹: 3500K
Spacing Crit.: 0.6
Beam Angle: 43°

Zonal summary

Zone	Lumens	%Luminaire
0-30	1354	88.7%
0-40	1469	96.3%
0-60	1526	100.0%
0-90	1526	100.0%

Angle	Mean CP	Lumens
0	3112	
5	3044	282
10	2785	
15	2410	652
20	1672	
25	837	420
30	324	
35	163	115
40	128	
45	77	57
50	0	
55	0	0
60	0	
65	0	0
70	0	
75	0	0
80	0	
85	0	0
90	0	

Single unit data

Height to lighted plane	Initial center beam foot-candles	Beam diameter (ft)*
5'	124	3.0'
6'	86	3.6'
7'	64	4.2'
8'	49	4.8'
9'	38	5.4'

* Beam diameter is where foot-candles drop to 50% of maximum.

Multiple unit data - RCR 2

Spacing on center	Initial center beam foot-candles	Watts per sq. ft.
5'	71.3	0.65
6'	46.8	0.43
7'	33.4	0.31
8'	27.8	0.25
9'	22.3	0.20

38' x 38' x 10' Room, Workplane 2.5'
above floor, 80/50/20% Reflectances

Efficacy: 103.8lm/w
Report#: T20161390

Adjustment factors

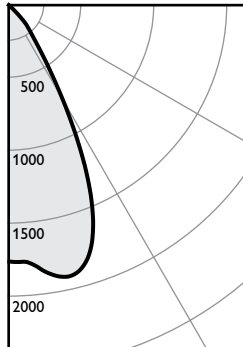
Finish	CCT	Lumens
CL = 100%	80CRI 4000K = 107%	3000lm = 200%
CC = 95%	80CRI 3500K = 100%	2500lm = 167%
CD = 87%	80CRI 3000K = 99%	2000lm = 133%
CZ = 63%	80CRI 2700K = 93%	1500lm = 100%
WH = 87%	90CRI 3000K = 87%	1000lm = 67%
BK = 57%	90CRI 2700K = 81%	500lm = 33%

Coefficients of utilization

Ceiling	80%				70%				50%				30%				0%
Wall	70	50	30	10	50	10	50	10	50	10	50	10	50	10	50	10	0
RCR	Zonal cavity method - Effective floor reflectance = 20%																
Room Cavity Ratio	0	119	119	119	119	116	116	111	111	106	106	100	106	106	100	95	100
1	114	112	110	108	110	106	106	103	103	102	100	95	102	100	95	91	95
2	110	106	102	99	104	98	101	96	96	98	94	88	98	94	88	84	91
3	105	100	96	92	99	92	96	90	94	89	86	82	94	89	86	82	86
4	101	95	90	87	94	86	92	85	90	84	82	78	90	84	82	78	82
5	97	90	85	82	89	81	88	81	88	81	78	74	86	80	78	74	78
6	93	86	81	77	85	77	84	77	83	76	74	70	83	76	74	71	74
7	90	82	77	74	81	73	80	73	79	73	71	67	80	73	71	67	71
8	86	79	74	70	78	70	77	70	76	69	68	65	77	69	68	65	68
9	83	75	70	67	75	67	74	67	73	66	65	62	74	67	65	62	65
10	80	72	67	64	72	64	71	64	70	64	62	60	70	64	62	60	62

Medium beam, 1500lm Engine, 114.6 lm/W at 14.2W or 121.4 lm/W at 13.4W (Power over Ethernet)

Candela Curve



Frame: **C4RN**
Engine: **C4L15835MZ10U**
Trim: **C4RDLCL**

Output lumens: 1627 lms
Input watts: 14.2 W
CRI: 80 min
CCT¹: 3500K
Spacing Crit.: 0.9
Beam Angle: 56°

Zonal summary

Zone	Lumens	%Luminaire
0-30	1269	78.0%
0-40	1537	94.5%
0-60	1627	100.0%
0-90	1627	100.0%

Angle	Mean CP	Lumens
0	1760	
5	1783	174
10	1886	
15	1887	524
20	1702	
25	1283	572
30	762	
35	406	268
40	236	
45	116	89
50	14	
55	0	1
60	0	
65	0	0
70	0	
75	0	0
80	0	
85	0	0
90	0	

Single unit data

Height to lighted plane	Initial center beam foot-candles	Beam diameter (ft)*
5'	70	4.5'
6'	49	5.4'
7'	36	6.3'
8'	28	7.2'
9'	22	8.1'

* Beam diameter is where foot-candles drop to 50% of maximum.

Multiple unit data - RCR 2

Spacing on center	Initial center beam foot-candles	Watts per sq. ft.
5'	74.8	0.63
6'	49.1	0.41
7'	35.0	0.30
8'	29.2	0.25
9'	23.4	0.20

38' x 38' x 10' Room, Workplane 2.5'
above floor, 80/50/20% Reflectances

Efficacy: 114.6lm/w
Report#: T20161397

Adjustment factors

Finish	CCT	Lumens
CL = 100%	80CRI 4000K = 102%	3000lm = 200%
CC = 95%	80CRI 3500K = 100%	2500lm = 167%
CD = 87%	80CRI 3000K = 97%	2000lm = 133%
CZ = 63%	80CRI 2700K = 87%	1500lm = 100%
WH = 87%	90CRI 3000K = 77%	1000lm = 67%
BK = 57%	90CRI 2700K = 73%	500lm = 33%

Coefficients of utilization

Ceiling	80%				70%				50%				30%				0%
Wall	70	50	30	10	50	10	50	10	50	10	50	10	50	10	50	10	0
RCR	Zonal cavity method - Effective floor reflectance = 20%																
Room Cavity Ratio	0	119	119	119	119	116	116	111	111	106	106	100	106	106	100	94	100
1	114	111	109	107	109	105	105	102	102	101	99	94	101	99	94	91	94
2	108	104	100	97	102	96	99	94	96	96	92	88	96	92	88	84	91
3	103	97	93	89	96	88	93	87	91	85	82	78	90	84	82	78	82
4	98	91	86	82	90	81	88	81	86	80	77	74	86	80	77	74	78
5	94	86	80	76	85	76	83	75	81	74	72	69	83	76	74	71	74
6	89	81	75	71	80	71	79	70	77	70	68	65	79	73	71	67	71
7	85	76	70	66	76	66	74	66	73	66	64	61	74	66	64	61	67
8	81	72	66	62	71	62	70	62	69	62	60	57	70	62	60	57	64
9	77	68	63	59	68	59	67	58	66	58	57	54	67	58	57	54	61
10	74	65	59	55	64	55	63	55	63	55	54	51	63	55	54	51	59

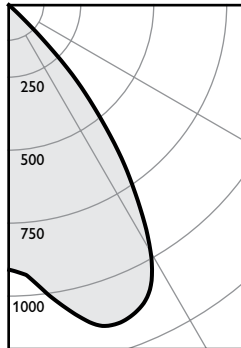
1. Correlated Color Temperature within specs as defined in ANSI_NEMA_ANSI C78.377-2008: Specifications for the Chromaticity of Solid State Lighting Products.
2. Tested using absolute photometry as specified in LM79: IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.

C4RDL Calculite LED generation 3

4" round downlight

Wide beam, 1500lm Engine, 106.6 lm/W at 14.2W or 113.2 lm/W at 13.4W (Power over Ethernet)

Candela Curve



Frame: **C4RN**
Engine: **C4L15835WZ10U**
Trim: **C4RDLCL**

Output lumens: 1517 lms
Input watts: 14.2 W
CRI: 80 min
CCT¹: 3500K
Spacing Crit.: 1.2
Beam Angle: 76°

Zonal summary

Zone	Lumens	%Luminaire
0-30	918	60.5%
0-40	1368	90.2%
0-60	1517	100.0%
0-90	1517	100.0%

Angle	Mean CP	Lumens
0	906	
5	945	93
10	1040	
15	1128	318
20	1153	
25	1114	506
30	978	
35	732	450
40	460	
45	175	148
50	18	
55	0	2
60	0	
65	0	0
70	0	
75	0	0
80	0	
85	0	0
90	0	

Single unit data

Height to lighted plane	Initial center beam foot-candles	Beam diameter (ft)*
5'	36	6.0'
6'	25	7.2'
7'	18	8.4'
8'	14	9.6'
9'	11	10.8'

* Beam diameter is where foot-candles drop to 50% of maximum.

Multiple unit data - RCR 2

Spacing on center	Initial center beam foot-candles	Watts per sq. ft.
5'	68.5	0.63
6'	45.0	0.41
7'	32.1	0.30
8'	26.8	0.25
9'	21.4	0.20

38' x 38' x 10' Room, Workplane 2.5' above floor, 80/50/20% Reflectances

Efficacy: 106.6 lm/w
Report#: T20161406

Adjustment factors

Finish	CCT	Lumens
CL = 100%	80CRI 4000K = 102%	3000lm = 200%
CC = 95%	80CRI 3500K = 100%	2500lm = 167%
CD = 87%	80CRI 3000K = 97%	2000lm = 133%
CZ = 63%	80CRI 2700K = 87%	1500lm = 100%
WH = 87%	90CRI 3000K = 77%	1000lm = 67%
BK = 57%	90CRI 2700K = 73%	500lm = 33%

Coefficients of utilization

Celling	80%				70%				50%				30%				0%
Wall	70	50	30	10	50	10	50	10	50	10	50	10	50	10	50	10	0
RCR	Zonal cavity method - Effective floor reflectance = 20%																
Room Cavity Ratio	0	119	119	119	119	116	116	111	111	106	106	100	106	106	100	97	93
1	113	110	108	105	108	104	104	104	100	97	91	94	89	86	86	86	86
2	107	102	98	94	100	93	93	97	91	94	89	86	86	86	86	86	86
3	101	94	89	85	93	84	84	90	83	88	81	79	79	79	79	79	79
4	96	87	82	77	86	77	77	84	76	82	75	72	72	72	72	72	72
5	90	81	75	70	80	70	70	78	69	77	69	66	66	66	66	66	66
6	85	75	69	64	75	64	64	73	64	72	63	61	61	61	61	61	61
7	80	70	64	59	69	59	59	68	59	67	58	56	56	56	56	56	56
8	76	65	59	55	65	54	54	64	54	63	54	52	52	52	52	52	52
9	72	61	55	50	61	50	50	60	50	59	50	48	48	48	48	48	48
10	68	57	51	47	57	47	47	56	47	55	46	45	45	45	45	45	45

1. Correlated Color Temperature within specs as defined in ANSI_NEMA_ANSLG C78.377-2008: Specifications for the Chromaticity of Solid State Lighting Products.
2. Tested using absolute photometry as specified in LM79: IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.



raye G2

2"H X 6"W

INTERIOR COVE LIGHT

Type LK-6



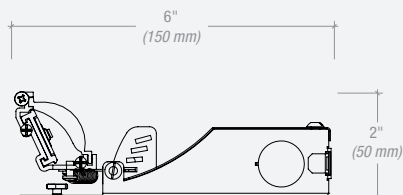
18" FIXTURE



72" FIXTURE

5-year warranty

Dimensions



Application

raye Generation 2 (G2) is today's answer to high performance cove applications. Available in a 2" x 6" housing (3" x 3" housing also available), much of the extruded aluminum heat sinking (required for Raye Gen 1) has been removed enabling a cost reduction while maintaining superior thermal management. **io** utilizes the highest efficacy LEDs and tightest Binning (2-step MacAdam). **raye** Gen 2 is the high-performance, affordable answer to new and retrofit cove applications. While exceeding T8 & T5 high performance alternatives, **raye's** optical assembly has been designed to uniformly illuminate the interior surfaces of the cove while offering a very precise asymmetric beam projection. Now field adjustable, the fixture can be tilted up to illuminate various types of ceiling conditions (i.e. barrel vaults). An LED tray can be removed in the field via a quick disconnect for future maintenance without disrupting the permanent installation. The driver is also easily accessible for future maintenance. Projected average rated life is 50,000 hours at 70% of lamp lumen output. **io** utilizes LEDs that are compliant with LM 80 standards. Ambient temperature surrounding the fixture shall not exceed 122°F (50°C).

Light Output

raye is available with four lumen outputs for white light only. All values listed below represent initial lumens. LM79 IES format files are available on the Cooper website. **io** only delivers high quality white light solutions with 2-step Binning. 80+CRI is standard. For 90+ CRI, please consult factory for pricing and lead-time.

>> 2-step MacAdam Binning.

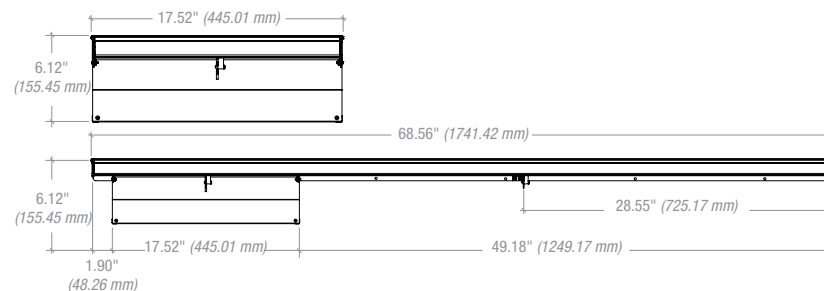
	Standard Output	High Output	Very High Output	V2HO
INITIAL LUMENS				
2700K White:	342 lms/ft	456 lms/ft	661 lms/ft	684 lms/ft
3000K White:	384 lms/ft	512 lms/ft	742 lms/ft	768 lms/ft
3500K White:	390 lms/ft	520 lms/ft	754 lms/ft	780 lms/ft
4000K White:	414 lms/ft	552 lms/ft	800 lms/ft	828 lms/ft
POWER CONSUMPTION*				
	4.80 w/ft	6.40 w/ft	9.60 w/ft	10.56 w/ft

Non-standard color temperatures available as a custom offering for a modest additional cost and lead-time.

* Power Consumption does not include power supply losses.

Construction

raye's wireway housing is die formed 20 gauge prime cold rolled steel. The wireway is 17.15" in length for both the 18" & 72" fixtures. Knockouts are provided for 1/2" conduit fittings. Wiring components and Drivers are mounted to a one piece back housing, permitting removal of the cover for ease of maintenance. An anodized aluminum channel which houses the LED tray and optic is mechanically fastened to a metal channel that runs the length of the fixture.



Mounting Options

raye is designed to be surface mounted within an architectural cove for indirect illumination. For a uniform distribution (with no socket shadows) of light fixtures should be mounted end-to-end.

Electrical

All fixtures are pre-wired and pre-assembled for easy installation. Electronic drivers (universal power supplies, 120-277v) are integral within the sheet metal wire way housing for both the 18" and 72" units.

Finish

White powder coat paint finish is standard.

io Lighting

Light Output (Lumens)	3369
Watts	74.4
Lumens per Watt (Efficacy)	45
Color Accuracy Color Rendering Index (CRI)	83
Light Color Correlated Color Temperature (CCT)	3155 (Bright White)
Warranty**	Yes

All results, except LED Lumen Maintenance, are according to IESNA LM-79-2008: Approved Method for the Electrical and Photometric Testing of Solid-State Lighting. The U.S. Department of Energy (DOE) verifies product test data and results.

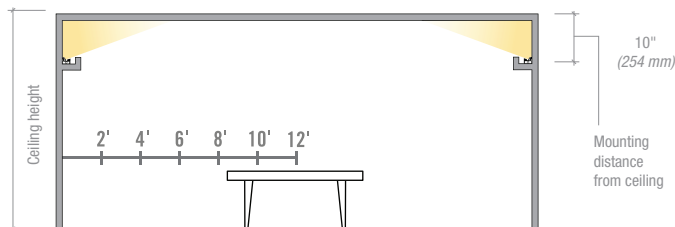
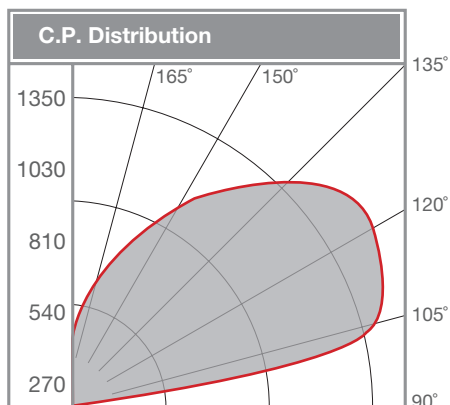
** See www.lightingfacts.com/products for details.

Registration Number: PNE4-GEJS2H (7/11/2013)
Model Number: 0.08.3KV2HO.C33.1.72
Type: Cove light

Label references 72" **raye** fixture in V2HO 3000K. Lighting Facts for additional beam spreads and light output levels may be obtained from **io** Lighting.

COVE LIGHTING

3KV2H0 – 72" Length



10" MOUNTING DISTANCE

Ceiling Height	2'	4'	6'	8'	10'	12'
11'-6" (3.51m)	25.5fc	26.3fc	25.5fc	23.5fc	22.4fc	22.2fc
10'-6" (3.20m)	26.8fc	27.3fc	25.4fc	22.9fc	20.9fc	20.4fc
9'-6" (2.90m)	28.5fc	28.3fc	24.8fc	21.5fc	19.1fc	18.5fc
8'-6" (2.59m)	32.5fc	32.2fc	27.2fc	21.9fc	18.0fc	17.3fc

*Calculations based on 3KV2H0 LEDs.

LIGHT OUTPUT CONVERSION TABLE

	Standard Output	High Output	Very High Output	V2H0
2700K White	0.44 ⁽¹⁾	0.72 ⁽¹⁾	0.95 ⁽¹⁾	1.40 ⁽¹⁾
3000K White	0.47 ⁽¹⁾	0.75 ⁽¹⁾	1.00 ⁽¹⁾	1.47 ⁽¹⁾
3500K White	0.48 ⁽¹⁾	0.77 ⁽¹⁾	1.03 ⁽¹⁾	1.51 ⁽¹⁾
4000K White	0.47 ⁽¹⁾	0.75 ⁽¹⁾	1.00 ⁽¹⁾	1.47 ⁽¹⁾

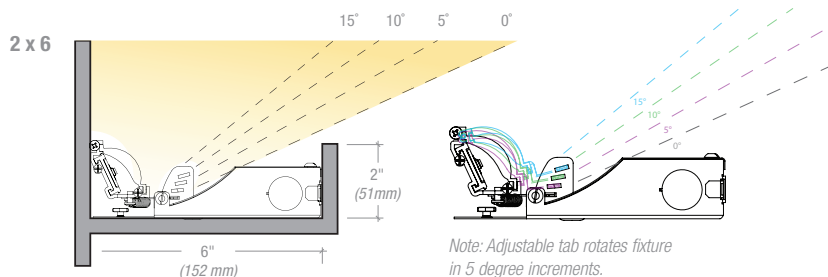
Visit www.iolighting.com or contact an **io** representative for IES format photometrics.

NEW: FIELD ADJUSTABLE ILLUMINATION ANGLES



Application Notes

- For cove applications, there should not be less than 6" of lampless (fixtureless) space at the end of all run lengths.
- For cove applications, **raye** luminaires shall be butted end to end to eliminate any opportunity for socket shadows.
- For ease of maintenance, the Printed Circuit Board (PCB) Assembly may be removed from the all **raye** housings via a quick disconnect and a removable extruded aluminum sliding tray (which contains the PCB). This can be accomplished without removing the wireway which is connected to line voltage.



Note: Adjustable tab rotates fixture in 5 degree increments.

Order Code

0	08			1			
io	1	2	3	4	5	6	

1. SERIES

08 raye Gen 2

2. COLOR

27K White 2700K SO⁽¹⁾
 27KH0 White 2700K HO⁽¹⁾
 27KVH0 White 2700K VHO⁽¹⁾
 27KV2H0 White 2700K V2HO⁽¹⁾
 3K White 3000K SO⁽¹⁾
 3KH0 White 3000K HO⁽¹⁾
 3KVH0 White 3000K VHO⁽¹⁾
 3KV2H0 White 3000K V2HO⁽¹⁾

35K White 3500K SO⁽¹⁾
 35KH0 White 3500K HO⁽¹⁾
 35KVH0 White 3500K VHO⁽¹⁾
 35KV2H0 White 3500K V2HO⁽¹⁾
 4K White 4000K SO⁽¹⁾
 4KH0 White 4000K HO⁽¹⁾
 4KVH0 White 4000K VHO⁽¹⁾
 4KV2H0 White 4000K V2HO⁽¹⁾
 CC Custom Color⁽²⁾

3. MOUNTING

C26 Cove 2" x 6"

Note: 3" x 3" profile also available

4. FINISH

1 White

5. LENGTH

UNITS (ACTUAL)
 18 18" (17.52"/445.01mm)
 72 72" (68.56"/1741.42mm)

FOR CONTINUOUS ROW
 Specify length (e.g., 51'-0")
 Note: Overall length must be multiples of 72" and 18" lengths.

6. VOLTAGE / DIMMING

ND Non-Dimming (120-277v)
 D 0-10V (Osram)⁽³⁾
 DALI DALI (Osram)⁽³⁾
 DMX DMX (Osram)⁽³⁾
 L Lutron Hi-lume A-Series

Footnotes

1. White light variance between LEDs is equal to or better than 3-step MacAdam Binning.
2. Non-standard color temperature and CRI are available. Consult factory for availability.
3. Consult factory for other dimming driver options.



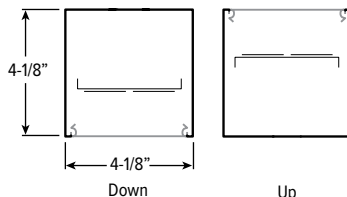
YouTube

raye applications
youtube.com/iolighting

MX4^{LED} 4" Continuous – Suspended

Type LL-4

4'



CATALOG #: _____

TYPE: _____

PROJECT: _____

FEATURES

- Create elegant spaces with a seamless, continuous row of illumination
- Flat and proud lenses give designers a variety of looks
- Moveable mounting hardware easily slides along the length of the fixture providing variable mounting points
- Maximize energy savings with efficacies as high as 117 lm/W
- Linear extrusion contains snap-in light rails for ease of installation and maintenance
- Versatile MX4 system includes recessed, surface, suspended and in-wall mounting, see hew.com
- Corner configurations available, see Product Builder at hew.com/product-builder
- Diffuse acrylic lens provides uniform illumination for visual comfort
- Made Right Here™ in the USA

ORDERING EXAMPLE: MX4D - 12'00 - L8/835 - F - AC/D48 - OPTIONS - DIM - UNV

SERIES **LENGTH**
MX4D Down Lengths specified in feet and inches
MX4U Up using 4" increments, 2' minimum.
 Example: 12'00 = 12'-0"

PRODUCT BUILDER

Easily build shapes & simplify ordering with the Williams Linear Product Builder at hew.com/product-builder ^[1]



LUMENS ^[2]	CRI	CCT	SHIELDING	MOUNTING (EXAMPLE: AC/D48) ^[3]
L8 800lm	8 80	27 2700K	F Flat, diffuse acrylic	Prefix Type Length
L12 1200lm	9 90	30 3000K	P Proud, diffuse acrylic with 5/16" drop ^[4]	AC/ D 1" grid & hardpan 24 24"
L15 1500lm		35 3500K		N 9/16" grid 48 48"
		40 4000K		S Slot grid 96 96"
		50 5000K		MSF_ Microstem, 1/4" IPS, specify length in inches ^[5]

SPECIFICATIONS

- HOUSING** – Extruded aluminum with die-cast end plates.
- SHIELDING** – Extruded, flat, diffuse acrylic lens.
- FINISH** – Textured matte white polyester TGIC powder coat bonded to phosphate-free, multi-stage pretreated metal. All parts painted after fabrication to facilitate installation, increase efficiency, and inhibit corrosion.
- ELECTRICAL** – High quality mid-power LED boards. L70 >60,000 hours per IES TM-21. 25°C maximum ambient operating temperature
- MOUNTING** – Suspended. 1/16" diameter adjustable steel leveling aircraft cable and mounting hardware necessary for grid and hardpan ceiling applications provided.
- LISTINGS** – cETLus conforms to UL STD 1598. Certified to CAN/CSA STD C22.2 No. 250.0. Suitable for damp locations.
- WARRANTY** – 5-year limited warranty, see hew.com/warranty.

OPTIONS ^[6]

EM/10W	10-watt emergency battery ^[8]
EM/10WRM	Remote mount 10-watt emergency battery ^[9]
OCC_	Factory-installed occupancy sensor ^[10] : OCCWS FS-355-L6
V90	Vertical 90° corner, suspended ^[11]

DRIVER ^[7]

DIM	Dimming driver
DRV	Non-dimming driver

VOLTAGE

120	120V
277	277V
UNV	120-277V
347	347V ^[12]

NOTES

- See page 4 for CORNER DETAILS.
- Lumens per foot output based on 3500K CCT and F shielding. Actual lumens may vary ± 5%. See page 2 for FIXTURE PERFORMANCE DATA.
- See page 3 for MOUNTING DETAILS.
- MX4D only. See page 3 for SHIELDING DETAILS. Not available with corner configurations or transition options.
- MX4D only.
- See page 3 for FINISH OPTIONS. Custom colors available upon request. See Technical Info for [Power Entry](http://hew.com) details.
- See page 2 for ADDITIONAL DRIVER OPTIONS.

- L8 and L12 only; 120-277V only. Not available with fixtures less than 4'.
- L15 only; 120-277V only. Must be remote mounted for fixtures less than 4'.
- Recommended for use in downlight orientation only. Utilizes 4" of housing at end of fixture. See page 3 for FIXTURE DETAILS. 120V or 277V only.
- Connects MX4D to vertically mounted MX4RW; F shielding only. MX4D only. See page 3 for FIXTURE DETAILS.
- Not available with EM drivers.



MX4^{LED} 4" Continuous – Suspended

FIXTURE PERFORMANCE DATA

	DOWN (PER FOOT)			UP (PER FOOT)		
	DELIVERED LUMENS	WATTAGE	EFFICACY (lm/W)	DELIVERED LUMENS	WATTAGE	EFFICACY (lm/W)
L8	824	7.3	113	851	7.3	117
L12	1175	10.8	108	1187	10.8	110
L15	1439	13.5	107	1439	13.5	107

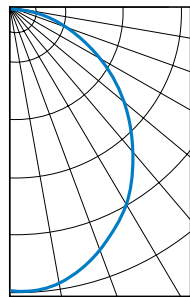
- Photometrics tested in accordance with IESNA LM-79. Results shown are based on 25°C ambient temperature.
- Wattage shown is average for 120V through 277V input.
- Results based on F shielding, 3500K, 80 CRI, actual lumens may vary +/-5%.
- Use multiplier table to calculate additional options.

MULTIPLIER TABLE

	COLOR TEMPERATURE	
	CCT	CONVERSION FACTOR
80 CRI	2700K	0.97
	3000K	0.99
	3500K	1.00
	4000K	1.03
	5000K	1.06
90 CRI	2700K	0.82
	3000K	0.83
	3500K	0.84
	4000K	0.86
	5000K	0.90

PHOTOMETRY

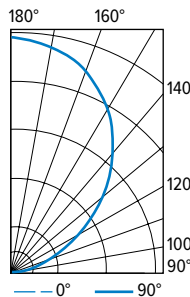
MX4D-4'00-L8/835-F-DIM Total Luminaire Output: 3296 lumens; 29.2 Watts | Efficacy: 113 lm/W | 80 CRI; 3500K CCT



VERTICAL ANGLE	HORIZONTAL ANGLE			ZONAL LUMENS
	0°	45°	90°	
0	894	894	894	
5	913	887	878	123
15	882	846	832	348
25	789	764	746	512
35	684	651	639	597
45	555	530	510	597
55	415	395	371	513
65	270	254	243	368
75	127	122	121	192
85	20	25	23	45
90	0	0	0	

LUMEN SUMMARY	ZONE	LUMENS	% FIXTURE
	0 - 30	983	30
	0 - 40	1580	48
	0 - 60	2690	82
	0 - 90	3296	100
	0 - 180	3296	100

MX4U-4'00-L8/835-F-DIM Total Luminaire Output: 3404 lumens; 29.2 Watts | Efficacy: 117 lm/W | 80 CRI; 3500K CCT



VERTICAL ANGLE	HORIZONTAL ANGLE			ZONAL LUMENS
	0°	45°	90°	
90	0	0	0	
95	20	19	17	29
105	161	123	103	138
115	382	285	242	298
125	643	516	431	477
135	933	818	688	624
145	1189	1112	1006	681
155	1389	1315	1261	603
165	1498	1456	1419	410
175	1557	1519	1501	144
180	1540	1540	1540	

LUMEN SUMMARY	ZONE	LUMENS	% FIXTURE
	90 - 120	465	14
	90 - 130	941	28
	90 - 150	2247	66
	90 - 180	3404	100
	0 - 180	3404	100

ADDITIONAL DRIVER OPTIONS

Note: Lumen restrictions apply, consult product builder at hew.com/product-builder.

CATALOG NUMBER	DESCRIPTION
DRV	Driver prewired for non-dimming applications
DIM	Dimming driver prewired for 0-10V low voltage applications
DIM1	1% dimming driver prewired for 0-10V low voltage applications
DIM LINE	Line voltage dimming driver (Must specify 120V or 277V only)
SD40	40% step-dimming driver
SD50	50% step-dimming driver
DALI	DALI dimming driver
LTE LINE	Lutron Hi-lume® A-Series 1% dimming driver for forward phase line voltage controls (120V only)
LDE1	Lutron EcoSystem® H-Series 1% dimming driver for EcoSystem® controls
LDE5	Lutron EcoSystem® 5-Series 5% dimming driver for EcoSystem® controls
ELDO SOLOB	EldoLED Solodrive, 0.1% dimming driver for 0-10V controls
ELDO SOLOB DALI	EldoLED Solodrive, 0.1% dimming driver for DALI controls
ELDO ECO1	EldoLED Ecodrive, 1% dimming driver for 0-10V controls
ELDO ECO1 DALI	EldoLED Ecodrive, 1% dimming driver for DALI controls

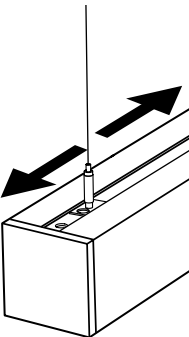


MX4^{LED} 4" Continuous – Suspended

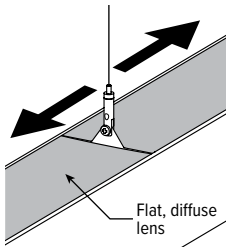
MOUNTING DETAILS

Aircraft cable and microstem mounting accessories can be repositioned along the length of the channel, providing flexible mounting locations to suit any application.

AIRCRAFT CABLE

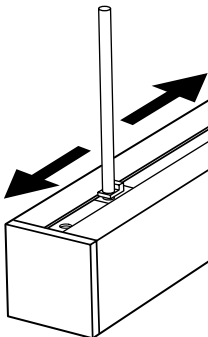


MX4D Direct Hanger



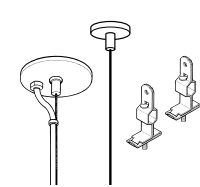
MX4U Mid-fixture Hanger

MICROSTEM

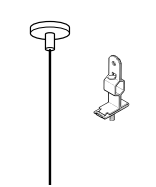


MX4D

STANDARD HARDWARE



Power End/Stand-Alone



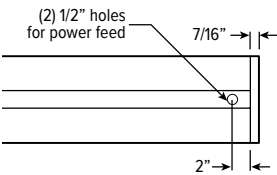
Row Mount Support

Notes:

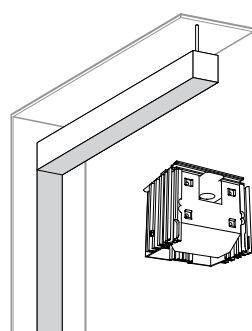
- Fixtures are provided with adjustable length aircraft cables and mounting hardware, must specify.
- Electrical supply is brought into the feeder (or stand-alone) fixture, either as part of a row or as an individual mount unit. Power feed locations are 2" from end (downlight) or at end of fixture (uplight).
- One 5" canopy included for each feeder fixture. One 2" canopy included for each additional fixture required in a row.

FIXTURE DETAILS

MX4D BACK VIEW



V90 CORNER ACCESSORY



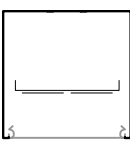
Includes tamper resistant lens bracket for lower end of vertical fixture.

OCCUPANCY SENSOR

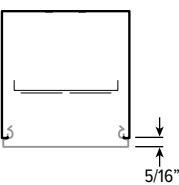


SHIELDING DETAILS

FLAT

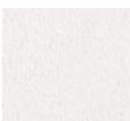


PROUD



FINISH OPTIONS

WHITE



BLACK



BRONZE



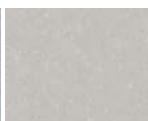
NICKEL



SILVER



ALUMINUM



For custom color, please specify RAL code or a manufacturer code with description. All custom colors other than RAL require two sample swatches, minimum 1" square.



H.E. Williams, Inc.

Carthage, Missouri

www.hew.com

417-358-4065

Designed and Manufactured in the USA

HEW.70769.JJ REV.03/07/19

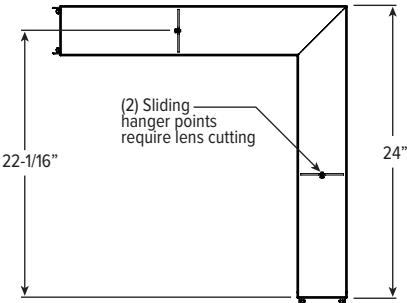
Suspended

Page 3 of 4

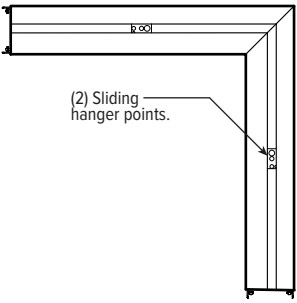
MX4^{LED} 4" Continuous – Suspended

CORNER DETAILS

MX490U BACK VIEW



MX490D BACK VIEW



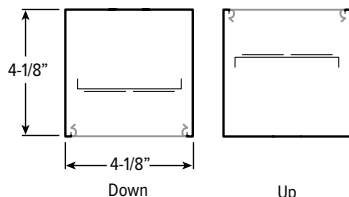
Note: Corner orientation determined in field.
Feeder corner end cap shipped separately.



MX4^{LED} 4" Continuous – Suspended

Type LL-

6'



CATALOG #: _____

TYPE: _____

PROJECT: _____

FEATURES

- Create elegant spaces with a seamless, continuous row of illumination
- Flat and proud lenses give designers a variety of looks
- Moveable mounting hardware easily slides along the length of the fixture providing variable mounting points
- Maximize energy savings with efficacies as high as 117 lm/W
- Linear extrusion contains snap-in light rails for ease of installation and maintenance
- Versatile MX4 system includes recessed, surface, suspended and in-wall mounting, see hew.com
- Corner configurations available, see Product Builder at hew.com/product-builder
- Diffuse acrylic lens provides uniform illumination for visual comfort
- Made Right Here™ in the USA

ORDERING EXAMPLE: MX4D - 12'00 - L8/835 - F - AC/D48 - OPTIONS - DIM - UNV

SERIES
MX4D Down
MX4U Up
LENGTH
 Lengths specified in feet and inches using 4" increments, 2' minimum.
 Example: 12'00 = 12'-0"

PRODUCT BUILDER

Easily build shapes & simplify ordering with the Williams Linear Product Builder at hew.com/product-builder ^[1]



LUMENS ^[2]	CRI	CCT	SHIELDING	MOUNTING (EXAMPLE: AC/D48) ^[3]
L8 800lm	8 80	27 2700K	F Flat, diffuse acrylic	Prefix Type Length
L12 1200lm	9 90	30 3000K	P Proud, diffuse acrylic with 5/16" drop ^[4]	AC/ D 1" grid & hardpan 24 24"
L15 1500lm		35 3500K		N 9/16" grid 48 48"
		40 4000K		S Slot grid 96 96"
		50 5000K		MSF_ Microstem, 1/4" IPS, specify length in inches ^[5]

SPECIFICATIONS

- HOUSING** – Extruded aluminum with die-cast end plates.
- SHIELDING** – Extruded, flat, diffuse acrylic lens.
- FINISH** – Textured matte white polyester TGIC powder coat bonded to phosphate-free, multi-stage pretreated metal. All parts painted after fabrication to facilitate installation, increase efficiency, and inhibit corrosion.
- ELECTRICAL** – High quality mid-power LED boards. L70 >60,000 hours per IES TM-21. 25°C maximum ambient operating temperature
- MOUNTING** – Suspended. 1/16" diameter adjustable steel leveling aircraft cable and mounting hardware necessary for grid and hardpan ceiling applications provided.
- LISTINGS** – cETLus conforms to UL STD 1598. Certified to CAN/CSA STD C22.2 No. 250.0. Suitable for damp locations.
- WARRANTY** – 5-year limited warranty, see hew.com/warranty.

OPTIONS ^[6]

EM/10W	10-watt emergency battery ^[8]
EM/10WRM	Remote mount 10-watt emergency battery ^[9]
OCC_	Factory-installed occupancy sensor ^[10] : OCCWS FS-355-L6
V90	Vertical 90° corner, suspended ^[11]

DRIVER ^[7]

DIM	Dimming driver
DRV	Non-dimming driver

VOLTAGE

120	120V
277	277V
UNV	120-277V
347	347V ^[12]

NOTES

- See page 4 for CORNER DETAILS.
- Lumens per foot output based on 3500K CCT and F shielding. Actual lumens may vary ± 5%. See page 2 for FIXTURE PERFORMANCE DATA.
- See page 3 for MOUNTING DETAILS.
- MX4D only. See page 3 for SHIELDING DETAILS. Not available with corner configurations or transition options.
- MX4D only.
- See page 3 for FINISH OPTIONS. Custom colors available upon request. See Technical Info for [Power Entry](http://hew.com) details.
- See page 2 for ADDITIONAL DRIVER OPTIONS.

- L8 and L12 only; 120-277V only. Not available with fixtures less than 4'.
- L15 only; 120-277V only. Must be remote mounted for fixtures less than 4'.
- Recommended for use in downlight orientation only. Utilizes 4" of housing at end of fixture. See page 3 for FIXTURE DETAILS. 120V or 277V only.
- Connects MX4D to vertically mounted MX4RW; F shielding only. MX4D only. See page 3 for FIXTURE DETAILS.
- Not available with EM drivers.



MX4^{LED} 4" Continuous – Suspended

FIXTURE PERFORMANCE DATA

	DOWN (PER FOOT)			UP (PER FOOT)		
	DELIVERED LUMENS	WATTAGE	EFFICACY (lm/W)	DELIVERED LUMENS	WATTAGE	EFFICACY (lm/W)
L8	824	7.3	113	851	7.3	117
L12	1175	10.8	108	1187	10.8	110
L15	1439	13.5	107	1439	13.5	107

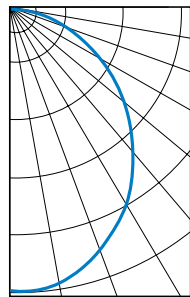
- Photometrics tested in accordance with IESNA LM-79. Results shown are based on 25°C ambient temperature.
- Wattage shown is average for 120V through 277V input.
- Results based on F shielding, 3500K, 80 CRI, actual lumens may vary +/-5%.
- Use multiplier table to calculate additional options.

MULTIPLIER TABLE

	COLOR TEMPERATURE	
	CCT	CONVERSION FACTOR
80 CRI	2700K	0.97
	3000K	0.99
	3500K	1.00
	4000K	1.03
	5000K	1.06
90 CRI	2700K	0.82
	3000K	0.83
	3500K	0.84
	4000K	0.86
	5000K	0.90

PHOTOMETRY

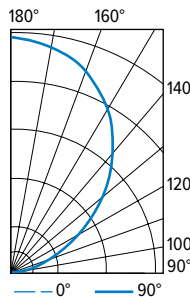
MX4D-4'00-L8/835-F-DIM Total Luminaire Output: 3296 lumens; 29.2 Watts | Efficacy: 113 lm/W | 80 CRI; 3500K CCT



VERTICAL ANGLE	HORIZONTAL ANGLE			ZONAL LUMENS
	0°	45°	90°	
0	894	894	894	
5	913	887	878	123
15	882	846	832	348
25	789	764	746	512
35	684	651	639	597
45	555	530	510	597
55	415	395	371	513
65	270	254	243	368
75	127	122	121	192
85	20	25	23	45
90	0	0	0	

LUMEN SUMMARY	ZONE	LUMENS	% FIXTURE
	0 - 30	983	30
	0 - 40	1580	48
	0 - 60	2690	82
	0 - 90	3296	100
	0 - 180	3296	100

MX4U-4'00-L8/835-F-DIM Total Luminaire Output: 3404 lumens; 29.2 Watts | Efficacy: 117 lm/W | 80 CRI; 3500K CCT



VERTICAL ANGLE	HORIZONTAL ANGLE			ZONAL LUMENS
	0°	45°	90°	
90	0	0	0	
95	20	19	17	29
105	161	123	103	138
115	382	285	242	298
125	643	516	431	477
135	933	818	688	624
145	1189	1112	1006	681
155	1389	1315	1261	603
165	1498	1456	1419	410
175	1557	1519	1501	144
180	1540	1540	1540	

LUMEN SUMMARY	ZONE	LUMENS	% FIXTURE
	90 - 120	465	14
	90 - 130	941	28
	90 - 150	2247	66
	90 - 180	3404	100
	0 - 180	3404	100

ADDITIONAL DRIVER OPTIONS

Note: Lumen restrictions apply, consult product builder at hew.com/product-builder.

CATALOG NUMBER	DESCRIPTION
DRV	Driver prewired for non-dimming applications
DIM	Dimming driver prewired for 0-10V low voltage applications
DIM1	1% dimming driver prewired for 0-10V low voltage applications
DIM LINE	Line voltage dimming driver (Must specify 120V or 277V only)
SD40	40% step-dimming driver
SD50	50% step-dimming driver
DALI	DALI dimming driver
LTE LINE	Lutron Hi-lume® A-Series 1% dimming driver for forward phase line voltage controls (120V only)
LDE1	Lutron EcoSystem® H-Series 1% dimming driver for EcoSystem® controls
LDE5	Lutron EcoSystem® 5-Series 5% dimming driver for EcoSystem® controls
ELDO SOLOB	EldoLED Solodrive, 0.1% dimming driver for 0-10V controls
ELDO SOLOB DALI	EldoLED Solodrive, 0.1% dimming driver for DALI controls
ELDO ECO1	EldoLED Ecodrive, 1% dimming driver for 0-10V controls
ELDO ECO1 DALI	EldoLED Ecodrive, 1% dimming driver for DALI controls

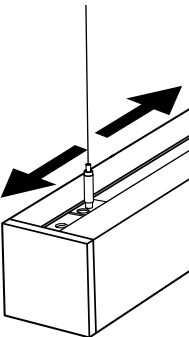


MX4^{LED} 4" Continuous – Suspended

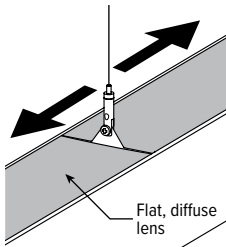
MOUNTING DETAILS

Aircraft cable and microstem mounting accessories can be repositioned along the length of the channel, providing flexible mounting locations to suit any application.

AIRCRAFT CABLE

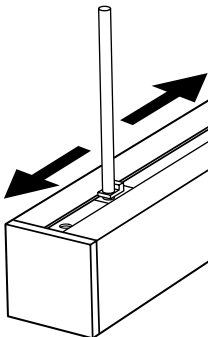


MX4D Direct Hanger



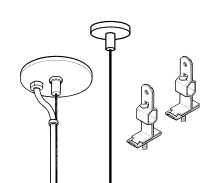
MX4U Mid-fixture Hanger

MICROSTEM

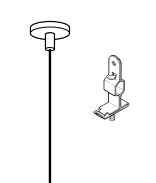


MX4D

STANDARD HARDWARE



Power End/Stand-Alone



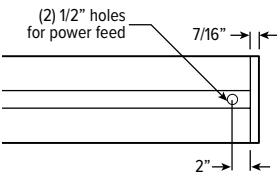
Row Mount Support

Notes:

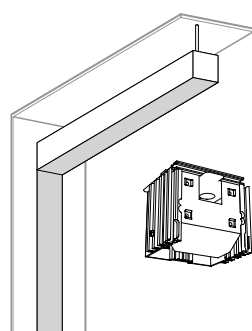
- Fixtures are provided with adjustable length aircraft cables and mounting hardware, must specify.
- Electrical supply is brought into the feeder (or stand-alone) fixture, either as part of a row or as an individual mount unit. Power feed locations are 2" from end (downlight) or at end of fixture (uplight).
- One 5" canopy included for each feeder fixture. One 2" canopy included for each additional fixture required in a row.

FIXTURE DETAILS

MX4D BACK VIEW



V90 CORNER ACCESSORY



Includes tamper resistant lens bracket for lower end of vertical fixture.

OCCUPANCY SENSOR

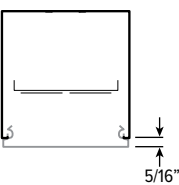


SHIELDING DETAILS

FLAT

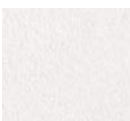


PROUD



FINISH OPTIONS

WHITE



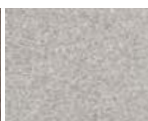
BLACK



BRONZE



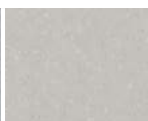
NICKEL



SILVER



ALUMINUM



For custom color, please specify RAL code or a manufacturer code with description. All custom colors other than RAL require two sample swatches, minimum 1" square.



H.E. Williams, Inc.

Carthage, Missouri

www.hew.com

417-358-4065

Designed and Manufactured in the USA

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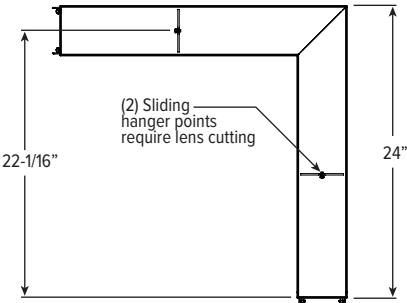
Suspended

Page 3 of 4

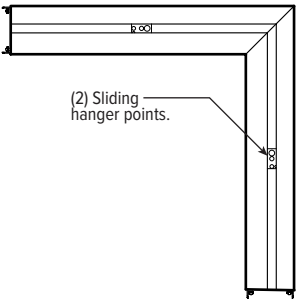
MX4^{LED} 4" Continuous – Suspended

CORNER DETAILS

MX490U BACK VIEW



MX490D BACK VIEW



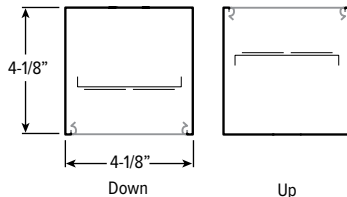
Note: Corner orientation determined in field.
Feeder corner end cap shipped separately.



MX4^{LED} 4" Continuous – Suspended

Type LL-

8'



CATALOG #: _____

TYPE: _____

PROJECT: _____

FEATURES

- Create elegant spaces with a seamless, continuous row of illumination
- Flat and proud lenses give designers a variety of looks
- Moveable mounting hardware easily slides along the length of the fixture providing variable mounting points
- Maximize energy savings with efficacies as high as 117 lm/W
- Linear extrusion contains snap-in light rails for ease of installation and maintenance
- Versatile MX4 system includes recessed, surface, suspended and in-wall mounting, see hew.com
- Corner configurations available, see Product Builder at hew.com/product-builder
- Diffuse acrylic lens provides uniform illumination for visual comfort
- Made Right Here™ in the USA

ORDERING EXAMPLE: MX4D - 12'00 - L8/835 - F - AC/D48 - OPTIONS - DIM - UNV

SERIES
MX4D Down
MX4U Up

LENGTH
 Lengths specified in feet and inches using 4" increments, 2' minimum.
 Example: 12'00 = 12'-0"

PRODUCT BUILDER

Easily build shapes & simplify ordering with the Williams Linear Product Builder at hew.com/product-builder ^[1]



LUMENS ^[2]	CRI	CCT	SHIELDING	MOUNTING (EXAMPLE: AC/D48) ^[3]
L8 800lm	8 80	27 2700K	F Flat, diffuse acrylic	Prefix Type Length
L12 1200lm	9 90	30 3000K	P Proud, diffuse acrylic with 5/16" drop ^[4]	AC/ D 1" grid & hardpan 24 24"
L15 1500lm		35 3500K		N 9/16" grid 48 48"
		40 4000K		S Slot grid 96 96"
		50 5000K		MSF_ Microstem, 1/4" IPS, specify length in inches ^[5]

SPECIFICATIONS

- HOUSING** – Extruded aluminum with die-cast end plates.
- SHIELDING** – Extruded, flat, diffuse acrylic lens.
- FINISH** – Textured matte white polyester TGIC powder coat bonded to phosphate-free, multi-stage pretreated metal. All parts painted after fabrication to facilitate installation, increase efficiency, and inhibit corrosion.
- ELECTRICAL** – High quality mid-power LED boards. L70 >60,000 hours per IES TM-21. 25°C maximum ambient operating temperature
- MOUNTING** – Suspended. 1/16" diameter adjustable steel leveling aircraft cable and mounting hardware necessary for grid and hardpan ceiling applications provided.
- LISTINGS** – cETLus conforms to UL STD 1598. Certified to CAN/CSA STD C22.2 No. 250.0. Suitable for damp locations.
- WARRANTY** – 5-year limited warranty, see hew.com/warranty.

OPTIONS ^[6]

EM/10W	10-watt emergency battery ^[8]
EM/10WRM	Remote mount 10-watt emergency battery ^[9]
OCC_	Factory-installed occupancy sensor ^[10] : OCCWS FS-355-L6
V90	Vertical 90° corner, suspended ^[11]

DRIVER ^[7]

DIM	Dimming driver
DRV	Non-dimming driver

VOLTAGE

120	120V
277	277V
UNV	120-277V
347	347V ^[12]

NOTES

- See page 4 for CORNER DETAILS.
- Lumens per foot output based on 3500K CCT and F shielding. Actual lumens may vary ± 5%. See page 2 for FIXTURE PERFORMANCE DATA.
- See page 3 for MOUNTING DETAILS.
- MX4D only. See page 3 for SHIELDING DETAILS. Not available with corner configurations or transition options.
- MX4D only.
- See page 3 for FINISH OPTIONS. Custom colors available upon request. See Technical Info for [Power Entry](http://hew.com) details.
- See page 2 for ADDITIONAL DRIVER OPTIONS.

