Bid No.030623

PLANS AND SPECIFICATIONS FOR

MADERA HIGH SCHOOL
KITCHEN HVAC RETROFIT

FOR

MADERA UNIFIED SCHOOL DISTRICT

200 SOUTH L STREET
MADERA, CA 93637

LAWRENCE
ENGINEERING GROUP

4910 E. Clinton Way, Suite 101
Fresno, CA 93727
(559) 431-0101

ELECTRICAL CONSULTANT

BORRELLI AND ASSOCIATES, INC.
John Borrelli, E16390
2032 N. Gateway Blvd.
Fresno, CA 93727
(559) 233-4138

STRUCTURAL CONSULTANT

PARRISH HANSEN
Robert Parrish, S2331
418 Clovis Ave.
Fresno, CA 93612
(559) 323-1023

AUGUST, 2022

PROJECT MANUAL FOR

MADERA HIGH SCHOOL BOX
KITCHEN HVAC RETROFIT
MADERA UNIFIED SCHOOL
DISTRICT

200 SOUTH L STREET
MADERA, CA 93637

PREPARED BY:

LAWRENCE ENGINEERING GROUP
CONSULTING MECHANICAL ENGINEERS
4910 E. CLINTON WAY, SUITE 101
FRESNO, CALIFORNIA 93727

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT
APP: 02-120316 INC:
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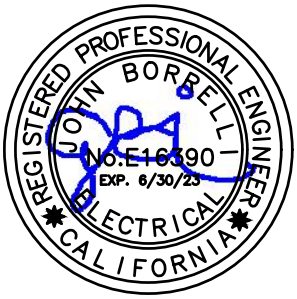
DATE: 02/13/2023

MECHANICAL ENGINEER:



ELECTRICAL ENGINEER:

STRUCTURAL ENGINEER:

TECHNICAL SPECIFICATIONS – TABLE OF CONTENTS

SECTION 06 10 00 – ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Rough carpentry.

1.02 REFERENCES

A. Chapters 23, 2019 CBC.

B. ANSI/AWC HDS - 2012.

C. DOC PS 1 - Department of Commerce Product Standard, U. S. Product Standard for Construction and Industrial Plywood.

D. DOC PS 20 - Department of Commerce Product Standard, American Softwood Lumber Standards.

E. DOC PS 2 - Department of Commerce Product Standard, U. S. Product Standard for Construction, Performance Standard for Wood-Based Structural-Use Panels.

F. ANSI A135.4 - Basic Hardboard.

G. WWPA - Western Lumber Grading Rules 88, Latest Edition, by Western Wood Products Association.

H. APA - American Plywood Association Design/Construction Guide (Engineered Wood Association).

I. AQMD - Local Air Quality Management District Regulations.

J. AWPA U1 - Use Category System: User Specification for Treated Wood.

K. WCLIB - West Coast Lumber Inspection Bureau Standard Grading Rules No. 17.

L. Title 8 - California Code of Regulations, Construction Safety Orders.

M. ICC –ES – International Code Council Evaluation Service, Inc.

N. RIS – Redwood Inspection Service, Standard Specifications for Grades of California Redwood Lumber.

O. FSC – Forest Stewardship Council Principles and Criteria.

1.03 SUBMITTALS

A. Product data. Do not submit manufacturer’s catalog’s without specifically identifying the products to be reviewed for installation to the project.

B. Current ICC-ES Reports for specified products and approved substitutions requiring ICC approvals.

1.04 QUALITY ASSURANCE

A. Rough Carpentry Lumber: Visible grade stamp on all products required.

B. Grade Stamp: Association under whose rules it was graded, or official grade mark of other recognized grading agencies using grading rules, equivalent to WWPA or WCLIB.

C. Association performing grading and grade marking of lumber shall be approved by Division of the State Architect (DSA).

D. Nailing guns and nail operators shall be approved in accordance with Title 8 Construction Safety Orders.

E. All Plywood shall be free of urea-formaldehyde binders and adhesives.

1.05 DELIVERY, STORAGE AND HANDLING

A. Do not deliver rough carpentry items until site conditions are adequate to receive the Work. Protect items from weather while in transit.

B. Store lumber and plywood at the site under cover or otherwise protected against exposure to weather, raise above ground and out of contact with damp or wet surfaces. Stack lumber and plywood and provide for air circulation within and around stacks and under temporary covers. For pressure treated lumber and plywood, provide spacers between courses to permit air circulation.

C. Certified wood shall be kept separate from non-certified wood. Auditing process as mandated by certifiers shall be complied with.

1.06 PROJECT CONDITIONS

A. Cooperate with other trades in coordinating their Work with the Work of this Section. Provide wood grounds, blocking and nailers where indicated or as required for Work of other trades.

PART 2 - PRODUCTS

2.01 ROUGH CARPENTRY MATERIALS

A. Lumber: Graded in accordance with WWPA or WCLIB; maximum moisture content of 19 percent at time of loading. Provide Douglas Fir Larch for structural and framing lumber, surfaced four sides to standards of the grading association unless otherwise indicated on Drawings, use the following grades
   1. Joists, rafters, beams, lintels, horizontal framing, posts, studs and vertical framing: Species and grades as indicated or noted on drawings.
   2. Non-bearing studs and plates, non-structural furring, concealed blocking, stripping and miscellaneous nailers and backing: No. 2 unless noted otherwise in the structural drawings.
   3. Structural Drawings take precedence for lumber grades.
   4. All lumber in contact with concrete shall be pressure treated.