- L8 and L12 only; 120-277V only. Not available with fixtures less than 4'.
- L15 only; 120-277V only. Must be remote mounted for fixtures less than 4'.
- Recommended for use in downlight orientation only. Utilizes 4" of housing at end of fixture. See page 3 for FIXTURE DETAILS. 120V or 277V only.
- Connects MX4D to vertically mounted MX4RW; F shielding only. MX4D only. See page 3 for FIXTURE DETAILS.
- Not available with EM drivers.



MX4^{LED} 4" Continuous – Suspended

FIXTURE PERFORMANCE DATA

	DOWN (PER FOOT)			UP (PER FOOT)		
	DELIVERED LUMENS	WATTAGE	EFFICACY (lm/W)	DELIVERED LUMENS	WATTAGE	EFFICACY (lm/W)
L8	824	7.3	113	851	7.3	117
L12	1175	10.8	108	1187	10.8	110
L15	1439	13.5	107	1439	13.5	107

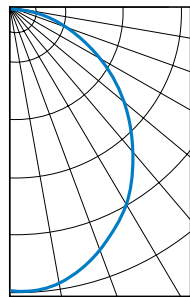
- Photometrics tested in accordance with IESNA LM-79. Results shown are based on 25°C ambient temperature.
- Wattage shown is average for 120V through 277V input.
- Results based on F shielding, 3500K, 80 CRI, actual lumens may vary +/-5%.
- Use multiplier table to calculate additional options.

MULTIPLIER TABLE

	COLOR TEMPERATURE	
	CCT	CONVERSION FACTOR
80 CRI	2700K	0.97
	3000K	0.99
	3500K	1.00
	4000K	1.03
	5000K	1.06
90 CRI	2700K	0.82
	3000K	0.83
	3500K	0.84
	4000K	0.86
	5000K	0.90

PHOTOMETRY

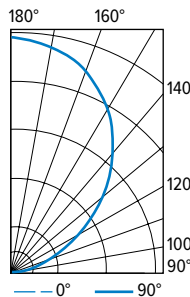
MX4D-4'00-L8/835-F-DIM Total Luminaire Output: 3296 lumens; 29.2 Watts | Efficacy: 113 lm/W | 80 CRI; 3500K CCT



VERTICAL ANGLE	HORIZONTAL ANGLE			ZONAL LUMENS
	0°	45°	90°	
0	894	894	894	
5	913	887	878	123
15	882	846	832	348
25	789	764	746	512
35	684	651	639	597
45	555	530	510	597
55	415	395	371	513
65	270	254	243	368
75	127	122	121	192
85	20	25	23	45
90	0	0	0	

LUMEN SUMMARY	ZONE	LUMENS	% FIXTURE
	0 - 30	983	30
	0 - 40	1580	48
	0 - 60	2690	82
	0 - 90	3296	100
	0 - 180	3296	100

MX4U-4'00-L8/835-F-DIM Total Luminaire Output: 3404 lumens; 29.2 Watts | Efficacy: 117 lm/W | 80 CRI; 3500K CCT



VERTICAL ANGLE	HORIZONTAL ANGLE			ZONAL LUMENS
	0°	45°	90°	
90	0	0	0	
95	20	19	17	29
105	161	123	103	138
115	382	285	242	298
125	643	516	431	477
135	933	818	688	624
145	1189	1112	1006	681
155	1389	1315	1261	603
165	1498	1456	1419	410
175	1557	1519	1501	144
180	1540	1540	1540	

LUMEN SUMMARY	ZONE	LUMENS	% FIXTURE
	90 - 120	465	14
	90 - 130	941	28
	90 - 150	2247	66
	90 - 180	3404	100
	0 - 180	3404	100

ADDITIONAL DRIVER OPTIONS

Note: Lumen restrictions apply, consult product builder at hew.com/product-builder.

CATALOG NUMBER	DESCRIPTION
DRV	Driver prewired for non-dimming applications
DIM	Dimming driver prewired for 0-10V low voltage applications
DIM1	1% dimming driver prewired for 0-10V low voltage applications
DIM LINE	Line voltage dimming driver (Must specify 120V or 277V only)
SD40	40% step-dimming driver
SD50	50% step-dimming driver
DALI	DALI dimming driver
LTE LINE	Lutron Hi-lume® A-Series 1% dimming driver for forward phase line voltage controls (120V only)
LDE1	Lutron EcoSystem® H-Series 1% dimming driver for EcoSystem® controls
LDE5	Lutron EcoSystem® 5-Series 5% dimming driver for EcoSystem® controls
ELDO SOLOB	EldoLED Solodrive, 0.1% dimming driver for 0-10V controls
ELDO SOLOB DALI	EldoLED Solodrive, 0.1% dimming driver for DALI controls
ELDO ECO1	EldoLED Ecodrive, 1% dimming driver for 0-10V controls
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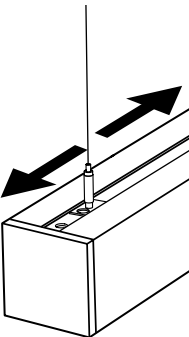


MX4^{LED} 4" Continuous – Suspended

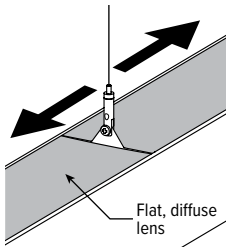
MOUNTING DETAILS

Aircraft cable and microstem mounting accessories can be repositioned along the length of the channel, providing flexible mounting locations to suit any application.

AIRCRAFT CABLE

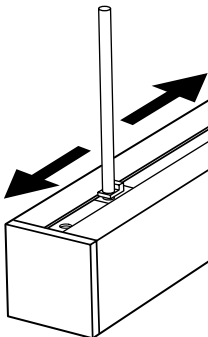


MX4D Direct Hanger



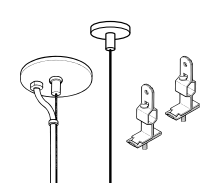
MX4U Mid-fixture Hanger

MICROSTEM

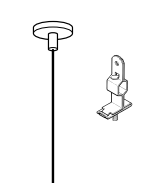


MX4D

STANDARD HARDWARE



Power End/Stand-Alone



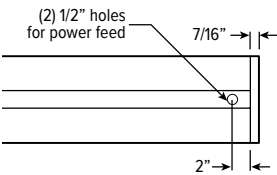
Row Mount Support

Notes:

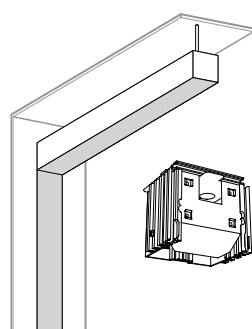
- Fixtures are provided with adjustable length aircraft cables and mounting hardware, must specify.
- Electrical supply is brought into the feeder (or stand-alone) fixture, either as part of a row or as an individual mount unit. Power feed locations are 2" from end (downlight) or at end of fixture (uplight).
- One 5" canopy included for each feeder fixture. One 2" canopy included for each additional fixture required in a row.

FIXTURE DETAILS

MX4D BACK VIEW



V90 CORNER ACCESSORY



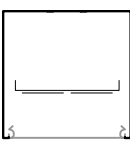
Includes tamper resistant lens bracket for lower end of vertical fixture.

OCCUPANCY SENSOR

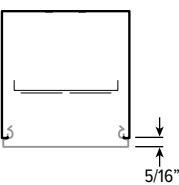


SHIELDING DETAILS

FLAT

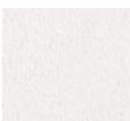


PROUD



FINISH OPTIONS

WHITE



BLACK



BRONZE



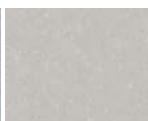
NICKEL



SILVER



ALUMINUM



For custom color, please specify RAL code or a manufacturer code with description. All custom colors other than RAL require two sample swatches, minimum 1" square.



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HEW.70769.JJ REV.03/07/19

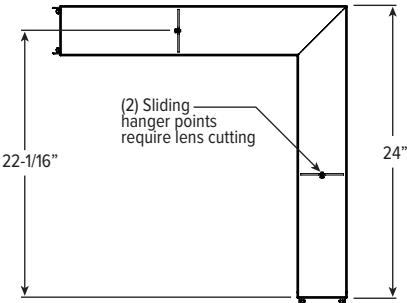
Suspended

Page 3 of 4

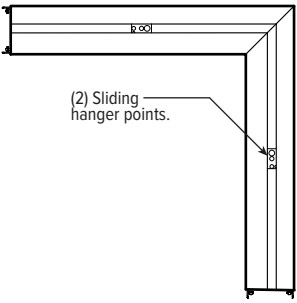
MX4^{LED} 4" Continuous – Suspended

CORNER DETAILS

MX490U BACK VIEW



MX490D BACK VIEW



Note: Corner orientation determined in field.
Feeder corner end cap shipped separately.



Equation™ 2 2x4

LED

Type LR-1



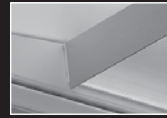
opal acrylic lens



MicroGlow lens

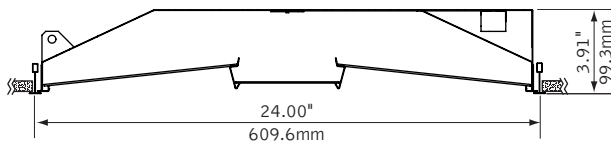


suspended or
surface mount



air return

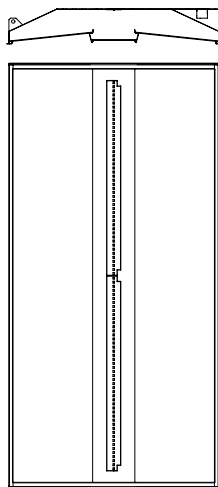
DIMENSIONAL DATA



Overall height of luminaire with air return is 4.62"–4.89"

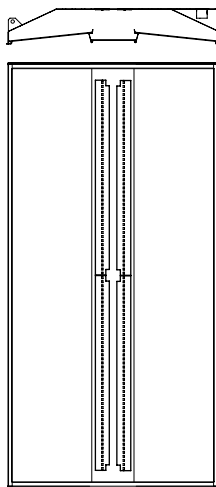
led options

Standard



2 LED boards

High Efficiency



4 LED boards

FEATURES

Equation™ 2 blends sleek aesthetics with uniform diffuse illumination.

Center diffuser features MicroGlow prismatic lens for brightness control and visual comfort. Opal acrylic center lens may also be specified.

Premium LEDs operate efficiently to achieve excellent thermal management and reliable operation.

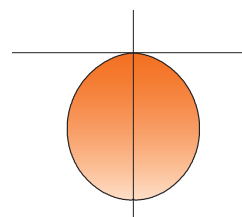
Connected Solutions: Integrates with wired and wireless building lighting control systems.

Preferred Light: Lighting for better color rendition and human preference.

PERFORMANCE

PRODUCT OVERVIEW

Lumen Output: 4000-8500lm
Wattage: 37-85W
LPW: 86-112
SDCM: 3



Opal Acrylic Lens

Delivered Lumens: 5000lm

Total System Watts: 47W



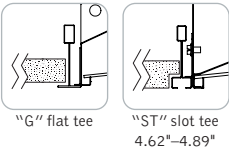
Photometric performance is measured in accordance with IESNA LM-79. Visit focalpointlights.com for complete photometric data. Visit designlights.org/QPL for model specifics.

fixture:

project:

MOUNTING INFORMATION

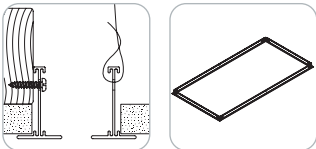
grid



"G" flat tee
"ST" slot tee
4.62"-4.89"

drywall frame kit

specify "F" Drywall Frame Kit for drywall ceiling conditions.



Use tie-wire or screws to secure frame kit.

Cut out dimensions:
2': Min: 24.25"
Max: 24.563"
4': Min: 48.25"
Max: 48.563"

SPECIFICATIONS

LED System

Proprietary linear LED module incorporates premium LEDs on a robust platform to achieve excellent thermal management. LEDs are placed to promote a uniform appearance. Available in 2700K, 3000K, 3500K or 4000K with CRI>80 or CRI>90, 3SDCM. Contact factory for additional color temperature and CRI options. 0-10V dimming driver standard. LED modules and drivers are replaceable from below.

Construction

One piece 24 Ga. steel reflector and housing. Bottom access 24 Ga. steel driver compartment. Positional brackets supplied as standard. Standard weight: 27.3 lbs. Surface-mount/suspended weight: 35.5 lbs.

Optic

24 Ga. steel reflectors finished in matte satin white powder coat. .080" thick frosted white acrylic diffusers. Center shielding options include .080" thick opal acrylic lens or MicroGlow prismatic lens with optical filter overlay.

Electrical

Standard 120-277V driver includes 0-10V analog dimming. Power factor > .9. Optional Lutron EcoSystem or Step-dimming drivers available.

Emergency Battery

Bodine BSL310-CAN. Emergency output—10 watts for 90 minutes.

Labels

UL and cUL listed. Suitable for Dry or Damp Locations, indoor use only.

Finish

Polyester powder coat applied over a multi-stage pre-treatment.

Lumen Maintenance

Reported: L70 at >61,000 hours Calculated: L70 at 460,000 hours
L80 at >61,000 hours L80 at 280,000 hours
(Derived from EPA TM-21 calculator. Based on typical conditions, consult factory for additional data.)

Reliability

At Focal Point, our products are designed to stand the test of time. Each luminaire is engineered using superior components, manufactured with the utmost care and rigorously tested. Contact us for reliability data.

Warranty

LED system rated for operation in ambient environments up to 25°C. 5-year limited warranty.

PERFORMANCE CHART

Delivered Lumens		Tested System Watts	LPW
4000 Lumens	4000L	41	97
	4000LH	37	112
4500 Lumens	4500L	47	94
	4500LH	42	110
5000 Lumens	5000L	54	90
	5000LH	47	108
5500 Lumens	5500L	61	86
	5500LH	53	105
6000 Lumens	6000LH	59	102
	6500LH	63	101
7000 Lumens	7000LH	68	100
	7500LH	73	100
8000 Lumens	8000LH	78	99
	8500LH	85	97

Based on 3500K, 80 CRI. Lumen multipliers: Preferred Light = 0.65, 90+ CRI = 0.87.
Lumen output may vary +/- 5%. Actual wattage may vary +/- 5%.

ORDERING

Luminaire Series	FEQ2
Equation 2	FEQ2
Nominal Size	24
2' x 4'	24
Shielding	
Opal Acrylic Lens	AC
MicroGlow Prismatic Lens	MG
Lumen Output Standard	
4000 Lumens	4000L
4500 Lumens	4500L
5000 Lumens	5000L
5500 Lumens	5500L
High Efficiency	
4000 Lumens	4000LH
4500 Lumens	4500LH
5000 Lumens	5000LH
5500 Lumens	5500LH
6000 Lumens	6000LH
6500 Lumens	6500LH
7000 Lumens	7000LH
7500 Lumens	7500LH
8000 Lumens	8000LH
8500 Lumens	8500LH
Color Temperature	
2700K, 80+ CRI or 90+ CRI	27K or 927K
3000K, 80+ CRI or 90+ CRI	30K or 930K
3500K, 80+ CRI or 90+ CRI	35K or 935K
4000K, 80+ CRI or 90+ CRI	40K or 940K
3500K, Preferred Light	P35K
Circuit	1C
Single Circuit	1C
Voltage	
UNV 120/277 Volt	UNV
347 Volt	347
(Not available with SD5 or DLM.)	
Control System & Dimming Level	
0-10V - 10% Dimming	LD1
0-10V - 1% Dimming	L11
Lutron Hi-Lume EcoSystem (LDE1) - 1% Dimming	LH1
Lutron 5-Series EcoSystem (LDE5) - 5% Dimming	LU5
Step Dimming (6000 lumens or less only. 120/277 only.)	SD5
Enlighted Smart Sensor - 1% Dimming (Cannot combine with 347V & EM.)	ENL1
Osram Connected Lighting Module for ENCELIUM systems - 1% Dimming (5500 Lumens or less. Cannot combine with 347V & EM. Compatible with Osram ENCELIUM and ENCELIUM EDGE systems only.)	CLM1
Osram Connected Lighting Module for ZigBee Wireless Networks - 1% Dimming (5500 Lumens or less. Cannot combine with 347V & EM. Not compatible with Osram ENCELIUM systems.)	CLM21
Wattstopper DLM - 1% Dimming	DLM1
Mounting	
24" Aircraft Cable	C24
48" Aircraft Cable	C48
96" Aircraft Cable	C96
Drywall Frame Kit (ENL1, CLM1, CLM21 & DLM1 not available) (Cut out dimensions: Min: 24.25"/Max: 24.563" Min: 48.25"/Max: 48.563")	F
Grid	G
Slot Tee	ST
Surface Mount (Not available with DLM1)	SM
Factory Options	
Air Return (Overall height with Air Return is 4.62"-4.89")	AR
Chicago Plenum	CP
Emergency Battery Pack with Integral Test Switch (Cannot combine with 347V)	EM
6' New York City Flex Whip (120V)	FN1
6' New York City Flex Whip (277V)	FN2
6' Flex Whip	FW
Finish	WH
Matte Satin White	WH



5/10 DAY*

Options in orange qualify for the Quickship program. 5-day up to 100 pieces, 10-day up to 300 pieces. Refer to Quickship Guide for complete details.

Focal Point provides flexibility in meeting the needs of each project by integrating with several building lighting control systems. A variety of sensors, drivers and other components can be specified that allow the luminaires to communicate with wired and wireless networks. All zoning can be digitally reconfigured through the application software. Daylight harvesting, occupancy sensing, integration with HVAC systems, and individual controls enable the monitoring and modulating of light levels and temperature in order to save energy, reduce costs and maximize occupants' comfort. All Connected Solutions luminaires require a compatible building control system.†



enlighted

Enlighted smart sensor allows for occupancy sensing, daylight harvesting, energy usage, temperature and light level control. Communicates wirelessly with the Enlighted network.

Enlighted Smart Sensor - 1% Dimming (ENL1)
Enlighted Model #SU-4E-01

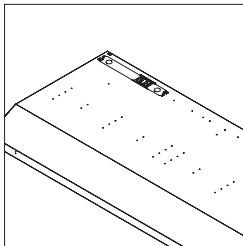


OSRAM

Connected Lighting Module (CLM) enables each luminaire to be independently controlled and configured. Communicates wirelessly with Daintree Networks®, Osram ENCELUM®, Osram ENCELUM EDGE™, and other networks using the ZigBee® HA communication protocol to allow for on/off and dimming functionality, occupancy sensing and multi-zone daylight harvesting.

Osram CLM - 1% Dimming (CLM1 & CLMZ1)
Osram Model #ZBHA-CLM DIM

Serial labels will be provided on outside of luminaires and control unit.



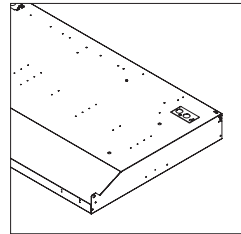
legrand®

WATTSTOPPER®

A Digital Lighting Management (DLM) system that provides two-way wired communication between networked luminaires and control system to allow for on/off and dimming functionality, occupancy sensing and multi-zone daylight harvesting.

Wattstopper DLM - 1% Dimming (DLM1)
Wattstopper Model #LMFC-011

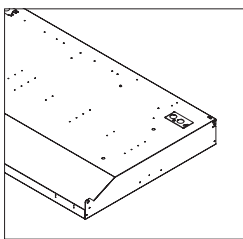
CAT-5 Cable provided by others. Serial labels will be provided on outside of luminaires and control unit.



LUTRON®

A two-way digital network that enables on/off and dimming functionality, occupancy sensing, and multi-zone daylight harvesting working with Quantum®, Energi Savr Node™, and Energi TriPak® using EcoSystem® communication protocol.

Lutron Hi-Lume EcoSystem - 1% Dimming (LH1)
Lutron Model #LDE1
Lutron 5-Series EcoSystem - 5% Dimming (LU5)
Lutron Model #LDE5



CRESTRON®

A two-way digital network that enables on/off and dimming functionality, occupancy sensing, and multi-zone daylight harvesting. Communicates with Züm wireless and SpaceBuilder working with Züm hub scheduling or FUSION management.

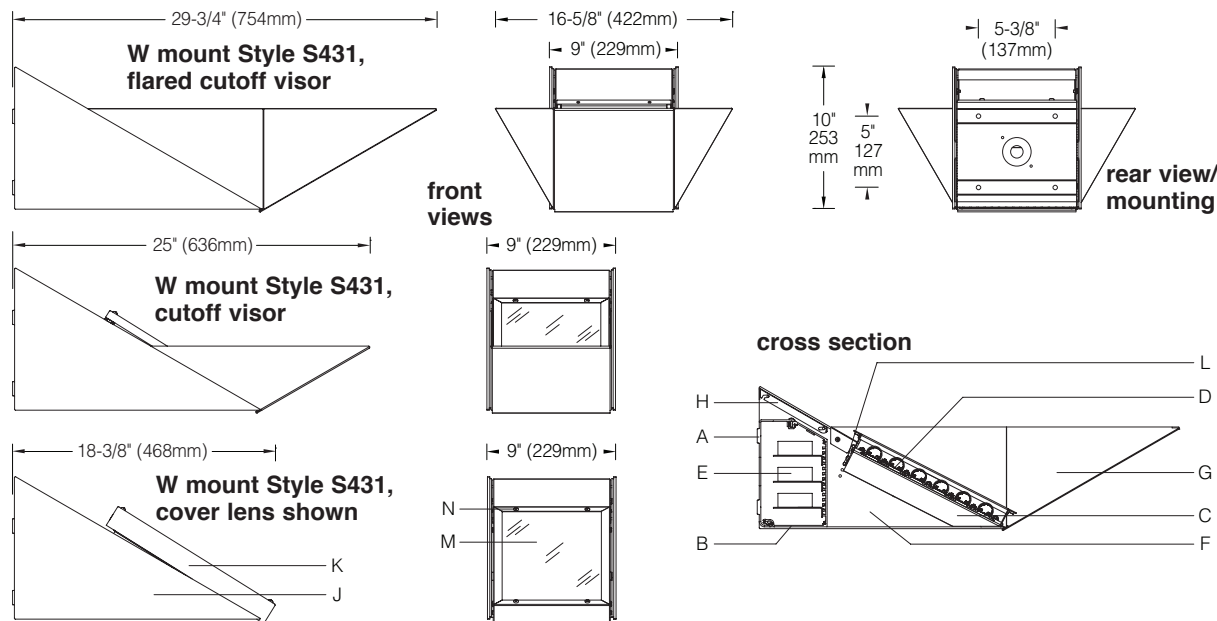
0-10V - 1% Dimming (L11)

Note: 0-10V is not a digital network but is compatible with Crestron Züm™ system.

CONNECTED SOLUTIONS DETAILS

Connected Solution	Model #	Protocol	Compatible Networks*	Occupancy	Daylight	Temperature Reporting	Communication to Luminaire	Drivers
Crestron (L11)	Specified Driver	0-10V	Crestron Züm Wireless & SpaceBuilder	Enabled	Enabled	No	Wired	Philips Xitanium
Enlighted Smart Sensor (ENL1)	SU-4E-01**	Enlighted RF	Enlighted	Integrated	Integrated	Yes	Wireless	Philips SimpleSet , Osram Optotronic
Legrand Wattstopper DLM (DLM1)	LMFC-011**	DLM	DLM	Enabled	Enabled	No	Wired	Philips SimpleSet , Osram Optotronic
Lutron EcoSystem (LH1 & LU5)	LDE1**, LDE5**	EcoSystem	Quantum, Energi Savr Node, Energi TriPak	Enabled	Enabled	No	Wired	Lutron Hi-Lume Lutron 5-Series
Osram CLM for ENCELUM systems (CLM1)	ZBHA-CLM**	ZigBee HA	Osram ENCELUM & ENCELUM EDGE	Enabled	Enabled	No	Wireless	Osram Optotronic
Osram CLM for ZigBee Wireless Networks (CLMZ1)	ZBHA-CLM**	ZigBee HA	Daintree Networks & open ZigBee Networks	Enabled	Enabled	No	Wireless	Osram Optotronic

*Not all compatible networks may be listed. **For performance data and additional control system details please visit the connected solutions manufacturer websites. Primary drivers are listed in **bold**. To specify a particular driver please consult factory. †Controls systems supplied by others.



Type LW-1



S431 with cutoff visor

Specifications

- | | | | |
|--|---|--------------------------------------|---|
| A Extruded aluminum mounting plate/driver cover | C Extruded aluminum heat sink/fixture head | F Aluminum reveal plates | K Lens door |
| B Extruded aluminum driver housing | D LED light engine | G Cutoff visor (flared shown) | L Aiming latch |
| | E Integral electronic driver | H Decorative cover | M Acrylic lens (OP, VP, FP options only) |
| | | J Aluminum sidearms | N Door retaining screws |

Features

- Adjustable aiming for fine tuning of ceiling uniformity
- All aluminum and stainless steel construction
- Natatorium option for harsh indoor pool environments
- Universal voltage drivers with programmable drive current
- Light engines are serviceable for replacement or upgrade



Housing and Optic Assembly:

Extruded aluminum heat sink/housing. Exterior heat sink anodized for maximum emissivity. Removable interior extrusion treated to maximize thermal conductivity. Precision extruded asymmetric optics of high temperature, water-clear polymer. Optional impact resistant exterior lens.

Finish:

Painted surfaces – 6 stage pretreatment and electrostatically applied thermoset polyester powder coating for a durable abrasion, fade and corrosion resistant finish. Formed aluminum visor. Extruded aluminum heat sink/housing, yoke, door frame, and decorative end plates are finished in semigloss white or specified custom color. All luminaire hardware is stainless steel.

Mounting:

Mounting plate covers recessed outlet box or conduit feed and forms reveal at wall. Suitable backing structure required (by others) – weight is approximately 21 lb/7.8 kg. Fixture hinges on plate for hands-free access to splices. Required upright pendant mounting assembly ordered and priced separately (see pg. SC22.1); specify mounting **1** or **2**.

Electrical:

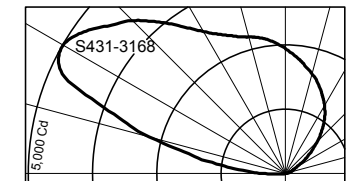
Use 90°C wire for supply connections. Integral electronic HPF constant current drivers. For complete driver specifications, see website, reference document [MA-1303](#).

Standard:

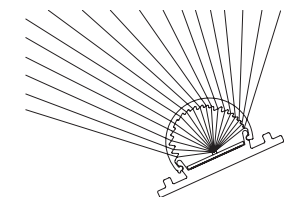
UL listed or CSA certified for dry locations (optional damp location rating – specify pool option **OP**, **VP** or **FP**). 5 year warranty, maximum ambient temperature 40°C (104°F).

Performance

Precisely extruded polymer optics produce an asymmetric distribution ideal for illuminating ceilings evenly from one edge.

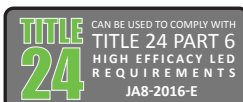
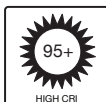


L90(10k) > 60,000 hrs. @ 25°C per TM-21



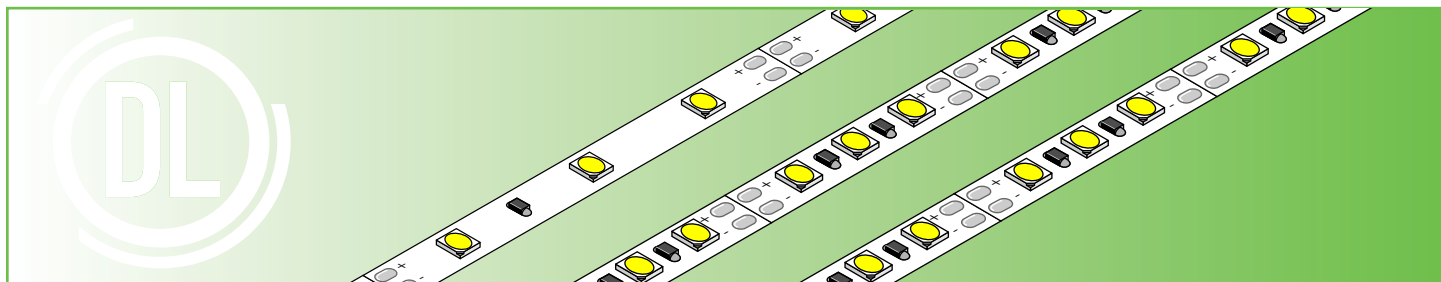
For LM79 and photometric reports, visit thelightingquotient.com





Item #

Project



		12V-BLX1	12V-BLX2	12V-BLX3	24V-BLX1	24V-BLX2	24V-BLX3
Voltage		12VDC			24VDC		
Wattage		1.54W /ft	3.1W /ft	4.3W /ft	1.54W /ft	3.1W /ft	4.3W /ft
Lumens	2700K	109/ft	221/ft	305/ft	112/ft	224/ft	318/ft
	3000K	122/ft	247/ft	339/ft	126/ft	253/ft	360/ft
	3500K	126/ft	241/ft	352/ft	131/ft	254/ft	357/ft
	4200K	127/ft	254/ft	349/ft	133/ft	264/ft	365/ft
	5000K	128/ft	262/ft	358/ft	135/ft	264/ft	378/ft
Cut Points		2 in.	1 in.	1 in.	4 in.	2 in.	2 in.
Max. Run ¹		37 ft.	22 ft.	20 ft.	70 ft.	45 ft.	40 ft.
LED Chips		18/ft	36/ft.		18/ft	36/ft.	
Color Temperature		2700K, 3000K, 3500K, 4200K, 5000K					
CRI		95+					
Dimmable		Yes					
Dimensions		0.32 x 0.1 in. (W x H)					
Environment ²		Indoor / Damp Location					
Certificatio		UL Listed 2108					
Warranty		12-Year Warranty					

3500k to match the
Showroom
luminaires

SKU Builder

DI

-

-

-

-

Voltage

Model

Color Temp

Length (in.)

12V

BLX1

27

Length (in.)

24V

BLX2

42

SP16 (Spool)

BLX3

30

SP100 (Spool)

50

35

Example: DI-12V-BLX3-27-SP16 = Diode LED, 12 Volt, BLAZE™ X, Type 3, 2,700° CCT, 16.4' spool.

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Specifications are subject to change without notice.

Toll Free: 877.817.6028 | Fax: 415.592.1596 | www.DiodeLED.com | info@DiodeLED.com

BLAZE X™ 100/200/300 LED Strip Light

SPECIFICATION SHEET

FULLY LOADED CHANNELS

FULLY LOADED SKU Builder

DI	-	LOADED	-		-		-		-		-		-		-		-		-	
		Channel Type		Channel Color		Voltage		Strip Type		CCT		Lens		Length (In.)		Driver (Optional)		Mounting (Optional)		

CHANNEL TYPE		CHANNEL COLOR	VOLTAGE	TYPE	CCT		LENS	DRIVER	MOUNTING
SL*	SCNC	AL	12VDC	BLX1	27	42	CL	ELECTRONIC (ELEC)	MOUNTING CLIPS (MTC)
SQ*	45DCO		24VDC	BLX2	30	50	FR	MAGNETIC (MAG)	VERTICAL MOUNTING CLIPS (VERT)
45*	90SD		BLX3	35				TRIAC (TRI)	ROTATING MOUNTING CLIPS (RTC)
SLR	DOME							0-10V (010)	TAPE (TP)
REC	SQC20							SWITCHEX (SWX)	HANGING HARDWARE (HNG)
RFCTR	RC20	*Black and White Channel Color options only available for (SL) Slim, (SQ) Square, & (45) 45 Degree.							
SQ10	RC10								

Example: DI-LOADED-SQBL-24V-BLX3-CL-36-CV = Diode LED, Fully Loaded, Square, Black Channel, 24 Volt, BLAZE™ X 300, Clear Lens, 36 inches, 96" Lead Wire, and with a Constant Voltage Driver.

NOTE: All Fully Loaded Channels include 96" lead wires.

24VDC LED Strip light, slim channel with aluminum finish, mounting clips for channel, and clear lens throughout (frosted lens available), 3500K to match showroom luminaires.

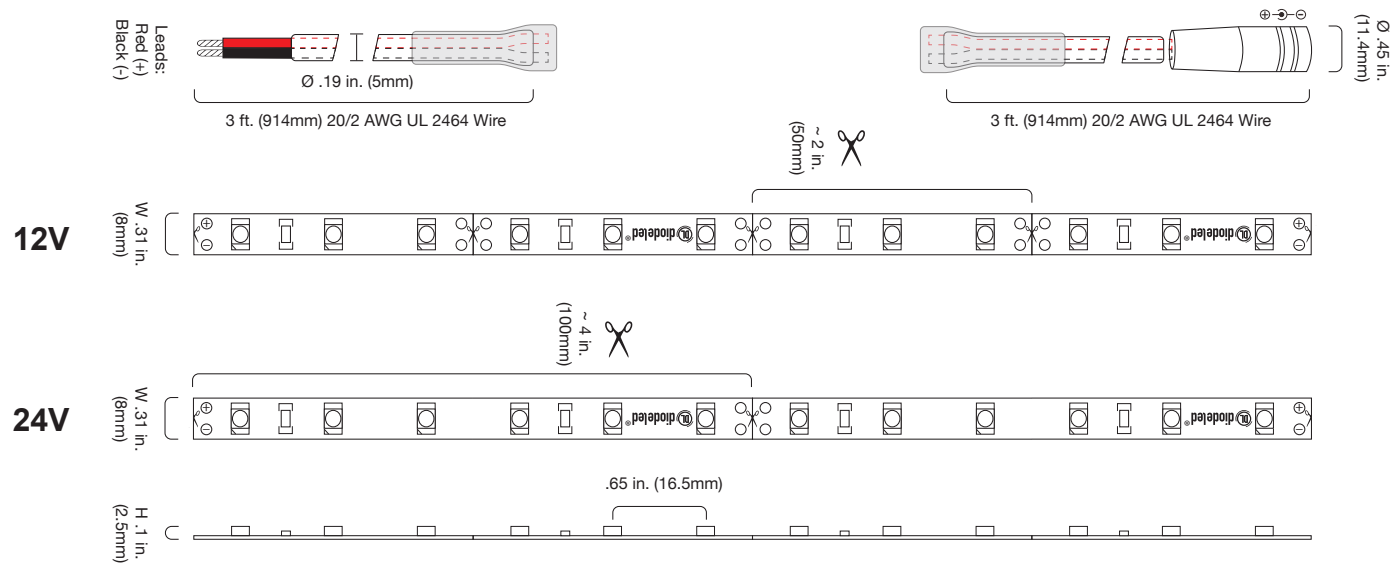
1. Lumen value measured in accordance to IES LM-80-08. LED chips have a luminous flux range with a tolerance of +/- 5%.
2. Each maximum run requires a dedicated power feed from the driver. Do not extend beyond the recommended maximum run length. Max run may exceed Class 2 limit. Actual wattage may differ from calculated wattage due to voltage drop across run.
3. Actual efficacy value is dependent to specified LED driver (power supply). An estimated efficacy value can be calculated as follows: Lumen value divided by average power consumption per foot.
4. Do not install product in an environment outside the listed ambient temperature. Exceeding the maximum ambient temperature may damage LED chips, reduce the total lamp life, lumen output, and/or adversely impact color consistency.
5. Operating temperature is measured according to the minimum and maximum ambient temperature environment.

BLAZE X™ 100/200/300 LED Strip Light

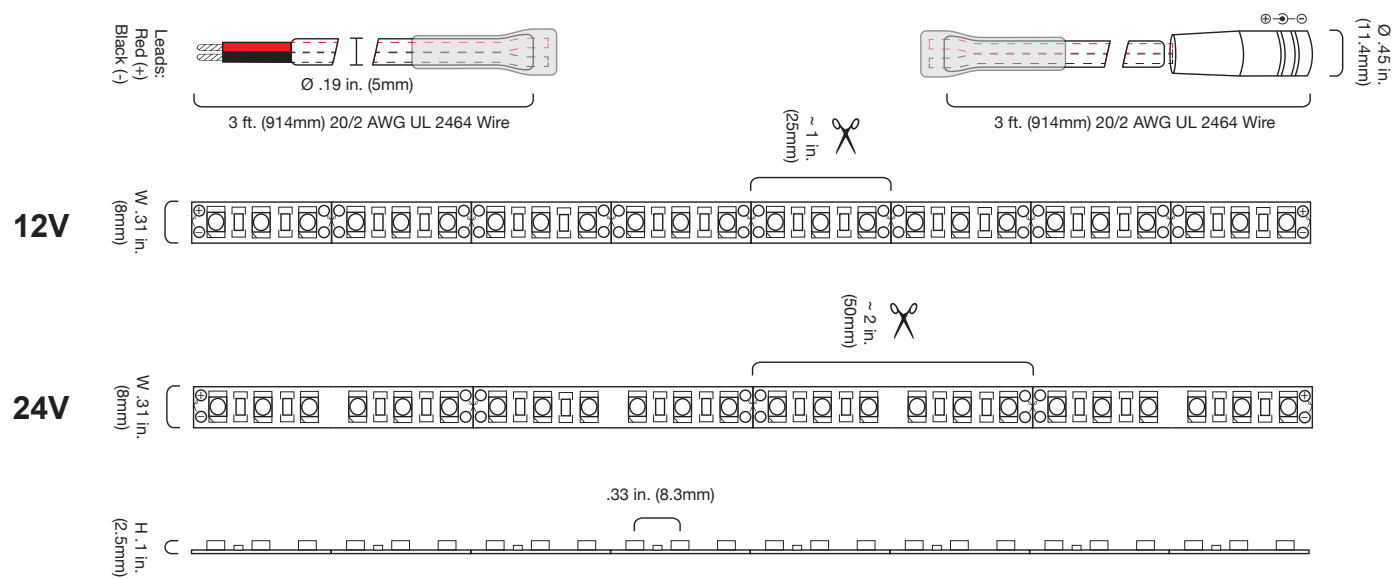
SPECIFICATION SHEET

MECHANICAL DIAGRAMS

BLAZE™ X 100



BLAZE™ X 200 & 300



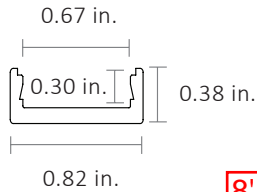
BLAZE X™ 100/200/300 LED Strip Light

SPECIFICATION SHEET

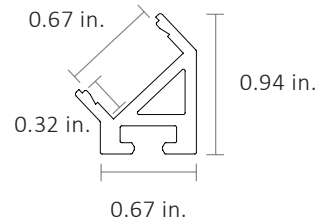
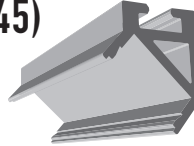
CHROMAPATH BUILDER CHANNELS

NOTE: Chromapath Builder channel covers are sold separately.

CHROMAPATH® BUILDER SLIM (SL)



CHROMAPATH® BUILDER 45° (45)



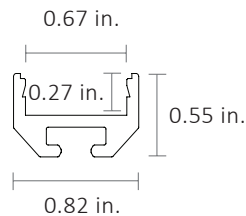
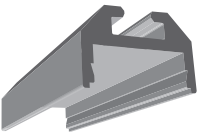
8' sections. See drawings for quantity. Aluminum finish.

CHANNEL ONLY SKU	FINISH	LENGTH	PRODUCT INCLUDES
DI-CPCHA-SL48**	AL	48 in.	Mounting Clips sold separately.
DI-CPCHA-SL48W**	WH		
DI-CPCHA-SL48B**	BL		
DI-CPCHA-SL96**	AL	96 in.	
DI-CPCHA-SL96W**	WH		
DI-CPCHA-SL96B**	BL		

** - SKUs listed above are for Single Channels only. Add a -10 for a 10 pack bundle (10 pack will include 10x the amount included accessories)

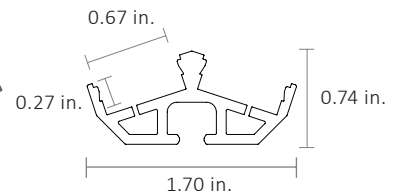
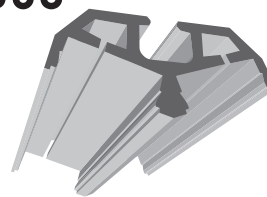
CHANNEL ONLY SKU	FINISH	LENGTH	PRODUCT INCLUDES
DI-CPCHA-4548B	BL	48 in.	4 Mounting Clips with screws and 2 End-to-End Interconnects.
DI-CPCHA-4596**	AL		
DI-CPCHA-4596W**	WH		
DI-CPCHA-4596B**	BL	96 in.	8 Mounting Clips with screws and 4 End-to-End Interconnects.

CHROMAPATH® BUILDER SQUARE (SQ)



CHANNEL ONLY SKU	FINISH	LENGTH	PRODUCT INCLUDES
DI-CPCHA-SQ48**	AL	48 in.	4 Mounting Clips with screws and 2 End-to-End Interconnects.
DI-CPCHA-SQ48W**	WH		
DI-CPCHA-SQ48B**	BL		
DI-CPCHA-SQ96**	AL	96 in.	8 Mounting Clips with screws and 4 End-to-End Interconnects.
DI-CPCHA-SQ96W**	WH		
DI-CPCHA-SQ96B**	BL		

CHROMAPATH® BUILDER DUO



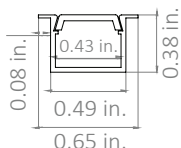
SKU	FINISH	LENGTH	PRODUCT INCLUDES
DI-CPCHA-DU48**	AL	48 in.	4 Mounting Clips
DI-CPCHA-DU48W**	WH		
DI-CPCHA-DU48B**	BL		

** - SKUs listed above are for Single Channels. Add a -10 for a 10 pack bundle (10 pack will include 10x the amount included accessories)

CHROMAPATH BUNDLE CHANNELS

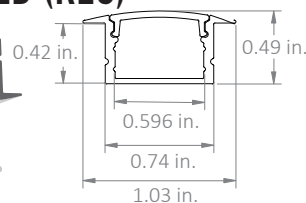
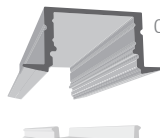
NOTE: CHROMAPATH Bundles are not interchangeable with each other nor compatible with CHROMAPATH Builder channels.

CHROMAPATH® BUNDLE SLIM RECESSED (SLR)



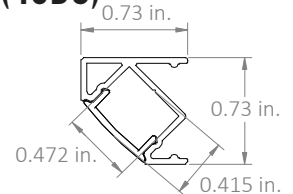
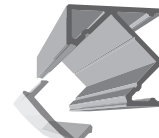
CHANNEL ONLY SKU	PRODUCT INCLUDES
DI-CPCHA-SLR48	<ul style="list-style-type: none">48 in. channel & frosted coverEnd caps: 1x open square, 1x open round, 1x closed square.

CHROMAPATH® BUNDLE RECESSED (REC)



CHANNEL ONLY SKU	PRODUCT INCLUDES
DI-CPCHB-REC-48	<ul style="list-style-type: none">48 in. channel & frosted coverEnd caps: 1x open, 1x closedMounting hardware

CHROMAPATH® BUNDLE 45° DECO (45DC)



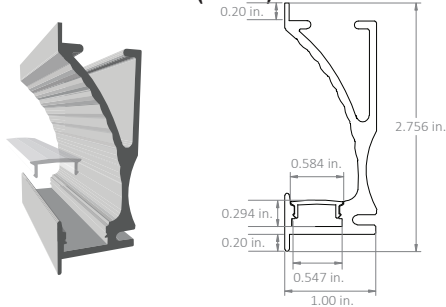
CHANNEL ONLY SKU	PRODUCT INCLUDES
DI-CPCHB-45DCO-48	<ul style="list-style-type: none">48 in. channel & frosted coverEnd caps: 1x open, 1x closedMounting hardware

BLAZE X™ 100/200/300 LED Strip Light

SPECIFICATION SHEET

CHROMAPATH BUNDLE CHANNELS (CONT.)

CHROMAPATH® BUNDLE REFLECTOR (RFC)



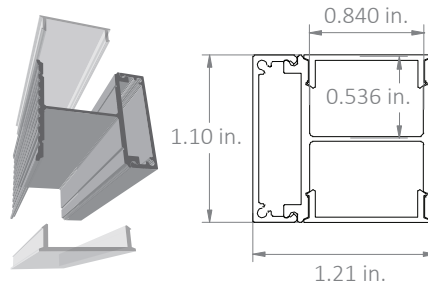
CHANNEL ONLY SKU

PRODUCT INCLUDES

DI-CPCHB-RFCTR-48

- 48 in. channel & frosted cover
- End caps: 1x open, 1x closed

CHROMAPATH® BUNDLE SCONCE (SCNC)



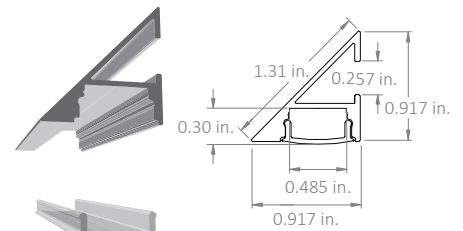
CHANNEL ONLY SKU

PRODUCT INCLUDES

DI-CPCHB-SCNC-48

- 48 in. channel, 48 in. mounting plate, 2x frosted covers
- End caps: 1x open, 1x closed

CHROMAPATH® BUNDLE 90° SIDEVIEW (90DC)



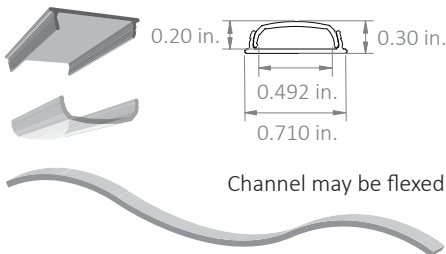
CHANNEL ONLY SKU

PRODUCT INCLUDES

DI-CPCHB-REC-90

- 48 in. channel & frosted cover
- End-caps: 1x open, 1x closed
- Mounting hardware

CHROMAPATH® BUNDLE WAVEFORM (WF)



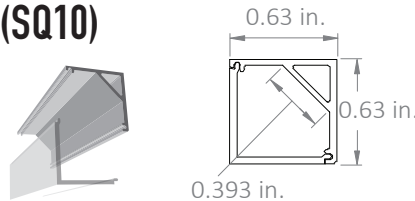
CHANNEL ONLY SKU

PRODUCT INCLUDES

DI-CPCHB-WF-48

- 48 in. channel & frosted cover
- End caps: 1x open, 1x closed
- 2x mounting clip

CHROMAPATH® BUNDLE 10mm SQUARE CORNER (SQ10)



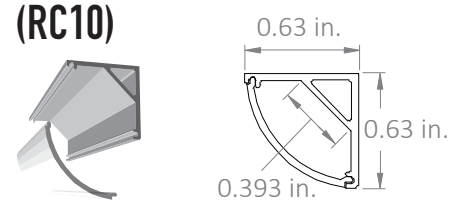
CHANNEL ONLY SKU

PRODUCT INCLUDES

DI-CPCHB-SQC10-48

- 48 in. channel & frosted cover
- End-caps: 1x open, 1x closed
- Mounting hardware

CHROMAPATH® BUNDLE 10mm ROUNDED CORNER (RC10)



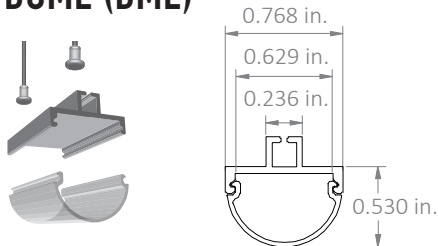
CHANNEL ONLY SKU

PRODUCT INCLUDES

DI-CPCHB-RC10-48

- 48 in. channel & frosted cover
- End-caps: 1x open, 1x closed
- Mounting hardware

CHROMAPATH® BUNDLE DOME (DME)



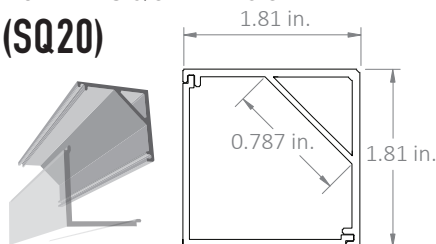
CHANNEL ONLY SKU

PRODUCT INCLUDES

DI-CPCHB-DOME-48

- 48 in. channel & frosted cover
- End caps: 1x open, 1x closed
- 2x pendant hardware

CHROMAPATH® BUNDLE 20mm SQUARE CORNER (SQ20)



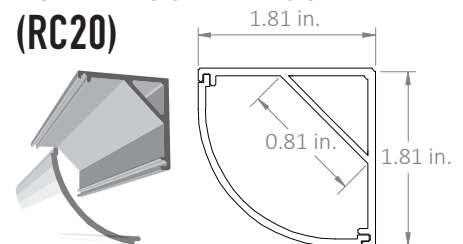
CHANNEL ONLY SKU

PRODUCT INCLUDES

DI-CPCHB-SQC20-48

- 48 in. channel & frosted cover
- End-caps: 1x open, 1x closed
- Mounting hardware

CHROMAPATH® BUNDLE 20mm ROUNDED CORNER (RC20)



CHANNEL ONLY SKU

PRODUCT INCLUDES

DI-CPCHB-RC20-48

- 48 in. channel & frosted cover
- End-caps: 1x open, 1x closed
- Mounting hardware

BLAZE X™ 100/200/300 LED Strip Light

SPECIFICATION SHEET

COMPATIBLE PRODUCTS

The following Listed LED Drivers are recommended for compatibility and to meet NEC code when installed according to specifications. For additional LED Driver options see Diode LED's product page at: <https://www.diodeled.com/products/led-power-supplies.html>

STAND ALONE

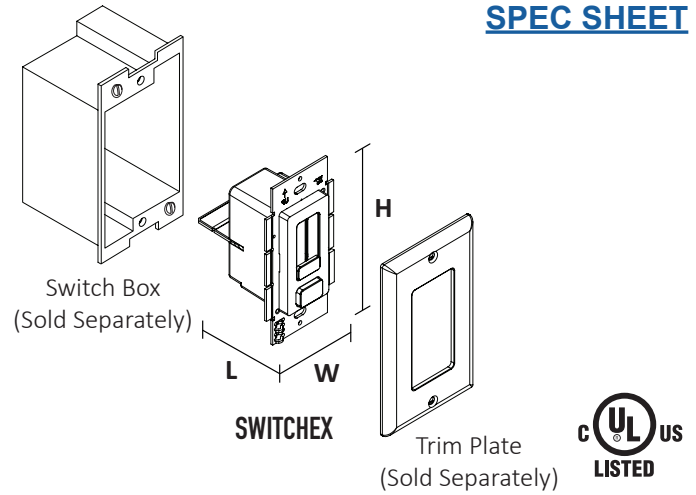
SWITCHEX® DRIVER + DIMMER SWITCH

SWITCHEX combines an LED driver and LED dimmer switch into a single integrated unit. Fits into standard switch boxes.

[SPEC SHEET](#)

	Voltage Output		Power Output
DI	24V	SE	60W
SKU	L - LENGTH	W - WIDTH	H - HEIGHT
DI-24V-SE-60W	1.40 in.	2.10 in.	4.10 in.
DI-24V-SE-100W	1.40 in.	2.10 in.	4.10 in.

Fits in Standard Switch Box



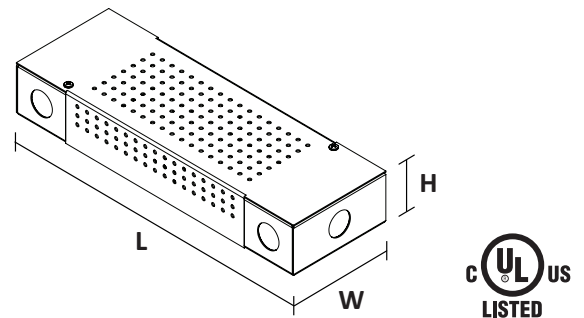
ON/OFF, DMX, & PWM CONTROL

LO-PRO® JUNCTION BOX & DRIVER COMBO - 24V CONSTANT VOLTAGE LED DRIVER

Use Constant Voltage Drivers to power your lighting system. Compatible with Standard 120VAC On/Off Switches, REIGN® Low Voltage Dimmers, TOUCHDIAL™ Control System, DMX Decoders, and PWM Controls.

[SPEC SHEET](#)

	Voltage & Power Output		Junction Box
DI	0970		LPS
SKU	L - LENGTH	W - WIDTH	H - HEIGHT
DI-0970-LPS	11.25 in.	3.75 in.	1.90 in.
DI-CV-MW24V60W-277-LPS	11.25 in.	3.75 in.	1.90 in.
DI-CV-MW24V90W-277-LPS	11.25 in.	3.75 in.	1.90 in.
DI-0954-LPL	13.5 in.	4.5 in.	2.37 in.



BLAZE X™ 100/200/300 LED Strip Light

SPECIFICATION SHEET

COMPATIBLE PRODUCTS

The following Listed LED Drivers are recommended for compatibility and to meet NEC code when installed according to specifications. For additional LED Driver options see Diode LED's product page at: <https://www.diodeled.com/products/led-power-supplies.html>

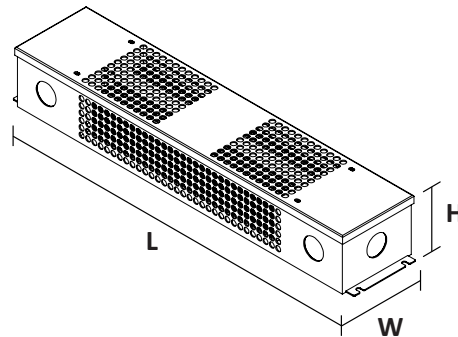
OMNIDRIVE® 2 ELECTRONIC DIMMABLE LED DRIVER

OMNIDRIVE 2 features a zero minimum load and 100-5% dimming range. Compatible with Forward Phase and Reverse Phase Dimmers. Please see Diode LED's Compatibility List at: <https://www.diodeled.com/custom/download/productFile/filename/DI-OD2-Compatibility%20List.pdf>

[SPEC SHEET](#)

Voltage & Power Output		
DI	OD2	24V24W

SKU	L - LENGTH	W - WIDTH	H - HEIGHT
DI-OD2-24V24W	13.75 in.	3.00 in.	1.60 in.
DI-OD2-24V60W	13.75 in.	3.00 in.	1.60 in.
DI-OD2-24V96W	15.00 in.	3.10 in.	2.40 in.
DI-OD2-24V120W	15.00 in.	3.10 in.	2.40 in.
DI-OD2-24V200W	16.10 in.	3.40 in.	2.40 in.



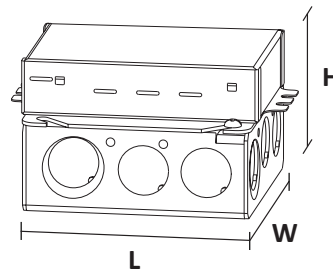
LUTRON OPTIONS

LUTRON® Hi-lume 1% LED DIMMABLE DRIVER

Hi-lume 1% LED Driver has a minimum load of 5W and dims from 100-1%.

Voltage & Power Output			3-Wire or 2-Wire Dimmers
DI-DM	24V40W	L3D	

SKU	L - LENGTH	W - WIDTH	H - HEIGHT
DI-DM-24V40W-L3D	4.89 in.	4.00 in.	2.62 in.
DI-DM-24V40W-LTE			



[L3D SPEC SHEET](#)

[LTE SPEC SHEET](#)

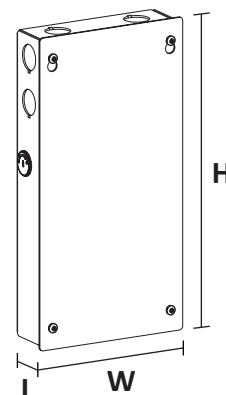


LUTRON® Hi-lume Premier 0.1% LED DIMMABLE DRIVER

Hi-Lume Premier 0.1% LED Driver has a minimum load of 5W and dims from 100-0.1%.

Voltage & Power Output		
DI-DM	24V96W	L3D

SKU	L - LENGTH	W - WIDTH	H - HEIGHT
DI-DM-24V96W-L3D	5.50 in.	2.20 in.	10.50 in.



[SPEC SHEET](#)



BLAZE X™ 100/200/300 LED Strip Light

SPECIFICATION SHEET

COMPATIBLE PRODUCTS

The following Listed LED Drivers are recommended for compatibility and to meet NEC code when installed according to specifications. For additional LED Driver options see Diode LED's product page at: <https://www.diodeled.com/products/led-power-supplies.html>

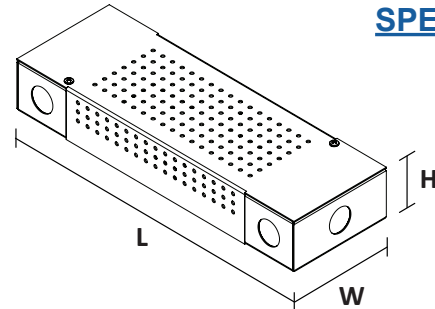
0-10V

LO-PRO® JUNCTION BOX & DRIVER COMBO - 24V COMMERCIAL GRADE 0-10V LED DIMMABLE DRIVER

Compatible with 0-10V controls and dimming systems.

Voltage & Power Output		Junction Box	
DI-DM	MW24V60W	0-10V	LPS

SKU	L - LENGTH	W - WIDTH	H - HEIGHT
DI-DM-MW24V60W-0-10V-LPS	11.25 in.	3.75 in.	1.90 in.
DI-DM-MW24V90W-0-10V-LPL	13.5 in.	4.5 in.	2.37 in.



[SPEC SHEET](#)



ELECTRONIC DRIVERS

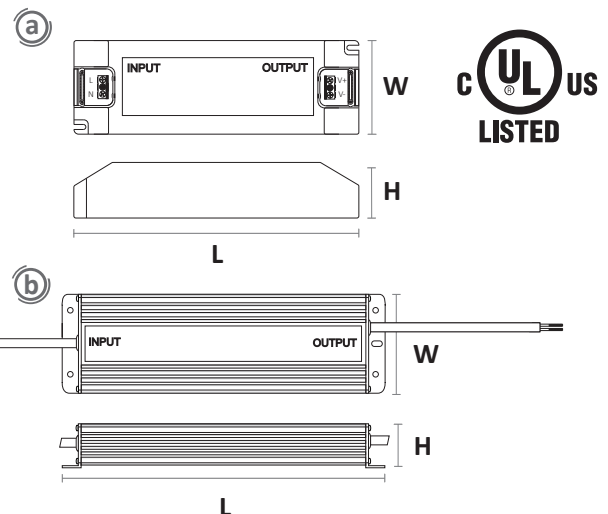
OMNIDRIVE® 24V ELECTRONIC DIMMABLE LED DRIVER

Compatible with Forward Phase and Reverse Phase Dimmers. Please see Diode LED's Compatibility List at: <https://www.diodeled.com/custom/download/productFile/filename/DI-OD2-Compatibility%20List.pdf/>

Voltage & Power Output	
DI	TD
24V-10W	

SKU		L - LENGTH	W - WIDTH	H - HEIGHT
DI-TD-24V-10W	a	5.5 in.	1.8 in.	1.1 in.
DI-TD-24V-20W	a	5.5 in.	1.8 in.	1.1 in.
DI-TD-24V-30W	a	7 in.	2.3 in.	1.4 in.
DI-TD-24V-45W	a	7 in.	2.3 in.	1.4 in.
DI-TD-24V-60W	b	7.9 in.	2.7 in.	1.8 in.
DI-TD-24V-80W	b	7.9 in.	2.7 in.	1.8 in.
DI-TD-24V-120W	b	9.1 in.	2.7 in.	1.8 in.

[INDOOR SPEC SHEET](#)
[OUTDOOR SPEC SHEET](#)



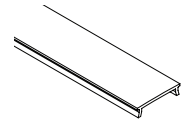
BLAZE X™ 100/200/300 LED Strip Light

SPECIFICATION SHEET

ACCESSORIES

CHROMAPATH® BUILDER CHANNEL COVERS (individual*) - SLIM / SQUARE / 45° / DUO

SKU	FINISH	FORM FACTOR	BUNDLES	DESCRIPTION
DI-CPCHC-FR48**	Frosted	Frosted Cover (48 in.)	Single or 10 Pack	Protects LED tape light and slightly softens light. Note: there is an average warm shift in Kelvin of 35K and an average 28% decrease in delivered lumens.
DI-CPCHC-FR96**	Frosted	Frosted Cover (96 in.)		
DI-CPCHC-CL48**	Clear	Clear Cover (48 in.)		Protects LED tape light with no visible color shift or change in delivered lumens.
DI-CPCHC-CL96**	Clear	Clear Cover (96 in.)		

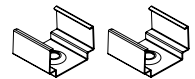


*not for use with Fully Loaded Channels

** - SKUs listed above are for Single covers. Add a -10 for a 10 pack bundle.

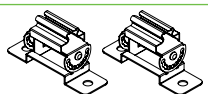
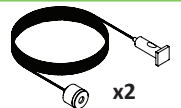
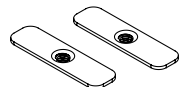
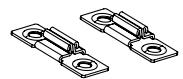
CHROMAPATH® BUILDER CHANNEL MOUNTING OPTIONS **SLIM**

SKU	FINISH	FORM FACTOR	BUNDLES	DESCRIPTION
DI-1633	N/A	SLIM Mounting Tape	4 ft. x 0.75 in.	3M® high-bond double-sided adhesive tape designed to install the CHROMAPATH SLIM on a flat, indoor surface.
DI-1634			12 ft. x 0.75 in.	
DI-CPCH-UC-BA DI-CPCH-UC-WH DI-CPCH-UC-BL	AL WH BL	SLIM Mounting U-Clips	Pack of 2 clips / 4 screws	Secure SLIM Channel to flat surface with this pressure-fit clip. Also compatible when installed with PREMIUM DIFFUSION cover. Adds 0.12in. height to channel.



CHROMAPATH® BUILDER CHANNEL MOUNTING OPTIONS - SQUARE / 45° / DUO

SKU	FINISH	FORM FACTOR	BUNDLES	DESCRIPTION
DI-CPMC2-SCR4	Steel	Mounting Clips (MTC)	Pack of 2 clips / 4 screws	Secure CHROMAPATH to flat surface with this pressure-fit clip. Adds 0.12in. height to channel.
DI-1630-20			Pack of 20 clips / 40 screws	
DI-1912	Steel	Vertical Mounting Brackets (VERT)	Pack of 2	Used to install CHROMAPATH in a vertical orientation and includes an Allen key and allen screws for securing to a vertical surface. Note: Mounting Clips, or Rotating Mounting Clips required for installation of Vertical Mounting Brackets.
DI-CPCH-HNG	Steel	Hanging Hardware Kit (HNG)	Pack of 2 hanging mounts / 2 Wire restrainers / 4 screws	Transform your CHROMAPATH Channel into a pendent fixture with CHROMAPATH Hanging Hardware Kit.
DI-CPCH-RC-BA DI-CPCH-RC-WH DI-CPCH-RC-BL	AL WH BL	Rotating Mounting Clips (RTC)	Pack of 2 clips / 4 screws	Secure CHROMAPATH to flat surface and adjust to desired angle with this pressure-fit clip. Adds 0.74in. height to channel.



BLAZE X™ 100/200/300 LED Strip Light

SPECIFICATION SHEET

SPECIFICATIONS

- LED Chip Type: Epistar 2835 SMD Chip
- LED Chip Beam Angle: 120°
- Luminous Efficac³ (lm/w): 71~88
- Mounting⁴: 3M™ 55280 Adhesive
- Connections⁵: 3 ft. Female DC plug on end. 3 ft. hard-wire lead opposing end. Leads: UL 2464 20/2 AWG
- Ambient Temp⁶: -4 ~ 122°F (-20 ~ 50°C)
- Operating Temp⁷: -4 ~ 176°F (-20 ~ 80°C)

SPECIFYING?

Note: The compatible products listed in this Specification Sheet are provided for reference only. For complete specifications of compatible products, click on the [SPEC SHEET](#) links provided.

COMPLIANCE & REGULATORY APPROVALS

Safety

- UL Listed 2108 Low Voltage Lighting System / Low Voltage Luminaire. UL 1598 / CSA 250.0-08, UL 8750. UL 879 / CAN/CSA-C22.2 no. 207-M89. Certified for United States and Canada. File # E469769.
- UL Listed Field Cuttable.
- UL Recognized Component - Sign Accessories. Available in UL Sign Components Manual (SAMS Manual). File # E469770.
- CE & EMC Compliant: Verification No. GZEM141200683705V

Environmental

- RoHS Compliant: Verification No. CANEC161009150

Performance

- Can be used to comply with TITLE 24 Part 6 High efficacy LED requirements - JA8-2016-E
- LED chip data measured in accordance to IES LM-80-08.
- Photometric & Colorimetry data measured in accordance to IES LM-79-08, in Elemental LED's Innovation Lab.

ADDITIONAL INFORMATION

- BLAZE™ X LED STRIP LIGHT Installation Guide

SAFETY / WARNINGS / DISCLOSURES

1. Install in accordance with national and local electrical code regulations.
2. This product is intended to be installed and serviced by a qualified, licensed electrician.
3. Only install with a listed Class 2 DC Constant Voltage LED Driver.
4. Not for use in or on walls of pools, fountains, or other partially or fully submersed locations.
5. Do not modify or disassemble product beyond instructions or this warranty will be void.
6. Actual color may vary from what is pictured above and on other print materials due to the limitations of photographic processes.
7. We reserve the right to modify and improve the design of our fixtures without prior notice. We cannot guarantee to match existing installed fixtures for subsequent orders or replacements in regards to product appearance, CCT, or lumen output.

WARRANTY

Limited Warranty

This product has a twelve (12) year limited warranty from the date of shipment. This warranty does not include the additional accessories referenced in this specification sheet. Complete warranty details for fixtures and additional accessories are available at www.diodeled.com/limited-warranty/ within the Policies section. For warranty related questions please contact product support.

Consumer's Acknowledgment

Elemental LED, Inc. stands behind its products when they are used properly and according to our specifications. By purchasing our products, the purchaser agrees and acknowledges that lighting design, configuration and installation is a complex process, wherein seemingly minor factors or changes in layout and infield adjustments can have a significant impact on an entire system. Choosing the correct components is essential. Elemental LED is able to work with the original purchaser to make an appropriate product selection to the extent of the limited information that the customer can provide, but it is virtually impossible for Elemental LED to design a system that foresees every unknown factor. For this reason, this Warranty does not cover problems caused by improper design, configuration or installation issues. Any statement from an Elemental LED employee or agent regarding a customer's bill of goods and/or purchase order is NOT an acknowledgment that the products purchased are designed and configured correctly. The purchaser agrees and acknowledges that it is the customer's responsibility to adhere strictly to all information contained in the Product Specification Sheets

There is often more than one way to design, configure and layout an LED lighting application properly to achieve the same lighting effect. Elemental LED strongly recommends that licensed professionals be used in the design and installation of lighting systems that include Elemental LED products. The specifications include important information that a designer and installer should carefully review and strictly follow. Qualified designers and certified and/or licensed installers, with access to the final installation environment, customer goals, and Elemental LED product specifications can make the requisite decisions appropriate for a successful finished lighting application.



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Specifications are subject to change without notice.

Toll Free: 877.817.6028 | Fax: 415.592.1596 | www.DiodeLED.com | info@DiodeLED.com



SimpleSpec 500.03

Lightbox Shelving

Introduction LT Series

- . LED Life of approximately 50K hours, under normal operating conditions
- . Low wattage, low heat, low voltage (24VDC Operation)
- . Design prevents “scalloping” effect, providing consistent and uniform illumination
- . Emits no UV or infrared light and does not contain lead, mercury, or glass, allowing for Eco-friendly handling and disposal when required
- . Simple user friendly installation
- . UL/cUL 2108 and CE Listed
- . 4 inch joinable segments; can be cut to 4 inch segments

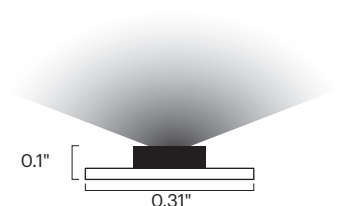


Table of Contents

1 Specifications

2 Wiring Installation Diagrams

2 Wiring Diagram

3 0-10V Dimming ≤100W

4 0-10V Dimming 100W-1200W

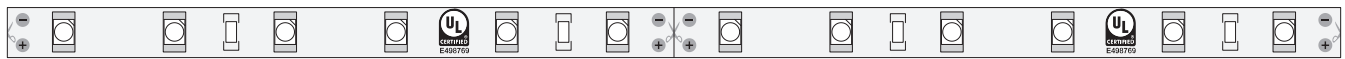
5 Dimensions

5 3-60-765 - Dimmable Power Supply

Specifications

LEDs

Part Number	LED Bar Color	Volts	Power (W/ft)	Max Feet per 100W PS	Color Temperature
3-60-766	Warm White	24	1.44	67'	2700K
3-60-767	Warm White	24	1.44	67'	3000K
3-60-768	Natural White	24	1.44	67'	4400K
3-60-769	Cool White	24	1.44	67'	6300K
3-60-770	Red	12	2.88	16'	Red
3-60-771	Green	12	2.88	16'	Green
3-60-772	Blue	12	2.88	16'	Blue



Drivers

Part Number	Description	Dimensions	Input Voltage	Input Current	Output Power	Output Voltage	Output Current
3-60-497	0-10V Slide Control Wall Dimmer	-	-	-	-	-	-
3-60-765	96W Dimmable Power Supply	11.7"×2.36"×1.4"	120-277VAC	.8/.35	96	24	4
3-60-779	50W Dimmable Power Supply	11.4"×2.36"×1.4"	120-277VAC	.5/.55/1.2	50	12	4.2



3-60-497 Slide Control

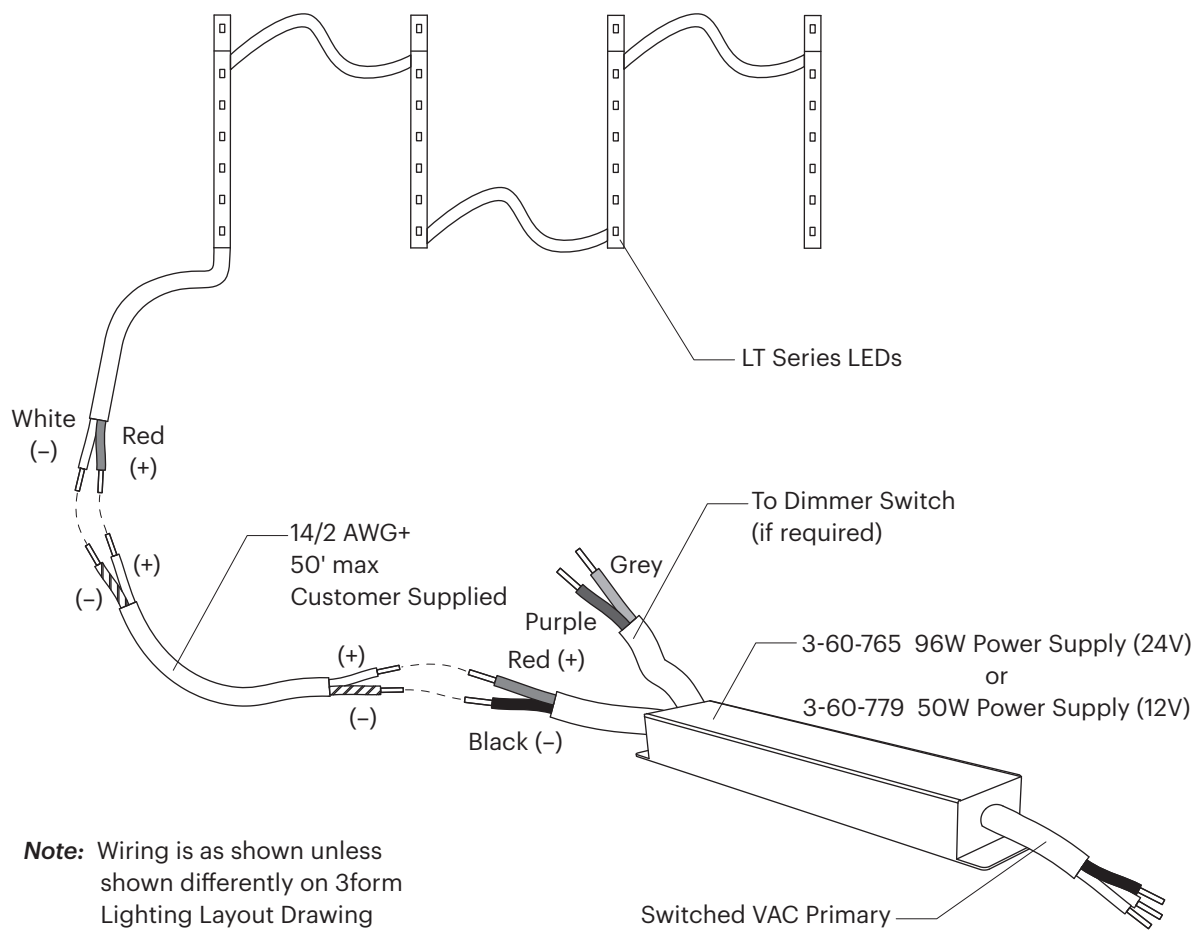


3-60-765 Dimmable Power Supply



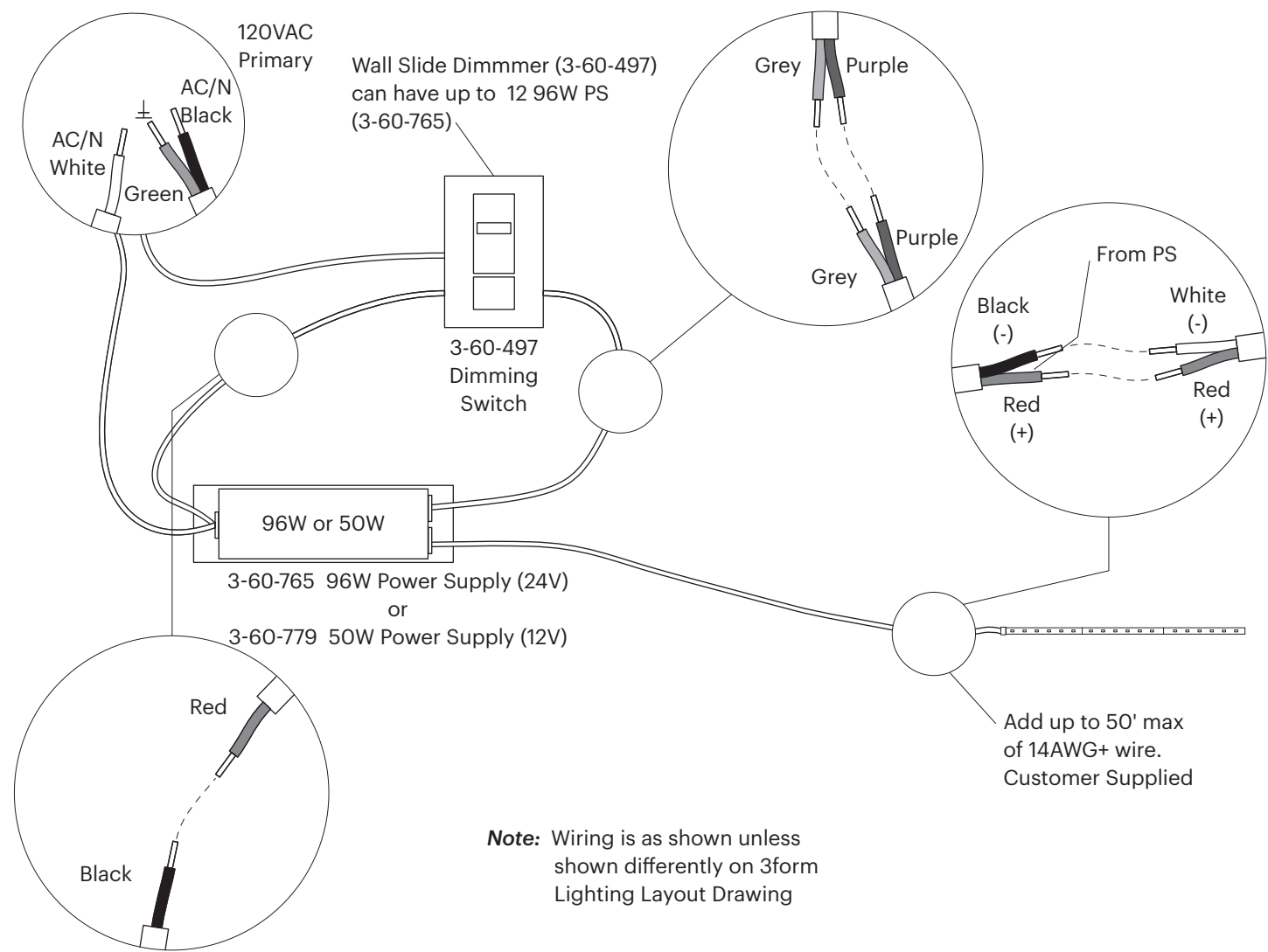
3-60-779 Dimmable Power Supply

Installation
Wiring Diagram



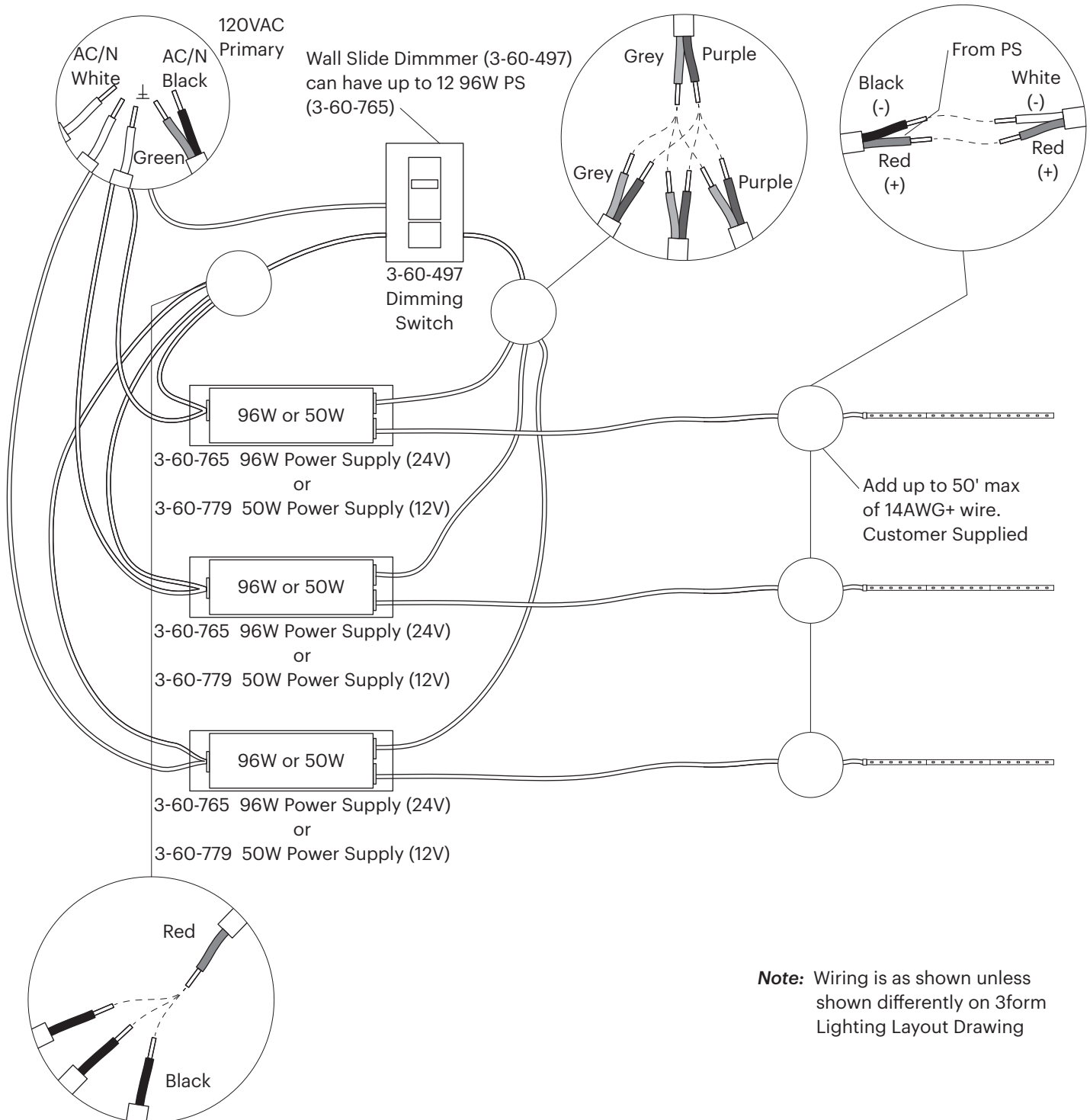
Installation

Wiring Diagram - 0-10V Dimming ≤100W



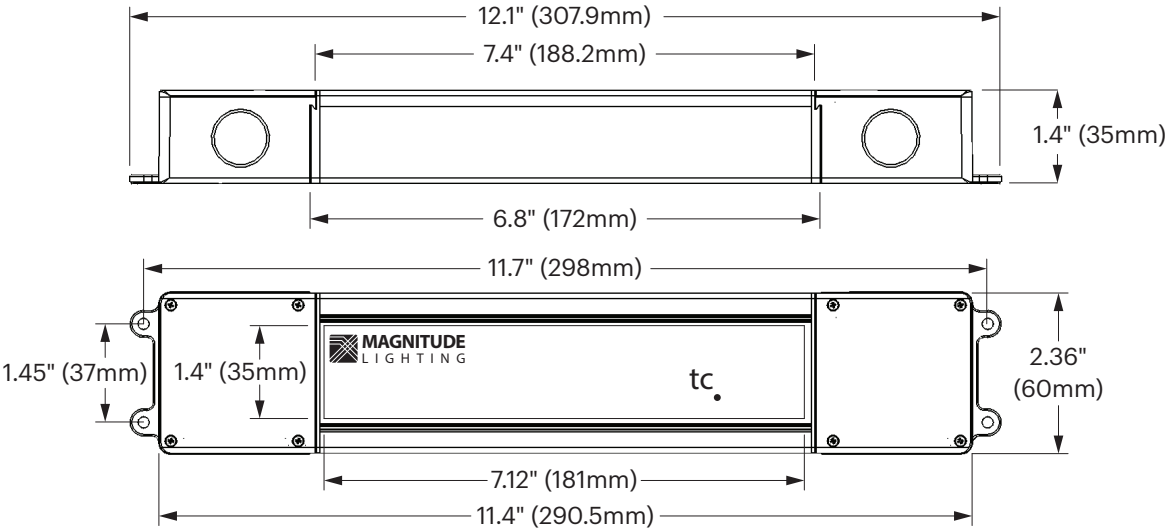
Installation

Wiring Diagram - 0-10V Dimming 100W-1200W



Dimensions

3-60-765 (24V) or 3-60-779 (12V) - Dimmable Power Supply



EDGE-LIT LED EXIT SIGN

TYPE EXW

Exit sign - wall or side mount

CATALOG #:

PROJECT:

NOTES:

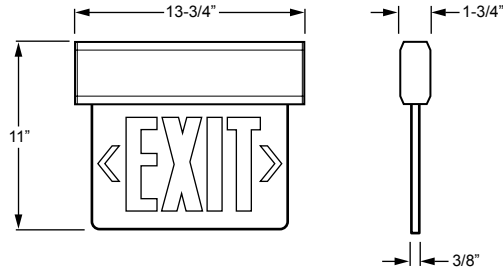
EXAMPLE

EXIT/EL - SF - R - CP - AN - AC - OPTIONS - D

SERIES NUMBER OF FACES LETTER COLOR FACEPLATE FINISH HOUSING COLOR POWER OPTIONS OPTIONS/ACCESSORIES VOLTAGE



CROSS SECTIONS



ORDERING INFORMATION

SERIES

EXIT/EL Edge-Lit LED Exit Sign

NUMBER OF FACES (Must specify)

SF Single face
DF Double face

see plans

LETTER COLOR (Must specify)

R Red
G Green

FACEPLATE FINISH (Must specify)

CP Clear panel (SF only)
MP Mirror panel
WP White panel

HOUSING COLOR (Must specify)

AN Anodized aluminum
BLK Black
WHT Industry-standard white

POWER OPTIONS (Must specify)

AC AC operation
EM AC operation with emergency battery backup

OPTIONS

COPY Consult factory for custom message
DC Dual circuit (AC only)
SDT Self-diagnostic test (EM only)

ACCESSORIES (Shipped separately)

See back for details.
PC2 Polycarbonate shield
WG Wireguard (wall mount only)

VOLTAGE

D 120V or 277V
SV Special voltage, consult factory for options (not available with SDT or DC)

FEATURES

- ▶ Ultra-bright, energy efficient, long-life LEDs available in red or green.
- ▶ Ceiling, side, or wall mount.
- ▶ Fully automatic solid-state system on EM units recharges battery in 24 hours.
- ▶ Compact, low profile design.
- ▶ Available as full-time AC powered unit or emergency unit with battery backup.
- ▶ UV-stabilized ultra-clear acrylic edgelit panel provides consistent, uniform illumination.
- ▶ Directional indicators can be installed on-site.
- ▶ Charge rate/power on LED indicator and built-in test switch on emergency units.
- ▶ 4.8V long-life, maintenance-free NiCd battery on emergency (EM) units provides 90 minutes of emergency operation.
- ▶ Custom messages available, consult factory for details.



LED

SPECIFICATIONS

Housing – Premium-grade extruded aluminum

Electrical – Universal voltage, 120 or 277 VAC operation.

Mounting – Aluminum mounting canopy for ceiling, side, or wall mount installation.

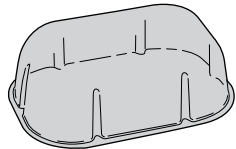
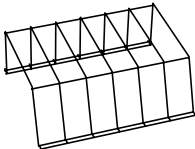
Labels – Listed to UL 924 standard as an exit light suitable for dry or damp locations (0°C - 50°C). Meets NFPA 101 Life Safety Code, NEC, OSHA, Local and State Codes.

Warranty – 5-year limited warranty

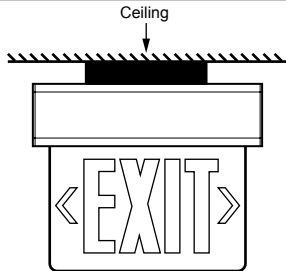
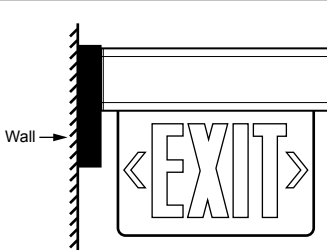
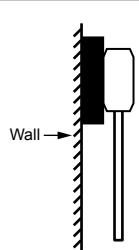
ELECTRICAL INFORMATION

Catalog Number	Input Watts (W)		Input Amps (A)	
	120V	277V	120V	277V
EXIT/EL	3.8	4.5	0.030	0.020

ACCESSORIES

PC2	WG
	

FIXTURE DETAILS

Ceiling Mount	Side Mount	Wall Mount
		

TYPE EXP

Exit sign - pendant

EDGE-LIT LED EXIT SIGN

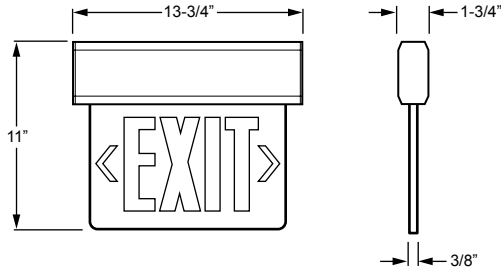
CATALOG #:	TYPE:
PROJECT:	NOTES:

EXAMPLE **EXIT/EL - SF - R - CP - AN - AC - OPTIONS - D**

SERIES NUMBER OF FACES LETTER COLOR FACEPLATE FINISH HOUSING COLOR POWER OPTIONS OPTIONS/ACCESSORIES VOLTAGE



CROSS SECTIONS



ORDERING INFORMATION

SERIES
EXIT/EL Edge-Lit LED Exit Sign

NUMBER OF FACES (Must specify)
SF Single face
DF Double face **see plans**

LETTER COLOR (Must specify)
R Red
G Green

FACEPLATE FINISH (Must specify)
CP Clear panel (SF only)
MP Mirror panel
WP White panel

HOUSING COLOR (Must specify)
AN Anodized aluminum
BLK Black
WHT Industry-standard white

POWER OPTIONS (Must specify)
AC AC operation
EM AC operation with emergency battery backup

OPTIONS
COPY Consult factory for custom message
DC Dual circuit (AC only)
SDT Self-diagnostic test (EM only)

ACCESSORIES (Shipped separately)
 See back for details.
PC2 Polycarbonate shield
WG Wireguard (wall mount only)

VOLTAGE
D 120V or 277V
SV Special voltage, consult factory for options (not available with SDT or DC)

FEATURES

- ▶ Ultra-bright, energy efficient, long-life LEDs available in red or green.
- ▶ Ceiling, side, or wall mount.
- ▶ Fully automatic solid-state system on EM units recharges battery in 24 hours.
- ▶ Compact, low profile design.
- ▶ Available as full-time AC powered unit or emergency unit with battery backup.
- ▶ UV-stabilized ultra-clear acrylic edgelit panel provides consistent, uniform illumination.
- ▶ Directional indicators can be installed on-site.
- ▶ Charge rate/power on LED indicator and built-in test switch on emergency units.
- ▶ 4.8V long-life, maintenance-free NiCd battery on emergency (EM) units provides 90 minutes of emergency operation.
- ▶ Custom messages available, consult factory for details.



LED

SPECIFICATIONS

Housing – Premium-grade extruded aluminum
Electrical – Universal voltage, 120 or 277 VAC operation.

Mounting – Aluminum mounting canopy for ceiling, side, or wall mount installation.

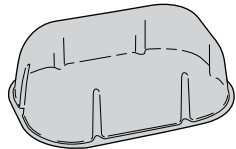
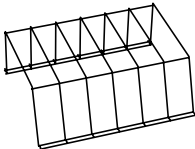
Labels – Listed to UL 924 standard as an exit light suitable for dry or damp locations (0°C - 50°C). Meets NFPA 101 Life Safety Code, NEC, OSHA, Local and State Codes.

Warranty – 5-year limited warranty

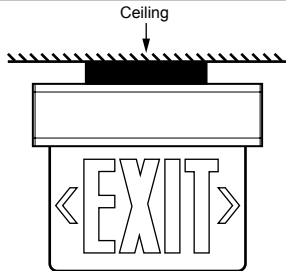
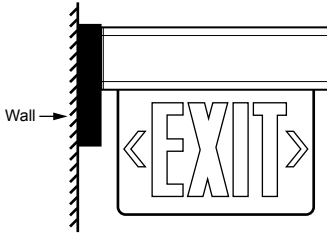
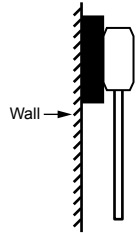
ELECTRICAL INFORMATION

Catalog Number	Input Watts (W)		Input Amps (A)	
	120V	277V	120V	277V
EXIT/EL	3.8	4.5	0.030	0.020

ACCESSORIES

PC2	WG
	

FIXTURE DETAILS

Ceiling Mount	Side Mount	Wall Mount
		

SECTION 27 0000

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.
3. Section 270526, "Communication Bonding"
4. Section 270528, "Communication Building Pathways"
5. Section 270533, "Communication Building Pathways – Conduits and Boxes"
6. Section 270811, "Communication Twisted Pair Testing"
7. Section 271100, "Communication Equipment Rooms"
8. Section 271513, "Communication Horizontal Twisted Pair Cabling"
9. Section 274116, "Integrated Audio Video Equipment"

1.2 REFERENCES**A. General**

1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Consider such codes and/or standards a part of this specification as though fully repeated herein.
2. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
3. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid unless otherwise specifically stated.

- B. Codes:** Perform work and furnish materials and equipment under Division 27 in accordance with applicable requirements of the latest edition of governing codes,

rules and regulations including but not limited to the following minimum standards, whether statutory or not:

1. California Code of Regulations (CCR):
 - a. Title 8, "Industrial Relations"
 - 1) Chapter 3.22, "California Occupational Safety and Health Regulations (CAL/OSHA)"
 - b. Title 24, "California Building Standards Code"
 - 1) Part 1, "California Building Standards Administrative Code"
 - 2) Part 2, "California Building Code" (CBC)
 - 3) Part 3, "California Electrical Code" (CEC)
 - 4) Part 11, "California Green Building Standards Code" (CALGreen)
 2. National Fire Protection Agency (NFPA)
 - a. NFPA 75, "Protection of Information Technology Equipment"
 3. Code of Federal Regulations (CFR) Title 47 "Telecommunication", Chapter I "Federal Communications Commission (FCC)":
 - a. Part 15, "Radio Frequency Devices and Radiation Limits"
 4. International Code Council (ICC):
 - a. "International Building Code" (IBC)
 - b. "International Fire Code" (IFC)
 - c. "ICC Performance Code"
 5. Other applicable national, state, and local binding building and fire codes
- C. Standards: Perform work and furnish materials and equipment under Division 27 in accordance with the latest editions of the following standards as applicable:
1. Building Industry Consulting Services International (BICSI):
 - a. "Telecommunications Distribution Methods Manual" (TDMM)
 2. EIA testing standards

3. National Electrical Contractors Association (NECA):
 - a. ANSI/NECA 1-2015, "Standard Practices for Good Workmanship in Electrical Construction"
4. Telecommunications Industry Association (TIA):
 - a. ANSI/TIA-568.0-D, "Generic Telecommunications Cabling for Customer Premises"
 - b. ANSI/TIA-568.1-D, "Commercial Building Telecommunications Cabling Standards"
 - c. ANSI/TIA-568.2-C, "Balanced Twisted Pair Telecommunications Cabling and Components"
 - d. ANSI/TIA-568.3-D, "Optical Fiber Cabling Components"
 - e. ANSI/TIA-569-D, "Telecommunications Pathways and Spaces"
 - f. ANSI/TIA/EIA-598-D, "Optical Fiber Cable Color Coding"
 - g. ANSI/TIA-606-C, "Administration Standard for Telecommunications Infrastructure"
 - h. ANSI-TIA-607-C, "Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises"
 - i. ANSI/TIA-1005-A, "Telecommunications Infrastructure Standard for Industrial Premises"

1.3 DEFINITIONS

- A. The definitions of Divisions 00 and 01 shall apply to Division 27 sections.
- B. In addition to those definitions of Divisions 00 and 01, the following list of terms as used in this specification defined as follows:
 1. "AFF": Above Finished Floor
 2. "As directed": As directed or instructed by the Owner, or their authorized representative
 3. "AHJ": Authority Having Jurisdiction
 4. "Cabling": installed media ready for electronic or optical signal circuit use; a complete media connection comprised of cables, termination apparatus (patch

panels, blocks, connectors), outlets, connecting media (path cord, crossconnects), labeling

5. "CBC": California Building Code (CCR Title 24 Part 2)
6. "CCR": California Code of Regulations
7. "CEC": California Electrical Code (CCR Title 24 Part 3)
8. "Connect": To install patch cords, equipment cords, crossconnect wire, etc. to complete an electronic or optical signal circuit
9. "Cord": a length of cordage having connectors at each end. The term "Cord" is synonymous with the term "Jumper" and "Lead"
10. "Engineer": TEECOM
11. "First-In-Place": a single unit of work for the Owner's and Engineer's review and written approval prior to proceeding with the work of the entire project
12. "Furnish": To purchase, procure, acquire, and deliver complete with related accessories
13. "General Contractor": <name><successful bidder>
14. "Identifier": A unique code assigned to an element of the Telecommunications infrastructure that links it to its corresponding record
15. "Install": To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Make installation complete and ready for regular operation
16. "IOR": Inspector Of Record
17. "ISP": Inside Plant
18. "LED": Light Emitting Diode
19. "MSDS": Material Safety Data Sheets
20. "NEC": National Electrical Code (NFPA 70)
21. "NEMA": National Electrical Manufacturers Association
22. "NFPA": National Fire Protection Agency
23. "NIC": Not In Contract (work or equipment)

- 24. "OFCI": Owner-furnished contractor-installed; coordinate the integration of components furnished by the Owner; provide mounting hardware, cable, connectors, etc. to ensure proper integration of OFCI equipment
- 25. "OFE": Owner Furnished Equipment
- 26. "Owner": <name>
- 27. "Owner's Representative": <name>
- 28. "PDF": portable document format (electronic file format / *.pdf)
- 29. "Pigtail": a length of cordage having connectors at one end
- 30. "Provide": To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation
- 31. "UL": Underwriters Laboratories

1.4 SYSTEM DESCRIPTION AND PROJECT CONDITIONS

- A. In circumstances where the Specifications and Drawings conflict, the Drawings shall govern quantity and the Specifications shall govern quality.

1.5 SUBMITTALS

- A. Submit required submittals to the Architect in the quantities and formats as required under the general contract. In the absence of requirements, provide as described in the following with reference to quantity and format.
- B. Failure to comply with requirements in part or whole shall constitute grounds for non-review and/or rejection of resubmittal packages.
- C. Resubmittals: For resubmittals, include a cover letter that lists actions taken and revisions made to each product in response to the Engineer's submittal review comments. Lack of this actions-taken cover letter shall constitute grounds for non-review and/or rejection of resubmittal packages.
- D. Obtain written approval from the Engineer for the product data submittal, the shop drawing submittal, and other required pre-construction submittals prior to materials and equipment purchase order and prior to installation.
- E. Submittal Description: Product Data
 - 1. Electronically submit the product data submittal via cloud-based project management application (such as Proliance) or as a file transfer (such as Dropbox).

2. File Format:
 - a. File format shall be PDF, either as a single compiled PDF file or as a PDF portfolio.
 - b. PDF files should be produced from original electronic media, not scans of printed media. If scans from prints are the only option, annotate electronically, not on the prints prior to scanning.
 - c. Page size should be letter (8.5"x11").
3. Organization:
 - a. Organize the Content in the following order:
 - 1) Cover
 - 2) Table of Contents (TOC)
 - 3) Statement of compliance
 - 4) Product information
 - 5) Seismic calculations (as required)
 - b. Clearly and precisely indicate the submitted product and accessories by part number using an electronic annotation (arrow, rectangle, oval, etc.). Where the product data presents "part number builds", list the exact part number of the submitted products and accessories.
 - c. Add page numbers in numerical order with no gaps to each page that correctly correspond to the TOC.
 - d. Add bookmarks to the file to improve navigation.
4. Content:
 - a. Cover: Include a cover that clearly displays the following information:
 - 1) Owner name
 - 2) Project name and address
 - 3) Submittal name (e.g., "Product Data Submittal for Telecommunications Equipment Rooms")
 - 4) Project submittal number

- 5) Contractor's submittal number (discretionary)
- 6) Submittal date; format: Month Day, Year (e.g., "January 1, 2020")
- 7) Specification section numbers included in the submittal (e.g., "Section 271100")
- 8) Contractor name and contact information

- b. Table of Contents (TOC): Include a TOC that lists materials by section number, article and paragraph number. Add a brief product description (what it is, size or color or other optional features), manufacturer and part number. List the submittal page number per product. Example heading for TOC:

Section	Article	Paragraph	Description	Manufacturer	Part #	Page #
---------	---------	-----------	-------------	--------------	--------	--------

- c. Statement of Compliance: Include a "Statement of Compliance" letter or memorandum on the submitter's company letterhead from the highest ranking employee assigned to this project stating the submittal has been reviewed (quality control check) and is in full compliance with the requirements of the contract documents, and listing the submittal's contents. Wet sign (and stamped, if applicable) the letter.
- d. Product Information: Include manufacturer's technical data, product literature, "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary) that clearly describe the product's characteristics, physical and dimensional information, electrical performance data, materials used in fabrication, material color and finish, and other relevant information such as test data, typical usage examples, independent test agency information, and storage requirements. Include products listed in the specifications, at a minimum. Include relevant products that will be installed, which are not listed in the specifications.
- e. Seismic Calculations: Include structural calculations for anchorage and seismic restraint of floor-mounted equipment (such as racks, frames, cabinets), wall-mounted equipment (such as video display equipment, etc.), and overhead-mounted equipment (such as cable tray, overhead cable support, etc.) in conformance with CBC, Chapter 16. Calculations shall be based on fully loaded equipment and support systems. Calculations shall demonstrate that the equipment and support systems will remain attached to the mounting surface during and after experiencing seismic forces in conformance with the CBC. A Structural Engineer registered in the State of California shall prepare Structural Calculations and shall wet stamp and sign them. Obtain approval from approving agency for the calculations.