B. Shop Fabricated Structural Wood:

1. LSL: Where indicated, use Timberstrand material per ICC ESR-1387 – Fb = 2600 psi, Fv = 400 psi, E = $1.7x10^6$, or approved equal. (Approved substitutes shall have ICC approval.)
2. PSL: Where indicated, use Parallam material per ICC ESR-1387 – Fb = 2700 psi, Fv = 260 psi, E = $1.9x10^6$, or approved equal. (Approved substitutes shall have ICC approval.)
3. LVL: Where indicated, use Microllam material per ICC ESR-1387 – Fb = 2600 psi, Fv = 285 psi, E = $1.9x10^6$, or approved equal. (Approved substitutes shall have ICC approval.)

C. Plywood (Wood Structural Panels): Section 2303.1.5 CBC, Douglas Fir 1 Group Species, PS 1, APA Structural I Rated Sheathing. Bond Classification: Exterior. Thickness as indicated; span rating sized for spacing.
1. For natural finished plywood: Panel Grade N veneer on face and B on back side.
2. For painted finish: APA Sanded Plywood Panels, A-C Group 1, Exterior, sanded face, touch sanded back side.
3. Thickness: Minimum 15/32 inch for walls and 19/32 inch for roof, or as indicated on Drawings.
4. Plywood shall be FSC certified; other sustainable forestry certifications will not be accepted.

D. Oriented Strand Board (OSB): PS 2, APA PRP-108, 15/32 inch through 3/4 inch APA Rated Sheathing and Structural 1 Rated Sheathing, Exposure 1, meeting NES “Oriented Strand Board Roof and Wall Sheathing, Combination Subfloor/Underlayment OSB Lap and Panel Siding (NER-124)”.

E. Preservative (Pressure) Treated Lumber: Section 2303.1.9 Conform to AWPA Manual of Recommended Practice, kiln dry after treatment. Use preservative complying with AWPA U1, latest edition. Products NOT containing arsenic or chromium. Conform to AQMD, Local Regulations.
1. Douglas Fir Larch, used as required by Section 2303, CBC, shall conform to the following
    a. Lumber shall be WWPA or WCLIB grade stamped.
    b. Lumber shall be No. 1 grade or better unless indicated otherwise on Drawings.

F. Waterproof Membrane: ASTM D4601; Type II, asphalt saturated glass felt.

G. Fire-Retardant Treated Wood: Section 2303.2 CBC
1. Fire-Retardant Douglas Fir Lumber: Lumber shall be grade stamped by an approved agency at the factory, and shall bear identification indicating the fire performance rating thereof, Flame Spread Less than 25, ASTM E84. Lumber: AWPA C20.
2. Fire-Retardant Treated Douglas Fir Plywood: AWPA Standard C-27, NFPA 703, ASTM D-5516, ASTM E-84, Section 2303.2, CBC, PS 1-09, APA structural rated sheathing, Exposure 1, 5/8 thick. Plywood shall comply with the following Maximum Flame Spread Classifications in the following locations

H. Plywood Backing Panels

1. Telephone and Electrical Equipment, fixed equipment, cabinets, grab bars, door stops and plates: DOC PS 1, Exposure 1, APA A-C, sanded, Veneer Grade, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1 inch nominal thickness. Installed “A” side out for paint finish. Install with minimum #12 sheet metal screws or wood screws for steel stud or wood stud wall construction, respectively at 6” o.c. all edges and intermediate support studs.

I. Nails, Spikes and Staples: Section 2303.6 and 2304.10 CBC, Hot-Dipped Zinc Coated Galvanized for exterior exposed applications, high humidity locations and installation into treated wood and within 8" of soil or exterior slabs; plain finish for other interior locations; size and type to suit application. Comply with Table 2304.10.1. Use common nails only.

J. Bolts, Nuts, Washers, Lags, and Screws: Section 2304.10 CBC, sized to suit application, galvanized for exterior locations, high humidity locations and treated wood, plain finish for other interior locations. Full diameter body bolts only per ASME B18.2.1(.2) or B18.2.6 for structural applications.

K. Fasteners: Expansion type or powder actuated type for anchorage to solid masonry or concrete. Refer to Structural Drawings for acceptable types and required testing. Where installation and torque verification of wedge-type anchors is inspected by the IOR, testing of anchors will not be required unless directed by the SEOR for structural tension applications.

L. Stock Framing Connectors: Section 2304.10 CBC types indicated on Drawings, galvanized, with nails fully driven in all holes in each face of connector. Conform to the following.
1. Manufacturers: Simpson Strong Tie Co., Inc., San Leandro, CA, United Steel Products, Montgomery, MN. or equal as approved in accordance with Division 01 General Requirements for Substitutions.
2. ICC Listed.

M. Non-Stock Framing Connectors: Conform to details. No substitutions allowed.

N. Non-shrink Grout: ASTM C1107, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 5,000 psi in 7 days; of consistency for application and a 30-minute working time. Acceptable Manufacturers: Dayton Superior, Miamisburg, OH; Sonneborn, Shakopee, MN; Novex Systems International, Clifton NJ, or equal.

O. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

P. Adhesives: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.01 LAYOUT MARKINGS

A. Layout markings shall not be made with xylene-based inks, paint, or dyes, or with other solvent-based products that may bleed through finishes.