F. Submittal Description: Shop Drawings

1. Electronically submit the shop drawings submittal via cloud-based project management application (such as Proliance) or as a file transfer (such as Dropbox).
2. Format:
 - a. Use the same sheet size as the contract drawings.
 - b. Use the same title block as the contract drawings, modified to include contractor information.
 - c. Text: 3/32" - 1/8" high when plotted at full size.
 - d. Symbols should match those in the contract documents.
 - e. Screen background information.
 - f. Plot system components (symbols, outlet, devices, pathways, cable routes, etc.) and text using a heavier line weight sufficient enough to stand out against background information.
 - g. Scaling:
 - 1) Scale floor plans and reflected ceiling plans at 1/8"=1'-0"
 - 2) Scale enlarged room plans at 1/4"=1'-0"
 - 3) Scale wall elevations at 1"=1'-0"
 - 4) Scale rack elevations at 1"=1'-0"
3. Content:
 - a. Cover Letter: Accompany each shop drawing submittal with a cover letter stating that the shop drawings have been thoroughly reviewed by the Contractor and are in full compliance with the requirements of the contract documents. Have the person who prepared the submittal sign (and stamped, if applicable) the cover letter and include a drawing index.
 - b. Drawings: Shop drawing submittals shall consist of symbols list, point-to-point diagrams, block diagrams, riser diagrams, line diagrams, floor plans, reflected ceiling plans, enlarged room plans, wall and rack elevations, installation details, and other aspects of the system. Include detailed labeling examples for cables, outlets, termination apparatus, devices, equipment, etc.

- c. **Seismic Calculations:** Include structural calculations for anchorage and seismic restraint of floor-mounted equipment (such as racks, frames, cabinets), wall-mounted equipment (such as video display equipment, etc.), and overhead-mounted equipment (such as cable tray, overhead cable support, etc.) in conformance with CBC, Chapter 16. Calculations shall be based on fully loaded equipment and support systems. Calculations shall demonstrate that the equipment and support systems will remain attached to the mounting surface during and after experiencing seismic forces in conformance with the CBC. A Structural Engineer registered in the State of California shall prepare Structural Calculations and shall wet stamp and sign them. Obtain approval from approving agency for the calculations.

G. Submittal Description: As-Built Drawings

1. As-built drawings shall accurately represent actual installed conditions and shall incorporate modifications made during construction.
2. Electronically submit the as-built drawings submittal via cloud-based project management application (such as Proliance) or as a file transfer (such as Dropbox).
3. **Format:**
 - a. Electronic files shall include native format and plotted PDF files. The file names shall include the sheet number.
 - b. Use the same sheet size as the approved shop drawings.
 - c. Use the same title block as the approved shop drawings.
 - d. Text: 3/32" - 1/8" high when plotted at full size.
 - e. Use symbols identical to the symbols shown on the approved shop drawings.
 - f. Screen background information.
 - g. Plot system components (symbols, outlet, devices, pathways, cable routes, etc.) and text using a heavier line weight sufficient enough to stand out against background information.
4. **Content:**
 - a. Title Sheet, including symbols list and sheet index
 - b. Diagrams, such as (but not limited to) point-to-point diagrams, block diagrams, riser diagrams, line diagrams, and other diagrams that conceptually describe the system

- c. Floor Plans and Reflected Ceiling Plans: Scale plans at 1/8"=1'-0". Plans shall show:
 - 1) Locations and identifiers of telecommunications outlets
 - 2) Routes, types, sizes, and quantities of pathways (such as cable trays, conduits, hangers, and other pathways)
 - d. Enlarged Rooms Layouts: Applicable rooms: MDF, IDF. Room drawings shall show:
 - 1) Floor layouts – scaled at 1/4"=1'-0", showing dimensioned placement of equipment cabinets/frames, rack bays, etc.
 - 2) Overhead layouts – scaled at 1/4"=1'-0", showing dimensioned placement of overhead cable support (e.g., cable tray, cable runway, conduit sleeves, etc.)
 - 3) Rack elevations – scaled at 1"=1'-0", showing placement of termination apparatus and other equipment installed onto rack bays
 - 4) Wall Elevations – scaled at 1"=1'-0", showing dimensioned placement of termination apparatus (e.g., termination/crossconnect blocks)
- H. Submittal Description: Operation and Maintenance (O&M) Manual
- 1. Quantity and Media: Submit O&M Manual as described in Division 01. In the absence of requirements given, submit one packaged O&M Manual set and one electronic copy.
 - 2. Electronic Submission: Submit the product data submittal via cloud-based project management application (such as Proliance) or as a file transfer (such as Dropbox).
 - 3. Electronic Format:
 - a. File format shall be PDF, either as a single compiled PDF file or as a PDF portfolio.
 - b. PDF files should be produced from original electronic media, not scans of printed media. If scans from prints are the only option, annotate electronically, not on the prints prior to scanning.
 - c. Page size should be letter (8.5"x11") or full size for drawings.
 - d. Insert bookmarks to improve navigation through the file.

4. Printed Format:
 - a. Package contents in a 3-ring binder with front cover and spine clear pockets for insertion of the submittal information.
 - b. Page size should be letter (8.5"x11") or tabloid (17"x11") for drawings.
 - c. Include tabbed separators to improve navigation through the manual.
5. Content and Organization:
 - a. Cover, showing the following information
 - 1) Owner name
 - 2) Project name and address
 - 3) Manual name (e.g., "Operation and Maintenance Manual for Telecommunications Cabling System")
 - 4) Date; format: Month Day, Year (e.g., "January 1, 2020")
 - 5) Contractor name and contact information
 - b. Table of Contents (TOC)
 - c. Product information (the final approved product submittal and updates through construction)
 - d. As-built drawings (the final approved as-built submittal)
 - e. Seismic calculations (the final approved product submittal)
 - f. Warranty Information
 - 1) Warranty certificate from the manufacturer and the contractor
 - 2) Instructions on making a warranty claim during the warranty period
 - 3) Contact information during the warranty period
 - 4) Contact information beyond the warranty period for maintenance and related service
 - g. Manufacturer's instructions for system or component use
 - h. Instructions and requirements for proper maintenance (according to the manufacturer) and as to maintain warranty

1.6 QUALITY ASSURANCE**A. Manufacturer Qualifications**

1. Five continuous years, minimum, design and manufacture of the materials and equipment specified herein.
2. Manufacturer(s) of products and equipment specified herein shall demonstrate that they have a quality assurance program in place to assure that the specifications are met. Include in the program, at a minimum, provisions for:
 - a. Incoming inspection of raw materials
 - b. In-process inspection and final inspection of the cable product
 - c. Calibration procedures of test equipment to be used in the qualifications of the product
 - d. Recall procedures in the event that out of calibration equipment is identified.
3. Conform to government standards on quality assurance for applications within these specifications.

B. Contractor Qualifications

1. A current, active, and valid and C7 or C10 California State Contractors License
2. Five, minimum, continuous years of experience
3. Five, minimum, completed projects of similar scope and cost
4. Evidence of technicians qualified for the work (such as successfully completed training by the cabling vendor or BICSI, etc.)
5. IBEW / CWA union affiliation

C. Materials

1. Materials, support hardware, equipment, parts comprising units, etc., shall be new, unused, without defects and of current manufacturer, materials
2. Use specified products and applications, unless otherwise submitted and approved in writing.

D. Regulatory Requirements

1. Work and materials shall conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and shall conform

to the regulations of the State Fire Marshal, OSHA and the codes of the governing local municipalities. Work under Division 27 shall confirm to the most stringent of the applicable codes.

2. Provide the quality identified within these specifications and drawings when codes, standards, regulations, etc. allow Work of lesser quality or extent. The contract documents address the minimum requirements for construction.

E. Drawings

1. Follow the general layout shown on the contract drawings except where other work may conflict with the drawings.
2. Contract drawings for the work within this division are essentially diagrammatic within the constraints of the symbology applied.
3. Contract drawings do not fully represent the entire installation. Rather, they indicate the general route for pathways and cables and show general locations of outlets. Contract drawings might not expressly show every conduit, sleeve, hanger, etc.; regardless, a complete system is required.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery

1. Do not deliver products to the site until protected storage space is available.
2. Coordinate materials delivery with installation schedule to minimize storage time at jobsite.
3. Deliver materials in manufacturer's original, unopened, undamaged packaging and containers with identification labels (name of the manufacturer, product name and number, type, grade, UL classification, etc.) intact.
4. Immediately replace equipment damaged during shipping at no cost to the Owner, so as not to impact the construction schedule.

B. Storage and Protection

1. Store materials in clean, dry, ventilated space free from temperature and humidity conditions (as recommended by manufacturer) and protected from exposure to harmful weather conditions.
2. Comply with manufacturer's storage requirements for each product. Comply with recommended procedures, precautions or remedies as described in the MSDS as applicable.

3. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.
4. Storage outdoors covered by rainproof material is not acceptable.
5. Provide heat where required to prevent condensation or temperature related damage.

C. Handling

1. Handle materials and equipment in accordance with manufacturer's written instructions. Handle with care to prevent damage, breakage, denting, and scoring.
2. Do not install damaged materials and equipment. Replace damaged equipment at no cost to the Owner.

1.8 SCHEDULING

- A. Unless otherwise specified, the construction schedules of the Sections within Division 27 may be combined into a single, overall schedule.
- B. Do not proceed without written approval from the Owner or Owner's Representative for schedule of this Work.

1.9 PROJECT MANAGEMENT AND COORDINATION

A. Project Management and Coordination Services

1. Provide a project manager for the duration of the project to coordinate this Work with other trades. Coordination services, procedures and documentation responsibility include, but are not limited to, the items listed in this section.
2. Review of Shop Drawings Prepared by Other Subcontractors:
 - a. Obtain copies of shop drawings for equipment provided by others that require telecommunication service connections or interface with work.
 - b. Thoroughly review other trades' shop drawings to confirm compliance with the service requirements contained in the Division 27 contract documents. Document discrepancies or deviations as follows:
 - 1) Prepare memo summarizing the discrepancy
 - 2) Submit a copy of the specific shop drawing, indicating via cloud, the discrepancy

- c. Prepare and maintain a shop drawing review log indicating the following information:
 - 1) Shop drawing number and brief description of the system/material
 - 2) Date of the review
 - 3) Name of the individual performing the review
 - 4) Indication if follow-up coordination is required
- 3. Should existing conditions prohibit construction progress as submitted and approved, coordinate the adjusted installed locations with the other contractors (AV, electrical, etc).

B. Concurrent Installation

- 1. The network will be installed concurrent with the work of Division 27. Coordinate your work with the Owner's/network integrator's work. For example, coordinate scope and dates for rack and cabling (terminations) readiness to allow the network integrator to plan and schedule installation of the network equipment (for example, access switches).

C. Role of the Engineer

- 1. The network will be installed concurrent with the work of Division 27. Coordinate your work with the Owner's/network integrator's work. For example, coordinate scope and dates for rack and cabling (terminations) readiness to allow the network integrator to plan and schedule installation of the network equipment (for example, access switches).

D. Use of Electronic Drawing Files

- 1. Should the Contractor require the Engineer's electronic files to produce shop drawings and/or as-built drawings, the Engineer will require the Contractor sign a file release agreement.

1.10 WARRANTY

- A. As a minimum, warrant products and labor provided will, under normal use and service, be free from defects and faulty workmanship for period of 1 year from the date of acceptance. During the warranty period the entire system shall be kept in operating condition at no additional material or labor costs to the Owner. Also refer to specific sections for additional warranty requirements that supersedes the project's minimum warranty.

- B. Render service within 24 hours of system failure notification. Note deviations or improvements to this service at the time of bid and obtain written acceptance from the Owner, or Owner's Representative.
- C. Manufacturers of the major system components shall maintain a replacement parts department and provide testing equipment when needed. Provide complete replacement parts within 24 hours during the warranty period.
- D. Conformance to certain government standards on quality assurance may be required for some applications outlined in these specifications.

PART 2 PRODUCTS**2.1 GENERAL**

- A. Materials used shall present no environmental or toxicological hazards as defined by current industry standards and shall comply with OSHA and EPA standards, other applicable federal, state, and local laws.
- B. Product numbers are subject to change by the manufacturer without notification. In the event a product number is invalid or conflicts with the written description, notify the Engineer in writing prior to ordering the material and performing installation work.

2.2 PRODUCT SUBMITTAL AT TIME OF BID

- A. At the time of bid, include a list of major products in the Contract documenting the intended cabling system solution, AV equipment, etc.

2.3 SUBSTITUTIONS

- A. Conform to the substitutions requirements and procedures outlined in Division 01.
- B. Only one substitution for each product specified will be considered.
- C. Where products are noted as "or equal", a product of equivalent design, manufacture, and performance will be considered. Submit product data (product information, catalog cuts, pertinent test data, etc.) to substantiate that the product is in fact equivalent to that specified. The burden of proof that the substituted product is equivalent to the specified product rests with the Contractor. Whenever material, process or equipment is specified in accordance with an industry specification (ANSI, TIA, etc.), UL rating, or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, submit supporting test data to substantiate compliance.
- D. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the contract documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be

approved as substitutions to that specified when "or equal" follows the manufacturers' names or model number(s).

- E. When the Engineer accepts a substitution in writing, it is with the understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Do not provide substituted material, processes, or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor.
- F. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the work, or from provisions of the specifications.
- G. Pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, subcontractor's or another Contractor's work.

PART 3 EXECUTION

3.1 PERMITS AND INSPECTIONS

- A. Obtain and pay for permits and inspections required for the work.
- B. Furnish materials and execute workmanship for this work in conformance with applicable legal and code requirements.
- C. Perform tests required herein, or as may be reasonably required to demonstrate conformance with the Specifications or with the requirements of legal authority having jurisdiction.
- D. Arrange and pay for review/inspection from compliance officials responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with requirements of reference codes indicated herein.

3.2 EXAMINATION

- A. Verify existing conditions, stated under other sections, are acceptable for installation in accordance with manufacturer's instructions.
- B. Verify cable routes and lengths prior to pulling cables. Immediately notify the Engineer if actual lengths are expected to exceed project's maximum length requirement(s).

3.3 FIELD QUALITY CONTROL

- A. Staffing: Provide a qualified foreman to supervise the crew performing the work and who is present at the job site at times work is being performed.

- B. Construction Meetings: Participate in construction coordination meetings throughout the course of construction to review the progress and to resolve issues and conflicts. Prepare and distribute meeting agenda for telecommunication issues prior to, and meeting notes after meetings, in a format acceptable to the Owner. Publish meeting notes within 3 business days following the meeting.
- C. Scheduling: Perform the work within the approved construction schedule. Keep the construction schedule current, based on the results of the construction meetings. At minimum, schedule shall document critical due dates, tasks, and milestones. Submit revised schedules for approval within 3 business days whenever there are modifications.
- D. Inspection: Inspect the work after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion ready for inspection. Document completion and inspection as required.

3.4 INSTALLATION

- A. Complete work in conformance to applicable federal, state and local codes, and telephone standards.
- B. Complete work in a neat, high-quality manner, relative to common industry practices, and in accordance to NECA "Standard of Installation".
- C. Coordinate the entire installation throughout the construction team (general contractor and subcontractors).
- D. Manufacturer's Instructions: Comply with manufacturer's published installation instructions, product data, product technical bulletins, product catalog, and other instructions for installation. Maintain a file on the jobsite of MSDSs for each product delivered to jobsite packaged with an MSDS.
- E. Adjusting: Make changes and revisions to systems to optimize operation for final use. Make changes to systems such that defects in workmanship are corrected and completed systems pass the minimum test requirements.
- F. Protection: Protect installed products and finish surfaces from damage during construction.
- G. Repair/Restoration: Replace or repair work completed by others that you deface or destroy. Pay the full cost of this repair/replacement. Repair defects prior to system acceptance.

3.5 CLEANING

- A. Remove temporary coverings and protection of adjacent work areas. Remove unused, excess, and left over products, debris, spills, or other excess materials. Remove installation equipment.

- B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.
- C. Repair or replace damaged installed products.
- D. Legally dispose of debris.
- E. Clean installed products in accordance with manufacturer's instructions prior to Owner's, or Owner's Representative's, punch walk.

3.6 PUNCH WALKS AND PUNCH LISTS

- A. Punching the work of individual sections of Division 27 may be combined when noted so.
- B. Execute a punch walk with the Engineer and the Owner or Owner's Representative to observe Work.
- C. Develop a punch list for items needing correction. Issue this punch list to Engineer.
- D. Correct the Work as noted on punch list.
- E. Execute follow up punch walk with the Engineer and the Owner or Owner's Representative to verify punch list items have been corrected.

3.7 SYSTEM ACCEPTANCE

- A. Complete corrections (punch list items) prior to submitting acceptance certificate.
- B. On completion of the acceptance test, submit system acceptance certificate to the Owner or Owner's Representative requesting their signature and return of the certificate. Issue copies of the signed certificate back to the Owner or Owner's Representative with copy to the Engineer.

3.8 TRAINING

- A. After acceptance, schedule a time convenient with the Owner, or Owner's Representative, for instruction in the configuration, operation, and maintenance of the system.
- B. Refer to individual sections within Division 27 for additional training requirements.

END OF SECTION

SECTION 27 0526

COMMUNICATIONS BONDING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Bonding of support infrastructure and equipment to approved grounding point for telecommunications.
- B. Related Sections
 - 1. Comply with the Related Sections requirements of Section 270000.
 - 2. Section 260526, "Communications Grounding Backbone System"
 - 3. Section 271100, "Communications Rooms"

1.2 REFERENCES

- A. Comply with the References requirements of Section 270000.
- B. In addition or particular 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), particularly the following Articles:
 - a. Article 250: Grounding
 - b. Article 770: Optical Fiber Cables and Raceways
 - c. Article 800: Communications Systems
 - 2. NFPA 70, "National Electrical Code", particularly the following Articles:
 - a. Article 250: Grounding
 - b. Article 770: Optical Fiber Cables and Raceways
 - c. Article 800: Communications Systems
 - 3. Underwriters Laboratories, Inc. (UL) UL 467: Grounding and Bonding Equipment

4. Building Industry Consulting Services International (BICSI) "Telecommunications Distribution Methods Manual" (TDMM), 12th Edition (or later), particularly Chapter 9 "Bonding and Grounding (Earthing)"
5. Telecommunication Industry Association (TIA) ANSI/TIA-607-B (or later), "Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises"
6. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. IEEE 467, "IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems"
 - b. IEEE P1100, "IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems"

1.3 DEFINITIONS

- A. Definitions as described in Section 270000 shall apply to this section.
- B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:
 1. "Bond" (v): to provide a TBC (sized per BICSI TDMM 12th Edition Chapter 9) and appropriate connecting terminals/connectors and associated hardware (screws, bolts, washers, nuts, etc.)
 2. "CM": Circular Mil.
 3. "GE": Grounding Equalizer
 4. "MBRGB": Main Building Reference Grounding Busbar
 5. "SRG": Signal Reference Grid
 6. "TBB": Telecommunications Bonding Backbone
 7. "TBC": Telecommunications Bonding Conductor
 8. "TEGS": Telecommunications Equipment Grounding System
 9. "TGB": Telecommunication Grounding Busbar
 10. "THHN": Thermoplastic High Heat-resistant Nylon-coated
 11. "TMGB": Telecommunication Main Grounding Busbar

12. "TR": Telecommunications Room**1.4 SYSTEM DESCRIPTION****A. Work provided under another Section**

1. TEGS: The TEGS (or grounding backbone) includes busbars, backbone conductors, and connecting components (lugs, clamps, exothermic welds, etc.) to provide a low impedance path to ground for stray voltages or spurious signals present on telecommunications media and equipment. Refer to Section 260526 for detailed information regarding the TEGS. The TEGS consists of the following:
 - a. TMGB: The TMGB is located in the Main Telecommunications Room/ Entrance Facility Room. The TMGB has a connection to the following:
 - 1) Structural steel, via TBC
 - 2) BCT, via direct connection
 - 3) Ground bushings installed on each entrance conduit within the Entrance Facility, via TBC
 - 4) Electrical panels (dedicated to the room), via TBC
 - 5) Each TBB, via direct connection

B. Base Bid Work

1. Furnish materials, accessories, fasteners, etc., and provide the labor and associated services necessary to bond telecommunications support infrastructure and equipment to approved grounding point. Coordinate the installation through the General Contractor.
2. The work under this section shall comply with BISC TDMM 12th Edition Chapter 9.
3. Bonding connections shall be intentional and visually verifiable. Permanent bonding connections shall be irreversible.
4. Approved grounding points for telecommunications include the following:
 - a. TEGS: the TEGS present within each telecommunications room as a TGB.

5. Provide bonding within telecommunications rooms between the approved grounding points for telecommunications (e.g., busbars) and the following components:
 - a. Rack bay: equipment racks, vertical management sections, frames, frame bays, cabinets, and other similar support infrastructure
 - b. IT/Server Cabinets
 - c. Overhead cable support (e.g., cable tray, basketway, runway) and vertical cable support (e.g., wire mesh cable tray, runway)
 - d. Termination apparatus (e.g., wall-mounted 110 blocks)
 - e. Conduit: bond metallic conduits longer than 1 meter including ground bushings
 - f. Exit pathways
6. TBC conductor material within rooms shall be THHN (or approved similar). Bare copper may be allowed as the bonding conductor for items such as cable tray.
7. TBC sizing: Refer to drawings for TBC sizing.
8. Rack Bay Bonding: Refer to drawings for diagrammatic requirements for approved rack bay bonding.
9. Server Cabinet Bonding: Refer to drawings for diagrammatic requirements for approved server cabinet bonding.
10. Overhead and Vertical Cable Support Bonding: Refer to drawings for diagrammatic requirements for approved cable support bonding.
11. Termination Apparatus Bonding
 - a. Refer to drawings for diagrammatic requirements for bonding the termination apparatus.
12. Conductor Connections
 - a. For conductor-to-conductor or conductor-to-object connection, compression connectors will be accepted, subject to submittals. Exothermic weld will also be accepted.
13. Labeling
 - a. Provide 1 label at end of each TBC connected to TMGB.

14. Testing

- a. Test bonding to ensure connection integrity and minimum resistance performance.
- b. Perform a 2-point resistance measurement using an earth grounding resistance test set configured for a continuity test. Connect meter leads to the TMGB (not at the TBC's terminal) and to the object being bonded (not at the TBC's terminal). The maximum resistance value shall not exceed 0.1 Ohms.
- c. For bonding configurations with multiple objects (such as equipment racks in a string configuration), test each object to ensure connection integrity.

1.5 SUBMITTALS

- A. Comply with Submittal procedural, quantity, and format requirements of Section 270000.
- B. Submittal Requirements at Start of Construction:
 - 1. Product Data Submittal
- C. Substitutions
 - 1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270000.

1.6 QUALITY ASSURANCE

- A. Comply with Quality Assurance requirements of Section 270000.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Delivery, Storage and Handling requirements of Section 270000.

1.8 WARRANTY

- A. Warrant Work to perform as described within this Section for a period of 1 year. Correct deficiencies within 24 hours of notification.

PART 2 PRODUCTS**2.1 BONDING CONDUCTOR (FOR TBC)**

- A. Conductor: stranded copper, 6 AWG or larger (sized as required per Part 1)
- B. Insulation: Low smoke, green in color

- C. Print on the Insulation: insulation grade, conductor gauge, and applicable UL jacket listings
- D. Type THHN, or approved similar

2.2 CONNECTORS

- A. General: Connectors shall be UL Listed for the purpose used
- B. Lug, 2-hole, Compression Type
 - 1. Application: conductor-to-surface (e.g., TBC-to-busbar or TBC-to-rack)
 - 2. Standard (or long) compression-type barrel lug, 2-hole (1/4" dia. x 5/8" on center)
 - 3. Manufacturer:
 - a. Panduit
 - 1) #LCD6-14A-L, compression lug for #6 AWG conductor
 - b. Thomas & Betts
 - 1) #54205, compression lug for #6 AWG conductor
 - c. Or equal
- C. Lug, Mechanical Type
 - 1. Application: conductor-to-surface (e.g., TBC-to-busbar or TBC-to-rack)
 - 2. Screw termination type lug, 2-hole (1/4" dia. x 5/8" on center)
 - 3. Manufacturer:
 - a. Panduit
 - 1) #HL4-2-X, screw termination lug, for #6 AWG conductor
 - b. Or equal
- D. "C" Tap, compression type
 - 1. Application: conductor-to-conductor connection (e.g., run-to-tap off)
 - 2. C-type copper thick wall compression tap

3. Manufacturer:

a. Panduit

- 1) #CTAPF4-12-C; CTAP for #6 AWG run –to– #6 AWG tap
- 2) #CTAPF2-12-C; CTAP for #2 AWG run –to– #6 AWG tap
- 3) #CTAPF1/0-12-L; CTAP for 1/0 AWG run –to– #6 AWG tap
- 4) #CTAPF2/0-12-Q; CTAP for 2/0 AWG run –to– #6 AWG tap
- 5) #CTAPF3/0-12-Q; CTAP for 3/0 AWG run –to– #6 AWG tap

b. Or equal

E. Split-Bolt, Mechanical Type

1. Application: conductor–to–wire mesh cable tray connection
2. Type: split-bolt mechanical connector
3. Manufacturer:

a. Panduit

- 1) #SBC3-C, split-bolt connector for #6 AWG conductor

b. Or equal

2.3 LABELS FOR TBCS

- A. Labels shall be machine-printable (such as laser printer, thermal transfer printer, or hand-held printer).
- B. Labels shall be adhesive-backed. Labels shall have a self-laminating feature.
- C. Printable Area: 2" x 0.5", minimum.
- D. Color (print area): White.
- E. Manufacturer:

1. Panduit

- a. #LJSL7-Y3-1; laser/ink jet labels for wire diameters 0.16"-0.32", white
- b. #LJSL8-Y3-1; laser/ink jet labels for wire diameters 0.31"-0.69", white

2. Or equal

2.4 MISCELLANEOUS

A. Wire Clamp

1. Application: non-metallic wire clamp to support and hold in place bonding conductors
2. Manufacturer:
 - a. Panduit
 - 1) #CCS25-S8-C; nylon clamp, for 6 AWG (0.25" max diameter)
 - 2) #CCS38-S8-C; nylon clamp, for 4 to 2 AWG (0.38" max diameter)
 - b. Richco Inc. #N4B-BLK; nylon clamp, black, for 6 AWG (0.25" diameter)
 - c. Or equal

PART 3 EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Prior to the start of work of this section, examine communications rooms and TEGS for completeness, compatibility with the work of this section, and readiness for connections with the work of this section.

3.3 INSTALLATION

A. TBCs:

1. Install TBCs in a manner that will protect them from damage.
2. Install TBCs with no bend sharper than 8-inch radius.
3. Secure TBCs in place using approved wire clamps or similar management/attachment components.
4. Route TBCs in the shortest possible path and place TBCs with as few bends as possible. Route on outside edges of wall plywood. Do not cut across the middle/usable area of the plywood (taking space away from wall mounted

equipment/apparatus). When bending, do so based on a 1-foot minimum bend radius.

5. Do not route TBCs through fully encircled metallic apparatus, such as through wire mesh cable tray or through the rungs of cable runway.
6. Do not place TBCs in ferrous metallic conduit. If it is necessary to place TBCs in ferrous metallic conduit, bond the conductors to each end of the conduit using a grounding bushing, a 6 AWG (minimum size) pigtail, and an irreversible conductor-to-conductor connector (per TIA-607-B, 7.4.1).

B. At Connection Points:

1. Thoroughly clean surfaces prior to attaching lugs (or other connectors).
2. At painted surfaces (such as racks, cabinets, cable tray, runway, etc.), remove paint to completely expose metal – enough for the connector to make 100% contact by area with the surface. Apply antioxidant joint compound to the surface prior to attaching lugs (or other connectors).
3. At non electrotin-plated busbars, apply antioxidant joint compound to the surface prior to attaching lugs (or other connectors).
4. Attach lugs using appropriately sized bolt, flat washer, Belleville or split washer, and nut.
5. Torque connections.

3.4 LABELING

A. General Requirements

1. Labeling, identifier assignment, and label colors shall conform to TIA-606-B Administration Standard or as approved by Owner's Representative before installation.
2. Permanently label TBCs. Affix label as close as practical to each end of the conductor. Affix label such that the label's text is easily and fully visible by a technician in a normal stance.

B. Label Format

1. Labels shall be permanent and shall fully wrap around conductors with a self-laminating feature to protect label text/markings.
2. Text shall be machine-generated (hand written labels will not be accepted).

C. Identifier Format

1. Identifier format for TBC attached to TMGB: *fs*-TMGB/*object*, where:

- a. “*fs*” = space identifier (refer to 271100 for space identifier)
- b. “*object*” =
- c. Example: “1A–TMGB/RackBay”

D. Label for BCT, TBB, and/or GE: Provide a label at each end of the conductor. The label shall read “BONDING CONDUCTOR FOR TELECOMMUNICATIONS – DO NOT DISCONNECT”.

3.5 FINAL INSPECTION AND CERTIFICATION

- A. Punch the work of this section compliant to the requirements of Section 270000. Punching the Work of this Section may be combined with punching the telecommunications rooms.
- B. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION

SECTION 27 0528

COMMUNICATIONS BUILDING PATHWAYS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Pathway systems within buildings to support telecommunications, and other signal (low voltage) systems - namely cable hangers and rated sleeves.
- B. Related Sections
 - 1. Comply with the Related Sections paragraph of Section 270000.
 - 2. Section 270533, "Communications Conduits and Boxes"
 - 3. Section 270526, "Communication Bonding"
 - 4. Section 271100, "Communication Rooms"

1.2 REFERENCES

- A. Comply with the References requirements of Section 270000.
- B. In addition to those codes, standards, etc., listed in 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. Underwriters Laboratories (UL)
 - a. UL 5, "Standard for Surface Metal Raceways and Fittings"
 - b. UL 5A, "Nonmetallic Surface Raceways and Fittings"
 - c. UL 5C, "Standard for Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits"
 - 2. Underwriters Laboratories (UL)
 - a. UL 467, "Grounding and Bonding Equipment"

1.3 DEFINITIONS

- A. Definitions of Section 270000 apply to this Section.

- B. In addition to those Definitions of Section 270000, the following list of terms as used in this Section defined as follows:
1. “Cable Hanger”: A cable support component often shaped (section view) similar to the letter J (thus gaining the nickname “J hanger”), metallic (most often steel) or non-metallic (most often thermoplastic); available in different sizes (to support different quantities of cables) and with different attachment hardware suiting multiple installation methods (e.g., wire support, beam flange clip, etc.).
 2. “Cable Strap”: A flexible cable support that generally ‘wraps’ around cables and ‘latches’ into a fixed position, most often textile, available in different sizes (to support different quantities of cables) and with different attachment hardware suiting multiple installation methods (e.g., wire support, beam flange clip, etc.).
 3. “Enclosure”: The case or housing of apparatus, or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage.
 4. “J Hanger” and “J Hook”: nickname for cable hanger
 5. “NEC”: National Electrical Code (NFPA 70)
 6. “NFPA”: National Fire Protection Agency
 7. “UL”: Underwriters Laboratories

1.4 SYSTEM DESCRIPTION

A. Base Bid Work:

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 pathways.

B. Linear Ring Pathway System

1. Provide pathway system in accordance with requirements of the CEC, with recognized industry practices, and with manufacturer’s instructions. Provide materials (accessories, hardware, etc.) required for a complete system.
2. Provide dedicated supports for system at no greater than 48” (1200mm) on center, per a given route. Supports shall consist of 3/8” (9.5mm) threaded rod with appropriate hardware (nuts, washers, etc.). Do not share threaded rod with other trades. Do not support from ductwork, piping, or other equipment hangers.
3. Provide UL classified connector bolt type splice kits for joining sections, supplied by the same manufacturer.

4. Bond system to approved ground per CEC 70 Article 250. Provide approved connection bolt to join system sections such that the spine of the system is considered a bonding jumper.
5. Properly bond system to approved ground, as per CEC 70 Article 250. Provide materials required for proper bonding.

C. Cable Hanger Systems

1. Provide a complete cable hanger system compliant with requirements of the CEC (in particular, compliant with the requirements of Article 300.11), in accordance with NECA's "Standards of Installation" (pertaining to general electrical installation practices), compliant with applicable portions of NFPA 70B, in accordance with manufacturer's instructions, and in accordance with recognized industry practices. A "complete system" shall include cable hangers, supports, anchors, fasteners, and other required accessories.
2. Provide cable hangers between telecommunications rooms and outlet locations at intervals up to 48 inches on center per a given route, at transitions downward/upward, and within 24 inches of an outlet stub/outlet location.
3. Supports:
 - a. Provide dedicated supports for cable hangers. Do not support cable hangers on ceiling grid support wires. Do not share supports with other trades. Do not support hangers from ductwork, piping, or other equipment hangers.
 - b. Support Wires:
 - 1) Support wires shall consist of #12 drop wire (or as approved) with integral clip and fastener (such as power-actuated deck pin, beam flange, or other fastener appropriate for the use).
 - 2) Secure support wires at both ends in accordance with CEC.
 - c. Support Rods:
 - 1) Support rods shall consist of 1/4 inch (6.3mm) or 3/8 inch (9.5mm) threaded or smooth rod and concrete anchor or beam flange clip or angled flange clip (as required for attachment to the building structure).
4. Clearances (minimum):
 - a. From fluorescent light fixtures, or other EMI sources = 6 inches (150 mm)
 - b. From any motor = 48 inches (1,220mm)

- c. From flue, hot water, steam line or other non-insulated heat sources = 12 inches (300 mm)

D. Fire Rated Sleeves

1. Provide complete fire rated sleeve systems where shown on the drawings and where cables penetrate rated walls, in accordance with ASTM E814 (UL1479). Complete shall include sleeves, brackets, frames, plates, etc, and other required accessories necessary for a complete installation according to UL System drawings.
2. Provide complete fire rated sleeve systems equal to (or greater than) the F rating of the barrier in which the device is installed.
3. Provide a system label at each penetration instance.

E. Surface Raceway

1. Provide a complete surface raceway system in accordance with NEC Article 386 where required by manufacturer's installations. Complete shall include base and cover straight sections, couplers, corners, 'T' junctions, feed connectors, compartment dividers, end caps, and hardware required for a fully enclosed pathway system that fully houses and conceals cables and wires. Refer to Drawings for locations and routes.
2. Surface raceway shall be mechanically and electrically continuous. Bond surface raceway system to approved electrical ground in accordance with NEC Article 250 and ANSI-J-STD-607-A. Provide bonding straps where necessary to assure electrical continuity.
3. Surface raceway shall have a minimum two inch radius control at all bend points.
4. Coordinate raceway lengths with building walls, counter, and other actual field conditions. Raceways mounted above benches and counters shall align with each end of bench or counter, within 1/16-inch tolerance.
5. Finish:
 - a. Paint surface raceway system to match existing walls.
 - b. Touch-up any marks, blemishes or other finish damage suffered during installation.

F. Spiral Wrap

1. Provide spiral wrap to support and dress cables from feed pathways to the point where the cables enter the furniture system.

1.5 SUBMITTALS

- A. General: Conform to Submittal requirements as described in Section 270000.
- B. Quantity: Furnish quantities of each submittal as noted in Section 270000.
- C. Submittal Requirements Prior to the Start of Construction:
 - 1. Product Data Submittal, showing product dimensions, fabrications materials, fabrication details, knockout sizes and locations, capacities, finishes, and accessories
 - 2. Shop Drawings Submittal, consisting of proposed changes to pathways (routes, types, sizes, etc.) compared to the contract documents
 - 3. Seismic Calculations for Anchoring and Bracing: Submit seismic calculations for support systems in conformance Section 270000. Calculations shall be prepared and signed by a Structural Engineer registered in the state of California. If used, specify proof loads for drilled-in anchors.
- D. Submittal Requirements at Close Out:
 - 1. As-Built Drawings, showing the routes/locations, dimensions, types, sizes, quantities, etc., of pathways/pathway devices.
 - 2. O&M Manual, including as-builts, a parts list, repair information, and detailing ongoing maintenance requirements
- E. Substitutions
 - 1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270000.

1.6 QUALITY ASSURANCE

- A. Comply with Quality Assurance requirements of section 270000.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Delivery, Storage and Handling requirements of section 270000.

1.8 WARRANTY

- A. Comply with Warranty requirements of section 270000.

PART 2 PRODUCTS

2.1 HANGERS AND STRAPS

- A. Application: Suitable for indoor installation within ceiling space for the support of communications cables.
- B. Hanger shall be rated for use in air handling space.
- C. Hangers shall contain a closing loop, retainer, or latch to prevent cables from falling off the hanger.
- D. Manufacturer:
 - 1. CEAS "Stiffy" low voltage supports (such as Figure 200 series)
 - 2. Eaton B-Line
 - a. #BCH21-W2; for drop wire installation
 - b. #BCH32-W2; for drop wire installation
 - c. #BCH21; for wall installation
 - d. #BCH32; for wall installation
 - 3. Erico
 - a. #CAT12 (or variation per installation method); cable hanger
 - b. #CAT21 (or variation per installation method); cable hanger
 - c. #CAT32 (or variation per installation method); cable hanger
 - d. #CAT425 (or variation per installation method); cable strap
 - 4. Panduit
 - a. #JMJD2-X20
 - 5. Or equal

2.2 DROP WIRE

- A. Application: Suitable for indoor installation within ceiling space into structure above (e.g., deck or slab) for the support of cable supports such as cable hangers.
- B. Listings: UL 2043, for use in air handling spaces

- C. Drop wire shall be equipped with pre-mounted ceiling clip, fastening pin, and pre-tied wire. Pin shall be 7/8". Wire shall be 12 gauge.
- D. Manufacturers:
 - 1. Hilti #CC27 X-AL-H22P8T x ft. PT (100); drop wire assembly, "X" for length
 - 2. Armstrong #7891
 - 3. Dottie #CWC
 - 4. Garvin Industries
 - 5. Oregon Wire Products
 - 6. Or Equal

2.3 DROP ROD

- A. Application: Suitable for indoor installation within ceiling space into building structure above (e.g., deck or slab) for the support of cable supports such as cable hangers.
- B. Listings: UL 2043, for use in air handling spaces
- C. Zinc plated for corrosion resistance
- D. Manufacturers:
 - 1. CEAS #01014801; "Stiffy" straight rod, 1-1/4" power-actuated pin, 48 inches (or configured as required per instance)
 - 2. Or equal

2.4 FIRE RATED SLEEVE

- A. Application: Suitable as a sleeve for cables to pass through a full-height partition or floor, and as a through-penetration fire stop system maintaining the fire rating of the penetrated partition.
- B. Sleeve system shall be tested in accordance with ASTM E 814 (ANSI/UL1479).
- C. Sleeve system shall be UL Listed and shall bear a UL Classification marking.
- D. Sleeve system shall match (or exceed) the partition's/floor's F and T rating.

E. Manufacturers:

1. Specified Technologies Inc (STI)
 - a. #EZDP44; "EZ Path Series 44" 4-inch square sleeve kit

2.5 SURFACE RACEWAY – SINGLE CHANNEL

- A. Application: Pathway system specifically designed and intended for surface-mounting to walls that house, route, and protect communications (and other signal) wiring and, as applicable, power wiring, and present communications (and other signal) and power services via standard receptacles.
- B. Material: Raceway's base, cover, couplers, and end plates shall be fabricated from cold rolled steel, 0.094 inch thickness minimum.
- C. Size: Raceway size and length as shown on Drawings or, if not expressly shown, as required for the intended use.
- D. Fittings: Boxes, extension rings, couplings, elbows, and connectors shall be designed for use with raceway system.
- E. Finish: Primed and finished with power coated or similar 'paintable' finish.
- F. Raceway shall be UL listed and labeled as such.
- G. Assembly: Installed and fully assembled raceway shall fully house and conceal cables and wires, shall hold cables and wires securely in place (such as wire retention clips), shall accept the communications connectors as specified in Section 271513, shall accept wiring devices (e.g., NEMA 5-20R or similar) as specified in Division 26.
- H. Double compartment / Two-channel raceway shall come factory pre-assembled, pre-cut and complete, including bases, covers, end plates, compartment dividers, wiring, receptacles, fittings and connections as required. U.L. labeled.

2.6 SPIRAL WRAP

- A. Application: Suitable for an indoor installation for the support of telecommunications cables from a feed pathway to furniture systems, or similar.
- B. Material shall be flame retardant polyethylene (UL94V-0), or equivalent.
- C. Color: Black.
- D. Size: As required to support the given cable bundle size (e.g., 3/4" minimum).

E. Manufacturers:

1. Panduit
2. Or equal

PART 3 EXECUTION**3.1 GENERAL**

- A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Prior to starting the work of this section, examine areas to receive pathways systems to verify conditions are ready for work and to verify conformance with manufacturer and specification tolerances. Notify the Owner's Representative in writing of conditions that would adversely affect the installation, or subsequent utilization, of the system. Do not proceed with installation until unsatisfactory conditions are corrected.
- B. Prior to installation, plan routes and locations of pathway systems and coordinate with other trades (ductwork, plumbing, electrical raceways, wall construction, ceilings, etc.). Pathway systems shall not unnecessarily cross other trade's work, shall not prevent removal of ceiling tiles or panels, and shall not block access to mechanical or electrical equipment. Provide offsets as required to avoid obstruction of pathway systems with other trades.

3.3 INSTALLATION**A. Linear Ring Pathway System**

1. Install the system compliant to applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.
2. Install system at locations indicated on the drawings. Routes are diagrammatic in nature. Field verify route prior to installation.
3. Install system a minimum of 6" (150mm) from light fixtures, or other EMI sources. Install system between 6" (150mm) and 12" (300mm) above ceiling grid.
4. Properly bond system to approved ground, as per CEC.

B. Hangers and Straps

1. Install hangers so they are accessible through the ceiling grid and are not blocked by other building infrastructure.

2. Install hangers above ceiling grid to result in cables sag 6 to 12 inches (150 to 300 mm), minimum, above ceiling grid. Cables shall not rest on the ceiling grid and/or ceiling tiles.
3. Where hangers have loops/retainers, close loop/retainer (latch after cable installation).

C. Fire Rated Sleeve

1. Install the sleeves in strict accordance with the UL System drawing, with the approved shop drawings, and with the equipment manufacturer's instructions.
2. Framed Walls – Pre-Framed and Cut-In
 - a. Coordinate location of penetration with other trades such as framing (wall studs), electrical (lighting), mechanical (ducts), and other trades.
 - b. For cut-in instances, cut wallboard to fit rated sleeve system – no more wallboard than is necessary to fit the system.
 - c. Apply the factory-supplied gasket prior to the installation of the wall plates.
 - d. Secure wall plates to sleeves per the equipment manufacturer's recommendations.
3. Affix a label at each fire sleeve location onto the wall or floor – within 2 to 3 feet. Place label in a location that will not be obscured after cables get installed through the sleeve. Label shall describe the system's applicable ratings, such as F, T, and L ratings.

D. Surface Raceways

1. Install surface raceway in accordance with CEC Article 352 and in accordance with ANSI/TIA-569-B.
2. Install surface raceway systems free from dents, bruises or deformations. Remove and replace any damaged products with new undamaged material.
3. Securely support surface raceway straight sections at intervals not exceeding 10 feet (3m) or in accordance with manufacturer's installation sheets. Securely fasten together straight sections and fittings using manufacturers' instructions and approved couplings and/or fasteners.
4. Install surface raceway level, plumb, and parallel/perpendicular to surfaces or exposed structural members. Follow surface contours where possible.
5. Use flat-head screws to fasten base to surfaces/substrate.

6. Close unused raceway openings.
7. Vacuum clean surface raceway after installation.

3.4 FINAL INSPECTION AND CERTIFICATION

- A. Punch the Work of this Section compliant to the requirements of Section 270000.
- B. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION

SECTION 27 0533

COMMUNICATIONS BUILDING PATHWAYS – CONDUITS AND BOXES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Pathway systems within buildings consisting of conduit and boxes (outlet, device, pull, and other boxes) to support telecommunications, and other signal (low voltage) systems
- B. Related Sections
 - 1. Comply with the Related Sections paragraph of Section 270000.
 - 2. Section 260533, "Raceways and Boxes for Electrical Systems"
 - 3. Section 270526, "Communication Bonding"
 - 4. Section 271100, "Communication Rooms"

1.2 REFERENCES

- A. Comply with the References requirements of Section 270000.
- B. In addition to those codes, standards, etc., listed in 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. American National Standards Institute (ANSI)
 - a. ANSI C80.3, "Specifications for Electrical Metallic Tubing"
 - 2. ASTM International
 - a. ASTM A123, "Standard Specification of Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products"
 - b. ASTM A653, "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process"
 - c. ASTM D1654, "Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments"

- d. NEMA FB 1, "Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable"
 - e. NEMA OS 1, "Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports"
 - f. NEMA OS 3, "Selection and Installation Guidelines for Electrical Outlet Boxes"
3. Underwriters Laboratories (UL)
- a. UL 1, "Flexible Metal Conduit"
 - b. UL 467, "Grounding and Bonding Equipment"
 - c. UL 514A, "Metal Outlet Boxes"
 - d. UL 514B, "Conduit, Tubing, and Cable Fittings"
 - e. UL 797, "Electrical Metallic Tubing - Steel"

1.3 DEFINITIONS

- A. Definitions of Section 270000 apply to this Section.
- B. In addition to those Definitions of Section 270000, the following list of terms as used in this Section defined as follows:
- 1. "Backbox": A box [see "Box"] used to house cable terminations, to house devices, and to interface with cords/equipment; a backbox is installed with walls (such as within the cavities of framed walls and/or cast-in-place within concrete walls) such that the outlet/device finish (e.g., the coverplate/faceplate) is flush with the wall finish
 - 2. "Box": A box (often 5-sided with 1 side open) manufactured of sheet metal with welded corners, drawn metal, cast metal, or nonmetallic material (thermoplastic) in accordance with NEMA OS 1 or NEMA OS 2 and installed in accordance with NFPA 70 Article 314; available in different sizes (volumes) and modular design configurations (gangable) that may be field assembled, one to another, to accommodate multiple devices; boxes may be used as outlet boxes, device boxes, backboxes, junction boxes, or pull boxes, depending on their intended use, and handhole enclosures.
 - 3. "CEC": California Electrical Code (California Code of Regulations, Title 24 Part 3)
 - 4. "Device Box": A box [see "Box"] with provisions for attaching and housing electrical devices (switches, receptacles, or similar wiring devices) manufactured in accordance with NEMA OS 1 and NEMA OS 2 and installed in accordance

with NFPA 70 Article 314; available in different sizes (volumes) and modular design configurations (gangable) that may be field assembled, one to another, to accommodate multiple devices

5. “EIMC”: Electrical Intermediate Metal Conduit – see “IMC”
6. “EMT”: Electrical Metallic Tubing type conduit, as defined in ANSI C80.3 and NFPA 70 Article 358 An unthreaded thinwall raceway, generally made of steel (ferrous) with protective coatings or aluminum (nonferrous), of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed utilizing appropriate fittings (per NEC Article 358)“FMT: Flexible Metal Tubing type conduit, as defined in NFPA 70 Article 360
8. “Floor Box”: A box [see “Box”] used to house cable terminations, to house wiring devices, and to interface with cords/equipment; a floor box is a special purpose box installed with floors (such as cast-in-place within concrete) such that the box finish (e.g., the coverplate) is flush with the floor finish
9. “HDPE: High Density Polyethylene type conduit, as defined in NFPA 70 Article 353
10. “Innerduct”: A continuous cylindrical pipe fabricated of extruded thermoplastic, available in corrugated, smooth, or other wall types and in different sizes (to support different quantities of cables), generally to provide a separate pulling channel and physical protection for fiber, coaxial, and metallic cables in telecommunications and other networks, and used in multiple applications such as the following:
 - a. within conduit to compartmentalize or create ‘sub-ducts’
 - b. in cable tray to create an isolated pathway
 - c. by itself as a pathway system
11. “IMC”: Intermediate Metal Conduit type conduit, as defined in ANSI C80.6 and NFPA 70 Article 342
12. “Junction Box”: A box used to join different runs of raceway (such as conduit) or cables, or both, and to provide space for the connection and branching of the enclosed conductors; most boxes can be used solely as junction boxes as long as they are used with an appropriate cover and with appropriate (code-required) access
13. “MaxCell”: a textile subduct product (also, fabric innerduct)
14. “LFMC”: Liquidtight Flexible Metal Conduit type conduit, as defined in NFPA 70 Article 353

15. "Outlet Box": A box [see "Box"] used to house cable terminations (connectors, modular jacks, receptacles, or similar wiring interfaces) and to interface with cords/equipment
16. "NEC": National Electrical Code (NFPA 70)
17. "NEMA": National Electrical Manufacturers Association
18. "NFPA": National Fire Protection Agency
19. "Pull Box": A box used in a conduit-based pathway system to allow access to and enclose conduit ends for placing cables and to house the interface between duct banks segments
20. "RMC": Rigid Metal Conduit type conduit, as defined in NFPA 70 Article 344 and ANSI C80.1
21. "RNC": Rigid Nonmetallic Conduit type conduit, as defined in NFPA 70 Article 352 and as manufactured to NEMA TC 2 specifications
22. "Textile Subduct": A continuous enclosed assembly fabricated of polymer-coated nylon fabric used in conduit to compartmentalize or create 'sub-ducts', available in different sizes and 'cell' counts (to support different quantities of cables); an example of textile subduct includes "Maxcell"
23. "UL": Underwriters Laboratories

1.4 SYSTEM DESCRIPTION

- A. The scope of work of this section includes planning and coordination with General Contractor and other trades of inside plant conduit pathway systems, furnishing necessary materials, and labor and associated services required to install these pathway systems. The scope of work includes innerduct/subducting within conduit.
- B. The drawings do not explicitly show on plans 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 low voltage drawings, and provide reasonably inferred standard conduits, fittings, and products required to complete the conduit installation to meet the design intent.
- C. The scope of work includes conduit, boxes, and related construction materials that may not be expressly specified herein or expressly called out on the drawings, such as: 1- and 2-hole straps, nail straps, clamps and clamp backs, strut clamps, U-bolts, pipe hangers, clip-in and bolted hangers, bushings, ground bushings, service entrance cap/weatherhead, pull rope/tape, etc.
- D. The scope of work includes 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.

E. Conduit Systems, including Pull Boxes

1. Provide conduit systems in accordance with CEC (Chapter 3 and Article 250), UL listing information, manufacturer's instructions, and compliant to local inspections and seismic restraint requirements. Conduit systems shall conform to ANSI/TIA-569-B standard and BICSI TDMM guidelines. Complete shall include all reasonably inferred conduits, fittings, connectors, couplers, straps, pull boxes, supports, etc., necessary for a complete installation to meet the intended application whether noted, indicated or specified in the Contract Documents or not. Duct bank routes and pull and junction box locations and elevations shown on the Drawings are diagrammatic in nature. Field verify route prior to installation.
2. Provide pull boxes as necessary to facilitate proper cable placement, including the following:
 - a. no more than 180 degrees bend between placement points
 - b. no more than 150-200 feet conduit length (depending on the total bend between end points)
 - c. to meet AHJ requirements
3. Seismic Bracing: Provide seismic bracing to conduit system (duct banks, pull boxes, etc). Seismic bracing shall be approved by a structural engineer licensed in the state of California.
4. Seismic Joints: Provide seismic joints to conduit at building seismic joints. Seismic joint configurations shall be approved by a structural engineer licensed in the state of California.
5. Expansion Joints/Fittings: Provide expansion joints and/or fittings to conduit where necessary. Expansion joints/fittings shall be approved by a structural engineer licensed in the state of California.
6. Conduit systems shall be mechanically and electrically continuous throughout. Where EMT and associated fittings are used as part of equipment grounding system, provide a bonding type locknut where hub type fitting terminates into a threadless opening and provide compression ring type fittings for terminating and coupling.
7. Minimum Conduit Size: Refer to drawings.

8. When cast in concrete floors and/or walls, adhere to structural design requirements. Unless otherwise noted on the drawings, the largest trade size conduits shall not exceed 1/3 the floor or wall thickness, and conduits shall be spaced a minimum of three conduit diameters apart.
9. Bend radii for conduit trade sizes 63.5 mm (2-1/2") and larger shall be 10 times the conduit outside diameter (OD) and bend radii for conduit trade sizes 51 mm (2") and smaller shall be 8 times the conduit OD.
10. Provide transition couplings where dissimilar conduit types are joined.
11. Conduit bodies or 'condulets' (LBs, etc.) are prohibited for telecommunications and audiovisual cables.
12. For type EMT conduits:
 - a. Provide steel (preferred) zinc plated or die cast set screw (or compression fittings). For set screw fittings, provide single screw fittings (e.g., 1-screw connectors and 2-screw couplers) for 37mm (1.5") and smaller conduits and provide double screw fittings (e.g., 2-screw connectors and 4-screw couplers) for 51mm (2") and larger conduits.
 - b. When cast in concrete, embedded masonry, or installed in dry locations (as defined by CEC), provide compression fittings and couplings.
 - c. When installed in damp locations (as defined by CEC), provide rain-tight type fittings and couplings.
13. When attaching to concrete ceilings, provide vibration and shock resistant bases.
14. Conduit Straps: Provide steel straps – for interior applications, provide straps without spacers
15. For unused conduits, provide a mechanical-type seal/cap for protection and to keep the conduit free from debris.
16. Provide a pull line into each conduit/duct between pull points.
 - a. Where boxes are exposed in damp or wet locations or located in hazardous areas, provide cast metal boxes with gasketed cast metal cover plates.
 - b. Provide supports for pull (and junction) boxes independently of conduit system and directly to the structure above. Provide seismic bracing for pull boxes.
17. Labeling:
 - a. Provide permanent labels on conduit ends and pull box lids.

18. Conduit Application

- a. At interior concealed or exposed applications, 4" and smaller, provide EMT type conduit, unless otherwise note. EMT is the preferred conduit type.
- b. In cast-in-place concrete, EMT types will be allowed for telecommunications and other low voltage systems.

F. Clearances (minimum):

1. From fluorescent light fixtures, or other EMI sources = 6 inches (150 mm)
2. From any motor, transformer = 48 inches (1,220mm)
3. From flue, hot water, steam line or other non-insulated heat sources = 12 inches (300 mm)
4. No conduit and/or supports shall encroach into ceiling height, head room of walkways, and/or doorways.

G. Penetrations:

1. When penetrating partitions and other construction assemblies, use approved methods.
2. When penetrating concrete walls (including shear walls) and/or floors, scan the area to be penetrated and core openings using methods approved by the structural engineer and by the AHJ. Obtain written approval for locations and means when not using methods included in the contract documents.
3. When penetrating fire rated assemblies, provide UL Classified and FM Approved fire rated systems in accordance with ASTM E814 (UL1479). Provide labels at both sides of the penetration. Refer to drawings for approved systems per application.
4. When penetrating acoustic rated assemblies, provide sealant to fill gaps, cavities, etc, to fully seal penetration.

H. Outlet Boxes

1. Provide outlet boxes and covers/rings (raised and/or flat) in accordance with CEC Article 314 and NEMA OS 3. Ground and bond metal outlet boxes in accordance with NEC Article 250, Parts I, IV, V, VI, VII, and X.
2. Provide support for outlet boxes. Outlet boxes for telecommunications and audiovisual may share a support bracket (such as a stud span bracket) with electrical outlet boxes.

I. Floor Boxes

1. Provide floor boxes, covers, and related products in accordance with CEC Article 314 and NEMA OS 3. Bond metal boxes to ground in accordance with applicable portions of CEC Article 250 (such as Parts I, IV, V, VI, VII, and X).
2. At floor boxes shared with power service, provide separation means in accordance with CEC.

1.5 SUBMITTALS

- A. General: Conform to Submittal requirements as described in Section 270000.
- B. Quantity: Furnish quantities of each submittal as noted in Section 270000.
- C. Submittal Requirements Prior to the Start of Construction:
 1. Product Data: Submit product data showing manufacturer, part numbers, listings, fabrication materials, dimensions, capacities, finishes, knockout sizes and configuration, accessories, etc.
 2. Shop Drawings: Submit shop drawings consisting of the following:
 - a. Conduit layout/routes, supports locations, support details
 - b. Highlight proposed changes to pathways (routes, types, sizes, etc.) compared to the contract documents
 - c. Clearance variations and/or requests for exceptions
 - d. Seismic bracing details (also see "Seismic Calculations" below)
 - e. Instances of penetrations through fire and smoke rated barriers, including calling out firestopping type/UL System, size, quantity, and other relevant information
 3. Seismic Calculations: Submit seismic calculations for support systems in conformance Section 270000. Structural Calculations shall be prepared and signed by a California Registered Structural Engineer. If used, specify proof loads for drilled-in anchors.
- D. Submittal Requirements at Close Out:
 1. As-Built Drawings, showing the routes, types, sizes, quantities, dimensions, etc., of pathways (backbone pathways, primary pathways, conduit – required; secondary such as hangers – not necessary)

2. O&M Manual, including as-built drawings, parts list (essentially final approved product data submittal), repair information, and maintenance requirements

E. Substitutions

1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270000.

1.6 QUALITY ASSURANCE

- A. Comply with Quality Assurance requirements of section 270000.
- B. NEC Compliance: Comply with NEC, as applicable to construction and installation of conduit and boxes.
- C. NFPA Compliance: Comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to conduit and boxes.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Delivery, Storage and Handling requirements of section 270000.

1.8 WARRANTY

- A. Comply with Warranty requirements of section 270000.

PART 2 PRODUCTS

2.1 ELECTRICAL METALLIC TUBING (TYPE EMT) CONDUIT AND FITTINGS

- A. Application: Products and assembled system shall be suitable for indoor applications, in accordance with the NEC Article 358
- B. Type EMT Conduit:
 1. Type EMT conduit shall be formed of cold rolled strip steel, electrical-resistance welded continuously along the longitudinal seam, and zinc coated after welding. Type EMT conduit bore shall be smooth and free of blisters, nicks or other imperfections which could mar cables.
 2. Type EMT conduit shall be listed by a nationally recognized testing laboratory to UL 797, and shall bear (stamped or molded on conduit and fittings) the UL label. Markings shall be permanent. Type EMT conduit shall meet ANSI C80.3 specifications.
 3. Type EMT conduit shall be listed by a nationally recognized testing laboratory to UL Safety Standard 797 and UL Safety Standard 514B, and shall bear (stamped

or molded on conduit and fittings) the UL label. Markings shall be permanent. Type EMT conduit shall meet ANSI C80.3 specifications.

4. Type EMT conduit shall be recognized as a bonding conductor per NEC Article 250.118
5. Factory elbows and bends minimum bend radius shall be 48".
6. Manufacturers – Type EMT Conduit:
 - a. Allied Tube and Conduit Co (Electrical Group) "E-Z Pull" EMT conduit (Kwik-Fit EMT also acceptable)
 - b. Cal Conduit Products "CalBrite" EMT conduit
 - c. Republic Conduit
 - d. Western Tube and Conduit Corp
 - e. Or equal

C. Fittings for EMT:

1. Fittings (connectors, couplers, straps, accessories, etc.) shall be listed by a nationally recognized testing laboratory to UL 514B, and shall bear the UL label (stamped or molded - such markings shall be permanent).
2. Fittings shall be manufactured compliant to ANSI/NEMA FB 1.
3. Standard Set-Screw Fittings: fabricated of steel with zinc electro-plated finish. Die cast zinc / cast malleable iron fittings not acceptable. Set-screws shall be case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
4. Compression Fittings: gland and ring compression type construction; fabricated of steel zinc plated or cast malleable iron; UL Listed as raintight and suitable for concrete
5. Manufacturers – Fittings for EMT
 - a. Appleton Electric Co and/or O-Z Gedney (Emerson Electric Co)
 - b. Thomas & Betts Corp
 - c. Or equal

D. Deflection/Expansion Sleeve:

1. Application: Deflection/expansion sleeve shall compensate for movement in any direction between two conduit ends and shall withstand occasional vibration transmitted to conduit by rotating equipment or vehicular traffic.
2. Deflection/expansion sleeve shall be listed by a nationally recognized testing laboratory to UL 514B and UL 467, and shall bear the UL label (stamped or molded - such markings shall be permanent).
3. Deflection/expansion sleeve shall be fabricated of an inner sleeve, bonding braid, a neoprene outer sleeve with internal flexible stainless steel braid and outer stainless steel bands, ended with couplings (for connection to conduits).
4. Deflection/expansion sleeve shall accommodate 0.75 inch (19mm) deflection, expansion, contraction, or parallel misalignment in any direction, shall allow up to 30 degree angular deflections, and shall be raintight.
5. Manufacturer – EMT Expansion/Deflection Sleeve:
 - a. Cooper Crouse-Hinds XD series
 - b. O-Z Gedney (Emerson Electric Co) DX series
 - c. Or equal

E. Expansion Sleeve:

1. Application: Expansion sleeve shall compensate for parallel movement between two conduits.
2. Expansion sleeve shall comply with UL514.B and NEMA FB-1.
3. Expansion sleeve shall be fabricated of an inner steel sleeve with an oversized outer sleeve sealed with slip bushings, configured such that the outer sleeve can move over the inner sleeve. Sleeve shall come equipped with internal or external bonding braid and be ended with couplers suitable to connect to conduit ends.
4. Manufacturers – EMT Expansion Sleeve:
 - a. Cooper Crouse-Hinds XJG-EMT series
 - b. O-Z Gedney (Emerson Electric Co) TX series
 - c. Or equal

2.2 PULL STRING

- A. Application: For use with manual or power fishing systems for light duty cable or tape pulling applications
- B. Description: round, woven, polypropylene line
 - 1. Packaged in storage container with easy, quick, and tangle-free dispensing
 - 2. UV resistant, and resistant to rot and mildew
 - 3. Low elongation
- C. Manufacturers:
 - 1. Ideal Industries Inc Powr-Fish® or Valu-Line™ poly pull line
 - 2. Klein Tools #56110 poly pull line
 - 3. Or equal

2.3 STEEL OUTLET BOXES AND COVERS

- A. Application: For use indoors as outlet box, backbox, and/or junction box of low voltage systems to house wiring, cabling, terminations, and connectors; may also house and support components.
 - 1. Outlet boxes shall permit access to conductors for maintenance
 - 2. Outlet boxes shall come with knock-outs or punch-outs for easy creation of holes to accept conduit connectors.
- B. Compliances:
 - 1. Outlet boxes shall meet the requirements of CEC Article 314.
 - 2. Outlet boxes shall be listed by a nationally recognized testing laboratory to UL 514A for Class 2 and Class 3 power-limited circuits (such as data and signal) providing bonding without the use of bonding jumpers, for remote control circuits, and for telecommunications circuits in accordance with NEC Article 314.
 - 3. Outlet boxes shall be manufactured compliant to NEMA: FB-1 and OS-1.
 - 4. Outlet boxes shall be fire resistant and suitable for use in rated spaces (reference: UL Fire Resistance Directory / “Orange Book”).

C. Material and Finish:

1. Material: <AISI/SAE 1008 Steel> <hot rolled, pre-galvanized steel, minimum spangle, AISI C-1008>
2. Thickness: CEC 314.40(B) / 1.59 mm (0.0625in), minimum
3. Finish: G60 hot dip zinc galvanized (0.60 oz/sq ft), meeting ASTM A123, or pre-galvanized (continuous sheet galvanizing) meeting per ASTM A653
4. Finish Thickness: ~0.0005 inches

D. Square Box and Covers/Rings – 5”

1. Dimensions: 5 in square x 2.875 in deep
2. Volume: 64 in³
3. Outlet box shall come equipped with integrated cable management/slack support.
4. Manufacturers:
 - a. Randl Industries
 - 1) #T-55017; “5 Square” outlet box, knockouts: one 1” + one 1-1/4” per side, one 1/2” per back
 - 2) #T-55018; “5 Square” outlet box, knockouts: one 1/2”, + one 3/4” + one 1” per side, one 1/2” per back
 - 3) #T-55019; “5 Square” outlet box, knockouts: one 1/2”, + two 1” per side, one 1/2” per back
 - 4) #T-55057; “5 Square” outlet box with side mounting bracket, knockouts: one 1” + one 1-1/4” on 3 sides, one 1/2” per back
 - 5) #T-55058; “5 Square” outlet box with side mounting bracket, knockouts: one 1/2”, + one 3/4” + one 1” on 3 sides, one 1/2” per back
 - 6) #T-55059; “5 Square” outlet box with side mounting bracket, knockouts: one 1/2”, + two 1” on 3 sides, one 1/2” per back
 - 7) #R-55000; blank cover for “5 Square” outlet box
 - 8) #N-54000; 4”-sq cover for “5 Square” outlet box, flat
 - 9) #N-54012; 4”-sq cover for “5 Square” outlet box, 1/2” raised

- 10) #N-54058; 4"-sq cover for "5 Square" outlet box, 5/8" raised
- 11) #N-54034; 4"-sq cover for "5 Square" outlet box, 3/4" raised
- 12) #N-54010; 4"-sq cover for "5 Square" outlet box, 1" raised
- 13) #N-54114; 4"-sq cover for "5 Square" outlet box, 1-1/4" raised
- 14) #N-54112; 4"-sq cover for "5 Square" outlet box, 1-1/2" raised
- 15) #D-52G000; two gang cover for "5 Square" outlet box, flat
- 16) #D-52G012; two gang cover for "5 Square" outlet box, 1/2" raised
- 17) #D-52G058; two gang cover for "5 Square" outlet box, 5/8" raised
- 18) #D-52G034; two gang cover for "5 Square" outlet box, 3/4" raised
- 19) #D-52G010; two gang cover for "5 Square" outlet box, 1" raised
- 20) #D-52G114; two gang cover for "5 Square" outlet box, 1-1/4" raised

b. Or equal

E. Square Box – 4-11/16", Deep

1. Dimensions: 4-11/16 in square x 2-1/8 in deep
2. Volume: 42 in³
3. Box shall have standard 4-11/16 screw pattern (accept standard 4-11/16" covers/mud rings/tile covers/etc).
4. Manufacturers:
 - a. Appleton Electric Co and/or O-Z Gedney (Emerson Electric Co)
 - b. Garvin Industries #72171-1-1/4 drawn 4-11/16"S x 2-1/8"D box, (4) 1-1/4" KOs
 - c. RACO (Hubbell Electrical Products)
 - d. Steel City (Thomas & Betts)
 - e. Or equal

F. Square Box – 4", Deep

1. Dimensions: 4 in square x 2-1/8 in deep

2. Volume: 30.3 in³
3. Box shall have standard 4-square screw pattern (accept standard 4-sq covers/mud rings/tile covers/etc).
4. Manufacturers:
 - a. Appleton Electric Co and/or O-Z Gedney (Emerson Electric Co)
 - b. Garvin Industries
 - c. RACO (Hubbell Electrical Products)
 - d. Steel City (Thomas & Betts)
 - e. Or equal

2.4 BOX SUPPORT ACCESSORIES

- A. Box accessories shall comply with UL standards and shall be listed by a nationally recognized testing laboratory.
- B. Stud-Mount Single-Box Bracket
 1. Erico #SGBS16A; stud-mount bracket, for 1-1/2" or 2-1/8"D box, fits 16" stud spacing
 2. Erico #SGBS24A; stud-mount bracket, for 1-1/2" or 2-1/8"D box, fits 24" stud spacing
 3. Garvin #BMB16218; stud-mount bracket, for 2-1/8"D box, fits 16" stud spacing
 4. Garvin #BMB16350; stud-mount bracket, for 3-1/2"D box, fits 16" stud spacing
 5. Garvin #BMB24218; stud-mount bracket, for 2-1/8"D box, fits 24" stud spacing
 6. Garvin #BMB24350; stud-mount bracket, for 3-1/2"D box, fits 24" stud spacing
 7. Garvin #BMB16SL; stud-mount bracket, 'sliding' position for 1-1/2" or 2-1/8" D box, fits 16" stud spacing
 8. Garvin #BMB24SL; stud-mount bracket, 'sliding' position for 1-1/2" or 2-1/8" D box, fits 24" stud spacing
 9. Raco #9004; fixed stud-mount bracket, for 2-1/8"D box, fits 16" stud spacing
 10. Raco #9006; fixed stud-mount bracket, for 2-1/8"D box, fits 24" stud spacing

11. Raco #9013; adjustable stud-mount bracket, for 2-1/8"D box, fits 10-3/8" to 18" stud spacing
12. Raco #9015; adjustable stud-mount bracket, for 2-1/8"D box, fits 15" to 26" stud spacing

C. Stud-Mount Multi-Box Bracket

1. Erico #RBS16; stud-mount bracket, 3 positions for 4S and/or 4-11/16"S box, fits 16" stud spacing
2. Erico #RBS24; stud-mount bracket, 4 positions for 4S and/or 4-11/16"S box, fits 24" stud spacing
3. Garvin #BMB4S3P; stud-mount bracket, 3 positions for 4S and/or 4-11/16"S box, fits 16" stud spacing
4. Raco #9002; stud-mount bracket, 3 positions for 4S and/or 4-11/16"S box, fits 16" stud spacing
5. Raco #9002; stud-mount bracket, 4 positions for 4S and/or 4-11/16"S box, fits 24" stud spacing

D. Floor-Mount Box Mounting Bracket

1. Erico #FMBS18; floor mount support bracket for box, puts box at 18.5" above wall footer
2. Garvin #KP4-12; floor mount support bracket for 4S and/or 4-11/16"S box, puts box at 12" above wall footer
3. Garvin #KP4-18; floor mount support bracket for 4S and/or 4-11/16"S box, puts box at 18" above wall footer
4. Garvin #KP4-24; floor mount support bracket for 4S and/or 4-11/16"S box, puts box at 24" above wall footer
5. Raco #9009; floor mount support bracket for 4S and/or 4-11/16"S box, puts box at 12" above wall footer
6. Raco #9010; floor mount support bracket for 4S and/or 4-11/16"S box, puts box at 18" above wall footer

E. T-Bar Bracket

1. Erico #510HD; bracket for outlet box, attaches to T-bar ceiling grid

F. T-Bar Support

1. Erico #4ACS; adapter/support for outlet box, attaches to T-bar ceiling grid

2.5 MULTIPURPOSE FLOOR BOXES**A. Application:**

1. Indoor use as a multi-service (audiovisual, telecommunications, power) outlet box to house wiring, cabling, termination, connectors, and receptacles
2. Cast concrete floor, slab-on-grade, and/or raised access floor
3. Carpet, tile, wood, bare (polished) concrete, and terrazzo floor finishes

B. Compliances:

1. Floor boxes shall be listed by a nationally recognized testing laboratory to UL 514A for Class 2 and Class 3 power-limited circuits (such as data and signal) providing bonding without the use of bonding jumpers, and remote control) circuits and for telecommunications circuits in accordance with NFPA 70 Article 314 for use in tile, terrazzo, carpet, and wood covered floors.
2. Cover assemblies shall meet UL requirements under UL514A for scrub water exclusion for use in tile, terrazzo, carpet, and wood covered floors.
3. Floor boxes shall be listed by a nationally recognized testing laboratory as suitable for use in air handling spaces in accordance with Sec 300-22(c) of the NEC.

C. Fire Rating:

1. Floor boxes shall be listed by a nationally recognized testing laboratory and Fire Classified to U.S. safety standards. UL fired rated up to 2-hour rated floors.
2. Floor boxes shall provide two-hour fire rating to maintain the fire classification of the floor.
3. Floor boxes shall be suitable for use in air handling spaces in accordance with Sec 300-22(c) of the NEC.

D. Load Capacity: Floor box assembly (back box, cover, etc) shall be rated to 1,800 lbs static load.**E. Material and Construction:** steel (14 gauge), continuous seam welded**F. Cover Finish:** coordinate cover/trim with architect

G. Features:

1. <6> <8> <10> gangs
2. Knock-outs (or punch-outs) for easy creation of holes to accept conduit connectors
3. Permit access to conductors behind terminations (for maintenance)
4. Accept AAP connector/adaptor plates

H. Manufacturers:

1. Wiremold
 - a. #EFB6S; "Evolution" floor box, 6-gang, standard
 - b. #EFB6S-OG; "Evolution" floor box, 6-gang, on-grade
 - c. #EFB6S-FC; "Evolution" floor box, 6-gang, fire classified
 - d. #EFB8S; "Evolution" floor box, 8-gang, standard
 - e. #EFB8S-OG; "Evolution" floor box, 8-gang, on-grade
 - f. #EFB8S-FC; "Evolution" floor box, 8-gang, fire classified
 - g. #EFB10S; "Evolution" floor box, 10-gang, standard
 - h. #EFB10S-OG; "Evolution" floor box, 10-gang, on-grade
 - i. #EFB10S-FC; "Evolution" floor box, 10-gang, fire classified
2. Or equal

2.6 MULTI-SERVICE FLOOR BOXES

- A. Application: For use indoors as a multi-service (telecommunications, audiovisual, power) outlet box to house wiring, cabling, termination, connectors, and receptacles installed within a cast concrete floor
- B. Box Construction: Seam welded 14 gauge steel
- C. Compliances:
 1. Floor boxes shall be listed by a nationally recognized testing laboratory to UL 514A for Class 2 and Class 3 power-limited circuits (such as data and signal) providing bonding without the use of bonding jumpers, and remote control)

circuits and for telecommunications circuits in accordance with NFPA 70 Article 314 for use in tile, terrazzo, carpet, and wood covered floors.

2. Floor box assemblies shall meet the scrub water exclusions requirements of UL 514A for use in tile, terrazzo, carpet, and wood covered floors.
- D. Load Capacity: Floor box assembly (back box, cover, etc) shall be rated to 300 lbs (minimum) static load.
- E. Features:
1. Suitable for cast-in-place concrete applications
 2. 8 gangs, minimum
 3. Knock-outs (or punch-outs) for easy creation of holes to accept conduit connectors
 4. Permit access to conductors behind terminations (for maintenance)
- F. Cover Finish: Coordinate with Architect
- G. Manufacturers:
1. FSR Inc.
 - a. #FL-500P-2.25; c-i-p floor box, 2.25-in depth
 - b. #FL-500P-3; c-i-p floor box, 3-in depth
 - c. #FL-500P-4; c-i-p floor box, 4-in depth
 - d. #FL-500P-6; c-i-p floor box, 6-in depth
 - e. #FL-500P-8; c-i-p floor box, 8-in depth
 - f. #FL-500P-10; c-i-p floor box, 10-in depth
 2. FSR Inc.
 - a. #SF-PB; 'SmartFit' c-i-p floor box (round), 4-in diameter x 5.9-in depth
 - b. #SF-DDP; sub-plate for 4" box – two decora openings
 - c. #SF-2SDP; sub-plate for 4" box – one decora, one 5-20R electrical outlet, and two keystone ports

- d. #SF-IPSPS; sub-plate for 4" box – IPS interface (3 position) and one 5-20R electrical outlet
 - e. #SF-BC-CV; type/finish? cover for 4" box, carpet applications
 - f. #SF-BLKC-CV; type/finish? cover for 4" box, carpet applications
 - g. #SF-SC-CV; type/finish? cover for 4" box, carpet applications
 - h. #SF-BT-CV; type/finish? cover for 4" box, tile applications
 - i. #SF-BLKT-CV; type/finish? cover for 4" box, tile applications
 - j. #SF-ST-CV; type/finish? cover for 4" box, tile applications
3. Hubbell
- a. #CFB7G4; c-i-p floor box, 4 in depth, 7 gangs
 - b. #CFB7G6; c-i-p floor box, 6 in depth, 7 gangs
 - c. #CFB7CVRBRS; brass cover for 7-gang floor box, 1/4" edging
 - d. #CFB7CVRALU; aluminum cover for 7-gang floor box, 1/4" edging
 - e. #CFB7TBRS; brass cover for 7-gang floor box, 1/2" edging
 - f. #CFB7TALU; aluminum cover for 7-gang floor box, 1/2" edging
 - g. #CFB11G4; c-i-p floor box, 4 in depth, 11 gangs
 - h. #CFB11G6; c-i-p floor box, 6 in depth, 11 gangs
 - i. #CFB11CVRBRS; brass cover for 11-gang floor box, 1/4" edging
 - j. #CFB11CVRALU; aluminum cover for 11-gang floor box, 1/4" edging
 - k. #CFB11TBRS; brass cover for 11-gang floor box, 1/2" edging
 - l. #CFB11TALU; aluminum cover for 11-gang floor box, 1/2" edging
4. Wiremold
- a. #RFB-11; c-i-p floor box, 6 in depth, 11 gangs
 - b. #RFB-9; c-i-p floor box, 4 in depth, 9 gangs
 - c. #RFB119CTCAL; cover for carpet floors, with carpet cut-out area, brushed aluminum

- d. #RFB119CTCBK; cover for carpet floors, with carpet cut-out area, painted black
 - e. #RFB119CTCGY; cover for carpet floors, with carpet cut-out area, gray
 - f. #RFB119BTCAL; cover for flush tile or carpet floors, brushed aluminum
 - g. #RFB119BTCBK; cover for flush tile or carpet floors, painted black
 - h. #RFB119BTCGY; cover for flush tile or carpet floors, gray
5. Or equal

2.7 MULTI-SERVICE FLOOR BOXES

- A. Application: For use indoors as a multi-service (telecommunications, power) outlet box to house wiring, cabling, termination, connectors, and receptacles within a cast concrete floor
- 1. Floor boxes shall permit access to conductors for maintenance
 - 2. Floor boxes shall come with knock-outs or punch-outs for easy creation of holes to accept conduit connectors.
- B. Compliances:
- 1. Floor boxes shall be listed by a nationally recognized testing laboratory to UL 514A for Class 2 and Class 3 power-limited circuits (such as data and signal) providing bonding without the use of bonding jumpers, and remote control) circuits and for telecommunications circuits in accordance with NFPA 70 Article 314 for use in tile, terrazzo, carpet, and wood covered floors.
 - 2. Floor box assemblies shall meet the scrub water exclusions requirements of UL 514A for use in carpet and wood covered floors.
- C. Construction: Seam welded 14 gauge steel.
- D. Cover Finish: Coordinate with Architect.
- E. Manufacturer:
- 1. Wiremold
 - a. #RFB-4; c-i-p floor box, 3-7/8 in depth, 4 gangs
 - b. #RFB2-OG; two-compartment floor box, 6-1/2" W x 13-1/8" L x 3-7/16" D
 - c. #RFB22AB; internal communication bracket

2. Or equal

2.8 MULTI-SERVICE WALL BOXES FOR FLAT PANEL DISPLAYS

- A. Application: indoor use as a multi-service (telecommunications, audiovisual, power) outlet box to house wiring, cabling, termination, connectors, and receptacles and serve a flat panel display
- B. Listings: Wall boxes shall be listed by a nationally recognized testing laboratory to UL 514A.
- C. Fabrication Material: Backbox: Seam welded 14 gauge steel; Cover: 1/16" steel, electro-painted
- D. Outlet box shall feature capacity for the following:
 1. Power: 1 duplex receptacle, duplex or decora style
 2. Telecom/Network: 2 network jacks (refer to section 271513 for jack information)
 3. AV: _ positions for AAP (or equivalent) modules
 4. Conduit Connections: _ positions for 1.25-inch conduits at top, _ positions for 1.25-inch conduits at bottom, _ positions for 1.25-inch conduits at each side,
- E. Manufacturers:
 1. FSR
 - a. #PWB-100; in-wall multi-service box for flat panel display
 - b. #PWB-200; in-wall multi-service box for flat panel display
 - c. #PWB-250; in-wall multi-service box for flat panel display
 - d. Refer to 274116 for AV accessories
 - e. Refer to 271513 for telecom accessories
 2. Wiremold
 - a. #EFSB2; 2-gang in-wall multi-service box for flat panel display
 - b. #EFSB4; 4-gang in-wall multi-service box for flat panel display
 - c. Refer to 274116 for AV accessories

- d. Refer to 271513 for telecom accessories
- 3. Or equal
- F. Application: indoor use as a multi-service (telecommunications, audiovisual, power) outlet box to house wiring, cabling, termination, connectors, and receptacles and serve a flat panel display
- G. Listings: Wall boxes shall be listed by a nationally recognized testing laboratory to UL 514A.
- H. Fabrication Material: Backbox: Seam welded 14 gauge steel; Cover: 1/16" steel, electro-painted
- I. Outlet box shall feature capacity for the following:
 - 1. Power: 1 duplex receptacle, duplex or decora style
 - 2. Telecom/Network: 2 network jacks (refer to section 271513 for jack information)
 - 3. AV: _ positions for AAP (or equivalent) modules
 - 4. Conduit Connections: _ positions for 1.25-inch conduits at top, _ positions for 1.25-inch conduits at bottom, _ positions for 1.25-inch conduits at each side,
- J. Manufacturers:
 - 1. Chief Manufacturing
 - a. #PAC521P; in-wall multi-service box for flat panel display
 - b. #PAC516; in-wall pre-wire box for flat panel display
 - c. #PAC522; in-wall pre-wire box for flat panel display
 - d. Refer to 274116 for AV accessories
 - e. Refer to 271513 for telecom accessories
 - 2. Or equal

PART 3 EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Prior to installation, plan routes and locations of pathway systems and coordinate with other trades and building systems (ductwork, plumbing, electrical raceways, wall construction, ceilings, etc.). Pathway systems shall not unnecessarily cross other trade's work, shall not prevent removal of ceiling tiles or panels, and shall not block access to mechanical or electrical equipment. Provide offsets as required to avoid obstruction of pathway systems with other trades/systems.
- B. Prior to installation, examine areas to receive pathways systems to verify conditions are ready for work and to verify conformance with manufacturer and specification tolerances. Notify the Owner's Representative in writing of conditions that would adversely affect the installation, or subsequent

3.3 INSTALLATION

- A. Secure raceway/pathway systems to building structures using approved support methods and components (fasteners, anchors, clamps, hangers, etc) and complaint to the CEC.
- B. Outlet Boxes / Back Boxes
 - 1. Install boxes plumb and square. Match heights of surrounding outlets (e.g., an adjacent electrical receptacle). Adjust locations and heights as required to suit coordination requirements of construction conditions.
 - 2. Install boxes flush with walls, ceilings and floors except where exposed work is called for on the drawings, required, or appropriate.
 - 3. Do not make unused openings in boxes (such as knocking out fabricated knock-outs without using the opening for a conduit connector). Replace boxes containing inadvertent or unused openings.
 - 4. Framed Walls, both Fire Rated and Non-Rated
 - a. Install outlet boxes and covers/raised rings during rough-in such that the finished condition is flush with wall finishes.
 - b. Do not install outlet boxes back-to-back (outlet boxes facing opposite sides of a wall). At framed walls not fire rated, install boxes with at least 6" separation. At fire rated framed walls, install boxes with at least 24" and 1 framing stud separation.
 - c. Patch/repair openings in wall (plaster, drywall, and/or plasterboard) around boxes and/or raised rings to eliminate visible gaps after outlet gets finished, in accordance with CEC 314.21.

5. Ceilings

- a. At ceilings, install boxes, supports (such as T-bar support bracket), and cover/ring such that the finished condition is flush with ceiling finishes, except where noted otherwise and where conditions prevent a flush installation
- b. At non-accessible ceilings, install service conduit continuous to an accessible location

6. Concrete Cast-In-Place Walls and Floors

- a. Set boxes in place within forms (for walls) and casting volume (for floors) such that the finished condition is flush with wall and floor finishes. Ensure proper concrete cover, according to structural requirements.

7. Masonry Walls

- a. Adjust position of outlet boxes to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for boxes.

C. Wall Boxes for Flat Panel Displays

1. Install boxes plumb and square. Install boxes and covers/raised rings during rough-in such that the finished condition is flush with wall finishes. Patch openings around covers/raised rings to eliminate visible gaps after outlet gets finished.
2. Confirm heights of each box. Coordinate with heights of associated services (e.g., electrical receptacle). Adjust locations and heights as required to coordinate with construction conditions.
3. Do not make unused openings in boxes (such as knocking out fabricated knock-outs without using the opening for a conduit connector). Replace boxes containing inadvertent or unused openings.
4. Do not install boxes back-to-back in a framed wall (boxes facing opposite sides of a wall), unless noted so on the drawings. At framed walls not fire rated, install boxes with at least 6" separation. At fire rated framed walls, install boxes with at least 24" and 1 framing stud separation.

D. Floor Boxes

1. Install floor boxes square, plumb, level, and flush with structural floor. Align box with adjacent surfaces.
 - a. Tolerance: 1/16"

2. For floor boxes with combined power and communications circuits, install metal dividers for separation of circuits.
3. Install covers to suit finish conditions. Coordinate floor finishes (such as carpet) with other trades.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

3.5 FINAL INSPECTION AND CERTIFICATION

- A. Punch the Work of this Section compliant to the requirements of Section 270000.
- B. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION

SECTION 27 0811

COMMUNICATIONS TWISTED PAIR TESTING

PART 1 GENERAL**1.1 SUMMARY**

- A. Section Includes: Testing of communications Horizontal twisted pair cabling subsystem.
- B. Base Bid Work
 - 1. Testing of a completed communication infrastructure cabling system, which includes:
 - a. Submittals
 - b. Testing of the twisted pair cabling as follows:

Table 270811-1.1: Tests For UTP Cabling

Subsystem	Type	Test	Configuration	Notes
Horizontal	CAT6A	Category 6A	Permanent Link	per TIA-568

- c. Record Documents, including test results.
- C. Work Provided Under Other Sections
 - 1. Horizontal twisted pair cabling
- D. Related Sections
 - 1. Comply with the Related Sections paragraph of section 270000.
 - 2. 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, and section 271513.
- 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.
 4. "Cord": Shall mean a length of cordage having connectors at each end. The term "Cord" is synonymous with the term "Jumper" and "Lead".
 5. "MPTL": modular plug terminated link (a permanent link terminated at the work area end via a plug as opposed to a jack)
 6. "Permanent Link": Shall mean the 'permanent' portion of the Horizontal cabling to each outlet with the test cords de-embedded from the measurements; this includes cable, consolidation point (if used), termination/connecting apparatus in the IDF and the connector at the outlet.
 7. "System Cord": Shall mean the cord used in the operating transmission circuit.
 8. "Test Cord": Shall mean the cord certified for use in testing, as described in this section.

1.4 SYSTEM DESCRIPTION

- A. Refer to section 270000, and section 271513 for addition system description information.

1.5 SUBMITTALS

- A. Comply with the Submittal requirements of section 270000.

B. Submittal Requirements prior to the Start of Testing

1. Testing Procedures Submittal: Submit as a PDF file the step-by-step procedures that the field technicians will follow during testing.
2. Product/Equipment Submittal: Submit as a PDF file cutsheets of testing equipment and applicable accessories to be used. As applicable, note software/firmware versions and last factory calibrations.
3. Schedule Submittal: Submit as a PDF file a proposed schedule of work. This schedule may be combined with the schedule developed for the work of Related Sections (listed above).

C. Submittal Requirements at Closeout

1. Test Reports and Measurement Data: After completing testing of cabling and before final closeout, submit test reports and measurement data. This report may be combined with the test reports of section 270821.

a. Test Reports Content and Organization

1) Cover Page, with the following information:

- a) Client/Owner Name
- b) Project Name and Address
- c) Report Name (e.g., "Test Reports for Horizontal Cabling System")
- d) Date of Submittal – date format: **Month Day, Year** (e.g., "January 1, 2018")
- e) Testing Company Name

2) Table of Contents

- 3) Warranty Certificate: include a certificate stating that the testing company warrants the validity of the test reports; this may be a letter on company letterhead or a traditional certificate format.
- 4) Test Reports: report per link showing tested parameters and results from prescribed performance levels (e.g., CAT6A PASS); organize test reports by backbone cabling/horizontal cabling, by building, by floor, and by telecom room.

b. Test Reports Format

- 1) Submit test reports as a PDF file. The Table of Contents shall have links to organized sections.

c. Measurement Data

- 1) Submit native measurement data format (for example, an *.FLW file from a Fluke tester); if native data format is not possible to submit, then submit measurement data as an exported Microsoft Excel compatible format. Include 'Viewer' software necessary to view, sort, filter, and print individual and summary test results from the native data format.

d. Transmittal

- 1) The preferred method of transmitting closeout submittals is via a cloud-based file transfer platform (such as Dropbox or similar).
- 2) If by data storage disc (not preferred), 'burn' the test reports and measurement data onto one storage disc (e.g., CD-ROM or DVD). Clearly label the disc with the "Cover Page" information described above.

1.6 QUALITY ASSURANCE

- A. Comply with the Quality Assurance requirements of section 270000.
- B. Under no circumstances shall any cable's and/or conductor's test results be substituted for another's. If an instance of falsification is confirmed, the Contractor is liable for a complete retest of the cabling system at no additional cost to the Owner. This includes the retaining the services of a neutral party to observe all retesting.

1.7 WARRANTY

- A. Warrant the validity of the test results.

PART 2 PRODUCTS**2.1 CATEGORY 6A HORIZONTAL CABLE TESTER**

- A. Certification: Test equipment and accessories (adapters, cords, etc.) shall be independently verified to and compliant with ANSI/TIA-1152-A Level 2G field tester accuracy requirements to 2000 MHz.
- B. Test Standards (minimum): TIA-568 Category 6A under a permanent link, MPTL, and channel configuration; IEEE 802.3 100Base-TX, 1000Base-T, and 10Base-T; screen continuity along path of cabling;

C. Equipment, or equal:**1. Fluke Networks**

- a. #DSX-5000 or DSX-8000 (or DSX2-8000); “CableAnalyzer” test kit (main unit, remote unit, CAT6A permanent link adapters, CAT6A channel adapters, CAT6A patch cord adapters, accessories), loaded with the latest firmware version.
- b. “LinkWare Live” cloud-based management “LinkWare” PC management software, latest version of and documentation software

PART 3 EXECUTION**3.1 SCHEDULING**

- A. Prepare a testing schedule based on the construction schedule developed in section 271513 for the testing activities. Update testing schedule when changes in the cabling schedules occur.

3.2 FIELD QUALITY CONTROL

- A. Calibrate test sets and associated equipment per the manufacturers printed instructions at the beginning of each day’s testing and after each battery charge. Fully charge the test sets prior to each day’s testing to ensure proper operation.
- B. Ensure test equipment and test cords are clean and undamaged during testing activities. At the Engineer’s discretion, halt testing activity and clean testing equipment, test cords, and related apparatus.

3.3 HORIZONTAL CATEGORY 6A TESTING PROCEDURES**A. Precautions**

- 1. Adhere to the equipment manufacturer’s instructions during all testing.
- 2. Prior to any testing activity or any measurements taken, ensure the test equipment is at room temperature – approximately 70 degrees F (e.g., if necessary, bring the test equipment in from outdoors and let it set for about 15 minutes or for however long it takes to bring the test equipment to reach room temp).
- 3. Fully charge power sources before each day’s testing activity

B. Test Equipment Set Up

- 1. Set up the tester to perform a full CAT6A test, as a Permanent Link configuration.

2. If the tester has cable-specific test parameters pre-loaded, set up the tester as product-specific setting. If not, set as generic CAT6A.
3. Set the tester to save the full test results (all test points, graphs, etc.).
4. Save the test results with the associated cable link identifier.
5. Calibrate the test set per the manufacturer's instructions.

C. Acceptable Test Result Measurements

1. Overall Test Results:
 - a. The Owner shall accept only individual test results that result in a Pass.
 - b. Links which report a Fail, Fail* or Pass* for any of the individual tests shall result in an overall link Fail.
 - c. Any reconfiguration of link components required as a result of a test Fail, must be re-tested for conformance.
 - d. Remove and replace any cabling links failing to meet the criteria described in this specification, at no cost to the Owner, with cables that prove, in testing, to meet the minimum requirements.
2. Wire Map: Correctly terminate all pairs of the cabling link at both ends. Provide only continuous pairs. No exceptions.
3. Length: Ninety-four meters is the maximum acceptable electrical length measurements for any cabling link measured under a Permanent Link configuration, including test cords.
4. Insertion Loss: The acceptable insertion loss measurements for any CAT6A cabling link is that which is no greater than that listed in TIA-568.1-D.
5. Worst Pair-to-Pair Near End CrossTalk (NEXT) Loss: The acceptable worst pair-to-pair NEXT loss for any CAT6A cable is that which is no greater than that listed in TIA-568.1-D.
6. Power Sum NEXT Loss: The acceptable power sum PS-NEXT loss for any CAT6A cable is that which is no greater than that as listed in TIA-568.1-D.
7. Worst Pair-to-Pair ELFEXT and FEXT Loss: The acceptable worst pair-to-pair ELFEXT and loss for any CAT6A cable is that which is no greater than that listed in TIA-568.1-D.
8. Power Sum ELFEXT and FEXT Loss: The acceptable PS-ELFEXT and loss for any CAT6A cable is that which is no greater than that listed in TIA-568.1-D.

9. Alien Near End CrossTalk (ANEXT) Loss: The acceptable ANEXT loss for any CAT6A cable is that which is no greater than that listed in TIA-568.1-D.
10. Alien Far End CrossTalk (AFEXT) Loss: The acceptable AFEXT loss for any CAT6A cable is that which is no greater than that listed in TIA-568.1-D.
11. Return Loss: The acceptable return loss measurements for any CAT6A cable is that which is no greater than that listed in TIA-568.1-D.
12. Propagation Delay and Delay Skew: The acceptable propagation delay and delay skew measurements for any CAT6A cable is that which is no greater than that listed in TIA-568.1-D.

3.4 TEST REPORTS

- A. Permanently record measurements and test results.
- B. Submit test results to the Engineer after testing for approval. The Engineer will check these test reports for a format acceptable to the Owner, or Owner's Representative. Each cabling link test record shall contain the following information:
 1. Project name and address
 2. Testing Company's name and Operator's name
 3. Date of measurement/test
 4. Test equipment, including the following:
 - a. Manufacturer, model, and serial number
 - b. Date and time of last calibration
 5. Cable identification and (as applicable) pair identification
 6. Overall test result
- C. Cable and pair identifiers of the test reports shall match the identifiers as labeled in the field – i.e., use the ID on the cable label/termination label in the test reports.

END OF SECTION

SECTION 27 1100

COMMUNICATIONS EQUIPMENT ROOMS

PART 1 GENERAL**1.1 SUMMARY**

- A. Section Includes: Buildout / fit-up of communications equipment rooms.
- B. Base Bid Work
 - 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).
 - e. Based on this coordination, determine final equipment locations and final layout per telecom room.
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.
 - c. Provide bonding (also refer to 270526).
5. IT Cabinets:
- a. Provide IT cabinets and cabinet bays, seismic anchoring to building structure, accessories, fasteners, etc., required for a complete installation. For the IT cabinets, provide frames, doors, sides, tops, accessories, etc., as shown on the drawings. If not explicitly shown, provide a side panel on each end of cabinet bays, a perforated front door for each cabinet, a solid 'split' back door for each cabinet, and a top for each cabinet.
 - b. Provide power strips as shown on the drawings. If not shown, provide 2 vertical power strips per IT cabinet.
 - c. Provide bonding (also refer to 270526).
6. Overhead and Vertical Cable Support:
- a. Provide overhead cable support system, trapeze and wall supports, anchoring (e.g., to the underside of the structure above), accessories, fasteners, etc., required for a complete installation.
 - b. Provide seismic bracing for the overhead cable support system, including layout, configuration, detailing, and seismic calculations.
 - c. Provide drop-out as shown on Drawings. If not shown, provide a default of one dropout over each vertical management section.
7. Cable, wire and patch cord management
8. First-In-Place

- a. Server Room IT Cabinet: Install a single cabinet as a first-in-place. Coordinate a meeting for the Owner and Engineer to review the installation. Proceed after obtaining approval.
9. Identification tags, plates and labeling
10. Warranty
- C. Work Covered Under Other Sections
 1. Plywood backboards
 2. Bonding
 3. Grounding busbars
 4. Conduit and device boxes
 5. Power service to and within the room, and power service to the cabinets
 6. Cooling service to and within the room and controls
 7. Lighting
 8. Fire / life safety
- D. Related Divisions and Sections
 1. Consult other Divisions, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
 2. Drawings, general provisions of the Agreement, and Division 01 apply to this Section.
 3. Comply with the Related Sections requirements of section 270000 "Basic Communications Requirements"
 4. Refer to section 270526, "Communications Bonding", for related work.
 5. Seismic Calculation requirements of section 270000, Article 1.05, apply to this Section.

1.2 REFERENCES

- A. Comply with the References requirements of section 270000.

- B. In addition to those codes, standards, etc., listed in section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. EIA/ECA-310-E, "Cabinets, Racks, Panels, and Associated Equipment"
 - 2. National Fire Protection Association (NFPA):
 - a. NFPA 255, "Standard Method of Test of Surface Burning Characteristics of Building Materials"
 - b. NFPA 703, "Standard for Fire Retardant—Treated Wood and Fire—Retardant Coatings for Building Materials"
 - 3. ASTM E 84, "Standard Test Method for Surface Burning Characteristics of Building Materials"

1.3 DEFINITIONS

- A. Definitions as described in section 270000 shall apply to this section.
- B. In addition to the "Definitions" of section 270000, the following list of terms as used in this specification defined as follows:
 - 1. "BDF": Building Distribution Facility
 - 2. "IDF": Intermediate Distribution Facility
 - 3. "MDF": Main Distribution Facility
 - 4. "MPOE": minimum point of entry – applicable to telecom utilities, as defined in Public Utilities Commission regulations
 - 5. "MTR": Main Telecommunications Room
 - 6. "TR": Telecommunications Room
 - 7. "UPS": Uninterruptible Power Supply – a system that provides conditioned power with batteries acting as a continuous power source for equipment during a utility power interruption

1.4 SYSTEM DESCRIPTION

- A. General: Communications rooms shall fall into one of the following space titles:
 - 1. Entrance Facility
 - 2. Main Distribution Facility (MDF)

3. Intermediate Distribution Facility (IDF)
- B. Telecommunications rooms shall fall into one of the following space titles and functions:
1. Entrance Facility will serve the following functions:
 - a. House the MPOE for telecommunications utility/ies (e.g., AT&T)
 - b. House telecom utility's termination fields and interface between telecom utility's facilities and premises facilities
 2. Main Distribution Facility (MDF) will serve the following functions:
 - a. House network equipment (i.e., core switch/router, processing eqmt/servers) and voice system equipment (i.e. PBX and voice mail server)
 - b. House interbuilding and intrabuilding twisted pair and fiber optic backbone cabling and main crossconnect field
 - c. House network equipment (i.e. access switches) serving the horizontal cabling
 - d. House horizontal termination field – for voice/data/CATV – outlets served from this room (refer to floor plans for area served)
 3. Intermediate Distribution Facility (IDF) will serve the following functions:
 - a. House intrabuilding twisted pair and fiber optic backbone cabling from MDF
 - b. House horizontal termination field – both voice and data – of outlets served from this room (refer to floor plans for area served)
 - c. House network equipment (i.e. access switch) serving users of the room's service area
- C. Clearances: Refer to the drawings for minimum clearances associated with IT cabinets. If not explicitly shown, apply the following minimum clearances.
1. IT Equipment Cabinets:
 - a. Front: 36" clearance from the front door trim
 - b. Back: 36" clearance from the back door trim

1.5 SUBMITTALS

- A. Submittals of this section shall comply with the "Submittal" requirements of section 270000.
- B. Quantity: Furnish quantities of each submittal as noted in section 270000.
- C. Submittal Requirements at Start of Construction:
 - 1. Product Data Submittal
 - 2. Shop Drawings Submittal: Consisting of any proposed changes to room plans.
 - 3. Sample Submittal: Submit sample of equipment rack label.
 - 4. Seismic Calculations:
 - a. Equipment rack anchorage to flooring with overall rack bay bracing, based on racks' maximum rated load capacities.
 - b. Overhead cable support, including anchorage into structure above and seismic bracing detailing
 - 5. Schedule Submittal: Submit proposed schedule of work (this schedule may be combined with the schedule developed for Division 27).
- D. Submittal Requirements at Closeout:
 - 1. As-Built drawings; showing room layouts (floor layouts, overhead layouts), rack elevations, and other information pertinent to the built conditions
 - 2. O&M Manual, containing the final approved products and maintenance instructions
- E. Substitutions
 - 1. Requests for substitutions shall conform to the general requirements and procedure outlined in section 270000.

1.6 QUALITY ASSURANCE

- A. Comply with "Quality Assurance" requirements of section 270000.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with "Delivery, Storage and Handling" requirements of section 270000.

1.8 WARRANTY

- A. Warrant work and products described within this section for a period of 1 year. Correct deficiencies within 24 hours of notification.