3.02 FRAMING, FURRING AND STRIPPING

A. Erect wood framing, furring, stripping and nailing members true to lines and levels. Do not deviate from true alignment more than 1/4 inch in 10 feet, non-cumulative.

B. Construct members of continuous pieces of longest possible lengths.

C. Construct and erect required headers and lintels.

D. Use multiple wall framing members at openings as indicated on structural drawings. Space short members above and below openings in same manner as for walls.

E. Provide double joist headers at joist ends and around openings unless otherwise indicated on Drawings. Bridge joists and rafters to conform Section 2304 CBC and as noted on plans. For pre-manufactured joists, provide bridging in accordance with manufacturer's recommendations.

F. Construct walls with studs of size spacing indicated, 16 inches on center unless otherwise indicated on drawings. Install single sill member at bottom and double plate at top. Stagger upper and lower members of double plate with joints not less than 4 feet o.c. or as indicated on Drawings. Where sill or any wood member contacts concrete or masonry within 8" of soil or exterior slab or setting on interior slab, install preservative-treated lumber.

G. Provide one row of solid blocking not less than 2 inch nominal thickness and same width of stud at ceiling and floor lines and at spacing not to exceed 8 feet on center vertically. Fit snugly and attach with not less than two 10d nails.

H. Install 3 studs at corners unless otherwise indicated. Accommodate corner holdown attachments where they occur. Conform to structural drawing requirements for limits of cutting, notching and boring of sills, plates, studs, joists and beams.

I. Conform to Section 717, California Building Code for fire blocks and draft stops. Fire blocks and stops at 10-feet intervals and at ceiling level.

J. Fire-Retardant Wood: Ripping and milling are not permissible. Cross cutting to length, drilling holes, joining cuts and light sanding are permissible. It is not necessary to field treat cut ends to maintain flame spread rating. All cuts on plywood are considered end cuts and is permissible to be cut.

3.03 PLYWOOD SHEATHING

A. Thickness as indicated on the Drawings, minimum thickness 15/32 inch.

B. Nailing: of size and spacing indicated. Common wire only unless indicated use hot-dipped zinc coated galvanized in treated wood or wood within 8" or soil or exterior slabs.

C. Boundary Nailing: Not less than 3/8 inch from edge, spaced not more than 6 inches on center, unless noted otherwise on Drawings.

D. Blocking: Panel edges shall bear on framing members or solid blocking.

E. Minimum Size Vertical Panel: 16 inches wide.

F. Minimum Size Horizontal Panel: 24 inches wide.

G. Oriented Strand Board not permitted for shear panels unless indicated on structural drawings.

3.04 FOUNDATION FRAMING, PLATES, SILLS AND SLEEPERS

A. Preservative treated wood required. Set wood sills on a bead of continuous butyl sealant on both edges of sill.

B. Use hot-dipped zinc coated galvanized nails in treated wood and wood within 8" of soil or exterior slabs.

3.05 HORIZONTAL FRAMING

A. Bearing: 1-1/2 inch minimum on wood or metal, 3 inches on masonry unless otherwise detailed on drawings. Lay framing members with crown up. Members with knots at bottom not permitted.

B. Lateral Support: Use solid blocking, cross bridging or other approved means.

C. Do not run joists continuous beyond one span unless indicated otherwise on Drawings.

D. Openings: Frame openings in walls as specified on the structural drawings.

E. Treat ends of timber beams and posts exposed to weather by dipping in water-repellent preservative for 15 minutes.

3.06 INSTALLATION OF BACKBOARDS

A. Provide backing panels as indicated on Drawings to support telephone and electrical equipment, fixed equipment, cabinets, grab bars, door stops and plates. Fasten securely to framing. Ensure that backing panels are installed with good side out (whose face side is free of blemishes) side by side, no mix of sides permitted.

B. Install to extent indicated on the drawings or as required for electrical or communication system installation.

C. Install with sheet metal screws, No.10 minimum, at 12 inches on center minimum. Drywall screws will not be permitted.

D. Prime paint exposed faces. Do not cover manufacturer’s trade stamps indicating fire treatment.

E. Final finish per Section 09 90 00, Painting.

END OF SECTION

SECTION 23 00 00 - GENERAL MECHANICAL PROVISIONS

PART 1: - GENERAL

1.1 GENERAL CONDITIONS:

A. The preceding General and Special Conditions and Divisions 00 and 01 requirements shall form a part of this Section with the same force and effect as though repeated here. The provisions of this Section shall apply to all of the Sections of Divisions 23 of these Specifications and shall be considered a part of these sections.

1.2 CODES AND REGULATIONS:

A. All work and materials shall be in full accordance with current rules and regulations of all applicable codes. Nothing in these Drawings or Specifications is to be construed to permit work not conforming to these codes. Should the Drawings or Specifications call for material or methods of construction of a higher quality or standard than required by these codes, the Drawings and Specifications shall govern. Applicable codes and regulations include, but are not necessarily limited to, the following:
   1. California Code of Regulations (CCR):
      a. Title 8, Industrial Relations
      b. Title 24, Part 1, Administrative Regulations
      c. Title 24, Part 6, California Energy Code, 2019 Edition
      d. Title 24, Part 11, California Green Building Code, 2019 Edition
   2. California Building Code - CBC - 2019
   3. California Mechanical Code - CMC - 2019
   4. California Plumbing Code - CPC - 2019
   5. California Fire Code - CFC - 2019
   6. California Electrical Code - CEC - 2019
   7. Air Diffusion Council - ADC
   8. American Gas Association - AGA
   9. Air Movement and Control Association - AMCA
   10. American National Standards Institute - ANSI
   11. Air Conditioning and Refrigeration Institute - ARI
   12. American Society of Heating, Refrigerating, and Air Conditioning Engineers - ASHRAE
   13. American Society of Mechanical Engineers - ASME
   14. American Society for Testing and Materials - ASTM
   15. American Water Works Association - AWWA
   16. Cast Iron Soil Pipe Institute - CISPI
   17. National Electrical Manufacturers Association - NEMA
   18. National Fire Protection Association - NFPA
   19. National Sanitation Foundation - NSF
   20. Occupational Safety and Health Act - OSHA
   21. Plumbing and Drainage Institute - PDI
   22. Sheet Metal and Air Conditioning Contractors National Association - SMACNA
   23. Underwriters' Laboratory - UL

1.3 PERMITS AND FEES:

A. The Contractor shall take out all permits and arrange for all tests in connection with his work as required. All charges are to be included in the work. Permits for equipment connected to a particular system are to be considered as part of the work included under each system. All charges or fees for service connections, meters, etc. shall be included in the work.

1.4 COORDINATION OF WORK:

A. Layout of materials, equipment and systems is generally diagrammatic unless specifically dimensioned. Some work may be shown offset for clarity. The actual locations of all materials, piping, ductwork, fixtures, equipment, supports, etc. shall be carefully planned prior to installation of any work in order to avoid all interference with each other, or with structural, electrical, architectural or other elements. Verify the proper voltage and phase of all equipment with the electrical plans. If discrepancies are discovered between drawing and specification requirements, the more stringent requirement shall apply. All conflicts shall be called to the attention of the Architect and the Engineer prior to the installation of any work or the ordering of any equipment. No work shall be prefabricated or installed prior to this coordination. No costs will be allowed to the Contractor for any prefabrication or installation performed prior to this coordination.

B. Mandatory Coordination and Shop Drawings:

1. Prepare or have prepared high level detailed Shop Drawings in plan view, with cross-sections as necessary, indicating the proposed installation plan for all HVAC, mechanical, fire sprinkler, and plumbing installations for the project. These Drawings should depict actual elevations and linear dimensions, as well as all routing changes, transitions, major offsets, deck and structural attachments deemed necessary to accomplish the installation. Individual Shop Drawings may be prepared for each trade working within the designated space or area; however, the coordination of the consolidated installation shall remain the responsibility of the Contractor. These Shop Drawings shall be provided to each Subcontractor having Work in each area for coordination. Any fittings, offsets or other changes due to coordination shall be at no additional cost to District.
2. Whereas the Drawings are diagrammatic, showing only the general arrangement of the systems, Contractor shall have responsibility for the fitting of materials and equipment to other parts of the equipment and structure, and to make adjustments as necessary or required to resolve space problems, preserve service room, and avoid architectural and structural elements and the Work of other trades. Contractor may be required to identify certain areas to relocate installations within the spaces depicted on the Drawings, e.g., ductwork and/or piping may be shifted within the space shown to accommodate other systems. Such functional relocations shall not be deemed a change to the requirements of the Contract. In the event a major re-routing of a system appears necessary, Contractor shall prepare and submit for approval, Shop Drawings of the proposed rearrangement.
3. Because of the diagrammatic nature and small scale of the Drawings, all necessary offsets, adjustments, and transitions required for the complete installation are not shown. Contractor shall carefully investigate the conditions affecting all the Work and shall arrange such Work accordingly, furnishing such fittings, equipment, valves, accessories, offsets, etc., as may be required, regardless of size or cost, to meet such conditions, at no additional cost to the Owner.
4. Coordination changes are not design changes and shall be provided at no additional cost to Owner. Any guidance, drawing or clarification issued by the Architect or Engineer to assist the Contractor or their sub-contractors in their coordination during construction are not design changes and shall be provided at no additional cost to Owner.
5. Resolve differences or disputes between subcontractors and materials suppliers concerning coordination, interference, or extent of work between sections. The Contractor's decisions, if consistent with the Contract Documents, shall be final. The Architect and their Consultants are not required to coordinate work between sections and will not do so. Any changes required that affect the design intent shall be presented to and approved by the Architect and Engineer of Record.
6. The coordinated Shop Drawings must be signed off by HVAC, Plumbing, Fire Sprinkler, Electrical, Framing, Ceiling Installation, and Data and Low Voltage Subcontractors.
7. The signed off Shop Drawings shall be submitted to the Owner's Representative for review and approval prior to commencement of installation.
8. Provide reviewed Shop Drawings to each Subcontractor having Work in each area.

1.5 GUARANTEE:

A. Guarantee shall be in accordance with the General Conditions. These Specifications may extend the period of the guarantee for certain items. Where such extensions are called for, or where items are normally provided with guarantee periods in excess of that called for in the General Conditions, the certificate of guarantee shall be furnished to the Owner through the Architect. Equipment that is started and operated prior to acceptance shall have the guarantee extended to cover that period. Owner guarantee shall start at acceptance.

1.6 QUIETNESS:

A. Piping, ductwork and equipment shall be arranged and supported so that vibration is a minimum and is not transmitted to the structure.