PART 2 PRODUCTS**2.1 SHEET HARDWOOD / PLYWOOD (AS BACKBOARD)**

- A. Application: Sheet hardwood/plywood used as backboard in telecommunications rooms, "Use Category" UCFA per AWWA U1-17.
- B. Plywood shall be new and free from defects, and shall be interior "Type A" with a veneer grade of A-C.
- C. Size: 8' x 4' plywood sheets, 11/16" to 13/16" thick.
- D. Plywood shall be fire retardant treated with a flame spread rating of 25 or less / Class A, when tested in accordance with ASTM E84. Plywood shall be:
 - 1. Chemically treated and pressure impregnated
 - 2. Kiln dried after treatment to maximum moisture content of 15%.
 - 3. Stamped with the fire rating and the certifying lab.
- E. Plywood shall not contain VOCs, urea formaldehyde or formaldehyde, halogens, sulfates, chlorides, or ammonium phosphate.
- F. Manufacturers, or equal:
 - 1. Hoover Treated Wood Products, Inc. "Pyro-Guard" plywood
 - a.

2.2 IT EQUIPMENT CABINET

- A. Application: Suitable for the support of IT equipment (servers, storage, etc.), network equipment (switches, routers, firewalls, etc.), power strips (vertical, horizontal), termination apparatus, cable and cord management apparatus, common communications equipment, and other similar equipment.

- B. The cabinet shall be fundamentally comprised of a frame, mounting rails, front door, back doors, side panels and a top panel.
 - 1. Frame
 - a. The frame shall be the primary structural portion onto which everything else attaches. The frame shall be cubic in design/final construction.
 - b. The frame shall have the capacity for four mounting rails, minimum. The frame shall allow adjustability to the mounting rails, equipment installation/storage, and accessories.
 - c. Frame Material: steel or high strength, lightweight 6061-T6 aluminum.
 - 2. Mounting Rails:
 - a. 45U capacity
 - b. RMUs shall be permanently marked on the mounting rails
 - c. The mounting 'holes' shall be square punches for caged nuts. Caged nuts shall be pre-threaded as #12-24 rolled threading.
 - 3. Cable Management
 - a. The frame shall come equipped with 2 full-height vertical cable/cord managers, installed onto the back side of the frame.
- C. Static load rating: 2,000 lbs, minimum.
- D. Finish: power coat paint, black
- E. Manufacturer:
 - 1. CPI cabinets
 - a. #MIS-TS1512414; , 45U; frame dimensions: 84.6" (2149mm) H x; 27.6" (700mm) W x 39.4" (1000mm) D; equipped with Black square punched rails with 4X cable port openings – includes rail grommet kit (1); top panel, network, one-piece, with 4X grommets pass-thru brushes; standard caster and leveler kit; globalframe perf metal curved door-install front; single point keyed lock-install front; double perforated metal flat door-install rear; three point keyed lock-install rear; side panel with 8X pass-thru brushes- install left; side panel with 8x pass-thru brushes-install right; (4) short finger manager with door – install front left rail front right rail rear left rail and rear right rail (1) standard dual two piece PDU bracket, 3.9" wide; Common part kit, GF, non-UL; Packaging kit

- b. #13239-755; Metered Horizontal Rack-Mount Power Strip

2.3 BLANKING/FILLER PANELS

- A. Application: Suitable for an IT cabinet or equipment rack to prevent/slow front-to-back air flow.
- B. Manufacturers
 - 1. CPI
 - a. #34537-000; "snap-in" blanking panel, 1U, black

2.4 RACK BAY ACCESSORIES

- A. Mounting Screws
 - 1. Manufacturers
 - a. CPI
 - 1) #40605-005; mounting screws, #12-24, package of 50, black finish

2.5 LABEL PLATES

- A. Application: Suitable to affix onto top angle of equipment rack or onto the top front of a frame/cabinet.
- B. Label plate shall be engrave-able stock melamine plastic laminate substrate.
- C. Size (example): 1"H x 6"L x 1/16"T.
- D. Color: Black.
- E. Lettering shall be white, engraved, 1/2" high.

2.6 CABLE RUNWAY

- A. Application: Suitable for the support and management of telecommunications (and other low voltage) cables, either overhead or vertically on a wall, within telecommunications rooms.
- B. Straight Sections and Fittings:
 - 1. Construction: Straight sections and fittings shall be constructed of two longitudinal side elements – "stringer", with elements periodically crossing between stringers – "rung". Straight sections shall be manufactured in 9'-11 ½" lengths with rungs spaced 12" on center, and welded to stringers.

2. Material - stringer and rung: rectangular steel tube, 1-1/2" x 3/8" x 0.65" wall thickness
- C. Compliances: Cable runway shall be UL listed.
- D. Manufacturers, or equal:
 1. B-Line (Eaton) "Redi-Rail" Series
 - a. #SB13AL12FB; "Redi-Rail" cable runway, straight section, 12"W, black
 2. B-Line (Eaton) "Tubular Stringer (Boxed)" series
 - a. #SB17U12BFB; cable runway, straight section, 12"W, black
 3. B-Line (Eaton) "Tubular Stringer (Value Line)" series
 - a. #SB1712BFB; cable runway, straight section, 12"W, black
 4. B-Line (Eaton) Installation Accessories
 - a. #9ZN-R238; side-attach hanger rod bracket kit – 3/8" dia, zinc plated
 - b. #9ZN-R250; side-attach hanger rod bracket kit – 1/2" dia, zinc plated
 - c. #SB157ABZ; slotted C-type hanger rod bracket kit – 1/2" dia, black zinc
 - d. #SB157BBZ; slotted C-type hanger rod bracket kit – 5/8" dia, black zinc
 - e. #SB156ABZ; C-type hanger rod bracket kit – 1/2" dia, black zinc
 - f. #SB156BBZ; C-type hanger rod bracket kit – 5/8" dia, black zinc
 - g. #SB211312KFB; wall angle support kit – for 12"W runway, black powder coat
 - h. #SB21312KFB; wall triangle support kit – for 12"W runway, black powder coat
 - i. #SB166ABZ (SB2107BZ); butt splice kit, black zinc
 - j. #SB2110ABZ; adjustable butt splice kit, black zinc
 - k. #SB165BZ (SB2101ABZ); 90-degree junction splice kit, black zinc
 - l. #SB167BZ (SB2103ABZ); adjustable junction splice kit, black zinc
 - m. #SB2104BZ; 90-degree corner angle kit, black zinc

- n. #SB210512FB; end closing kit – for 12"W cable runway, black powder coat
 - o. #SB21B; end cap – neoprene, or #SB110A1B; end cap – PVC
 - p. #SB213312FB; rack-to-runway attachment kit – for 12"W runway, black powder coat
 - q. #SB16411/2FB (SB2114AFB); hold-down bracket (vertical wall) kit, black powder coat
 - r. #SB2106ABZ; foot bracket (vertical floor) kit – for 3/8" dia. fastener, black zinc
 - s. #SB2106BBZ; foot bracket (vertical floor) kit – for 1/2" dia. fastener, black zinc
 - t. #SB6691x7³/₄; grounding strap, 7.75"L
5. B-Line (Eaton) Cable/Cord Management Accessories
- a. #SB13ALDO12FB; rung drop out kit, 11.24"W, black powder coat
 - b. #SB212912UFB; rung drop out kit, 10"W cable runway, black powder coat
 - c. #9ZN-MB1-4; multi-purpose mounting bracket
6. CPI "Adjustable Cable Runway" series
- a. #14300-712; adjustable cable runway, straight section, 12"W, black
7. CPI "Universal Runway" series
- a. #10250-712; cable runway, straight section, 12"W, black
 - b. #10724-712; cable runway vertical inside sweep fitting, 12"W, black
8. CPI Installation Accessories
- a. #11301-001; butt splice kit
 - b. #10487-001; swivel butt splice kit
 - c. #11314-001; 90-degree junction kit
 - d. #11302-001; junction splice ("T") kit
 - e. #10488-001; swivel junction splice ("T") kit
 - f. #10608-001; vertical wall bracket kit

- g. #10642-001; end caps
 - h. #11421-712; wall angle support kit for 12" wide cable runway, black
 - i. #11312-712; triangle support kit for 12" wide cable runway, black
 - j. #11770-712; end closing kit for 12" wide cable runway, black
 - k. #12730-712; runway-to-rack attachment kit, for 12"W runway, black
 - l. #14307-001; bonding strap
9. CPI Cable/Cord Management Accessories
- a. #14305-012; drop-out for rung, 12"W, black
 - b. #14305-000; drop-out for stringer, 10.5"W, black
 - c. #13392-711; rung spool/divider, black

PART 3 EXECUTION

3.1 GENERAL

- A. Comply with the "Execution" requirements of section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Prior to installation, verify rooms are suitable for the construction scope of this section. Schedule work to prevent damage caused by other trades during their construction.
- B. Prepare surfaces, such as floors, for permanent installation of products, such as racks.

3.3 INSTALLATION

A. Plywood Backboards

1. General

- a. Complete work in a neat, high quality manner. The final conditions shall conform to applicable codes, BICSI's TDM, TIA's 569 standard, and telecom utility standards.
- b. Coordinate the plywood installation with the outlets to result in a clean finish.

2. Preparation

- a. Prior to installing wood materials, condition wood to the prevailing humidity conditions in installation areas.

3. Plywood Installation

- a. Install plywood in accordance with WIC Custom or Premium Quality Standard, as scheduled. Ensure work complies with applicable codes and recognized standards.
- b. Install plywood as indicated on Drawings to the dimensions shown. In lieu of no dimensions, install plywood from +0'-6" to +8'-6" above the finished floor.
- c. Install plywood plumb, level, true, and straight with no distortions. Shim as needed using concealed shims.
- d. Trim plywood around electrical and telecommunications outlets to result in a clean finish.
- e. Install plywood such that the fire rating stamp is visible.
- f. Install plywood to a tolerance of 1/8" in 8' for plumb and level; and with 1/16" maximum offset in flush adjoining, 1/8" maximum offsets in revealed adjoining surfaces.
- g. Do not install plywood that has defects or is not new.
- h. Do not install pieces of plywood that are too small for the area (thus resulting in an excessive number of joints).

4. Fasteners

- a. Install plywood using screws, concrete anchors, or other fasteners suitable for the purpose/ required for application/mounting substrate.
- b. Do not use aluminum fasteners.
- c. Install fastener such that fastener heads are flush with and not protruding from the plywood finished surface. Countersink fastener heads as needed.

5. Painting

- a. Paint plywood with a low-gloss, white (or similar bright color) paint.
- b. Mask the plywood's fire rated stamp from the paint such that the stamp is still visible after painting.

6. Cleaning, Finishing, and Protection

- a. Clean exposed surfaces. Touch-up finishes to restore damaged or impaired areas.
- b. Protect and maintain protection to ensure finished work will be without damage. Repair or replace finished work and materials defaced or destroyed prior to acceptance.

B. IT Equipment Cabinets**1. Pre-Installation:**

- a. Layout the cabinets within equipment rooms, and mark the floor where cabinets will be installed. Obtain written approval from either the Engineer or Owner prior to proceeding with the installation.
- b. The layout shall satisfy the clearance requirements under "System Description".

2. Anchoring

- a. Use anchors and methods of the approved seismic submittal.
- b. Drill the structure using means approved for this project.
- c. As required, scan the structural floor to identify reinforcing bar and other elements that cannot be interrupted using means approved for this project (e.g., X-ray).
- d. Anchor cabinets to the structural floor at four points.

3. Leave no fastener loose and un-torqued.**4. Bonding: Bond cabinets to approved ground using approved means, configurations and products. Also refer to section 270526 for additional information on bonding.****5. Cabinet Set-Up**

- a. Set the front doors to open leftward (hinged on the left).
- b. Set the front mounting rails to 2 inches from the front edge of the cabinet frame.
- c. Set the back mounting rails to 2 inches from the back edge of the cabinet frame.

- d. Install the 3rd mounting rails facing to the back to 16 inches from the back edge of the cabinet frame.
 6. Accessories
 - a. Install accessories, such as equipment shelves, pull-out drawers, etc. per the Owner's instructions.
- C. Overhead Cable Support
1. Install support apparatus (e.g., brackets and threaded rod with strut) for overhead cable management system. Install the system per the manufacturer's instructions and hung from overhead or braced to the wall using appropriate fasteners.
 2. Install parts required for complete installation (e.g., mounting brackets, splice kits, hardware, etc.).
 3. Tolerances
 - a. Install overhead cable support as shown on the drawings. If not explicitly shown, center the overhead cable support to the equipment rack and 3" from the perimeter wall.
 4. Interface with Other Work: Coordinate the installation of the overhead cable support with other trades. Trapeze supports and hanger rods ("all-thread"), for example, may be shared to lower overall construction cost.
- D. Horizontal Power Strips
1. Install horizontal power strips as shown on the drawings. If not explicitly shown, coordinate the installation height with the Owner / Owner's Representative. Install fasteners and parts required to complete the installation.
 2. Route the input cord within designated cable management and install cord fasteners to prevent movement of the input cord. Plug the input cord into the receptacle designated by the Owner / Owner's Representative.
- E. Vertical Power Strips in Cabinets/Frames
1. Install vertical power strips as shown on drawings. If not explicitly shown, install two vertical power strips per cabinet at the back, one on each side. Install fasteners and parts required to complete the installation.
 2. Route the input cords within designated cable management and provide cord fasteners to prevent movement of the input cord. Plug the input cord into the receptacle designated by the Owner / Owner's Representative.

F. UPSs (In-Rack Systems)

1. Install UPSs as shown on drawings. If not explicitly shown, install one UPS per telecommunications room. Install the UPS at the bottom of the left-most rack, including fasteners and parts required for a complete installation.
2. Plug the UPS into the electrical service designated by the Owner.

G. Track Busway Power Module

1. Coordinate power modules to balance load between track busway phases. Since each IT cabinet in the Equipment Room requires two power modules, provide modules that plug into phases A and B for the first cabinet, C and A for the next cabinet, B and C for the next, and so on.

3.4 LABELING

- A. General Requirements: Labeling and identifier assignment shall conform to the TIA-606 standard and as approved by Owner before installation.
- B. Equipment Rack Label Requirements: Provide two label plates per rack. Permanently affix label plate as shown on the drawings or (if not shown) centered on the rack's front top angle and back top angle
- C. IT Cabinet Label Requirements: Provide two label plates per IT cabinet. Permanently affix label plates as shown on the drawings or (if not shown) centered at the top of the cabinet's front door and back door.
- D. Identifier Assignment
 1. IT Cabinets
 - a. First field: the room's identifier; for example: "MDF0.1".
 - b. Second field: the row identity; for example: "A".
 - c. Third field: the cabinet position number; for example: "01".
 - d. Example; "MDF0.1-A01"

3.5 FINAL INSPECTION AND CERTIFICATION

- A. Punch the work of this section compliant to the requirements of section 270000.
- B. Comply with system acceptance and certification requirements of section 270000.

END OF SECTION

SECTION 27 1513

COMMUNICATIONS HORIZONTAL TWISTED PAIR CABLING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes: Horizontal twisted pair cabling
- B. Base Bid Work
 - 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. 270811, "Communication Twisted Pair Testing"
 - 3. 270528, "Communication Building Pathways"

D. Work Provided Under Other Sections

1. Pathways: Communications pathways (conduits, stubs, etc.) are covered under another section. Refer to the drawings for type, size/capacity and route information. Refer to sections 270528 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.

E. Products furnished but not installed under this section

1. Connecting Media:
 - a. Patch cords in the MDF between horizontal termination fields and network equipment (e.g., access/edge switch.)
 - b. Patch/line cords at the work areas between outlet and user equipment (e.g., phone, computer, etc.)

F. Products installed but not furnished under this section

1. Owner-furnished equipment
2. Wireless access points

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 (or as noted) of the following applicable specifications and standards except as otherwise shown or specified:
 1. National Fire Protection Agency (NFPA)
 - a. NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces"
 2. Underwriters Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
 - a. UL 444, "Communications Cables"

- b. UL 1863, "Communications-Circuit Accessories"
- 3. Insulated Cable Engineers Association (ICEA):
 - a. ICEA S-116-732, "Standard for Category 6 and 6A, 100 Ohm, Individually Unshielded Twisted Pairs, Indoor Cables (With Or Without An Overall Shield) for Use in LAN Communications Wiring Systems"

1.3 DEFINITIONS

- A. The Definitions in section 270000 apply to this section.
- B. In addition, define the following list of terms as used in this specification as follows:
 - 1. "Cabling": cabling consists of cables, connectors (jacks, plugs), termination apparatus (panels, blocks, outlets, etc.), consolidation points, connecting media (patch cords, line cords, crossconnect wire, etc.), and labeling/identification.
 - 2. "CAT3": Category 3 performance grade
 - 3. "CAT5E": Category 5 Enhanced performance grade
 - 4. "CAT6": Category 6 performance grade
 - 5. "CAT6A": Category 6 Augmented performance grade
 - 6. "Channel": End to end transmission path; e.g., the Permanent Link and connecting media such as line cord (at the workstation), patch cord, and (if a full crossconnection is implemented) the crossconnect termination/connecting apparatus and equipment cord.
 - 7. "CMP": Communications Media Plenum [plenum rating]
 - 8. "CMR": Communications Media Riser [riser {non-plenum} rating]
 - 9. "FEP": Fluorinated Ethylene Propylene
 - 10. "F/UTP": twisted pair cabling with an overall foil shield
 - 11. "FTP": synonymous with "F/UTP", unless otherwise noted
 - 12. "ID": identifier
 - 13. "MDF": Main Distribution Facility
 - 14. "PE": Polyethylene

15. "Permanent Link": Test configuration for a horizontal cabling link excluding patch cords, equipment cords, and line cords; e.g., the permanent portion of the horizontal cabling to each outlet consisting of cable, consolidation point (if used), termination/connecting apparatus in the telecommunications and the connector at the outlet.
16. "PVC": Polyvinyl chloride
17. "IDF": Intermediate Distribution Facility
18. "U/UTP": twisted pair cabling with no shield
19. "UTP": synonymous with "U/UTP", unless otherwise noted

1.4 SYSTEM DESCRIPTION

- A. Horizontal twisted pair cabling shall consist of the cabling from telecommunications rooms to outlets/connectors at work areas, to equipment, to devices, or other items that require network connections or other telecommunications services.
 1. Refer to other sections for pathways and cable support.
 2. Refer to other section for testing.
- B. Cabling Length Requirements: Note that cable length means the electrical length (pair length), not the sheath length. Also, length requirements must account for test equipment accuracy tolerances (for example, TIA568-C.2 allows for 10% uncertainty).
 1. The maximum electrical length of any permanent link shall not exceed 90 meters. If consolidation points or multi-user outlets are used, then the lengths shall not exceed those listed in the TIA-568 standard and the cabling system manufacturer's guidelines (whichever is shorter).
 2. The maximum electrical length of any channel shall not exceed 100 meters. If consolidation points or multi-user outlets are used, or if the total length of cords needs to exceed 10 meters, then the permanent link lengths shall not exceed those listed in the TIA-568 standard and the cabling system manufacturer's guidelines (whichever is shorter).
 3. The minimum electrical length of any permanent link shall be no shorter than as required by the manufacturer (as described in written guidelines).
- C. Jack Wiring: Jacks shall be wired to T568B configuration.

1.5 SUBMITTALS

- A. Comply with the Submittals requirements of section 270000.

- B. Quantity: Furnish quantities of each submittal as noted in section 270000.
- C. Substitutions: Conform to substitutions requirements and procedures in section 270000.
- D. Submittal requirements prior to the start of construction:
 - 1. Product Data submittal, indicating specifications and conformance with CEC, UL, TIA listings, and other applicable certifications.
 - 2. Sample submittal, consisting of the following components:
 - a. Type "A" Outlet Sample – one fully configured outlet including faceplate, modular jacks, and labeling
 - b. Cable label sample
 - 3. Schedule submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for 27xxxx series sections
 - 4. Shop Drawings submittal, consisting of proposed changes to cable routing, or termination locations/configurations
 - a. service areas
 - b. the location of every complement of cabling
 - c. rack elevations showing termination sequences
- E. Submittal requirements at closeout:
 - 1. As-Built Drawings: Submit a set of floor plans and (as appropriate) RCPs showing the location of every complement of cabling with its respective ID – these as-built drawings may be combined with those showing the pathways (cable trays, conduits, etc.). The IDs on the shop drawings shall exactly match the physical labeling applied to cabling components.
 - 2. Link ID –to– Office Number Key: Submit a "link ID-to-office number key" as an electronic format (such as an MS-Excel spreadsheet file or cloud-based medium) that lists every permanent link associated with the final location / office number.
 - 3. Crossconnection records/cut sheets
 - 4. Operations and Maintenance (O&M) Manuals

F. Posted Documentation

1. Post one full size plot of as-built drawings, specifically the floor plans and (as applicable) reflected ceiling plans, within the MDF showing the MDF's serving area. Coordinate location with Owner.

1.6 QUALITY ASSURANCE

- A. Comply with the Quality Assurance requirements of section 270000.

B. Contractor Qualifications

1. In addition to the Contractor Qualifications requirements of section 270000, the Contractor shall be certified by the manufacturer to provide the cabling system (proposed, submitted, and approved) and to provide an extended warranty. Submit satisfactory evidence of certification in the form of a current certificate or letter from the manufacturer as part of the bid.
2. In addition to the Contractor Qualifications requirements of section 270000, the Contractor shall be an authorized Belden Partner Alliance Networking Installer and must have successfully completed design and installation training required and provided by Belden. Installation. Installation and testing shall be performed by a contractor who is part of the Belden Partner Alliance Program and be supervised by individuals qualified to install and test the Belden System 10GX, in accordance with Belden's requirements. The supervisor(s) shall have successfully completed Belden IBDN installation training provided by Belden Inc. To qualify for System Warranties, the installed cabling system shall fully comply with all relevant Belden IBDN design and applications guidelines, including any pre-approved deviations as specified in the latest release of the Belden IBDN Certification Guide.
3. In addition to the Contractor Qualifications requirements of section 270000, the Contractor shall be a current Panduit ONESM Partner, Silver and above or Gold and above or Platinum, that has completed the Structured Cabling Deployment Training (Panduit Certified Installer), and shall submit certification under Panduit letterhead. The Contractor's lead technical staff shall have a current Panduit Certified Technician (PCT) certificate, and shall submit certification under Panduit letterhead.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Delivery, Storage and Handling requirements of section 270000.

1.8 WARRANTY

- A. Provide to the Owner an extended system warranty covering all components of the horizontal cabling system (cables, jacks, panels, patch cords, equipment, workmanship, etc.). This extended warranty shall cover parts and labor for the

duration of the extended warranty. This extended warranty shall also guarantee the cabling system performance to the Category specified herein, per ANSI/TIA-568 standards series performance criteria for horizontal cabling. The warranty period shall be 15 years, or greater.

- B. The horizontal cabling system, as specified in this section, shall carry a 25-year Component Warranty and Lifetime Application Assurance.
- C. Provide to the Owner a Limited Lifetime Product and Performance Warranty covering all components of the horizontal cabling system (cables, jacks, panels, patch cords, equipment, workmanship, etc.). The warranty shall guarantee the cabling system performance to the Category specified herein. Submit a written warranty statement with system documentation. The warranty period shall begin on the system's first use by the Owner.
- D. The horizontal cabling system, as specified in this section, shall carry a 25-year Certification PLUS™ System Warranty. This warranty shall guarantee system performance for 25 years from acceptance that the installed system will support data link protocols for which that copper Category is engineered to support per IEEE and TIA standards.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Belden cabling system
- B. Panduit TX Copper Cabling System based on Mini-Com connectivity ~~–OR–~~ Panduit Enterprise Solutions cabling system (no other substitutions allowed)

2.2 HORIZONTAL CABLE – CAT6A U/UTP PLENUM RATED (CMP)

- A. Application: Suitable for indoor installation, within ceiling space in primary and secondary pathways.
- B. Conductors:
 - 1. Insulated Conductors: 23 AWG solid copper, fully insulated with a flame retardant thermoplastic material (material = FEP, or similar).
 - 2. Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair) color-coded to industry standards (EIA-230).
- C. Cable Sheath:
 - 1. Shielding: none

2. Outer Jacket: seamless outer jacket (material = LS-PVC, or similar) applied to and completely cover the internal components (twisted pairs).
- D. Flame Rating: CMP, UL listed as such, and the rating shall be printed on the jacket.
- E. Electrical and Mechanical Performance: Meet or exceed requirements of TIA-568 standard series, ANSI/ICEA S-116-732, ISO 11801 Class E_A Edition 2.2, and IEEE Std. 802.3an channel for CAT6A cabling.
- F. Limited Power: UL certified as “Limited Power (LP)”, and the rating shall be printed on the jacket.
 1. Listed to 0.5 A per conductor.
- G. Jacket marking: “CMP–LP (0.5A)”
- H. Color: Black
- I. Manufacturer, or equal:
 1. Belden “10GXS” Series CAT6A U/UTP Plenum Rated (CMP) Cable, Non-Bonded Pairs
 - a. #10GXS13 D151000; CAT6A 4 pair U/UTP cable “10GXS” non-bonded, CMP
 - b. #10GXS13 0091000; CAT6A 4 pair U/UTP cable “10GXS” non-bonded, CMP
 2. Belden “10GXS” Series CAT6A U/UTP Plenum Rated (CMP) Cable, Bonded Pairs
 - a. #10GXS33 D151000; CAT6A 4 pair U/UTP cable “10GXS” bonded, CMP
 - b. #10GXS33 0091000; CAT6A 4 pair U/UTP cable “10GXS” bonded, CMP
 3. Belden “10GX” Series CAT6A U/UTP Plenum Rated (CMP) Cable, Non-Bonded Pairs
 - a. #10GX13 D151000; CAT6A 4 pair U/UTP cable “10GX” non-bonded, CMP
 - b. #10GX13 0091000; CAT6A 4 pair U/UTP cable “10GX” non-bonded, CMP
 4. Belden “10GX” Series CAT6A U/UTP Plenum Rated (CMP) Cable, Bonded Pairs
 - a. #10GX33 D151000; CAT6A 4 pair U/UTP cable “10GX” bonded, CMP
 - b. #10GX33 0091000; CAT6A 4 pair U/UTP cable “10GX” bonded, CMP

5. Panduit “10Gig” “Vari-MaTriX” Series CAT6A U/UTP Plenum Rated (CMP) Cable
 - a. #PUP6AV04BU; CAT6A 4 pair U/UTP cable “10Gig” “Vari-MaTriX”, CMP
 - b. #PUP6AV04WH; CAT6A 4 pair U/UTP cable “10Gig” “Vari-MaTriX”, CMP,
6. Panduit “10Gig” Series CAT6A U/UTP Plenum Rated (CMP) Cable
 - a. #PUP6AM04BU-UG; CAT6A 4 pair U/UTP cable “10Gig”, CMP
 - b. #PUP6AM04WH-UG; CAT6A 4 pair U/UTP cable “10Gig”, CMP

2.3 HORIZONTAL CABLE – CAT6A OSP/UNDERGROUND RATED

- A. Application: Suitable for outdoor installation, within underground pathways (conduit, pull boxes) and/or in slab (slab-on-grade).
- B. Conductors:
 1. Insulated Conductors: 23 AWG solid copper, fully insulated with a thermoplastic material (material = PE, or similar).
 2. Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair) color-coded to industry standards (EIA-230).
- C. Cable Sheath:
 1. Separator: optional
 2. Filled: Cable core (interior to the sheath) shall be flooded with filling compound to protect against moisture penetration. Filling compound: “FLEXGEL”, or similar.
 3. Outer Jacket: seamless outer jacket (material = PE, or similar) applied to and completely cover the internal components (twisted pairs), embedded with UV inhibitors, and black in color.
- D. Electrical Signal Performance: Meet or exceed TIA-568 standard series, ISO 11801 Class E_A Edition 2.2, and IEEE Std. 802.3an channel requirements for supporting 10GBASE-T.
- E. Color: Black
- F. Manufacturer, or equal:
 1. Belden
 - a. #OSP6AU 0101000; CAT6A 4 pair U/UTP OSP cable

- b. #2148A 0101000; CAT6A 4 pair CMR/CMX indoor/outdoor cable

Panduit "TX6A" Series CAT6A OSP cable, shielded (F/UTP)

- a. #PFO6X04BL-CEG; CAT6A 4 pair "TX6A" OSP cable, shielded (F/UTP)

2.4 PATCH CORDS – MODULAR, CAT6A U/UTP

- A. Application: Suitable for indoor installation within a telecommunications room or workstation environment.
- B. Cords shall be factory-assembled from a single, continuous length (no splices permitted) of cordage, homogenous in nature, and terminated at both ends via 8 position modular plugs.
- C. Cordage
 - 1. Insulated Conductors: 23AWG stranded copper, fully insulated with a flame retardant thermoplastic material (such as PVC, or similar).
 - 2. Twisted Pairs: Two insulated conductors "twisted" into a "pair" (twisted pair), color coded.
 - 3. Unshielded sheath and flame-retardant polyvinyl chloride (PVC) jacketed.
 - 4. Flame Rating: CEC CM (or higher) rated, and UL listed as such.
- D. Electrical Performance: Meet or exceed TIA-568 standard series and ISO/IEC 11801 requirements for CAT6A cabling.
- E. Length: Refer to Outlet Schedule for length requirements.
- F. Manufacturer, or equal:
 - 1. Belden

Coordinate color of patch cords with Owner prior to purchasing.

- a. #CA211ccIII; patch cord, where "CA" = performance (CAT6A), "01" = cable type (24 AWG solid, bonded-pair, CMR), "1" = termination type, "cc" = color, "III" = length
 - 1) Colors: black = 00, red = 02, yellow = 04, green = 05, blue = 06, purple = 07, gray = 08, white = 09, almond = 21
 - 2) Length: 001-015 ft. in 1 ft. increments, then 20 ft. or 25 ft.

2. Panduit

- a. #UTP6A7; CAT6A modular patch cord, 7 feet, off white

- b. #UTP6A10; CAT6A modular patch cord, 10 feet, off white
- c. #UTP6A7BU; CAT6A modular patch cord, 7 feet, blue
- d. #UTP6A10BU; CAT6A modular patch cord, 10 feet, blue

Belden “10GX KeyConnect” Patch Panels, preloaded with CAT6A KeyConnect Jacks

- a. #AX103256; “10GX KeyConnect” flat patch panel, 2U, 48 preloaded CAT6A ports

TERMINATION APPARATUS – PATCH PANEL, JACK INSERT TYPE (EMPTY)

- A. Application: Patch panels shall be suitable for installation within a TR. Panels shall be horizontally oriented for a rack-mounted configuration. Panels shall be capable of supporting, organizing, labeling and patching.
- B. Manufacturer, or equal:
 - 1. Belden “KeyConnect” Series Patch Panels, empty
 - a. #AX103115; “KeyConnect” flat patch panel, 2U, 48 empty ports, black
 - 2. Panduit
 - a. #CPPL48WBL; patch panel with “Mini-Com” snap-in plates, flat, 48 ports, empty

2.6 TERMINATION APPARATUS – CAT6A PATCH PANEL, PUNCH DOWN TYPE

- A. Application: Panels shall be suitable for installation within a TR for the termination of the horizontal cables specified herein. Panels shall be horizontally oriented for a rack-mounted configuration. Panels shall be capable of supporting, organizing, labeling and patching/crossconnecting between the horizontal termination field and the equipment termination field.
- B. Modular patch panel shall have 110-type termination, and shall be compatible with the specified horizontal cables both electrically and physically.
- C. Mechanical Performance: Each port shall be an 8-position modular jack, compliant to ANSI/TIA-568.
- D. Electrical Performance: Each port shall meet or exceed TIA-568 standard series and ISO/IEC 11801 requirements for CAT6A U/UTP cabling through the cable termination and patch cord connection.

E. Manufacturer, or equal:

1. Panduit

- a. #DP486X88TGY; “DP6 10Gig” flat patch panel, 48 CAT6A ports

2.7 HORIZONTAL CABLE SUPPORT BAR

A. Application: Suitable to support horizontal cables behind patch panels from vertical cable managers to termination point.

B. Color: Match rack color

C. Manufacturer, or equal:

1. Belden

- a. #AX104303; cable management bar for Keyconnect Panels
- b. #AX101173; cable management bar for rack mounting

2. Panduit

- a. #SRB19BLY; extended strain relief bar
- b. #SRBS19BL-XY; straight strain relief bar
- c. #SRBCT; straight strain relief bar with cable tie clips

2.8 TERMINATION APPARATUS – CAT6A MODULAR 8-POSITION CONNECTORS, UNSHIELDED

A. Application: Modular connectors, i.e., jacks and plugs, shall be used for the termination of 4-pair U/UTP cables, and shall be compatible – both electrically and physically – with the cables specified herein.

B. Mechanical Performance: Modular connectors shall be 8-position, compliant to TIA-568 standard series.

C. Electrical Performance: Modular connectors shall meet or exceed TIA-568 standard series and ISO/IEC 11801 requirements for CAT6A U/UTP cabling.

D. Manufacturer, or equal:

1. Belden “KeyConnect 10GX” Series Modular 8-Position Jacks, CAT6A

- a. #AX102282; “KeyConnect 10GX” modular 8-position jack, CAT6A, white

2. Panduit "Mini-Com" "TX6 10Gig" Series Modular 8-Position Jack, CAT6A

- a. #CJ6X88TGWH; modular 8-position jack, CAT6A, white

2.9 WORK AREA OUTLETS – FLUSH-MOUNT FACEPLATES

- A. Application: Faceplates shall be suitable for indoor installation for standard 1-gang and 2-gang flush-mount devices.
- B. Faceplates shall have 6 ports, and shall include required accessories, such as icons, blank inserts, label windows and labels.
- C. Color: White
- D. Manufacturer, or equal:

1. Belden "KeyConnect" Series Faceplates

- a. #AX102671; "KeyConnect" faceplate, 2-gang, 6 ports, electrical white

2. Panduit "Mini-Com" "Ultimate ID" "Classic" series faceplates

- a. #UICFP6WH; faceplate, "Ultimate ID Classic" series, 1-gang, vertical, 6 ports, white

3. Panduit "Mini-Com" "Classic" series faceplates with label windows

- a. #CFPL6WHY; flat faceplate "Classic" series, 1-gang, vertical, 6 ports, white

E. Ceiling Support Wire Brackets

- 1. Application: Brackets shall retain and hold in place connectors above an accessible ceiling.
- 2. Manufacturer, or equal:
 - a. Wiremold
 - 1) #CM2-U2KEYA-BK; bezel adapter, accepts 2 keystone mount connectors, black

2.10 LABELS

- A. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.
- B. Labels shall be permanent, unless otherwise noted.

C. Cable and Wire Labels

1. Labels for cables and wires shall be either of the following types:
 - a. Tape – adhesive-backed, wrap-around, self-laminating
 - b. Strip – adhesive backed, under shrink-wrap
2. Face stock (print area) shall be white.
3. Size: as needed per cable size/diameter and to fit the full identifier (at least 1" wide).
4. Manufacturer, or equal:
 - a. Brady
 - b. Brother
 - c. DYMO XTL or Rhino
 - d. Panduit
 - 1) #S100X125YAJ; self-laminating cable label, white face stock (1"W x 0.38"W), for cable diameters 0.12"-0.28"
 - 2) #S100X150YAJ; self-laminating cable label, white face stock (1"W x 0.5"W), for cable diameters 0.16"-0.32"
 - 3) #S100X225YAJ; self-laminating cable label, white face stock (1"W x 0.75"W), for cable diameters 0.24"-0.48"

D. Patch Panel Labels

1. Application: For patch panels that do not have an integrated labeling feature and do not come packaged with labeling parts.
2. Patch panel labels shall be adhesive backed, and shall fit within the area suitable for labeling the ports on the panel.
3. Face stock (print area) shall be white.
4. Size: as needed.
5. Manufacturer, or equal:
 - a. Brady

- b. Brother
- c. DYMO XTL or Rhino
- d. Panduit
 - 1) #C061X030FJJ; component label, laser/inkjet print, white face stock, 0.61"W x 0.3"H
 - 2) #C125X030FJJ; component label, laser/inkjet print, white face stock, 1.25"W x 0.3"H
 - 3) #C150X030Y1J; component label, laser/inkjet print, white face stock, 1.50"W x 0.3"H
 - 4) #C188X030FJJ; component label, laser/inkjet print, white face stock, 1.88"W x 0.3"H
 - 5) #C252X030FJJ; component label, laser/inkjet print, white face stock, 2.52"W x 0.3"H

E. Faceplate Labels

- 1. Application: For faceplates that do not have an integrated labeling feature and do not come packaged with labeling parts.
- 2. Labels for faceplates shall be adhesive backed, and shall fit within the area for labeling the faceplate.
- 3. Face stock (print area) shall be white.
- 4. Size: as needed.
- 5. Manufacturer, or equal:
 - a. Brady
 - b. Brother
 - c. DYMO XTL or Rhino
 - d. Panduit
 - 1) #C061X030FJJ; component label, laser/inkjet print, white face stock, 0.61"W x 0.3"H
 - 2) #C125X030FJJ; component label, laser/inkjet print, white face stock, 1.25"W x 0.3"H

- 3) #C150X030Y1J; component label, laser/inkjet print, white face stock, 1.50"W x 0.3"H
- 4) #C188X030FJJ; component label, laser/inkjet print, white face stock, 1.88"W x 0.3"H
- 5) #C252X030FJJ; component label, laser/inkjet print, white face stock, 2.52"W x 0.3"H

F. Faceplate Port Labels

1. Application: For faceplates that do not have an integrated port identifying feature.
2. Labels for ports of faceplates shall be adhesive backed, and shall fit within the area suitable for applying a label per port on the faceplate.
3. Face stock (print area) shall be white.
4. Size: as needed.

G. Surface Outlet Labels

1. Application: For surface outlets that do not have an integrated labeling feature and do not come packaged with labeling parts.
 2. Labels for surface mount outlets shall be adhesive backed, and shall fit within the area for labeling the outlet box and for labeling ports of the outlet box.
 3. Face stock (print area) shall be white.
 4. Size: as needed.
 5. Manufacturer, or equal:
 - a. Brady
 - b. Brother
 - c. DYMO XTL or Rhino
 - d. Panduit
- 1) #C061X030FJJ; component label, laser/inkjet print, white face stock, 0.61"W x 0.3"H
 - 2) #C125X030FJJ; component label, laser/inkjet print, white face stock, 1.25"W x 0.3"H

- 3) #C150X030Y1J; component label, laser/inkjet print, white face stock, 1.50"W x 0.3"H
- 4) #C188X030FJJ; component label, laser/inkjet print, white face stock, 1.88"W x 0.3"H
- 5) #C252X030FJJ; component label, laser/inkjet print, white face stock, 2.52"W x 0.3"H

2.11 MISCELLANEOUS COMPONENTS

A. Loom Tubing

1. Application: manage and protect cables from feed point to furniture system, or similar
2. Manufacturer, or equal:
 - a. Panduit
 - 1) #CLT100F-C20; split corrugated loom tubing (polyethylene), 0.91" ID, black
 - 2) #CLT125F-L20; split corrugated loom tubing (polyethylene), 1.28" ID, black
 - 3) #CLT150F-T20; split corrugated loom tubing (polyethylene), 1.58" ID, black
 - 4) #CLT188F-C20; split corrugated loom tubing (polyethylene), 1.85" ID, black

B. Velcro Cable Ties

1. Width: .75".
2. Manufacturer, or equal:
 - a. Panduit "Tak-Ty" series cable ties
 - b. Panduit
 - 1) #HLS-15R0; black, 15' roll, cut to length

C. Plenum Cable Ties

1. Application: for use in plenum or air handling spaces

2. Compliance: AH-2
3. Manufacturer, or equal:
 - a. Panduit "Pan-Ty" PLT series plenum cable ties
 - b. Panduit
 - 1) #PLT.65M; Pan-Ty series plenum cable tie, 2.8" (71mm) length / 0.6" diameter bundle
 - 2) #PLT.7M; Pan-Ty series plenum cable tie, 2.8" (71mm) length / 0.6" diameter bundle
 - 3) #PLT1M; Pan-Ty series plenum cable tie, 3.9" (99mm) length / 0.87" diameter bundle

PART 3 EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Rooms: Prior to installation, verify equipment rooms are suitable to accept the horizontal cables and terminations.
- B. Pathways: Prior to installation verify that pathways and supporting devices, provided under other sections, are properly and completely installed (at least the portions into which cables will be placed), and that temporary supports, devices, etc., have been removed. Cable tray shall be complete prior to placing cables within them, per CEC (at least the portions into which cables will be placed). Verify dimensions of pathways, including length (for example, "True Tape" the conduits) to ensure that the resulting cable lengths will not exceed the maximum allowable length specified herein.
- C. Cable Integrity: Prior to installation, verify the cable's integrity – both sheath and conductors. Documentation of pre-installation testing is not a close out requirement, and is the responsibility of the Contractor.

3.3 INSTALLATION

- A. Cable Installation and Routing
 1. No cable length shall violate the requirements stated in "System Description".

2. Cables shall have continuous sheath continuity. Splices are not permitted anywhere.
3. Install cables within the cable manufacturer's published installation temperature range.
4. Place cables within designated pathways, such as cable tray, cable hangers, etc. Do not fasten (such as with cable ties) or attach cables to other building infrastructure (such as ducts, pipes, conduits, etc.), other systems (such as ceiling support wires, wall studs, etc.), or to the outside of conduits, cable trays, or other non-approved pathway systems.
5. Place and suspend cables during installation and termination in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination.
6. In general, route cables at 90-degree angles, along corridors (for improved maintenance and access).
7. Do not bend cables tighter than 2 inches during and after installation.
8. Do not exceed manufacturer's limits for pulling tension.
9. Do not use cable-pulling compounds / pulling lubricants for indoor installations.
10. Route cables under building infrastructure (such as ducts, pipes, conduits, etc.) – to result in easy accessibility to the cables for future maintenance.
11. Place cables at least 6 inches away from power sources – to reduce interference from EMI.
12. Neatly dress and organize cables using designated cable routing facilities, and fasten to support devices via Velcro-type straps.
13. When exiting primary pathways (such as cable tray) to the work area, exit via the top of the pathway.
14. Cable Ties: Install cables ties, where allowed, tight enough to keep cables organized/managed but loose enough to be moved about the cables/cable bundles. Cable ties shall not deform or cinch cables too tightly. Tie installed too tightly per the Engineer's opinion shall be subject to removal upon direction from the Engineer.

B. Cable Routing and Dressing within the TR

1. Place cables within the overhead cable support. When routing vertically, fasten the cables onto vertical cable support approximately every 24 inches using approved cable fastening means.
2. At the rack bay, route cables within the back of the vertical management sections (do not route cables into the front as this space is reserved for patch cords only). [Divide the cables equally between both sides of an equipment rack such that a cable does not travel past the midpoint of the rack prior to termination.](#) Dress and cut cables to length required to reach the designated termination point (maintaining bend restrictions) with no excess cable slack left in the horizontal cable manager (if used) and vertical management section.
3. Provide [10-15 feet](#), minimum, sheathed cable slack – length not to exceed permanent link maximum length requirement. Place the slack [in the overhead cable support](#)

C. Termination in the TR

1. Install and assemble termination apparatus, accessories and associated management apparatus according to the manufacturer's instructions.
2. Properly strain relieve cables at termination points per manufacturer's instructions.
3. [For OSP cables, apply sealant \(such as B-sealant\) where the pairs exit the cable jacket to seal the end of the cable and prevent water-blocking gel from leaking from the cable's sheath.](#)
4. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and TIA-568 series standard installation practices. Terminate cable pairs onto the [termination apparatus](#). Terminate twisted pairs compliant to TIA-568 series standards and wired per [1.04 System Description](#).

[5. Patch Panels and Horizontal Management Panels](#)

- a. Quantity: Provide patch panels [to support termination of cables](#). Provide horizontal management panels [based on the quantity of patch panels](#).
- b. Install and assemble discrete port patch panels and horizontal management panels according to the manufacturer's instructions.
- c. Install the patch panels and the horizontal management panels [as shown on the contract drawings. If configuration is not shown, install the patch panels in association with the horizontal management panels such that a management panel is mounted above and below given patch panel.](#)

6. Wall-Mounted Termination Block

- a. Provide termination blocks <to support termination of cables> <as shown on the drawings>. Provide management blocks <based on the quantity of blocks> <as shown on drawings>.
- b. Install the termination blocks such that the bottom row of terminations is at a height as shown on the drawings. If no height is shown, install at 24" AFF (+/- 3").
- c. Mount blocks plumb and square.

7. Termination Sequence

- a. Terminate the cables in sequential order using the link's identifier starting at the top left and completing a panel before moving to the next panel below.

D. Cable Routing and Dressing at the Work Areas

1. Leave 2-4 feet sheathed cable slack – length not to exceed permanent link maximum length requirement. Store slack within ceiling space neatly on a cable hanger.

E. Termination at the Work Areas

1. Mount faceplates plumb, square, and at the same level as adjacent device faceplates.
2. Patch gaps around faceplates so that faceplate covers the entire opening.
3. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and TIA-568 series standard installation practices and wired per 1.04 System Description.

F. Perform post-installation testing as described in the Telecommunication Testing specification (refer to section 270811). Replace permanent links (cables, terminations and connectors) not passing the required tests.

G. Patching and Crossconnecting

1. In TRs, provide modular patch cords as shown on contract drawings for network service. If not shown, provide one modular patch cord per complement/device; install between <the network switch><the equipment field> and the horizontal field. Neatly dress patch cords within the horizontal and vertical management components. Store cord slack within the vertical management section.
2. In TR, provide crossconnections as shown on contract drawings for voice service. If not shown, provide one 1-pair crossconnect to length from pair #1 per

voice link from the horizontal voice termination field to an available pair on the backbone voice termination field. Neatly route the crossconnect wire within the horizontal and vertical management components. Splices in crossconnect wire are prohibited. Color:

- a. For digital handsets, provide: White-Blue / Blue-White
 - b. For analog handsets, provide: White-Red / Red-White
3. Record crossconnections to backbone cabling for MTR crossconnection purposes and for close out documents.

3.4 LABELING

A. General Requirements

1. Labeling, identifier assignment, and label colors shall conform to the [TIA-606 standard](#) and as approved by the [Engineer](#) before installation.
2. Label text shall be machine-generated; hand written labels will not be accepted.

B. Label Formats and Text Attributes

1. Horizontal Cable Labels
 - a. Labels for cables shall be wrap-around self-laminating type.
 - b. Labels shall be permanent.
 - c. Text Attributes: color: black; size: approx. 1/8" high (#12 font size).
2. Termination Field \ Patch Panel Labels
 - a. Use labels included in the patch panel packaging. Any deviation from this requirement must be approved in writing by the [Engineer](#).
 - b. [Use a label color for the respective field type, per TIA-606.](#)
 - c. Text Attributes: color: black; size: approx. 1/8" high (#12 font size)
3. Termination Port \ Patch Panel Labels
 - a. (These labels are in the case that the patch panel does not have port numbers stenciled.)
 - b. Labels for patch panel ports shall be adhesive-backed polyester (or similar) type.

- c. Label color shall be white.
 - d. Text Attributes: color: black; size: approx. 3/32" high (#10 font size).
- 4. Termination Field \ Termination Block Labels
 - a. Use labels included in the block kit packaging. Any deviation from this requirement must be approved in writing by the [Engineer](#)
 - b. [Use a label color for the respective field type, per TIA-606.](#)
 - c. Text Attributes: color: black; size: approx. 1/8" high (#12 font size).
- 5. Outlet Labels
 - a. Use labels included in the faceplate/surface outlet packaging. Any deviation from this requirement must be approved in writing by the [Engineer](#).
 - b. Label color shall be white.
 - c. Text Attributes: color: black; size: approx. 1/8" high (#12 font size).
- 6. Outlet Port Labels
 - a. (These labels are in the case that the faceplate/surface outlet does not have port numbers stenciled or molded into the product.)
 - b. Labels for cables shall be adhesive-backed polyester (or similar) type.
 - c. Label color shall be white.
 - d. Text Attributes: color: black; size: approx. 1/8" high (#12 font size).

C. Identifier System

- 1. General: Separate fields of the identifier with a hyphen.
- 2. [Patch Panels](#)
 - a. First field: the destination room number; for example: "207".
 - b. Second field: the cable's intended service type – for example: "D" (data), and a unique sequential number – for example: "2".
 - c. Example: "207–D2"
- 3. [Individual Ports at Patch Panels](#)
 - a. First field: the destination room number; for example: "[207](#)".

- b. Second field: a unique sequential number, for example "01".
 - c. Third field: port identifier, for example "A".
 - d. Example: "207-01-A"
- 4. Outlets (Faceplates, Surface Outlets, etc.)
 - a. First field: the originating telecom room identifier; for example: "A2.1".
 - b. Second field: the destination room number; for example: "207".
 - c. Third field: a unique sequential number; for example: "01".
 - d. Example: "A2.1-207-01"
- 5. Horizontal Cables
 - a. First field: the originating room identifier; for example: "A2.1".
 - b. Second field: the destination room number; for example: "207".
 - c. Third field: a unique sequential number, for example "01".
 - d. Fourth field: port identifier, for example "A".
 - e. Example: "A2.1-207-01-A"

D. Label Installation

- 1. Horizontal Cable Labels
 - a. Install labels on both ends of cables no more than 4" from the edge of the cable jacket.
 - b. Install labels such that they are visible during normal maintenance.
- 2. Termination Group\Patch panel ports
 - a. Install labels on the front and on left side.
 - b. Install labels such that they are visible during normal maintenance.
- 3. Termination Port\Patch panel ports
 - a. If the patch panel does not have individual port numbers stenciled on the product, then install port labels at each port – above the top row and below the bottom row.

4. Outlet Labels

- a. Install label in the top label window. Leave the bottom label window blank.

5. Outlet Port Labels

- a. If the outlet does not have individual port numbers stenciled or molded into the product, then install port labels at each port – either to the sides (preferred) or above the top row and below the bottom row.

3.5 FINAL INSPECTION AND CERTIFICATION

- A. Punch the work of this section compliant to the requirements of section [270000](#).
- B. Remove cables and replace with new without impact to cost and schedule those failing to meet the indicated standards and not passing the testing requirements of section [270811](#). The [Owner's Representative](#) will not accept the installation until testing has indicated a 100% availability of cables and conductors. Any deviation from this requirement must be approved in writing by the [Owner's Representative](#).
- C. Comply with system acceptance and certification requirements of section [270000](#).

END OF SECTION

SECTION 21 4116

INTEGRATED AUDIOVISUAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes: Audiovisual systems – presentation systems, distributed audio systems distributed video systems, control systems, and interface with other systems. Refer to article 1.4 “System Description” for more information.
- B. Base bid work
 - 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. Equipment racks:
 - a. Provide standard or custom rack shelves and mount adapters for equipment installed in equipment racks as needed to properly mount equipment, power supplies, accessories, components, and the like. Provide cable management to properly route and mind wires, cables, and cords.
 - b. Provide power receptacle strips in quantities needed to supply power to the equipment within the rack.
 - c. Within racks greater than 18 RUs, provide one work light in the front and one in the back of each rack.
 - d. Provide spare rack mounting screws. Determine based on rack mount units (RUs) – one spare screw per 2 RU installed, minimum.
 - 3. 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 manufacturers’ 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.