1.7 DAMAGES BY LEAKS:

A. The Contractor shall be responsible for damages caused by leaks in the temporary or permanent piping systems prior to completion of work and during the period of the guarantee, and for damages caused by disconnected pipes or fittings, and the overflow of equipment prior to completion of the work.

1.8 EXAMINATION OF SITE:

A. The Contractor shall examine the site, compare it with Plans and Specifications, and shall have satisfied himself as to the conditions under which the work is to be performed. No allowance shall subsequently be made in his behalf for any extra expense to which he may be put due to failure or neglect on his part to make such an examination.

1.9 COMPATIBILITY WITH EXISTING SYSTEMS:

A. Any work which is done as an addition, expansion or remodel of an existing system shall be compatible with that system.

1.10 MATERIALS AND EQUIPMENT:

A. Materials and equipment shall be new unless otherwise noted. Materials and equipment of a given type shall be by the same manufacturer. Materials and equipment shall be free of dents, scratches, marks, shipping tags and all defacing features at time of project acceptance. Materials and equipment shall be covered or otherwise protected during construction as required to maintain the material and equipment in new factory condition until project acceptance.

1.11 SUBMITTALS:

A. Shop Drawings: Within 30 days of contract award, the Contractor shall submit six copies of shop drawings for all materials, equipment, etc. proposed for use on this project (this includes deferred approval items). Material or equipment shall not be ordered or installed until written review is processed by the Engineer. Any item omitted from the submittal shall be provided as specified without substitution.
   All shop drawings must comply with the following:
   1. Shop drawings are required for all material and equipment items and shall include manufacturer's name and catalog numbers, dimensions, capacities, performance curves, and all other characteristics and accessories as listed in the specifications or on the drawings. Descriptive literature shall be current factory brochures and submittal sheets. Capacities shall be certified by the factory. FAX submittals are not acceptable.
   2. All shop drawings shall be submitted at one time in a neat and orderly fashion in a suitable binder with title sheet including Project, Engineer and Contractor, table of

contents, and indexed tabs dividing each group of materials or item of equipment. All items shall be identified by the specification paragraph number for which they are proposed. All equipment shall also be identified by the mark number as indicated on drawings.

3. All capacities, characteristics, and accessories called for in the specifications or on the drawings shall be high-lighted, circled or underlined on the shop drawings. Calculations and other detailed data indicating how the item was selected shall be included for items that are not scheduled. Data must be complete enough to permit detailed comparison of every significant characteristic which is specified, scheduled or detailed.
4. Drawings shall be submitted in both hard copy and electronic form, electronic files shall be in their native format (i.e. DWG for AutoCAD, RVT for Revit, etc).
5. Electronic Submittals: Where allowed by Division 01, electronic submittals are acceptable providing the following requirements are met. Electronic submittals which do not comply with these requirements will be rejected.
    a. Submittal shall be a single file in PDF format, with bookmarks for table of contents and each tab, and sub-bookmarks for each item.
    b. All text shall be searchable (except text that is part of a graphic).
    c. Submittal shall include all items noted in 1 through 3 above, except a binder is not required.
    d. Electronic submittals shall be processed through normal channels. Do not submit directly to the Engineer unless the Engineer is the prime consultant for the project.
    e. Contractor shall provide Owner and Owner’s Representative with hard copies of the final submittal. Coordinate exact number required with Owner through Architect/Engineer.

B. Substitutions: Manufacturers and model numbers listed in the specifications or on the drawings represent the standard of quality and features desired (where equipment is scheduled on the drawings, any equipment submitted other than scheduled equipment is considered a substitution). Unless otherwise noted, alternate manufacturers may be submitted for review by the Engineer. Calculations and other detailed data indicating how the item was selected shall be included. The Contractor shall assume full responsibility that substituted items or procedures will meet the specifications and job requirements and shall be responsible for the cost of redesign and modifications to the work caused by these items. At the Engineer's request, furnish locations where equipment similar to the substituted equipment is installed and operating along with the user's phone numbers and contact person. Satisfactory operation and service history will be considered in the acceptance or rejection of the proposed substitution

C. Review: Submittals will be reviewed for general conformance with the design concept, but this review does not guarantee quantity shown, nor does it supersede the responsibility of the Contractor to provide all materials, equipment and installation in accordance with the drawings and specifications. The Contractor shall agree that shop drawing submittals processed by the Engineer are not Change Orders; that the purpose of shop drawing submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use. The Contractor shall agree that if deviations, discrepancies or conflicts between shop drawings and design drawings and specifications are discovered either prior to or after shop drawing submittals are processed by the Engineer, the design drawings and specifications shall control and shall be followed. If a resubmittal is required, submit a complete copy of the Engineer's review letter requiring such with the resubmittal.

1.12 MANUFACTURER'S RECOMMENDATIONS:

A. All material, equipment, devices, etc., shall be installed in accordance with the recommendations of the manufacturer of the particular item. The Contractor shall be

responsible for all installations contrary to the manufacturer's recommendations. The Contractor shall make all necessary changes and revisions to achieve such compliance. Manufacturer's installation instructions shall be delivered to and maintained at the job site through the construction of the project.

1.13 SCHEDULING OF WORK:

A. All work shall be scheduled subject to the review of the Architect, Engineer and the Owner. No work shall interfere with the operation of the existing facilities on or adjacent to the site. The Contractor shall have at all times, as conditions permit, a sufficient force of workmen and quantity of materials to install the work contracted for as rapidly as possible consistent with good work, and shall cause no delay to other Contractors engaged upon this project or to the Owner.

1.14 OPENINGS, CUTTING AND PATCHING:

A. The locations and dimensions for openings through walls, floors, ceilings, foundations, footings, etc. required to accomplish the work under this Specification Division shall be provided under this Division. Except as noted below, the actual openings and the required cutting and patching shall be provided by other Divisions. Coring through existing concrete or masonry walls, floors, ceilings, foundations, footings, etc., and saw cutting of concrete floors or asphaltic concrete required to accomplish the work under this Specification Division shall be provided under this Division. Patching of these surfaces shall be provided by other Divisions. Cutting or coring shall not impair the strength of the structure. Any damage resulting from this work shall be repaired at the Contractor's expense to the satisfaction of the Architect.

1.15 ACCESS DOORS:

A. Provide access doors as required where equipment, piping, valves, ductwork, etc. are not otherwise accessible. Access doors shall match the wall or ceiling finish and fire rating as indicated on the Architectural drawings. 16-gage steel frame and 14-gage steel door with paintable finish, except in ceramic tile, where door shall be 16-gage stainless steel with satin finish. Continuous hinge. Key and cylinder lock (except quick-opening type for Emergency Gas Shutoff Valve). Deliver doors to the General Contractor for installation. Milcor. Unless otherwise noted, the minimum sizes shall be as follows:

1 valve up to 1-1/2"	12" x 12"
1 valve up to 3"	16" x 16"

1.16 SEISMIC SUPPORT AND RESTRAINT DESIGN SERVICE:

A. All mechanical systems (equipment, ductwork, piping, etc.) shall be provided with supports and seismic restraints in accordance with the "Seismic Restraint Components for Suspended Utilities", 2020 Edition, as published by Mason West Inc., OPM-0043-13, or other OSHPD pre-approved system, and in accordance with ASCE 07-16, Chapter 13, as amended by CBC Section 1617A.1. Brace spacing shall be reduced by 50% for cast iron, plastic, no-hub, or other non-ductile piping. A copy of this manual shall be kept on site at all times during construction.

B. Contractor shall obtain the services of a Seismic Design service to provide engineered seismic supports and restraints for the project. Mason Industries, or pre-approved equal. .
Note: Use of the “12 inch rule” does not exempt Contractor from this requirement.

1. All seismic designs, including designs using OSHPD pre-approvals, shall be submitted as project specific engineered designs sealed and signed by a licensed California structural engineer. All seismic designs shall include project / application specific seismic design demand calculations. Said seismic design demand calculations shall account for seismic forces in all applicable direction including

axial, lateral, vertical tension, vertical compression, etc. Designs shall account for prying, eccentricity, uneven loading, weak axis bending, etc.

2. Seismic restraint layouts for piping, ductwork and electrical raceways shall be furnished on shop drawings or added to the contractor's shop drawings and shall include:
   a. The number, size and location of seismic braces.
   b. Maximum support loads and seismic loads at the seismic brace locations.
   c. Reference to specific details or pages from the OSHPD pre-approved system (OPM).
   d. **If use of the "12 inch rule" is intended by Contractor, design service shall verify locations where it is intended to be used is feasible and specifically identify these locations on the shop drawings, along with appropriate hanger details.**
3. Installations not addressed by the OPM approval must be designed, detailed and submitted along with the shop drawings.
4 Submit seismic restraint layout drawings and special details for approval of the project structural engineer per the requirements listed in the OSHPD pre-approval (OPM).
5. Seismic restraint layout drawings shall bear the stamp and signature of the registered professional structural engineer licensed in the state of California who designed the layout of the braces.

1.17 ASBESTOS CONTAINING MATERIALS AND ASBESTOS REMOVAL:

A. No materials or material coatings containing asbestos shall be allowed on this project.

B. All asbestos removal shall be by Owner. Asbestos is to be removed before the work is started. If the Contractor discovers asbestos which has not been removed, the Contractor shall immediately cease work in that area and promptly notify the Owner.

1.18 SYSTEM IDENTIFICATION:

A. Above Grade Piping: Provide markers on piping which is either exposed or concealed in accessible spaces. For piping systems, other than drain and vent lines, indicate the fluid conveyed or its abbreviation, either by pre-printed markers or stenciled marking, and include arrows to show direction of flow. Pre-printed markers shall be the type that wrap completely around the pipe, requiring no other means of fastening such as tape, adhesive, etc. Comply with ANSI A13.1 for colors. Locate markers at ends of lines, near major branches and other interruptions including equipment in the line, where lines pass through floors, walls or ceilings or otherwise pass into inaccessible spaces, and at 50' maximum intervals along exposed portions of lines. Marking of short branches and repetitive branches for equipment connections is not required.

B. Below Grade Piping: Bury a continuous, pre-printed, bright-colored, metallic ribbon marker capable of being located with a metal detector with each underground pipe. Locate directly over buried pipe, 6" to 8" below finished grade.

C. Equipment: All equipment shall be identified with a plastic laminated, engraved nameplate which bears the unit mark number as indicated on the drawings (e.g. AC-4) and identifies the area or space served by the equipment. Provide 1/2" high lettering - white on black background. Nameplates shall be permanently secured to the exterior of the unit.

D. Valves: Provide stamped brass valve tags with brass hooks or chains on all valves of each piping system, excluding check valves, valves within equipment, faucets, stops and shut-off valves at fixtures and other repetitive terminal units. Prepare and submit a tagged-valve schedule, listing each valve by tag number, location and piping service. Deliver to Owner through Architect.