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. Provide networks and pads, whether or not explicitly shown on the drawings, as required to achieve proper impedance matching and levels. Provide networks and pads that are balanced and constructed from 0.5 watt, 5% resistors, soldered to fixed connection points at each end.
6. 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.
 - g. Terminal blocks, patch panels, and other termination apparatus: Provide a label on each termination block, piece of termination apparatus and termination position on patch panels.
 - h. Handheld, lavalier, wireless, and other microphones and associated equipment (such as receivers)
 - i. User interface devices/plates

7. Coordination requirements
 - a. Coordinate with the construction team at large to ensure that equipment and other system components will be installed properly, and that there will be no compromises due to, among other aspects, spatial conflicts or power service incompatibilities.
 - b. Coordinate with the electrical contractor for power requirements and service connection to the System's equipment.
 - c. Coordinate with the telecom contractor and other trades/contractors (as needed) placement of cables and wires when sharing pathways (such as cable tray) with other low voltage systems. Do not place cables and wires into pathways provided by others without permission.
 - d. Coordinate with the telecom contractor (or Owner) for locations within racks for installing equipment"
 - e. Coordinate with the Owner (or Owner's network provider) for network configurations and/or settings required for the System's proper or correct operation.
- C. Related divisions and sections: Consult other divisions, determine the extent and character of related work. Coordinate the work of this section with, at least but not limited to, the following divisions and sections:
 1. Division 0 (for Bidding Requirements, Contract Forms, and Conditions of Contract) and Division 1 (for General Requirements) – provisions listed or specified therein apply to work under this section.
 2. Section 270000, "Communications Basic Requirements"
 3. Division 26, "Electrical Systems"
 4. Division 23, "Heating, Ventilating, and Air Conditioning Systems"
 5. Section 271513, "Communications Horizontal Cabling"
 6. Section 270811, "Communications Twisted Pair Testing"
 7. Section 270821, "Communications Fiber Optic Testing"
 8. Section 270831, "Communications Coaxial Cable Testing"
 9. Section 271333, "Communications Coaxial Backbone Cabling"
 10. Section 271533, "Communications Coaxial Horizontal Cabling"

- D. Products installed but not furnished under this section
 - 1. Laptops and Computer
- E. Products furnished and installed under another section
 - 1. Rough-in (device boxes, conduits, and related accessories)
 - 2. Electrical service (e.g., 120 VAC); refer to division 26
 - 3. Telecommunication cabling; refer to Section 271513
 - 4. Telecommunication pathways; refer to Section 270528 and/or 270532.

1.2 REFERENCES

- A. Comply with the References requirements of section 270000.
- B. In addition to the references listed in section 270000, perform work in accordance with applicable requirements of governing codes, rules and regulations including the following minimum standards, whether statutory or not:
 - 1. National Fire Protection Agency (NFPA)
 - a. NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces"
 - 2. Underwriters Laboratories (UL)
 - a. UL 969, "Marking and Labeling Systems"
 - b. UL 1419, "Professional Video and Audio Equipment"
 - c. UL 60065, "Audio, Video and Similar Electronic Apparatus – Safety Requirements"
 - 3. AVIXA
 - a. A102.01, "Audio Coverage Uniformity in Listener Areas"
 - b. ANSI/AVIXA D401.01:201X "Standard Guide for AV Systems Design and Coordination Processes"
 - c. V201.01:2018, "Projected Image System Contrast Ratio"
 - d. F501 01, "Cable Labeling for Audiovisual Systems"
 - 4. "Sound Systems Engineering", 3rd Ed., Davis and Davis

1.3 DEFINITIONS

- A. Refer to section 270000 for definitions. The definitions of section 270000 apply to this section.
- B. In addition to those definitions of section 270000 and Division 01, the following terms used in this specification are defined as follows:
 - 1. “ACEG”: alternating current equipment ground (an example of this is a ground bus within an electrical panel)
 - 2. “Approved Grounding Point”: an approved grounding point is one that satisfies the applicable electrical code and provides a low impedance path to earth. Examples include the following though may manifest in different means: a telecommunications grounding busbar (such as for bonding an equipment rack within a telecom room), the ACEG of the electrical panel serving the equipment requiring bonding to ground (such as for bonding a credenza rack within a conference room), or the ground conductor of a branch circuit (such as for bonding a single piece of equipment).
 - 3. “A/R”: Indicates that the quantity of an item is as required to meet the design criteria indicated in the audiovisual drawings and specifications.
 - 4. “A/S”: Indicates that the quantity of an item is as shown on the drawings.
 - 5. “Audience Area”: the portion of a presentation space intended to be occupied by an audience. An audience area includes the primary seating and standing spaces and may include the adjacent circulation spaces. An audience area generally excludes spaces reserved for presenters.
 - 6. “Custom” indicates systems or components the Contractor fabricates based on these specifications and drawings
 - 7. “EDID”: Extended display identification data
 - 8. “HDCP”: High-bandwidth digital content protection
 - 9. “HDMI”: High-definition multimedia interface
 - 10. “OFE”: Owner Furnished Equipment
 - 11. “Or equal” indicates an item that is equal in function and performance to the specified device or system
 - 12. “RU”: rack unit, as defined in EIA/ECA-310
 - 13. “Shall” denotes a mandatory requirement

14. "Should" denotes an advisory statement
15. "SPL": sound pressure level
16. "THD": total harmonic distortion
17. "Will" denotes an informative statement
18. "Project": The scope of work defined by this specification and its related drawings
19. "Software": Any executable programs, parameter files, user interfaces, or other coded content that are required to operate, control, or maintain the audiovisual systems in this Project
20. "Custom Created Software": Any software, parameter files, user interfaces, or other coded content created for the control or operation of the audiovisual systems in this Project
21. "Third-party software:" Any programming developed by a party other than the AV Contractor and the Owner to be used to operate, control, or maintain the audiovisual systems in this Project
22. "System": The audiovisual components, cabling, and programming incorporated in the descriptions and equipment lists herein

1.4 SYSTEM DESCRIPTION AND PERFORMANCE REQUIREMENTS

A. General

1. In circumstances where the specifications and drawings conflict, the drawings govern quantity and the specifications govern quality.
2. The contract drawings and specifications convey design intent. They are not intended to be used in lieu of shop drawings.

B. ADA compliance: Provide the following:

1. Display of closed captioning content
2. Accessible control systems
3. Assistive listening systems

C. Audio system performance criteria

1. Provide echo cancellation for microphones in audio and video conferencing systems.

2. Frequency Response:
 - a. Program audio system: 100 Hz to 12,000 Hz. 3 dB per octave roll off below 100Hz and above 12 kHz.
 - b. Distributed audio system: 125 Hz to 10,000 Hz. 3 dB per octave roll-off below 125 Hz and above 10 kHz.
 3. Total Acoustical Harmonic Distortion:
 - a. Program audio system: less than 2% at 90 dBC (1 kHz reference) at four feet (1,220 mm) above finished floor in the middle of the room.
 - b. Distributed audio system: less than 2% at 85 dBC (1 kHz reference) at four feet (1,220 mm) above finished floor in the middle of the room.
 4. Signal to noise ratio (mixer input to amplifier output): 75 dB from 50 Hz to 15 kHz minimum.
 5. Frequency response with equalizers bypassed: less than ± 1 dB from 50 Hz to 12 kHz.
 6. Distortion: less than 0.5% at 1 kHz at the equipment's rated input signal level.
 7. Output levels (in audience areas without objectionable distortion, rattles, or buzzes, employing as test signals several different samples of recorded music and microphones applied at each system input):
 - a. Program audio: not less than 95 dB
 - b. Speech reinforcement: not less than 85 dB
 8. Hum and Noise: inaudible (below the background noise level of the space) under normal operation observed in audience areas.
- D. Video system resolutions
1. System component minimum resolution: capability of 1920 X 1080.
 2. Supported resolutions: 1,280 x 720, 1,920 x 1,080, 1,920 x 1,200, 3840 X 2160, and 4096 x 2160.
- E. Wireless systems
1. Ensure that wireless AV systems do not create radio frequency interference to other systems.

2. Demonstrate at AV acceptance testing that wireless AV systems are not adversely affected by AV-related nor other radio frequency sources.

F. Control system

1. Provide user interfaces, such as control panels, that respect ergonomics and varying levels of technical ability among users. Follow these guidelines:
 - a. Avoid abbreviations
 - b. Size lettering at 1/8" minimum
 - c. Maintain background to lettering contrast
 - d. Positive logic: Avoid conditions which may cause command synchronization conflicts (i.e., alternate action (toggling) on/off without power reset of feedback. Provide power sensors or other devices where necessary to ensure that positive logic conditions are maintained.
 - e. Timing: Prevent two or more commands being sent simultaneously to the same piece of equipment.
 - f. Linking: Provide linking of functions to require the fewest number of user actions to effectively control the equipment.
 - g. Clearing: Ensure that each media selection clears the previous audio and visual selection (e.g., selecting COMPUTER clears the audio and video section of the previous Blu-ray disk selection).
 - h. Defaults: Establish default power-up conditions for the system including device audio levels, warm-up routine, power conditions, switcher status and other default conditions as required by the Owner or the Owner's representative.
 - i. Volume Memory: Provide easy-to-use memory for volume settings associated with each source device. Unless directed otherwise in this document, provide programming that maintains these settings between alternate selections during each use – through power-on and power-off.
 - j. Status indication: Program buttons for both touch panels and pushbutton panels to provide clear status indication using illumination when back-lighting is available or by changing color.
 - k. Failsafe: Provide program that ensures that no operation or sequence of operations causes the control system to become inoperable or interferes with further processing, correct operations or execution of commands.

1.5 ROOM TYPES**A. General**

1. Each room to receive audiovisual systems is shown on the drawings with a type designation.
2. For each room, adapt the audiovisual system to best suit the architectural layout such that each room of a certain type is similar to others of its type, with minor layout differences to accommodate architecture.
3. Refer to the drawings for the quantities of each type of room and for specific audiovisual interface information per room.

B. Showroom**1. General**

- a. The Showroom will be an area for various vendors to display goods to the public.

2. Audio

- a. Provide ceiling-mounted loudspeakers.
- b. Provide an audio amplifier to power the loudspeakers.
- c. Provide a business/ licensed music player.

3. Video

- a. Provide two landscape, monument-mounted displays at storefront window
- b. Provide two landscape, wall-mounted displays
- c. Provide one touch-interactive, monument-mounted portrait display at reception
- d. Provide networked digital signage players for all displays.

4. Control

- a. Provide a volume controller at reception desk.
- b. The digital signage players will control the displays.

C. Demo Kitchen

1. General
 - a. The Demo Kitchen will be used for cooking demonstrations and classes.
 2. Audio
 - a. Provide a separate zone for ceiling-mounted loudspeakers in this area. When a cooking demonstration or class is being held, use the loudspeakers for instructor audio. Reduce other audio sources to all other speakers in the showroom space. When the Demo Kitchen is not being used, play background music at normal level through the loudspeakers.
 - b. Provide an audio amplifier to power the loudspeakers.
 - c. Provide a wireless lavalier microphone system for the presenter. Provide antennas and antenna extension.
 3. Video
 - a. Provide a ceiling-mounted PTZ camera with preset views. Coordinate with Sonoma Clean power during the setting of these preset views.
 - b. Provide single extension
 - c. Provide a USB transmitter and receiver.
 - d. Provide an AV bridge connected to OFE laptop
 4. Control:
 - a. Provide a touch panel controller. Control functions are, but not limited to, system on/off, source selection, volume up/down, and pan/tilt/zoom of the PTZ camera. Password protect the touch panel so that the user cannot access settings.
 - b. Integrate the controller with the room's lighting and shades.
- D. Training Room
1. General
 - a. The Training Room is a flexible space that will support training functions, presentations, and video conferencing.
 2. Audio
 - a. Provide ceiling-mounted loudspeakers.

- b. Provide an audio amplifier to power the loudspeakers.
- c. Provide a wired, gooseneck, podium microphone.
- d. Provide rechargeable wireless microphones.
- e. Provide a wireless microphone docking station.
- f. Provide a portable assistive listening system with thin-profile mounting shelf.
- g. Provide a custom audio wallplate for portable assistive listening system.
- h. Provide antennas and extension.

3. Video

- a. Provide a 98-inch display.
- b. Provide a display wall-mount.
- c. Provide a ceiling-mounted PTZ camera.
- d. Provide HDMI and USB connections at the podium.
- e. Provide an HDMI adapter ring.
- f. Provide a USB transmitter and receiver.
- g. Provide an HDMI transmitter and receiver.

4. Control

- a. Provide a controller.
- b. Provide a touch panel controller. Control functions are, but not limited to, system on/off, source selection, volume up/down, and pan/tilt/zoom of the PTZ camera. Password protect the touch panel so that the user cannot access settings.
- c. Integrate the controller with the room's lighting and shades.
- d. Provide an IP to serial interface.

E. Lounge

1. General

- a. The lounge area is an overflow area for the Training Room, Showroom and Demo Kitchen. Source content to the lounge display includes Demo kitchen

camera feed, Training room camera feed, Training room presentation material, and Digital signage player.

2. Audio
 - a. No audio will be provided.
3. Video
 - a. Provide a display.
 - b. Provide a display wall mount.
4. Control
 - a. Provide control via display handheld remote.

F. IT/AV Room

1. GENERAL
 - A. Dedicated equipment rack to support Showroom, Demo Kitchen and Training Room.
2. Audio
 - a. Provide an audio digital signal processor to be shared by the Showroom, Demo Kitchen, and Training Room.

G. Add Alternate: mobile display on cart

1. Provide a mobile display on cart for digital signage and network connectivity.

1.6 SUBMITTALS

- A. Comply with the Submittal requirements of section 270000.
- B. Bid submittal: Submit bids in accordance with the project's overall bidding requirements, and include the following requirements of this section.
 1. Site visit: As possible, visit the site before submitting your bid. Coordinate site visit arrangements with the General Contractor. Include date of site visit in the bid submittal.

2. Firm information and qualifications: Include detailed information about the firm, including but not limited to the following, in the bid:
 - a. Firm's history – how long the firm has been in business, how long the firm has offered audiovisual systems integration services, etc.
 - b. Annual revenue for the three most current years
 - c. Bonding capacity and bonding insurance agent contact information
 - d. Three successfully completed projects of similar scope within the past 24 months. For each project, include the owner/client name, contact information (person's name, position, and telephone number or email address), project location, type of systems installed, total contract amount, date completed, and services included (e.g., engineering, installation, integration, maintenance, etc.).
 - e. Industry affiliations
 - f. Advanced certifications (CTS-I/D, DMC-D/E, ACE-D/I/P/RMS, XTP, etc.)
 - g. Manufacturer certifications
 - h. Contractor license number for the state where the work will take place
 - i. Union affiliation(s)
3. Personnel and certifications: Include information on key personnel in the bid.
 - a. Include résumés and certifications for personnel who will be assigned to the project including but not limited to the Project Manager, Systems Engineer, Field Installation Supervisor, Lead Control System Programmer, and other key personnel.
 - b. Include résumé(s) of CTS-I (Certified Technology Specialist – Installation) certified personnel
 - c. Include résumé(s) of DMC-E (DigitalMedia Certified Engineer) certified personnel.
 - d. Include résumé(s) of Q-Sys Level 2 (QSC Certification) certified personnel.
 - e. Include other relevant company-held industry, manufacturer, and educational certifications and designations for involved personnel
4. Subcontract information: Indicate in the bid, all subcontractors and their responsibilities and qualifications.

5. Schedule of values: Include a schedule of values in the bid. Break out the schedule of values into three areas – equipment costs, non-equipment costs, and service contract.
 - a. Equipment costs: List equipment costs (each piece of equipment), including required modifications and accessories.
 - b. Non-equipment costs: List non-equipment costs, such as the following:
 - 1) General and Administrative: shipping, insurance, and guarantees, etc.
 - 2) Fees: e-Waste/disposal, permits, etc.
 - 3) Engineering: design, drawings, run sheets, instruction manuals, etc.
 - 4) Pre-installation: fabrication, modification, assembly, rack wiring, etc.
 - 5) Installation: installation, coordination, supervision, testing, etc.
 - 6) Owner training: training session(s), manuals, etc.
6. Alternates/substitutions: Refer to section 270000 for alternate and substitution requirements. Submit bids based on the specified equipment. If the bid includes proposed alternates and/or substitutes, separate these from the costs of the equipment as specified and include for alternate equipment full technical information and cut sheets. Proposed alternate equipment will receive consideration if the differences between the specified and alternate/substituted equipment do not depart from the design intent and function of the system and are in the best interests of the Owner. If the inclusion of substituted equipment will result in a different connection configuration than that in the bid documents, include drawings that illustrate how the proposed system would be connected.
7. System enhancements: Include in the bid recommendations, if any, that will enhance the performance and/or functionality of the system, or will reduce costs without loss of performance/functionality. Recommendations that are of value to the Owner will be taken into consideration in the evaluation of the bids. Make such proposed recommendations as "alternates", with the appropriate cost modifications shown separate and apart from the costs of the system "as specified".
8. Exceptions: In the bid, explain exceptions, if any, to these specifications and related drawings. In the absence of exceptions, these specifications and related drawings are binding in letter and intent.
9. Guarantee compliance with requirements and regulations in effect on the job site. Explicitly state any such non-compliances or conflicts in the bid submittal. The bidder has the responsibility to investigate potential contract, union, and scheduling issues, and to notify the general contractor of such.

C. Pre-construction submittals

1. Product data: Prior to purchase and installation, submit as a PDF file information (such as cut sheets, etc.) for equipment, components, products, etc., that will be installed as part of the work of this section.
 - a. Include in the submittal, a Table of Contents, listing equipment, components, products, etc., by room, by system, and/or by other logical designation. A continuous list of all products with no reference to where the products will be installed will be rejected. Incomplete lists will be rejected.
 - b. Indicate (arrow, highlight or other designator) on each product's cut sheet the manufacturer, model/part number, accessories (as applicable), options (as applicable), color (as applicable), and other information to indicate the exact item to be installed. Where this information is not already provided on the cut sheet, manually input this information and a brief description (as applicable).
2. Substitutions [refer to section 270000 for substitution requirements]: Submit substitution requests based on the specified equipment and including associated equipment costs separate from the costs of the equipment as specified.
 - a. Proposals for alternate equipment will receive consideration if the differences between the specified and alternate/substituted equipment do not depart from the overall intent of the design and operation of the system and are in the best interests of the Owner.
 - b. Include full technical information and cut sheets for the proposed substitutions.
 - c. If the inclusion of substituted equipment will result in a different connection configuration than that in the bid documents, produce drawings that illustrate how the proposed system would be connected.
3. Shop drawings [refer to section 270000 for additional shop drawing requirements]: Submit shop drawings prior to installation and in accordance with the Conditions of Contract and Division 1, including the following.
 - a. Functional line diagrams for all systems – clearly tag each item with name, manufacturer, and manufacturer's model number (e.g., "Program Amplifier LabGruppen LUCIA 60/2M") and show the terminal number or input/output designation (e.g., "Mic 1-In", or "Record Out-Left").
 - b. Provide schematic diagrams of custom circuitry such as receptacle pin numbers and component callouts; show details of custom resistive attenuation and/or combining networks, filters, or pads which may be required in the assembly; show point to point wiring drawings for control

- system modules and interfaces, and for switches and relays in audio, video, or control systems
- c. Equipment rack elevations and patch panel assignments – clearly and consistently label rack elevations, patch panels, and on equipment controls.
 - d. Provide pushbutton and handheld remote control panel layouts –tag each button with function and ID matching installed labels
 - e. Factory and custom panels, plates, and designation strips, showing material, finish, color and engraving (exact lettering)
 - f. Custom designed face plates.
 - g. Equipment modifications (if any), including details of modifications that change or void manufacturers' warranties.
 - h. Cable run lists – clearly show at each terminal point the type of connector to be used; include typical wiring details of each connector; note where shields are connected and where they will float to ensure the integrity of the shielding system; indicate cable types and, where appropriate, color codes; assign wire numbers and patch bay locations to every wire and patch point in the drawing
 - i. Wattage tap setting per loudspeaker.
4. Touch screen submittal:
- a. Provide a PDF per system containing a page for each menu, submenu, and popup in that system's user interface. Include menus that are manually triggered and those that automatically appear as the result of events such as the connection of a source device. Ensure that the PDF is unlocked so that the Engineer may annotate it.
 - b. If the development environment allows, provide an executable menu simulation file or web link for control systems in addition to a PDF-based submittal.
5. Network coordination: Submit as an Excel file or cloud-based collaborative spreadsheet (such as Google Sheets) a list of equipment that will be connected to the network, including but not limited to the following (e.g., spreadsheet column headers):
- a. Item number
 - b. Description
 - c. Manufacturer

- d. Model/part number
 - e. MAC address
 - f. IP address type (DHCP or static)
 - g. Power-over-Ethernet (PoE) requirements (yes or no)
 - h. Specific network and/or subnet configuration requirements
 - i. Specific QOS requirements
 - j. Anticipated network traffic
6. Samples: Submit sample panels, plates, and designation strips, including details relating to terminology, engraving, finish and color.
7. Testing equipment and procedures:
- a. Submit a list of test equipment, including manufacturer, model number, and description that will be used for testing and adjustment of the installed systems.
 - b. Submit testing procedures to be performed during pre-functional testing and acceptance testing, including the minimum acceptable outcome for each test.

D. At the completion of the installation

- 1. Initial Testing and Tuning Report: After completing initial testing and tuning, checkout, settings, as-built drawings, and operational documentation, submit written notification to the Owner and Architect that initial checkout is complete. Include in this notification a completed Initial Testing and Tuning Report that satisfies the requirements of Part 3. In the Report, document the results for tests performed during initial testing and tuning. Organize the report per room, per system, and per test. Include the testing tools/equipment, manual and automated tests, testing procedures, and expected result per test. If the test equipment stores test results and has the capability to produce reports, also include these reports.
- 2. Wireless microphones frequencies. Submit a list of wireless microphone frequencies and associated channels used for each microphone and system.

E. Closeout Submittals

- 1. Acceptance Testing Report: After completing final acceptance testing, final tuning and settings, submit an Acceptance Testing Report that documents the results for tests performed during final testing and tuning. Organize the report per room,

per system, and per test. Include the testing tools/equipment, manual and automated tests, testing procedures, and expected result per test. If the test equipment stores test results and has the capability to produce reports, also include these reports. Include the system's normal settings.

2. As-built drawings [refer to Section 270000 for additional as-built drawing requirements]: Submit as-built drawings in accordance with the Conditions of Contract and Division 1, including the following.
 - a. System functional line drawings for all systems; clearly tag each item with name, manufacturer, and manufacturer's model number (e.g., "Program Amplifier Lab.Gruppen LUCIA 60/2M") and show the terminal number or input/output designation (e.g., "Mic 1-In", or "Record Out-Left").
 - b. Point-to-point wiring diagrams for switches and relays in audio, video, and control systems; point-to-point wiring diagram for control system modules and interfaces
 - c. Schematic diagrams of custom circuitry such as receptacle pin numbers and component callouts; show details of custom resistive attenuation and/or combining networks, filters, or pads which may be required in the assembly
 - d. Equipment rack elevations and patch panel assignment drawings. Clearly label the rack elevations, patch panels, and equipment controls.
 - e. Cable run lists – clearly show at each terminal point the type of connector to be used; include typical wiring details of each connector; note where shields are connected and where they will float to ensure the integrity of the shielding system; indicate cable types and, where appropriate, color codes; assign wire numbers and patch bay locations to every wire and patch point in the drawing
 - f. Pushbutton and handheld remote-control panel layouts, including tagging each button with function and ID that matches installed labels
 - g. Factory and custom panels, plates, and designation strips, showing material, finish, color and engraving (exact lettering)
 - h. Wattage tap setting per loudspeaker.
3. System Operation and Maintenance (O&M) manual:
 - a. Describe typical procedures necessary to activate each system for full functionality as required under the System Description.
 - b. Describe normal settings for equalizer, amplifier, signal processing, and user operated controls (as established during system check out) in tabular or pictorial form.

- c. Outline a recommended maintenance schedule with reference to the applicable pages in the manufacturer's maintenance manuals. Where inadequate maintenance information is provided by the manufacturer, provide the information necessary for proper maintenance.
 - d. Outline a recommended plan for a normal maintenance period of at least one year, including a list of necessary and recommended replacement parts.
 - e. Assume the reader of this manual to be technically competent, but unfamiliar with this particular facility.
 - f. Submit equipment manufacturer's operation and maintenance manuals for each piece of equipment.
4. Programming/software:
- a. Submit the project's control system programming and audio processor configuration files – refer to "Software License" below.

1.7 QUALITY ASSURANCE

- A. Audiovisual Contractor requirements: Demonstrate that your firm meets or exceeds the following requirements:
- 1. Five years' experience, minimum, with the design, engineering, assembly, installation, start-up and maintenance of audiovisual systems of similar or greater complexity to those identified in this specification
 - 2. Provide the necessary professional design, engineering, fabrication, installation, and project management personnel to execute the work of this section, and to guarantee a complete, functional system in compliance with the design intent
 - 3. Successfully completed in the past 24 months a minimum of three projects of similar scope
 - 4. Current state contracting license, as required to perform the work under this section
 - 5. Bondable to 100% of contract value
 - 6. Be an authorized supplier and installer for equipment listed in this section
 - 7. Maintain permanent fabrication, service and support facilities within 100 miles of the Project site.

- B. Audiovisual Contractor certifications: Demonstrate that your firm has the following certifications:
 - 1. An InfoComm CTS-I (Certified Technology Specialist-Installation) certified employee to actively manage this project – the Engineer will verify CTS credentials at the InfoComm website.
 - 2. A Crestron DMC-E (DigitalMedia Certified Engineer) certified employee to be actively involved in the design, implementation and commissioning of systems in this project – the Engineer will verify DMC-E credentials at the Crestron website.
 - 3. A QSC Q-Sys Level 2-certified employee to be actively involved in the design, implementation and commissioning of systems in this project – the Engineer will verify Q-Sys credentials with QSC.
- C. Manufacturer/equipment supplier requirements: Demonstrate that your firm meets or exceeds the following:
 - 1. Operate their business for not less than five years
- D. Subcontractor quality:
 - 1. Specifically identify in the bid submission, for Owner, Architect, or Engineer's approval, all subcontractors that will be used.
 - 2. Regardless of any subcontract arrangement, your firm will have sole responsibility for the successful implementation of the work in this section.

1.8 PROJECT MANAGEMENT AND COORDINATION

- A. Comply with the Project Management requirements of section 270000.
- B. Assign a project manager to this project for the entire duration. They shall oversee the design, submittals, implementation, testing, and close out – the entire process from start to finish. The project manager shall also coordinate this work of this section with other trades.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Comply with Delivery, Storage and Handling requirements of section 270000.

1.10 WARRANTY

- A. Warrant the System for a minimum of one year from the date of system acceptance by the Owner. Honor component warranties per manufacturers' terms if greater than one year.
 - 1. Include service as described in 3.14 "Maintenance and Extended Service" in the warranty.
- B. Activate manufacturers' equipment warranties in the Owner's name. The warranty period shall commence on the date of System Acceptance by the Owner.
 - 1. In the case of contractor-modified equipment (where the manufacturer's warranty could be voided), warrant such equipment equivalent to that of the original manufacturer.
- C. Warrant the Software and version updates – see "Software" below.

1.11 SOFTWARE LICENSE

- A. Nondisclosure
 - 1. During or after the termination of this Agreement, the Owner agrees not to disclose any proprietary information provided by the AV Contractor, to maintain such information as confidential and not use such information provided in Project documents for any purpose other than maintenance and support of in-house systems. This does not apply to any of the information that becomes generally known to the public due to publication or other legal means and through no fault of the Owner.
- B. Obligations governing the Software
 - 1. The AV Contractor shall own the copyright of any custom created software/parameter files ("Software") and hereby grants the Owner a royalty-free, non-exclusive license to use the Software for use with the audiovisual and other connected systems in this project. This license cannot be transferred.
 - 2. The Owner shall not rent, loan or re-license rights to use the Software to any third party.
 - 3. Any Third-party software provided or made available to the Owner by the AV Contractor, but not created by the AV Contractor, is sublicensed to the Owner through the AV Contractor. The AV Contractor agrees that such sublicense is granted with consent of the third-party at no cost to the Owner, and the Owner shall be entitled to use such software under the same terms as the AV Contractor.

4. The AV Contractor and third-party suppliers are not restricted from licensing the Software or any portion thereof to other customers.
 5. At acceptance testing, provide the source code for custom created software, applications required to use the source code, descriptions of the required equipment, and instructions detailing the modification and installation of the Software to the Owner.
- C. For project and custom Software, the following apply.
1. Provide the source code to the Owner either directly via file transfer or make it available through other means, such as cloud storage, an FTP site, etc. Maintain older versions within a folder structure and make them available to the Owner at the Owner's request. At the end of the warranty period, release the current and older versions of the source code to the Owner. If the AV contractor ceases to exist during the warranty period, release the source code to the Owner upon termination of the business.
 2. Provide the Software in a form suitable for immediate access by the System.
 3. The AV contractor grants the Owner the right to modify and to enhance the Software as furnished and licensed under the terms of this Agreement at its own risk and expense, and further agrees such modifications and enhancements developed by the Owner to be the property of the Owner. Any changes to the custom created software parameter files do not affect copyright ownership.
 4. During the warranty period, if the Owner discovers that the Software is no longer functioning in the same manner as had been approved at the beginning of the warranty period, they shall document the fault in sufficient detail to allow errors to be reproduced, and they will notify the AV contractor. Within two business days of this notification, update the software, provide or post updated Software files as detailed above, demonstrate that the error has been resolved, and maintain updated Software files as detailed above.
 5. Defend any suit brought against the Owner and pay any damages due to the resulting judgment from any suit brought against the Owner as it pertains to a violation of copyrights or patents of the Software or licenses. The Owner shall notify the AV contractor in writing promptly and give authority, information and assistance at the AV Contractor's expense.
 6. The AV contractor at its own expense and option shall, if able, procure for the Owner the right to continue to use the Software as licensed or to replace it with a non-infringing release. This shall not include any agreement by the AV Contractor to accept liability for patent or copyright infringement for beyond the Software as licensed and furnished for the Project. This also excludes any agreement by the AV contractor to accept liability for patent or copyright infringements for methods and processes to be carried out by using said Software except those inherent in the furnished System.

7. All contracts with Third-party software suppliers will transfer from the AV Contractor to the Owner at Project acceptance by the Owner.
8. The Owner shall apprise the AV Contractor of activities it takes with Third-party software providers during the warranty period. Included activities would include discontinuing the use of any Software component, installing updated or alternate versions of the Software, revising the configuration of affected systems.
9. The Owner can contact the AV Contractor for questions at no additional cost during the warranty period, providing:
 - a. The queries are related to the audiovisual systems defined in this document.
 - b. The query is asked by the Owner's staff or an authorized representative.
 - c. The inquirer has attended the AV Contractor's or the manufacturer's training in the use of the systems defined in this document.
 - d. The question is not intended as design consultation.
10. The Owner can only make copies as backup files of the Software and they are required to include the AV Contractor's copyright notice. The Owner shall make a reasonable effort to secure this Software to prevent theft or unlicensed usage.

D. Software license terms

1. The Software license is granted by the AV Contractor for the devices provided for the Systems. If any devices in the system fails, the license can be transferred to a replacement device on a temporary or permanent basis if the original device is to be phased out. The transference may only occur with written notification to the AV Contractor.
2. Additional licenses or changes to the Software are subject to a supplemental agreement between the AV Contractor and the Owner.

PART 2 PRODUCTS

2.1 GENERAL

- A. Comply with the Products requirements in section 270000.
- B. Provide products, equipment and software that are the latest version of the specified model or type available at the time of procurement, providing the updated devices provide the same or better capabilities and performance required by the system design.

- C. Only where denoted “or equal”, equal products will be considered. The manufacturers, product numbers, and types listed at those instances establish minimum performance.
- D. Substitutions: The Engineer may consider substitutions for certain equipment if the Contractor demonstrates that the substitution meets or exceeds the functional requirements described in the System Description and Performance Standards.

2.2 EQUIPMENT SCHEDULE

- A. Quantities: Quantities are either listed herein with a number, as “A/S” (as shown), or as “A/R” (as required). If listed as A/R or the quantity is marked with an asterisk, determine quantities as required for a fully operational system. Confirm the quantity listed here against the drawings. If the quantity is different than shown on the drawings, the drawings govern quantity and the specifications govern quality.

B. **Showroom**

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling-mounted loudspeakers	Klipsch	IC-650-T	A/S	
Audio amplifier	QSC	SPA2-60	2	
Business music player	Sonos	Connect	1	
Category: Video				
55" Portrait, reception touch display	Planar	PS5561T	1	
55" portrait reception floor mount	Premier Mounts	KIPC25	1	
55" storefront landscape floor mount	Displays2Go	TVSVM3270B	2	
55" landscape smart display	Samsung	QN55Q60RAFX ZA	4	
55" display tilt wall mount	Chief	LTM1U	2	
Digital signage player	BrightSign	XD234	5	
HDMI DA	Crestron	HD-DA-2	2	
HDMI transmitter	Extron	DTP HDMI 4K 230 Tx	A/R	

Description	Make	Model	Qty.	Notes
HDMI receiver	Extron	DTP HDMI 4K 230 Rx	A/R	
Category: Control				
Volume controller	QSC	WCP-1	1	
Category: Accessories				
Cables, screws, etc.	Various	Various	A/R	

C. Demo Kitchen

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling-mounted loudspeakers	Klipsch	IC-650-T	A/S	
Lavalier microphone	Shure	QLXD14/85-G50	A/S	Provide two Shure UA830 and two UABIAS [†]
Category: Video				
PTZ camera	Marshall	CV612HT-4K	A/R	Coordinate finish with Architect. Provide a Marshall VAC-HT48-POE-R per camera
Camera mount	Vaddio	535-2000-293	1	Coordinate finish with Architect. Include 2-feet of drop
SDI to HDMI converter	Crestron	DMC-SDI	A/R	Provide one Crestron DMCI per converter
USB transmitter	Extron	USB Extender Plus T	A/R	
USB receiver	Extron	USB Extender Plus R	A/R	
AV Bridge	Vaddio	AV Bridge Mini	A/R	
Category: Control				
Touch panel	Crestron	TSW-1060-NC-x-S	A/S	Coordinate finish with Architect.
Controller	Crestron	RMC3	A/S	

Description	Make	Model	Qty.	Notes
Category: Accessories				
Cables, screws, etc.	Various	Various	A/R	

D. Training Room

Description	Make	Model	Qty.	Notes
Category: Audio				
Ceiling-mounted loudspeakers	Klipsch	IC-650-T	A/S	
Audio amplifier	QSC	SPA2-60	A/R	
Wired podium microphone	Shure	MX415/S	A/S	
Podium USB and HDMI connections	Extron	CableCubby100		Confirm finish. Provide required MAAP plates
Rechargeable wireless microphones	Shure	QLXD124/85	A/S	Provide Shure SB900A (qty 2)
Dual docking station	Shure	SBC200-US	1	
Passive antenna splitter	Shure	UA221	A/S	
Portable Assistive Listening System	Listen Technologies	LS-06-072	1	Provide receiver quantity to meet Code
2-gang ALS wall shelf	Power Perch	2 gang	1	
Audio single gang wall plate	Custom	Custom	1	
Antenna	Shure	UA864US	A/S	Provide a Shure UABIAST per antenna
Category: Video				
Display	Samsung	QM98N	A/S	
Display wall mount	Chief	XSM1U	A/R	

TLCD ARCHITECTURE
**SONOMA CLEAN POWER
ADVANCED ENERGY CENTER**

Description	Make	Model	Qty.	Notes
PTZ camera	Marshall	CV612HT-4K	A/S	Coordinate finish with Architect. Provide a Marshall VAC-HT48-POE-R per camera
Camera mount	Vaddio	535-2000-293	1	Coordinate finish with Architect. Include 2-feet of drop
AV Bridge	Vaddio	AV Bridge Mini	1	
HDMI DA	Crestron	HD-DA-2	2	
HDMI adapter ring	Liberty	DL-AR3974	1	
USB transmitter	Extron	USB Extender Plus T	A/R	
USB receiver	Extron	USB Extender Plus R	A/R	
HDMI transmitter	Extron	DTP HDMI 4K 230 Tx	A/R	
HDMI receiver	Extron	DTP HDMI 4K 230 Rx	A/R	
Category: Control				
Controller	Crestron	RMC3	A/S	
Touch panel controller	Crestron	TSW-1060-NC-x-S	A/S	Coordinate finish with Architect.
IP to serial interface	Global Cache	IP2SL	A/R	
Category: Accessories				
Cables, screws, etc.	Various	Various	A/R	

E. Lounge

Description	Make	Model	Qty.	Notes
Category: Video				
55" Display	Samsung	QN55Q60RAFX ZA	A/S	
Display wall mount	Chief	MSM1U	A/R	
Digital Signage Player	XD234	1		

Description	Make	Model	Qty.	Notes
Category: Accessories				
Cables, screws, etc.	Various	Various	A/R	

F. IT/AV Room

Description	Make	Model	Qty.	Notes
Category: Audio				
Audio digital signal processor	QSC	Core 110f	A/S	
PoE switch	Crestron	CEN-SW-POE-5		

G. Add Alternate: Display cart

Description	Make	Model	Qty.	Notes
Category: Video				
Display	Samsung	QN55Q60RAFX ZA	1	
Floor cart	Displays2Go	TVSTNTR2M	1	
Digital signage player	BrightSign	XD234	1	
Category: Accessories				
Cables, screws, etc.	Various	Various	A/R	

2.3 CABLES AND WIRES

- A. Provide cables and wires that are continuous - without splices.
- B. For CATEGORY-type UTP cabling (cables, termination apparatus and installation requirements), refer to section 271513.
- C. Cable selection
 1. Refer to functional diagrams for signal type between equipment.
 2. Select a cable with the appropriate rating and configuration required by the applicable building code, electrical code, AHJ, and applicable codes and regulations governing the installation.
 3. For cables that will be installed in conduit within on-grade concrete, select a cable rated for underground construction.

4. For cables that will be installed outdoors in underground conduit, aerial, and/or corrosive environments, select a cable rated for outdoor construction.
 5. For signal extenders, use extender the manufacturer's recommended cable type and within the maximum cable run length to be used.
- D. Unless otherwise called for in these specifications and drawings, the following cables are approved for the associated application or signal type. Ensure the chosen cable is appropriate for the signal type, available pathway capacity, and run length.

Application	Non-Plenum Product, or equal	Plenum Product, or equal
Ethernet	Refer to section 271513	Refer to section 271513
HDBaseT	Belden 2183R West Penn 4246F Extron XTP DTP 24 Superior Essex 6H-246-xA Windy City Wire CAT6S	Belden 2183P West Penn 254246F Extron XTP DTP 24P Superior Essex 6H-246-xB Windy City Wire CAT6SP
Control cable (AMX AXLink, Crestron Cresnet)	Belden 1502R West Penn 77350, C4215 Liberty LLINX-U Windy City Wire CRESCOM	Belden 1502P West Penn D25350 Liberty LLINX-U-P Windy City Wire CRESCOMP
Microphone and line-level audio cable	Belden 9451 West Penn 454 Liberty 20-2C-SH-GRY Windy City Wire 22-1PREZ-BLK	Belden 9451P West Penn 25291B Liberty 20-2C-PSH-GRY Windy City Wire 22-1PREZP-BLK
Program loudspeaker cable	Belden 5000UE West Penn 227 Liberty 12-2C-GRY Windy City Wire 12-02-GRY	Belden 6000UE West Penn 25227B Liberty 12-2C-P-BLK Windy City Wire 12-02P-BLK
Distributed loudspeaker speaker cable	Belden 5300UE West Penn 224 Liberty 18-2C-GRY Windy City Wire 18-02-BLK	Belden 6300UE West Penn 25224B Liberty 18-2C-P-BLK Windy City Wire 18-02P-BLK
ALS emitter	See Antenna cable (wireless microphone) – 50-ohm, below	
Antenna cable (wireless microphone) – 50- Ohm	West Penn 813 Liberty RG8-CMR-BLK RG8-BLK Or equal by Belden	West Penn 2598G8 Liberty RG8-CMP-BLK RG8P-BLK Or equal by Belden
Antenna cable (wireless microphone) – 75- Ohm	See CATV trunk and drop cables, below	

Application	Non-Plenum Product, or equal	Plenum Product, or equal
Analog video coaxial cable, RG59-type	Extron 815 Liberty RG59-CCTV-CM-BLK Windy City Wire RG59-BLK	Extron 25815 Liberty RG59-CCTV-PL-BLK Windy City Wire RG59P-BLK
Serial digital coaxial cable	West Penn 819 Liberty 20-CMR-VIDEO-BLK Windy City Wire RG59HD-BLK	West Penn 25825 Liberty 20-CMP-VID-COAX-BLK Windy City Wire RG59HDP-BLK
CATV trunk cable	West Penn 811 Liberty RG11-CATV-BLK Windy City Wire RG11-BLK	West Penn 25821 Liberty RG11-CCTV-PL-WHT Windy City Wire RG11P-BLK
CATV drop cable	West Penn 806 Liberty 18-CMR-SD-BLK Windy City Wire RG6-BLK	West Penn 25841 Liberty 18-CMP-VID-COAX-BLK Windy City Wire RG6P-BLK

2.4 CUSTOM REMOTE CONTROL PANELS AND INTERFACE PLATES

- A. For custom remote control panels and interface plates, use 1/8 inch (3mm) thick #6061 T6 aluminum, with a brushed, anodized, black finish (or as approved by the Architect via submittals).

2.5 EQUIPMENT PLATES

- A. For equipment plates, utilize 1/32" to 1/16" thick by 1/4" high aluminum with a brushed anodized black finish.
- B. Provide engraved lettering 1/8" to 3/16" high.

2.6 LABELS

- A. General: Labels shall meet UL 969 product requirements.
- B. Equipment Labels
 - 1. Equipment labels shall be machine printable, shall be polyester (or similar) adhesive-back type, and shall be permanent.
 - 2. Face stock (print area) shall be white.
 - 3. Size: as needed.
 - 4. Manufacturer, or equal:
 - a. Brady

- b. Brother
- c. DYMO XTL or Rhino
- d. Panduit
 - 1) #C150X075YJJ; component label, laser/inkjet print, white face stock 1.5"W x 0.75"H
- e. Thomas and Betts

C. Cable and Wire Labels

1. Cable and wire labels shall be machine printable, shall be permanent, and shall be either of the following types:
 - a. Tape – machine-printable, wrap-around, self-laminating, permanent adhesive-backed tape
 - b. Machine-printable, shrink-wrapped labels
2. Face stock (print area) shall be white.
3. Size: as needed per wire/cable size (approximately 1" wide).
4. Manufacturer, or equal:
 - a. Brady
 - b. Brother
 - c. DYMO XTL or Rhino
 - d. Panduit
 - 1) #S100X075YAJ; self-laminating cable label, white face stock 1"W, for cable diameters 0.08"-0.16"
 - 2) #S100X125YAJ; self-laminating cable label, white face stock 1"W, for cable diameters 0.12"-0.28"
 - 3) #S100X150YAJ; self-laminating cable label, white face stock 1"W, for cable diameters 0.16"-0.32"
 - 4) #S100X225YAJ; self-laminating cable label, white face stock 1"W, for cable diameters 0.24"-0.48"

D. Speaker Labels

1. Speaker labels shall be polyester (or similar) adhesive-back type, shall be permanent, and shall be machine printable with a printer.
 2. Face stock (print area) shall be white.
 3. Size: as needed.
 4. Manufacturer, or equal:
 - a. Brady
 - b. Brother
 - c. DYMO XTL or Rhino
 - d. Panduit
- 1) # C075X050YJJ; component label, laser/inkjet print, white face stock
0.75"W x 0.5"H

2.7 RACK BONDING

- A. Refer to section 270526 for approved bonding products.

PART 3 EXECUTION**3.1 GENERAL**

- A. Comply with the Execution requirements of section 270000.
- B. Perform work in accordance with the standards and best practices defined by the AVIXA.
- C. Install products per manufacturers' instructions.
- D. Install panels, equipment, boxes, etc., plumb and square.
- E. Seismic safety:
1. Mount, anchor and/or brace permanently-installed equipment to the building structure using anchors, fastenings, supports, and methods approved by structural engineer with a safety load factor of at least 1.5. Provide installations that meet the most stringent of applicable codes and regulations to minimize potential damage to personnel and equipment from foreseeable seismic events.

2. Brace hanging audiovisual and associated equipment both to minimize sway and to prevent detachment from the overhead structure in accordance with applicable codes.
3. Firmly secure equipment in place unless requirements of portability dictate otherwise.

3.2 EXAMINATION

- A. Prior to starting the work of this section, examine areas to receive system components and pathways to receive cabling to verify conditions are ready for work of this section and to verify conformance with manufacturer and specification tolerances.
 1. Verify that pathways, including conduit, junction boxes, cable trays, ceiling enclosures, etc., are in place prior to placing cables into pathways and as required by applicable codes.
 2. Verify that rough-in (including conduit, device boxes, floor boxes, and the like) is ready to receive wiring, cabling, devices, equipment, and the like prior to installing into the rough-in.
 3. Verify that electrical power service is ready and stable prior to connecting equipment.
 4. Verify that support infrastructure, including equipment racks, are in place prior to installation.
 5. Check ceiling types, ceiling heights, and clearances above ceilings to ensure conditions are appropriate per manufacturer's installation requirements.
- B. Verify that the network is operational and ready to receive connection from and configuration for the System. "Ready" includes settings on the network required for the System to function properly. Coordinate with the network contractor as needed to ensure the network settings have been adjusted to support full functionality of the System.
- C. Proceed with installation work only after unsatisfactory conditions are corrected.

3.3 INSTALLATION

- A. Floor-standing equipment racks
 1. Completely assemble equipment racks. Include parts and accessories, such as electrical power distribution devices, cable dressing accessories, and blank and vent panels, required for a complete result.

2. Anchoring/bracing: Anchor racks to the floor at four points per approved structural details using anchors and methods approved by a structural engineer. Seismically brace racks (e.g., using brackets, threaded rod with strut, etc.) as required, attached to the wall or structure above using appropriate anchors or fasteners.
3. Tolerances: Verify dimensions to establish proper clearances. Install racks to attain clearance of at least 36" to the nearest piece of equipment from each enclosure's front and back doors.
4. Power strips: Install power strips on the back interior of the rack space on the left side as viewed from the back.
5. Lighting: Install lights on the back interior of the rack space centered within the rack, magnetically attached or fastened to the frame, and situated to illuminate the back of the rack-mounted equipment and wiring.
6. Cooling provisions
 - a. Coordinate cooling provisions (means to prevent equipment from overheating) within millwork/casework/cabinets, such as inlet holes/openings, exhaust fan openings, power service, etc. At a minimum, ensure airflow by installing active cooling devices or systems such as fans.
 - b. Adapt cooling provisions to suit the configuration of each instance.

B. Displays and Mounts

1. Wall-Mounted Displays: Install mounts using fasteners approved for the mounting substrate. For framed walls, firmly engage fasteners into backing or, if no backing is present, into framing studs.
2. Ceiling-Mounted Displays: Install mounts to structure using fasteners and mounting accessories approved for the mount and mounting substrate. Install seismic restraints as appropriate for the installation location. Conceal cabling within mounting columns where feasible.
3. Securely install displays onto mounts. Complete final connections (power, signal, control, etc.).
4. Install accessories onto mounts or displays using approved attachment methods that guarantee the longevity of the installation. Accessories may be attached mechanically, if allowed by the display/mount manufacturer, or by using 3M TB3571/3572 hook and loop fastener tape or an approved equal.
5. Dress cables; ensure they are maximally concealed yet serviceable.
6. Adjust each display and mount to attain a true, square and level installed result.

C. Podium microphone

1. Review podium drawings, and coordinate with the Architect and Engineer to resolve conflicts with other tabletop or through-table devices conflicting with microphone locations.
2. Coordinate microphone locations and installation activities with the Architect and Engineer prior to installing through-tabletop microphones and microphone receptacles.
3. Route analog microphone cabling separated from other cabling types to prevent signal interference. Where this cabling must cross other cabling types, cross it at a 90° angle.
4. Install microphone preamplifiers and other microphone-related conversion devices neatly, square to the table, and as hidden from view as possible. Coordinate the locations of these devices with the Architect and Engineer.
5. Label and dress all cables neatly and with approved cable management products.
6. Prior to acceptance testing, confirm microphones produce no audible buzz and/or noise.

D. Wireless microphone systems

1. Mount antennas external in the rooms in which they serve.
2. For wireless microphone systems using multiple antennas, space them per manufacturers' recommendations.
3. Sequentially turn on each wireless system within RF range and allow it to complete its scanning procedure. Verify correct operation.

E. Antennas

1. Use antennas designed specifically for the frequency bands they will carry.
2. For antennas extended from the attached equipment, use cabling appropriate for the frequency and distance.
3. Use extender devices (preamplifiers) and distribution amplifiers per cabling lengths and manufacturers' recommendations.
4. Install cabling per manufacturers' bend radius guidelines.
5. Locate and orient antennas to ensure coverage throughout the room(s). Verify this by walk-testing systems.

F. Loudspeaker tap settings

1. Where loudspeaker tap wattages are specified in the design documents, set transformers per these. Otherwise, set taps per best practices.
2. Set taps such that the total wattage of a series of loudspeakers will not exceed 75 percent of the associated amplifier's rated wattage.
3. Record tap settings per loudspeaker for inclusion on the as-built drawings.

G. Loudspeakers, ceiling mounted

1. Coordinate ceiling work (such as cutting holes) with the ceiling contractor.
2. Unless directed otherwise, center ceiling loudspeakers to ceiling tiles and evenly space loudspeakers.
3. Cut ceiling tiles to fit loudspeaker such that no gaps are visible after the loudspeaker cover/grille is installed.
4. Install ceiling loudspeakers with safety wires attached to the building structure per applicable codes and best practices.
5. Use tile rails and other support components to ensure loudspeakers do not sag.
6. Where manufacturer labels are visible on loudspeaker grills and are rotatable, align these consistently.
7. Replace ceiling tiles damaged during loudspeaker installation work.