1.19 CLEANING:

A. Progressively and at completion of the job, the Contractor shall thoroughly clean all of his work, removing all debris, stain and marks resulting from his work. This includes but is not limited to building surfaces, piping, equipment and ductwork, inside and out. Surfaces shall be free of dirt, grease, labels, tags, tape, rust, and all foreign material.

B. At the end of each work day, the Contractor shall cover all open ends of piping and ductwork with protective plastic.

1.20 ACCEPTANCE TESTING:

A. The Contractor shall perform, document and submit all acceptance testing as required by California Code of Regulations, Title 24, and as noted on the Certificate of Compliance form (MECH-1C), where applicable. Submit a copy of the documentation to the Engineer for review (hardcopy or electronic), prior to submitting to Administrative Authority.

1.21 OPERATION AND MAINTENANCE INSTRUCTIONS:

A. Printed: Three copies of Operation and Maintenance Instructions and Wiring Diagrams for all equipment and parts list for all faucets, trim, valves, etc. shall be submitted to the Engineer. All instructions shall be clearly identified by marking them with the same designation as the equipment item to which they apply (e.g. AC-3). All Wiring Diagrams shall agree with reviewed Shop Drawings and indicate the exact field installation. All instructions shall be submitted at the same time and shall be bound in a suitable binder with tabs dividing each type of equipment (e.g. Pumps, Fans, Motors, etc.). Each binder shall be labeled indicating "Operating and Maintenance Instructions, Project Title, Contractor, Date" and shall have a Table of Contents listing all items included.

B. Verbal: The Contractor shall verbally instruct the Owner's maintenance staff in the operation and maintenance of all equipment and systems. The controls contractor shall present that portion of the instructions that apply to the control system. The Engineer's office shall be notified 48 hours prior to this meeting.

1.22 RECORD DRAWINGS:

A. The Contractor shall obtain one set of blue line prints for the project, upon which a record of all construction changes shall be made. As the work progresses, the Contractor shall maintain a record of all deviations in the work from that indicated on the drawings. Final location of all underground work shall be recorded by depth from finished grade and by offset distance from permanent surface structures, i.e. building, curbs, walks. In addition, the water, gas, sewer, underfloor duct, etc. within the building shall be recorded by offset distances from building walls. As part of the Contractor’s overhead expense, request a full set of reproducible drawings to transfer the changes, notations, etc. from the marked-up prints to the reproducible drawings. The record drawings (marked-up prints and reproducibles) shall be submitted to the Engineer for review.

PART 2: - PRODUCTS (not used)

PART 3: - EXECUTION (not used)

END OF SECTION

SECTION 23 00 01 - HEATING, VENTILATING AND AIR CONDITIONING

PART 1: - GENERAL

1.1 GENERAL MECHANICAL PROVISIONS:

A. The General Mechanical Provisions, Section 23 00 00, shall form a part of this Section with the same force and effect as though repeated here.

1.2 SCOPE:

A. Included: Provide all labor, materials and services necessary for complete, lawful and operating systems as shown or noted on the drawings or as specified here. The work includes, but is not necessarily limited to, the following:
1. Air distribution system.
2. All equipment as shown or noted on the drawings or as specified. Furnish motor starters except where motor control centers are used. Coordinate with Division 26.
3. System energy balance.
4. Direct Digital Control and Energy Management System.
5. Drain system (including condensate drain).
6. Fuel gas system.
7. Demolition as indicated on drawings. Where demolition is called for, remove all equipment, piping, ductwork, braces, supports, housekeeping pads, temperature controls and related items no longer required.

B. Work Specified Elsewhere:
1. Line voltage power wiring, motor starters in motor control centers, disconnect switches and installation of all starters are included in the Electrical Section, unless otherwise noted.
2. Concrete and reinforcing steel unless specifically called for in the drawings or specifications.
3. Painting unless specifically called for in the drawings or specifications.
4. Carpentry.

PART 2: - PRODUCTS

2.1 PIPING MATERIALS:

A. Drain Piping (including Condensate): Hard temper seamless copper, ASTM B88. Wrought copper fittings, ANSI B16.22. Type L with brazed joints (1100F, min.). 1-1/2" and smaller above grade may be soldered, 95-5 tin-antimony solder. All nipples shall be lead-free red brass (85% copper).

B. Gas
1. Gas Piping: Schedule 40 galvanized steel pipe, ASTM A53. 150 psi galvanized malleable iron screwed fittings, ANSI B16.3, ANSI B31.8
2. Valves and Specialties:
a. Valves:
(1) General: Manufacturer's model numbers are listed to complete description. Equivalent models of Crane, Kitz, Milwaukee, Nibco, Stockham, Walworth or Watts are acceptable. All valves of a particular type or for a particular service shall be by the same manufacturer.
(2) Ball Valve: Full port. Lead free brass body, cap, stem, disk and ball. Screwed connection. Lever handle. PTFE seat and stem packing. Min. 400 psi CWP. CSA-US and UL listed. Nibco T-FP-600A-LF.