H. Cabling and wiring – at racks

1. Do not use electrical tape for bonding, splicing, joining, or any other purpose.
2. As a general practice, run power cables, control cables, and other cables with higher voltage levels on the left side of an equipment rack as viewed from the back; run other cables with lower voltage levels on the opposite side. Where wiring issues or wire routing facilities preclude this configuration, it is acceptable to deviate from the directions above, if separation is maintained between signal and electrical power cables.
3. To reduce signal contamination, group cables per the signals being carried. Maintain appropriate distances between cable groups, especially between high-current (power; loudspeaker) and low-current (microphone) groups. Form separate groups for the following cables/signal types:
 - a. Power

- b. Control
 - c. Analog video
 - d. Digital audio and video
 - e. Analog microphone audio
 - f. Analog line audio
 - g. Loudspeaker audio
 - h. Radio frequency
- 4. Within racks, install wires and cables with service loops. Provide sufficient cable to allow each piece of equipment to be removed from the front of the rack for servicing.
 - 5. At boxes or points of termination, install wires and cables with service loops. Provide sufficient cable to allow each piece of equipment to be removed and laid flat on a surface for servicing.
 - 6. For cables that interface with racks, cabinets, consoles, or equipment modules, use screw-type terminal blocks, terminal strips, or connectors. Telephone-style punch-down blocks (e.g., 110 blocks) are not acceptable.
 - 7. Do not bend any cable or wire tighter than the manufacturer's minimum bend radius.
 - 8. Install wires and cables such that the cable exerts no strain on its termination.
 - 9. Label wires and cables, regardless of length, using a cable label with a unique number or letter per the instructions below under "Labeling".
 - 10. Cable Shield Bonding: For cables with shields, connect them using approved connectors per an approved grounding topology.
 - 11. Encase umbilicals connecting moveable racks and cabinets to walls and other fixed locations in braided sleeving. Where racks and cabinets are installed in view of non-technical people, coordinate sleeving colors with the Architect.
- I. Cabling and wiring – overhead distribution
- 1. Use cabling appropriate to loudspeaker impedance, cabling distance, and installation conditions (such as plenum versus non-plenum).
 - 2. The use of electrical tape for bonding, splicing, joining, or any other purpose is prohibited.

3. Provide cable runs between termination points that are continuous, with sheath continuity. Splices are not permitted anywhere.
4. Place cables within designated pathways, such as cable tray, cable hangers, etc. Do not fasten cables to other building infrastructure (such as ducts, pipes, etc.), other systems (such as ceiling support wires, wall studs, etc.), or to the outside of conduits, cable trays, or other non-approved pathway systems.
5. Protect cables from physical interference and damage during installation and termination. Install cables with no kinks or twists.
6. Install HDMI, USB, and HDBaseT cables within manufacturers' length recommendations. If an distance exceedance is necessary, provide scive extension devices.
7. Comply with manufacturers' limits for pulling tension.
8. Do not use cable-pulling compounds for indoor installations.
9. Install cables within manufacturers' bend radius limits. If no minimum bend radius is given, then maintain a minimum bend radius of six times the cable diameter during and after installation.
10. Route cables under building infrastructure (such as ducts, pipes, conduits, etc.); do not route cables over building infrastructure. Install cables to provide accessibility for future service.
11. Place cables 6", minimum, away from power sources to reduce interference from EMI.

12. Connectors: Use the following connectors:

Category	Subcategory	Type	Acceptable Manufacturers				Comments
Audio	Low-level	RCA / S/PDIF	Switchcraft	Pomona			
Audio	Low-level	3.5mm TRS	Switchcraft	Neutrik	Amphenol		
Audio	Low-level	1/4" TS/TRS	Switchcraft	Neutrik	Amphenol		
Audio	Low-level	XLR	Switchcraft	Neutrik	ITT Cannon		
Audio	Low-level	Combo XLR/TRS	Neutrik				No substitutions
Audio	Low-level	TA-series (mini XLR)	Switchcraft				No substitutions
Audio	Low-level	Microdot	Lemo				
Audio	Microphone, no mute control	XLR-3	Switchcraft	Neutrik	ITT Cannon		

TLCD ARCHITECTURE

SONOMA CLEAN POWER ADVANCED ENERGY CENTER

Category	Subcategory	Type	Acceptable Manufacturers				Comments
Audio	Microphone, with mute control	XLR-5	Switchcraft	Neutrik	ITT Cannon		
Audio	Microphone under table or desktop, no mute	R3F	Switchcraft	Neutrik	ITT Cannon		
Audio	Microphone under table or desktop, with mute	R5F	Microphone under table or desktop, no mute				
Audio	Low or high-level	Phoenix	Phoenix Contact				
Audio	High-level	Banana	Pomona	GC Electronics			
Audio	High-level	Speakon	Neutrik	Switchcraft			
Video	50-ohm	BNC	Kings	AMP - TE Connectivity	Trompeter	Amphenol	
Video		Triax	Trompeter				
Video		HDMI bulkhead barrel	Switchcraft	Cliff	Neutrik	Harting	
Video		HDMI cable	Extron	Crestron			
Video		DisplayPort cable	Extron	Crestron			
Video		Mini DisplayPort/Thunderbolt cable	Extron	Crestron	Apple		
Video	D-sub	HD-15 ("VGA") cable	Extron	Crestron	Cables to Go		
RF	75-ohm	BNC	Kings	AMP - TE Connectivity	Trompeter	Amphenol	
RF		F-type	Belden	Amphenol	Liberty	Digicon	
RF		UHF	Amphenol				
Control	D-sub	DB-9, DB-25	Amphenol	TE Connectivity			
Control	Phoenix		Phoenix Contact				Or as provided with equipment
Control	Modular	4p4c plug	Cinch Connectivity	Molex	TE Connectivity	Hirose	
Control	Modular	8-contact	Ortronics	Panduit	Belden	Molex	
Control	USB cable	A, B, C types	Extron	Crestron	Hosa	Belkin	

Category	Subcategory	Type	Acceptable Manufacturers				Comments
Control	Crimp	Fork lug	TE Connectivity	Molex	Phoenix Contact		
Control		XLR	Switchcraft	Neutrik	ITT Cannon		
Control		DIN	CUI	Hirose			
Control	etherCON	RJ45	Neutrik				

J. Terminations and Cords at Floor Boxes

1. Provide strain relief for cables. Use appropriate cable management products (such as hook and loop straps for UTP and STP cabling, and nylon cable ties for other cables) to group similar cable types.
2. Provide permanent labels on cables within 6" of terminations.
3. Provide permanent labels on receptacles within floor boxes to clearly identify terminations and services.
4. Terminate connections at floor receptacles for use with mobile furniture.

K. Blank panels: Provide blank trim plates in floor, wall and furniture-mounted boxes at unused termination positions. Fill each module opening filled, either with a receptacle, a receptacle plate, or a module of the type the opening is intended to house.

L. Patch panels

1. Assignments: Wire patch panels so that signal sources appear on the upper row of a row pair; and destinations appear on the lower row of a row pair. Submit variations from this approach per the requirements in Submittals.
2. Designation strips: Utilize alphanumeric identifications and descriptive information on audio and video patch panel designation strips. Number the jack positions in each row sequentially from left to right. Letter the jack rows sequentially from top to bottom. Include the alphanumeric identification of each jack on the functional block drawings. Mount reproductions of these drawings in an appropriate location near the patch bays.

3.4 EDID MANAGEMENT

- A.** For each system, determine the maximum pixel resolution, frame rate, and color depth supported by all content displays, and designate this as the target resolution for the system. Omit digital signage displays from this process.

1. Scalers: Configure video scalers as follows:
 - a. Input: Emulate the EDID configuration of the native resolution of the connected display or projector for both analog and digital inputs.
 - b. Output: Configure to match the native resolution of the display system and at the highest supported scan rate.
- B. Determine the system's maximum audio parameters – output channel count, LFE capabilities, etc.
- C. Configure the system's EDID management to ensure that these audio and video parameters are sent to source devices.

3.5 HDCP MANAGEMENT

- A. Include HDCP support in all equipment that incorporates copy protection for the transport of copyrighted media.
 1. Installation requirements
 - a. Equipment capable of passing HDCP included in this project must support the same HDCP version (i.e. HDCP 1.4 or HDCP 2.2).
 2. Exceptions
 - a. HDCP may be defeated for educational institution projects per 'fair use' copyright terms.

3.6 NETWORK SECURITY

- A. Leave no network-connected device operating with its factory-default password.
- B. Obtain Owner defined password changes for all network-connected devices. Program these passwords into the devices.
- C. Where available, enable two-factor authentication.

3.7 PROGRAMMING AND EQUIPMENT CONFIGURATION

- A. General Programming
 1. Install the most current version of manufacturers' firmware on devices.
- B. Audio Processor Programming
 1. The following instructions apply to all systems including programmable audio processors and microphones.

2. Make equalization and other room tuning adjustments to obtain the flattest, and least colored result the system is capable of.
3. After tuning the system, perform other adjustments, such as dynamics, AEC, etc.

C. Control System and Touch Panels

1. Owner's requirements
 - a. Meet with the Owner and document their functional and user interface requirements (backgrounds, color scheme, screens, menus, functions, etc.).
 - b. Develop programming and user interfaces based on the user requirements including PTZ presets.
 - c. Submit touch panel layouts and menu flow documentation to the Owner and Engineer per submittal schedule.
 - d. Meet with the Owner and Engineer and present the control system programming and user interfaces. Obtain the Owner's approval on these items.
2. Programming guidelines
 - a. Create initial screens (splash screens) that use a version of the Owner's logo, generated without visible scaling artifacts.
 - b. Only use red for alarm indicators and other screen elements of special significance.
 - c. Avoid use of technical terms, rather, use clear, everyday language. For example, instead of "System On", use "Turn System On"; instead of "Power Down", use "Turn Power Off", etc.
 - d. Ensure soft buttons are sized consistently and spaced evenly.
 - e. Ensure spelling, punctuation, and grammar are 100% correct.
 - f. Provide menus on both touch panels and control system web pages that appear and function consistently throughout the project.
 - g. Ensure items with similar functions appear consistently in all menus.
 - h. Provide soft button presses that display visual feedback, and if required by the Owner, audible feedback.

3. Tech menu: Provide a “tech” menu for each touch panel. Include in tech menus:
 - a. Volume control for button audible feedback
 - b. A means to change the tech screen password; obtain from the Owner’s Representative a default password for all touch panel tech menus
 - c. Other technician-specific functions required for each system
4. Make IP control system devices (touch panels, controllers, processors, etc.) accessible and controllable via the network and via web access. For example, users and/or technicians shall be able to operate touch and pushbutton panel functions remotely Coordinate with the Owner’s Representative to ensure a successful implementation of this requirement.

D. Power control and sequencing

1. Whether explicitly listed in this specification or not, provide power control interfaces, e.g., remotely controllable PDUs, for equipment and devices that are not equipped with integrated power control. Provide power control interfaces that are fully compatible with the specified control system. Follow this directive for devices, such as audio power amplifiers, which would not be adversely affected by external power controls. Omit such power controls for devices, such as transmitters and receivers, that should not be externally power controlled.
2. Configure non-controlling items to power off or go into a standby/low power-consumption mode when systems are powered off. At minimum, program the AV system to power off the following types of devices when not in use.
 - a. Audio processors
 - b. Audio amplifiers
 - c. Displays
 - d. Projectors
3. Configure devices that detect connection to user devices to stay in standby/low power-consumption mode when audiovisual systems are turned off.
 - a. Video switchers and processors
4. When turning systems on, use the following sequence for audio components.
 - a. Turn on source devices.
 - b. Turn on processing and routing devices.

- c. Turn on amplifiers.
- 5. When turning systems off, use the following sequence for audio components.
 - a. Turn off amplifiers.
 - b. Turn off processing and routing devices.
 - c. Turn off source devices.
- E. Lighting and window covering control
 - 1. Program the control system to control room lighting and window covering systems:
 - a. When a user pushes a button to set the audiovisual system in presentation mode, the system will lower mesh shades.
 - b. Provide multiple presets to meet the various use cases of the spaces
- F. Lighting system programming and interface coordination
 - 1. Lighting designer responsibilities:
 - a. Via coordination with the Owner and the project lighting designer, determine lighting scenes for each area with an IP or low voltage-controlled lighting system.
 - b. Assign a short name for each lighting scene. Coordinate with the AV control system programmer to determine maximum scene name length based on hard and soft button text capacities.
 - c. Provide these names to the design team.
 - 2. Lighting system installer and programmer responsibilities
 - a. Program lighting scenes per the lighting designer's list into the rooms' lighting systems.
 - b. Provide appropriate control protocol/preset information to the AV control system programmer.
 - c. Coordinate with the AV control system programmer for hardware interface requirements between AV control systems and lighting systems.
 - d. Coordinate with the GC to determine where lighting control cabling will run and who will run it.

- e. Coordinate with the AV control system programmer for lighting system testing and fine-tuning.
- 3. AV control system programmer responsibilities
 - a. Program lighting scenes provided by the lighting designer into the appropriate control system menus. Use the provided scene names.
 - b. Coordinate with the lighting system designer and GC for control cabling and termination, etc.
 - c. Coordinate with the lighting system designer for testing and fine-tuning.
 - d. Train users in the use of appropriate lighting scenes ("Presentation" demos, etc.).

G. Equipment configuration:

- 1. Computer interfaces, signal extenders and transmitters with integral input switching: Program each device and related system components involved so that the analog audio input is active regardless of which video input is selected.

3.8 LABELING

- A. Provide labeling identifiers that match closeout documentation (e.g., as-built drawings, O&M Manual, etc.).
- B. Clean and degrease surfaces receiving nameplates and labels prior to affixing labels.
- C. When creating labels for user-facing equipment and cables, use colored labels where possible. Example uses are floor boxes, table boxes, cameras, displays, and user-facing cables. Use color coding to relate labels to related components, i.e., match the text and color on each user-facing cable, its corresponding button on the button panel, and its corresponding input on the display. Example: HDMI 2 cable has a yellow label printed with "HDMI 2", the button panel at the table box has a yellow "HDMI 2" label and the input on the display has a yellow label printed with "HDMI 2".
- D. Interface plate designation
 - 1. Provide wall-mounted interface plates with clearly engraved alphanumeric identification of input type (e.g., "MIC-1", "LINE IN", "SPEAKER", "VIDEO", etc.) and corresponding patch field designation.
- E. Equipment enclosures
 - 1. Install the label on the top of the rack or cabinet, centered horizontally.
 - 2. Example: line 1: "AV-01", line 2: "Audiovisual Devices".

F. Equipment

1. Rack-mounted equipment: Install labels in visible locations on equipment and devices on the front and back of the equipment.
2. Field equipment: Install labels in visible locations on miscellaneous field equipment and devices.

G. Wireless transmitters and receivers

1. Label wireless transmitters and receivers so users can clearly identify a given transmitter associated with its receiver.
2. Use an identifier, such as a room number, that associates each transmitter with a given room or system.
3. Example: RM.230–MIC.3–RCVR.1

H. Wire and cable

1. Comply with the Owner's labeling requirements. If the Owner does not have labeling requirements, conform with AVIXA F501.01.
2. Provide labels with machine-generated text; hand-written labels will not be accepted.
3. Use a numbering system with a consistent number of characters for each cable's unique identifier.
4. Generate a unique identifier for each cable and wire using either the Owner's system or AVIXA F501.01. Include primary level data elements per F501.01; secondary level data elements are optional.
5. Label installation:
 - a. Install labels on both ends of cables at least 1" (25mm) and no more than 12" (300mm) from the connector strain relief or the heat shrink tube from which individual wires exit the cable jacket.
 - b. Labels must be visible; they may not be concealed by strain relief elements or within bundles.
 - c. Install labels such that they are visible by a technician from a normal stance.
 - d. Install labels according to label manufacturers' guidelines.
6. Label legibility:

- a. Text margins shall be a minimum of 1mm in the printable area.
 - b. Text shall not be obscured by any part of the label.
 - c. Primary text shall be all capitals, no less than 2.5mm tall. Bold is permitted; italics are not.
 - d. Secondary text shall be all capitals, no less than 2.1mm tall. Neither bold nor italics are permitted.
7. Label consistency:
- a. All primary labels shall have the same width. All secondary labels shall also be the same width, but that width may differ from that of the primary labels.
 - b. All label shall be of sufficient height for the outer dimensions to meet the manufacturer's installation.
 - c. In environments and applications where additional physical protection is required to preserve label integrity and legibility for the specified design life, apply additional protective materials. In such cases, apply the additional materials to all labels in the system. If a specific design life is not otherwise specified, assume 10 years will be required.
 - d. Primary labels shall utilize the same font type, font size, font spacing, and margin spacing except in the case of user-accessible cable labeling. Secondary labels shall utilize the same font type, font size, font spacing, and margin spacing. The properties of the primary labels may differ from the secondary labels, but they shall be consistent within each label type.
 - e. Unless defined otherwise within the labeling schema, text shall be the same color. Text color shall present high contrast to the background color of the label. Black text on a white background is preferable, but where any other color scheme is used, a contrast of no less than 3:1 shall be achieved.

3.9 FIELD QUALITY CONTROL

- A. Initial tests and measurements: Prior to final adjustment and scheduling acceptance testing, perform initial tests and measurements. At minimum, include the following initial tests and measurements:
 - 1. Adjust, balance, and align equipment for optimum quality and to meet manufacturers' published specifications.
 - 2. Perform the test procedure provided at the end of this specification and return the completed form no less than one week prior to the initial punch walk.

3. For rack-mounted equipment with user-accessible controls, install 1/8" diameter vinyl "map dots" as indicators for nominal operating positions of rotary, slider, and other accessible controls. Provide multiple dots, adequately distinguished, for controls having more than one nominal operating position.
- B. Twisted-pair cable testing: Follow the following procedures to test CATEGORY-type twisted pair cabling.
 1. Equipment, or equal:
 - a. Fluke DSX CableAnalyzer
 2. Test procedure:
 - a. Configure the cabling and test set up as a permanent link.
 - b. Test each cable under a TIA-568 Permanent Link test script to match the category of the installed cabling.
- C. Digital video cabling: Follow the following procedure to test each provided digital video cable.
 1. HDMI: Quantum Data 780, or equal
 2. DVI/SDI/HD-SDI: Quantum Data 882D, or equal
 3. DisplayPort: Quantum Data 882E-DP, or equal
 4. Test Procedure:
 - a. Test each cable.
 - b. Replace all cables that fail.
- D. Audio system:
 1. Loudspeaker line impedance: Measure the impedance at 63 Hz, 250 Hz, and 1 kHz and the resistance of each loudspeaker line leaving the sound equipment rack with the line disconnected from its normal driving source. For lines to full range distributed loudspeaker systems, measure impedance at 1 kHz.
 2. Hum and noise level:
 - a. Measure the hum and noise levels of the overall system for each microphone input channel and line level input channel.
 - b. Adjust gain controls for optimum signal to noise ratio so that full amplifier output is achieved with 0 dBm at a line level input.

- c. Terminate line level inputs with resistors of 150 and 600 ohms, respectively, for these measurements.
 - d. Disconnect the loudspeaker lines and terminate the power amplifier outputs with power resistors for these measurements. Use load resistors within 5% of the nominal load impedance of the amplifier under test. Use resistors with power ratings equal to or greater than the power rating of the amplifiers.
- 3. System frequency response:
 - a. Measure audio system frequency response for the AV systems described in Part 1. Adjust systems to provide specified performance.
- 4. Uniformity of coverage:
 - a. Using a calibrated testing device, measure octave bands using a pink noise test signal played through the loudspeaker system(s).
- 5. System power output and signal level adjustment:
 - a. Measure the electrical distortion of the overall system for each line level input channel.
 - b. Adjust gain control as for the tests specified herein.
 - c. Apply a 1 kHz sine wave signal from a test signal generator having less than 0.5% total harmonic distortion at the input tested, at a level required to produce full amplifier output. Note that a pad with 150-ohm output impedance is required for driving the microphone level input in accordance with the EIA standard.
 - d. Use a distortion analyzer to measure the output level and total harmonic distortion of the audio equipment. In the absence of a distortion analyzer, a high input-impedance measuring device such as a DMM may be used to measure the output level.
- 6. Loudspeaker polarity
 - a. Perform loudspeaker line polarity checks using a polarity tester or use DC source at one end of each line and a voltmeter at the other end. Confirm that loudspeaker lines are correctly polarized with respect to color coding.
 - b. Confirm loudspeaker polarity using a polarity tester.
- 7. Freedom from parasitic oscillation and radio frequency pickup:
 - a. With systems set up for each mode of operation specified in the Part 1, confirm that systems are free from spurious oscillation and radio frequency

pickup, in the absence of audio input signal and when the system is driven to full output at 100 Hz.

- b. Confirm these tests audibly and by using an oscilloscope having at least 5 MHz bandwidth.
 - c. Apply a slow sine wave sweep from 50 Hz to 5 kHz at a level of 6 dB below rated power amplifier output to each system. Listen carefully for buzzes, rattles and objectionable distortion.
 - d. Correct causes of these defects unless the cause is clearly from other than the sound amplification system's equipment and installation, in which case bring the cause to the attention of the Owner and Architect.
8. Audio test signal paths: Verify operation from source inputs through system components to signal destinations.
- E. Control systems:
- 1. Verify all operational functions at each fixed control interface and wireless control devices position. Verify control functions are consistently repeatable.
 - 2. Verify all operational functions of the control system and interfaced devices.
- F. Radio frequency (RF) systems:
- 1. Connect an analog-capable TV to each system outlet. Make a subjective evaluation of picture quality and verify that no visible components of cross modulation, ghosting, or beat interference appear when the receiver is tuned to each of the desired channels.
 - 2. Using an RF signal strength meter, record the signal levels in dBmV of modulated carriers transmitted through the system at representative outlets.
 - 3. RF Test Signal Paths: Verify proper system operation from source inputs to the head end, including antennas, CATV feeds and modulators, through line amplifiers, splitters, and directional couplers, to system outlets.

3.10 CLEANING, PROTECTION AND REPAIR

- A. Comply with the cleaning requirements of section 270000.
- B. During the installation and up to the date of final acceptance, protect finished and unfinished work against damage and loss. In the event of such damage or loss, replace or repair such damaged work.

3.11 SUBCONTRACTOR MANAGEMENT

- A. Continuously supervise subcontractors during the installation; intermittent supervision is not acceptable.

3.12 SYSTEM ACCEPTANCE TESTS

- A. Perform system acceptance tests after completion of initial system checkout and after submitting the Initial Testing and Tuning Report.
- B. Prior to setting up a demonstration and/or punch walk with the Engineer, ensure that the System/Systems are complete, operational, and fully functioning, and that pre-functional and functional testing have been completed. Fees for any additional punch walks resulting from incomplete and/or non-functioning Systems may be assessed.
- C. System acceptance tests consist of the following:
 - 1. Take a physical inventory of equipment on site and compare it to equipment lists in the contract documents.
 - 2. Demonstrate the operation of system equipment.
 - 3. Perform both subjective and objective tests to determine compliance with the specifications. Provide test equipment specified for these tests.
 - 4. Provide final, "as built" drawings, run sheets, manuals, and other required documents, as detailed in Part 1.
 - 5. Provide complete testing reports generated by subsystems that provide self-testing.
 - 6. Perform power on/off cycles to ensure these take place with no audible and only minimally visible artifacts, pops, etc.
- D. Initial Testing and Tuning Report
 - 1. Perform the following tests for each system unless otherwise noted in Part 1.
 - 2. Use additional pages as necessary to allow complete comments.
 - 3. Where blanks are provided in the checklist below, observe the associated value in parenthesis.

Test	Description	Result	Comment
1	Record equipment that was specified but is not present. Provide a reason why this equipment is not present.		

Test	Description	Result	Comment
2	Confirm no sharp or jagged surfaces are accessible to users and technicians.		
3	Confirm that each active device's external temperature, measured using a non-contact thermometer, is within manufacturer's guidelines.		
4	Perform and log cable inspection. Confirm each cable is labeled, dressed, included in a bundle with cables with like signals, not under stress, is serviceable, is correctly strain-relieved, is not bent beyond manufacturer's recommended bend radius, does not have tie wraps tensioned excessively or used inappropriately. Confirm labels are positioned and oriented consistently and are legible and unambiguous.		
5	Demonstrate that the full inventory is new equipment, in full compliance with the specification, or as modified by approved submission. Record test results as pass/fail, and list exceptions.		
6	Confirm rack elevation and single-line drawings, cable and other labels and engravings are an accurate model of the furnished system, and comply with latest revised specifications. Record test results as pass/fail.		
7	Confirm switcher inputs and outputs are labeled (wherever possible), so that users can easily make manual routes quickly without having to refer to the system drawings.		
8	Confirm amplifier channels are properly labeled, so technicians can make quick adjustments without having to refer to the system drawings.		
9	Confirm rack mounted equipment is labeled and that the labels match those on the drawings (equipment symbols and/or description), control system, field plates, patch panels, and any labels associated with the system.		
10	Confirm modular terminations are solid in their connectors.		

Test	Description	Result	Comment
11	Confirm each coax cable respects the manufacturer's minimum bend radius or at least 5x the cable's diameter.		
12	Record ambient noise, A-weighted, slow.		
13	Confirm power amplifiers are working within rated load. <i>Record the impedance (and at what frequency) of each loudspeaker line on each power amplifier at 63, 250, and 1,000 Hz.</i>		
14	Using appropriate test signals, have the sound system produce a nominal operating level of __ (65) dB SPL for conference speech, __ (60) dB SPL for program material, "A" weighted at all listeners' ears \pm __ (2) dB ("Uniformity of Coverage") (or at least __ (15) dB above the ambient noise, A-weighted, whichever is greater), with the control system volume control indicating "normal" or default setting. <i>Record results for each channel and source.</i>		
15	Confirm the system is capable of producing an additional __ (15) dB above this level (__ (80) dB SPL) for each audio source, with less than 0.5% THD (Total Harmonic Distortion) plus noise. <i>Measure THD plus noise when source is at __ (15) dB above nominal operating level at each "destination", for all sources selected.</i>		
16	Confirm the system develops a noise level that is electrically __ (55) dB below the normal operating level for all audio sources. "Noise" refers to the aggregate of hum, electrostatic noise, RF interference, etc. <i>Measure and record Signal to Noise ("signal" measured electrically at nominal operating level at each destination, for all sources selected.</i>		
17	Confirm program loudspeakers are connected in the same polarity, and speech reinforcement systems are polarized such that a positive acoustic pressure on a microphone results in a positive acoustic pressure at the loudspeaker ("Polarity Test").		

Test	Description	Result	Comment
18	Confirm the system produces no more than a __ (1) dB variance in program source levels when each program source is playing audio from a calibrated medium (CD, test signal generator, etc.)		
19	Confirm there is no audible vibration caused by improper mechanical installation. <i>Use a continuous sweep signal at headroom level (from an audio test signal generator or test CD.) Provide a pass/ fail result and document which device fails and the frequency of these artifacts.</i> ("Buzzes and Rattles Test").		
20	Confirm speech reinforcement systems are stable, with no ringing nor feedback.		
21	For audio conference systems, adjust microphone input gain to demonstrate that a "standard talker" (60 dB SPL at 1 m), positioned at each talker position in the room, produces a 0 dB level at the input of the mixer bus of the audio conference DSP device. If there is local voice reinforcement ("mix-minus"), AGC and ALC may need to be restricted when performing this test. <i>Record test results as pass/fail. Record level across analog telephone line, if one is used. Inspect DSP mixer telephone line levels, both transmit and receive, when normal speech is encountered in the room.</i>		
22	For conferencing mode, at the __ (65) dB SPL listening level, confirm full duplex operation, with no reports of echo or "speech trails" as detected from the far end.		
23	Confirm equalizers, whether hardware or virtual, are adjusted for best intelligibility, and in accordance with any preferred acoustic level response curves. <i>Record the "house curve" before equalization, as well as after the equalizers have been tuned, with and without microphone input filters. If requested by the Consultant, produce this documentation for systems without equalizers, as this test may apply to the preamp filter settings in cases where intelligibility can be improved.</i>		

Test	Description	Result	Comment
24	If required, confirm system intelligibility, with a RSTI (Rapid Speech Transmission Index) greater than 0.85.		
25	For wireless microphone systems, with all wireless microphones turned on, confirm that throughout the specified operating area for the transmitter, there are no dropouts, intermodulation interactions between wireless systems, nor RF-caused artifacts.		
26	If required, for composite video sources, connect a test generator at each input and confirm 1 volt peak-to-peak to each destination $\pm 10\%$ (or 1dB). <i>Record results at each destination using NTSC/PAL bars, peak white, and five-step multiburst (0.5, 1.0, 2.0, 3.0, 3.58, and 4.2 MHz).</i>		
27	For NTSC sources, confirm optimum brightness, contrast, and color in displays using a SMPTE source with PLUGE display.		
28	Where several displays are visible in the same space, confirm picture tonal consistency across all of them. For composite video signals, use NTSC color bars with PLUGE signal to all. For digital video signals use a colorimeter and test color signal software to confirm consistent images		
30	Confirm that the system displays with stability, and with no scaling-related visual artifacts when switching between, at a minimum, the resolutions specified in 1.04 D. Record test results.		

Test	Description	Result	Comment
31	<p>Where HDMI, DVI, or DisplayPort signals are included in the system, confirm that an acceptable signal is being displayed on the monitor from each source position. Use the Alt Pixel test image (pixel-on, pixel-off) for each resolution included in the design intent: 1,920x1,200@60, 1,920x1,080@60, 1,280x720@60, as required. Inspect each, leaving the signal on for three minutes. Confirm that no artifacts are visible.</p> <p>For systems including 4k displays, test also at 3,840 x 2,160 and 4,096 x 2,160.</p> <p>Note: If the signal is going to a codec, disable HDCP. If the signal is going to a display, enable HDCP unless specified otherwise in Part 1.</p>		
32	Using a signal generator, confirm scaler and display/projector configurations by successfully passing video at the resolutions defined in 1.04 D.		
33	Confirm HDCP is maintained from sources to destinations except as excluded above. Confirm EDID is managed correctly and that devices output at resolutions supported by the system.		
34	Confirm the control system controls all of the required equipment as specified. Confirm system performs with stability and in sync with the equipment being controlled without the need to reset any item of equipment. Confirm that user interface requirements dictated in Part 3 of the audiovisual specifications have been met.		
35	Confirm system is serviceable: all devices must be easily removable for repair by one person; all cables must be dressed neatly and be provided with adequate services looks, must be bundled in forms (refer to "Sound System Engineering", Davis and Davis, 1987 and "Audio Systems Design and Installation", Giddings, 1990) having no excessive pressure on cables at termination points and connectors, and each cable number must agree with the shop drawings and cabling run list.		

Test	Description	Result	Comment
36	Confirm switches and receptacles are logically and permanently labeled.		
37	Confirm nomenclature for consistency: drawings, touch screen, wall plates, floor boxes, patch panels, equipment, etc.		
38	Confirm patch cables have cable numbers.		
39	Where cameras are included in system, confirm each operates correctly and provides correct image quality.		
40	Confirm camera presets are programmed as specified by the user. In the absence of Owner direction, create and document presets that are logical for the room's layout.		
43	Confirm and document the IP configuration information provided by the Owner is loaded into the equipment, including IP and MAC addresses, Dante device names, subnet masks, gateways, time server, gatekeeper, etc. Confirm that all network functions specified by the customer function properly on the customer's LAN.		
44	Confirm all web-based system control and monitoring features, and other IP system functionality (time servers, system-generated e-mail, etc.) are completely functional.		
45	Confirm that display devices have On-Screen Displays/Menus disabled. If the customer has directed otherwise, document from which person this direction came.		
46	Confirm that video projectors have blue screens or other images or colors displayed in the absence of an input signal disabled. If the customer has directed otherwise, document from which person this direction came.		

Test	Description	Result	Comment
47	Log test conference calls (audio and video). Include in the log start time, line used, number called, status of connection (completed/failed, etc.) who was spoken with at the far end, success of full duplex, success of auto-disconnect, dB SPL in the room. Note static, jitter/packet loss, or any other artifacts, distortion, etc. Note if auto-disconnect functions as specified.		
48	Using a full-screen white test signal, confirm no direct view display nor projector has more defective pixels than specified in Part 1. Note number and location of lost pixels, if any. Provide photos of defects. Include room numbers and any other distinguishing information in photo file names.		
49	Check for excessive vibration on VC camera(s) at full telephoto position.		
50	Provide video recordings of all non-conformances and anomalies.		
51	Confirm all visible devices are installed square and plumb.		
52	Confirm no dust, grease, scratches, or any other signs of handling are visible on any devices		
53	Confirm assistive listening systems work throughout intended listening areas		
54	Confirm closed captioning is functional on all displays		
55	Confirm control system user interfaces provide a means to enable and disable display of closed captions		

E. If further adjustment is required, or defective equipment must be repaired or replaced, tests may be suspended or continued at the option of the Owner or Owner's representative.

1. If the need for further adjustments becomes evident during the demonstration and testing, continue work until the installation operates properly. Included in the continued work, changes to or installation of resistive pads, adjustment of loudspeaker aiming, adjustment of system processing, programming changes to

the control system, convergence and/or alignment of the video projector, if these adjustments are required.

2. If acceptance of the system is delayed because of defective equipment or because the equipment does not fulfill this specification, reimburse the Owner for time and expenses for these tests during extensions of the acceptance testing period.

3.13 OWNER TRAINING

- A. Provide a minimum of 8 hours of training on the audiovisual systems specified herein at the project site (or other location designated by the Owner) by a qualified instructor (equipment manufacturer as needed) covering operation and maintenance of the systems.

3.14 MAINTENANCE AND EXTENDED SERVICE

A. Warranty Maintenance

1. On a quarterly basis during the warranty period, execute a service visit to check and adjust equipment and systems such that they maintain the original performance. Coordinate visits directly with the Owner.
2. Pre-emptive maintenance minimum requirements:
 - a. Clean filters, vents, and lenses, and dust the equipment.
 - b. Verify projector images fill screens appropriately and images are focused.
 - c. Test and verify that all system controls operate as labelled and that the controlled devices respond accordingly.
 - d. Document and photograph any conditions that may affect the continued function and long-term operation of the audiovisual system and report to owner.
 - e. Document and report projector lamp life to the Owner and replace lamps as directed.

B. Touch Panel Programming Updates

1. At a date determined by the Owner within six months following Substantial Completion, attend a single meeting with them regarding alterations or updates to the touch panel layouts or function. At a time approved by the Owner, implement those alterations or updates.
2. Provide any training necessitated by these revisions.

3. Provide documentation of these revisions to the Engineer.
4. Provide the source code documentation according to "Software License" in this section.

END OF SECTION

SECTION 28 3100

FIRE DETECTION AND ALARM SYSTEM

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. Refer to Section 260100, Electrical General Requirements.

1.2 WORK INCLUDED

- A. Fire Detection and Alarm System including test and operational check of the system.

1.3 SUBMITTALS

- A. Manufacturer's literature describing product.
- B. Shop drawings of Control Panel showing all modules and/or components exactly as located within the Control Panel.
- C. Point to point wiring diagrams showing all devices and each conductor identified in accordance with identification details shown on drawings.
- D. Internal connection of components and of the Control Panel.
- E. Operation and Maintenance manuals.
- F. Floor plans, drawn to scale, showing device layouts, conduit routing and number of cables or conductors.
- G. Battery sizing calculations.
- H. Voltage drop calculations for alarm notification circuits.
 - 1. point

1.4 CODES AND STANDARDS

- A. The System and all the devices shall be U.L. and Factory Mutual approved.
- B. The installation shall comply with the latest edition of the following National Fire Protection Association Standards except where more stringent requirements are specified:
 - 1. NFPA 70: National Electric Code, Article 760.
 - 2. NFPA 72: National Fire Alarm Code.
 - 3. NFPA 90A: Installation of Air Conditioning and Ventilation Systems.

- C. California Building Code (CBC).
- D. California Fire Code (CFC).
- E. The installation shall comply with the Americans with Disabilities Act of 1990 (ADA).

1.5 GOVERNMENT AGENCY APPROVAL

- A. The installation, including plans and material list shall require the review and approval by:
 - 1. Local Fire Department.
 - 2. State Fire Marshall's office.
- B. A walk-through of the building with the City Fire Inspector will be conducted by the Fire Alarm Contractor and attended by Owner just prior to the interior walls being finished and after rough-in conduit work is complete. The purpose of the walk-through is to pick up any changes or additions desired by the Fire Inspector.

1.6 OPERATIONAL TEST & START UP

See Part 3, Article 3.5

PART 2 – PRODUCTS

2.1 GENERAL SYSTEM REQUIREMENTS

- A. This specification outlines the requirements for a microprocessor based, electrically supervised, single stage, addressable fire detection and alarm system. The Contractor shall provide a complete, functional, tested fire detection and alarm system including all materials not specifically mentioned in the Specification but necessary for proper performance and operations.
- B. Major components of the system include but are not limited to the following:
 - 1. Central Control Panel including power supply, standby battery, battery charger and all required control devices.
 - 2. Alarm initiating devices include smoke, heat, and waterflow detection devices and manual activation (pull down) stations.
 - 3. Alarm notification devices include horns, strobes and combination horn/strobes.
 - 4. Hard-wired outputs for control of other related equipment or systems.
 - 5. Supervisory functions for fire sprinkler system valve switches, system wiring (open/grounded) and detection device degradation.
 - 6. Remote annunciation.

C. The System shall provide the following features:

1. The system shall have a maximum capacity of 250 monitoring points and shall be expandable to the maximum capacity without additional cabinets.
2. The system shall be programmable using a standard on-site laptop computer or a panel mounted keypad with password security, user defined. Programmed information shall be stored in non-volatile memory.
3. The system shall automatically indicate the total quantity of alarms and of troubles which have occurred prior to reset at the control unit.
4. It shall not be possible to reset the system until all alarm and trouble signals have been acknowledged.
5. The system shall be capable of:
 - a. Counting the number of addressable detectors within a "zone" which are in alarm.
 - b. Counting "zones" which are in alarm.
 - c. Counting the total number of addressable detectors which are in alarm.
 - d. Differentiating among types of addressable detectors such as smoke detectors, manual stations, water-flow switches and thermal detectors.
 - e. Cross-zoning.

D. System Function:

1. Activation of any manual station shall:
 - a. Sound evacuation horns continuously and flash visual devices (strobes) with no time-out. Annunciator display shall remain active until the activated device is restored to normal and the system is reset.
 - b. Flash system alarm lamp at the control panel. Acknowledgement of the alarm by operation of the silence switch shall silence the audible alarm and cause the alarm lamp to light steadily. Receipt of subsequent alarms shall cause the audible devices to sound and the alarm lamp to flash.

- c. Display individual detector and/or zone number on alpha-numeric display with user defined message.
 - d. Close fire doors and unlock security doors as shown.
 - e. Automatically notify the off-site 24 hour Central Station.
2. Activation of any automatic fire sprinkler water flow switch shall cause functions specified for manual stations and sound sprinkler riser bell.
3. Activation of any duct mounted smoke detector shall cause functions specified for manual stations and shut down fans and operate dampers as shown.
4. Activation of any ceiling mounted smoke detector shall cause functions specified for manual stations and perform related functions as shown on drawings.
5. Activation of any thermal detector shall cause functions specified for smoke detectors.
6. Activation of any supervisory switch for automatic fire sprinkler valves shall:
 - a. Sound audible alert at the control panel.
 - b. Indicate individual valve at the alphanumeric display with user defined message.
 - c. Indicate valve operations as a distinct function. Circuit trouble shall not be used for valve supervision.
 - d. Automatically notify the off-site 24 hour Central Station.
7. Failure of any circuit supervised by the Fire Alarm system shall:
 - a. Indicate the nature of the trouble at the alphanumeric display.
 - b. Automatically notify the Central Station of trouble condition.
8. Audible and visual trouble indications at the control panel shall be caused by:
 - a. Removal of a detection device from a detector circuit.
 - b. An open circuit or ground fault in a detector circuit.
 - c. An open circuit, short circuit, or ground fault in an audible/visual signal circuit.
 - d. Internal faults and failures within the system.
9. Failure of AC power shall:

- a. Cause a trouble indication at the Control Panel.
- b. Cause automatic transfer to the standby battery and maintain system operation for 60 hours.

2.2 ACCEPTABLE PRODUCTS

- A. Design basis: Honeywell Notifier. Products by Siemens, Cerberus Pyrotronics, Edwards or Simplex, conforming to these specifications are acceptable. Other products must be pre-qualified by Owner for consideration.

2.3 CONTROL PANEL

- A. The Control Panel shall be composed of plug-in modules factory interconnected to meet the specific installation requirements. All electrical connections shall be front access through the hinged door and removable dead front panel. All indicating lamps shall be light emitting diodes (LED).
- B. The control panel shall be of modular construction for ease of expansion and servicing. Each individual function shall be on a replaceable plug-in panel or module to accommodate functional changes when required. All plug-in modules and panel connectors shall be supervised so as to give a trouble signal if removed or disconnected.
- C. The Control Panel shall operate from a two-wire 120 VAC supply, and internal 24V back-up battery. See 2.4.
- D. The Control Panel shall contain equipment and modules for specified functions including but not limited to the following:
 1. Alarm initiating cards, appropriate for type of devices connected, shall provide separate, electrically supervised alarm initiating zones as shown on the plans. The wiring for the alarm initiating devices up to and including the alarm relay coil shall be supervised against an open circuit fault condition. Operation of an initiating device shall cause an individual red zone LED to lock on and shall provide an alarm output to other sections of the control unit. Circuitry shall be provided to connect remote annunciators.
 2. Each alarm initiating circuit shall be provided with an individual amber trouble lamp to indicate the location of any faults in the wiring to initiating devices. Fault conditions shall light the common trouble LED and sound the trouble buzzer.
 3. The control panel shall be equipped with a march time coding module to provide a common, continuously pulsed output of approximately 84 pulses per minute to all audible alarm circuits.
 4. Each alarm notification shall be provided with an individual zoned amber trouble LED circuit to indicate the location of any faults in the wiring to the audible/visual signals or signal circuit fuse.

5. LED test: The control unit alarm and trouble lamps may be tested to locate a failure by depressing the lamp test pushbutton.
6. When the alarm initiating devices have been restored the system control shall be reset by depressing a single reset pushbutton.
7. A green "power on" indication on the panel for each separate source of 120V AC input power.
8. Trouble indication: An amber trouble lamp and distinctive audible signal which shall operate when any of the specified supervised trouble conditions exist. The audible portion of the trouble signal shall be silenced with a "trouble silence" pushbutton. The trouble signal and indication shall automatically reset to normal when a trouble condition is corrected.
9. Ground Detection: A ground fault shall sound a trouble signal and illuminate an amber "ground fault" indication on the panel.
10. Program Control: If needed, a diode matrix shall be provided to program audible signal circuits and auxiliary relays to alarm receiving circuits individually or in groups in accordance with the system function schedule on drawings. The program control shall be reprogrammable to allow any signal circuit or auxiliary relay to be reprogrammed to any alarm initiating circuit to accommodate any changes in the zoning schedule without removing the panel from the premises.
11. Remote Annunciation:
 - a. Each zone module as well as common system trouble shall be remotely annunciated at the Building Fire Alarm Annunciator as specified hereafter.
 - b. In addition, each zone module or auxiliary relay integral with fire alarm panel, shall provide contacts for use by the site and/or any other remote fire alarm annunciator panel(s) including off-site Central Station(s).

2.4 BATTERY, BATTERY CHARGER AND BATTERY CABINET

- A. The back-up battery shall have capacity for at least 60 hours of operation. Provide battery calculations for standby and alarm conditions to comply with duration requirements of Local Fire Marshal.
- B. Unless indicated otherwise on drawings, the battery charger shall be integral with the power supply module located within the fire alarm panel. The power supply module shall include trouble indicators as follows:
 1. External Power Monitor
 2. Charger (Supervision of Charger Voltage to the Battery)

3. Battery Low/Card Out
 4. Ground Fault
 5. AC Pilot
- C. Battery cabinet shall have the following features:
1. Built-in battery tester with load for dynamic type testing of batteries
 2. Charge Current Meter
 3. Battery Terminal Voltage Meter
 4. Pre-drilled Holes for Wall Mounting
 5. Piano Hinged Door
 6. Accessible Battery Connectors

2.5 ALARM INITIATING DEVICES

- A. Manual Station: Non-code, individually addressable, single-action non-breakglass type equipped with key operated test-re-set lock and terminal strip. The stations shall be so designated that after actual emergency operations they cannot be restored to normal except by authorized personnel. Stations shall be red-faced, flush mounted with operating instructions on the cover.
- B. Smoke Detectors: Unless indicated otherwise on the plans, space smoke detectors shall be dual chamber ionization type. The combination detector head and twist-lock base shall be U.L. listed. The base shall, when required, include auxiliary SPDT relay contacts. The base shall be appropriate for either the ionization or Photoelectric detector. The detector shall have a flashing status indicating LED for visual supervision of normal conditions and latch on steady with full brilliance when activated. Field adjustments of the sensitivity shall be possible. The addressable interface base shall be part of the assembly.
- C. Duct Smoke-Detectors: Similar to smoke detectors but with duct mounted housing and sampling tubes. Provide auxiliary relays to control HVAC system. 120 Volt input unless noted otherwise. Provide weatherproof enclosure in wet locations. Provide remote reset on wall as shown.
- D. Automatic Sprinkler Flow Switches and Valve Switches: Switches shall be furnished and mechanically installed under another section of these Specifications. All material and labor required to connect the switches to the fire alarm system as indicated on the plans shall be provided under this Section of the Specifications. Provide interface device to make each switch an individually addressable device.

2.6 ALARM NOTIFICATION DEVICES

- A. Alarm Horn: 24 VDC, flush or surface mounted as indicated on drawings, with sound output of 92 dBA at 10 feet.
- B. Visual Alarm: 24 VDC Xenon strobe white lens with "FIRE" lettering. Strobe shall have 8000 peak candlepower and a minimum of 1 flash per second but not exceeding 3 flashes per second. Provide sync module.
- C. Combination Horn and Strobe: Where indicated on drawings combination horn and strobe shall be installed. Provide sync module.
- D. Sprinkler Flow Alarm Bell: 10" diameter, 24V DC weatherproof, vibrating type with matching backbox.

2.7 FIRE ALARM TERMINAL CABINET (FATC)

- A. Provide FATC's where indicated on drawings. Wiring to fire alarm system devices associated with that area shall be terminated in the FATC before extending to the Control Panel.
- B. The FATC shall be provided with double row terminal blocks suitable for terminating wires #22 to #12 AWG, complete with terminal marking cover strips. Where adjacent terminal blocks are jumpered together standard plug-in jumpers shall be used.

2.8 BUILDING FIRE ALARM ANNUNCIATOR

- A. The annunciator shall have a window for each initiating zone module in the Control Panel, common trouble window, sonalert buzzer, sonalert silencing switch and lamp test switch. Sonalert shall sound whenever any window is lit. The silencing switch when operated shall silence the sonalert but not reset the alarm. Reset shall be possible at the fire alarm panel only.

PART 3 – EXECUTION**3.1 GENERAL**

- A. Install and connect equipment in accordance with manufacturer's recommendations unless where more stringent requirement is specified.
- B. All equipment that must be serviced, operated or maintained shall be located in fully accessible locations.
- C. Equipment, device and raceway locations shown on the drawings are diagrammatic. Coordinate actual location with the Architectural elevations and other trades.
- D. Final connections shall be done under supervision of equipment manufacturer's field representative.

3.2 INSTALLATION OF DEVICES

- A. All devices shall be provided with back boxes, flush, surface, cast or weather proof, appropriate for the location:
- B. Boxes for devices flush mounted in steel wall shall be 4" x 4" square with a sheet rock ring that meets the device requirements, 1 or 2 gang. All device boxes shall be secured to the metal studs using a side bracket.
- C. All strobes and horn/strobes shall be mounted at 6'8" A.F.F. or 6" below the ceiling, whichever is lower. Before installing devices, confirm that the view of the strobes will not be obstructed by equipment, structure, etc. Contact the Architect for an alternate mounting location if obstructions are found.

3.3 WIRING

- A. All wiring shall be installed in conduit. The system shall be free from grounds, open and short circuits. Splices shall be allowed only in junction boxes, utilizing crimp type wire connectors and shields made continuous at the splice.
- B. All wires shall be identified at each terminal, splice and/or in each outlet. Use Brady Datab or similar devices.
- C. Wires shall be solid copper and listed (U.L. 2464) for use as fire alarm cable. Unless otherwise indicated on drawings minimum size shall be as follows:
 - 1. Alarm initiating circuits: #16 AWG.
 - 2. Alarm notification circuits: #14 AWG.
 - 3. Annunciator wires: #16 AWG.
 - 4. When installed in underground conduits: All circuits shall be #12 AWG minimum.
 - 5. Wiring for smoke detectors shall be shielded type if required by equipment furnished.
 - 6. 24 volt DC power supply circuit: #12 AWG.
- D. Wires within the Control Panel and relay panels shall be run in slotted plastic wire duct. T&B nylon ty-wraps and anchor blocks are acceptable where space is limited.

3.4 PROGRAMMING

- A. The Contractor shall be responsible for programming and configuring the fire alarm system to meet the operational requirements as specified above.
- B. The Owner will review and approve the program before it is installed.

3.5 OPERATIONAL TEST AND START-UP

- A. Each device shall be tested per the manufacturer's recommendations. When a device passes the prescribed test the Contractor shall initial that device on the device database. When the database is completely initialed a copy shall be given to the City Fire Inspector and the Owner.
- B. Each test shall provide an alarm giving device identification information to the Control Panel. Submit a copy to the Owner.
- C. Check initiating circuits to sprinkler flow and tamper switches. Check initiating circuits to pre-action system alarm pressure and low air switches.
- D. Check output circuits to pre-action release solenoids and smoke damper release modules.
- E. Check smoke detector initiating circuits associated with magnetic door holders. Check door release circuits. Confirm that doors close and latch when released.
- F. Perform a test of each area of the building, the result of which shall be zero trouble and zero alarms. This test shall be complete one week prior to occupancy. If any trouble or alarms occur, the problems shall be corrected and the test repeated until it passes.

3.6 TRAINING

- A. Allow four (4) hours of factory service engineer's time for training Owner's personnel in use, service and maintenance of the fire alarm system.
- B. Schedule the training session three (3) weeks in advance with the Owner.

END OF SECTION