(3) Plug Valve: Valves in gas piping systems must be UL or CSA listed for gas distribution. Eccentric bronze or nickel plated semi-steel plug. Semi-steel body. Bronze bushings. Buna-N-rings. 175 psi WOG. KeyPort Valve Series 400. 2" and smaller above grade may be listed full port ball valves, except in publicly accessible locations. Apollo, Jomar, Nibco.

b. Miscellaneous Specialties:

(1) Union: 2" and Smaller: AAR malleable iron, bronze to iron ground seat. 300 psi.. Anvil.

C. Miscellaneous Piping Items:

1. Pipe Support:

a. Pipe Hanger: Steel "J" hanger with side bolt. Load and jam nuts. Size and maximum load per manufacturer's recommendations. Felt liner for copper piping. Hanger and rod shall have galvanized finish. B-Line, Anvil, Unistrut.

b. Construction Channel: 12-gage, 1-5/8" x 1-5/8" galvanized steel channel. Single or multiple section. Self-locking nuts and fittings. B-Line, Anvil, Unistrut.

2. Flashing: Flashing for piping through roof shall be prefabricated galvanized steel roof jacks with 16" square flange around pipe. Provide clamp-on storm collar and seal water tight with mastic. Maintain dielectric separation between copper and galvanized materials. For cold process built-up roof, material shall be 4 lb/ft^2 lead instead of galvanized steel. For single-ply roofing, use the roofing manufacturer’s recommended flashing material.

2.2 DUCTWORK MATERIALS:

A. General: All ductwork materials shall have fire and smoke hazard ratings as tested under ASTM E-84 and UL 723 not exceeding a flame spread of 25 and smoke developed of 50. Shall comply with 2019 CMC.

B. Metal Ductwork: Metal ductwork shall be galvanized sheet steel, lock forming quality, ASTM A-653, with gage and construction to match SMACNA Standard for pressure required (26 gage minimum).

1. Grease Bearing Exhaust Ductwork: Exhaust ducts from Type I grease hoods shall be constructed in accordance with Chapter 5 of the California Mechanical Code with 16 gage galvanized steel or 18 gage stainless steel. All joints shall be made with a continuous weld.

C. Duct Sealants: All Joints Exposed to Weather: Sealant shall be water based, Foster 32-19/32-17, Childers CP-146/148, United Duct Sealer WB or G.E. “SilPruf” SCS2000 silicone sealant. Joints Not Exposed to Weather: Fiber reinforced. White in color. Foster 32-17, Childers CP-148, Design Polymerics DP1030, Hardcast Versa-Grip 181, Hardcast CCWI-181.

2.3 AIR TERMINALS AND DUCT FITTINGS:

A. Kitchen Hood:

1. General: Factory fabricated in accordance with CMC Chapter 5 and State codes. Install with bottom of hood 48" above cooking surface and 80” minimum above floor per CBC 11B-307.2. UL labeled. Greenheck.

2. Materials: Unless otherwise noted, all visible elements of the hood shall be constructed of stainless steel, 18 gage, type 304, with a No. 4 polished finish. All seams shall have a liquid tight, continuous weld, ground smooth and polished. Provide factory stainless steel enclosure panels.

3. Filters: Filters shall be fixed baffle type. 20 gage stainless steel construction. Filters shall be furnished with handles. Blank panels shall be installed where required to symmetrically space filters. 20 gage full length stainless steel filter rack with continuous, removable, stainless steel grease trough.

4. Lights: 100 watt, UL listed vapor proof lights. Conduit and conductors shall be pre-wired to a J-box on top of canopy.

2.4 DUCTWORK INSULATION MATERIALS:

A. General: All ductwork insulation materials shall have fire and smoke hazard ratings as tested under ASTM E-84 and UL 723 not exceeding a flame spread of 25 and smoke developed of 50.

B. Fiberglass Blanket: Installed thermal resistance at a mean temperature of 75ºF shall meet or exceed indicated value. 3/4 lb/ft3 or 1 lb/ft3, R-6 where ductwork is within the building thermal insulation envelope. 3/4 lb/ft3 R-8 where ductwork is outside the building thermal insulation envelope and/or above the roof. Faced with glass reinforced foil laminated to Kraft paper. Certainteed, Knauf, Johns-Manville, Owens-Corning.

C. Acoustic Lining: Glass fiber. Installed thermal resistance at a mean temperature of 75ºF shall meet or exceed indicated value. One side coated to prevent fiber erosion up to 6000 ft/min. Average noise reduction coefficient of 0.80. 1.5 lb/ft3 density. 1" thick (R-4.2) where ductwork is within the building thermal insulation envelope. 2" thick (R-8) where ductwork is outside the building thermal insulation envelope and/or above the roof. Certainteed, Knauf, Johns-Manville, Owens-Corning.

D. Bonding Adhesive: Design Polymerics DP2501, Foster 85-60.

E. Fire Resistive Duct Wrap: Nominal 1-1/2” thick, 6 lb/ft3 high-temperature fiber blanket thermal insulation encapsulated in a fiberglass-reinforced aluminized polyester foil. Grease Duct Listing Standards (Double Wrap) ASTM E 2336 / ICC-ES AC101. Ventilation Duct Listing Standard (Single Wrap) – ISO 6944. 3M Fire Barrier Duct Wrap 615+.

2.5 EQUIPMENT:

A. General Requirements:
1. Capacity: Capacities shall be in accordance with schedules shown on drawings. Capacities are to be considered minimum.
2. Dimensions: Equipment must conform to space requirements and limitations as indicated on drawings and as required for operation and maintenance. Where Architectural screening is indicated, equipment shall not extend above or beyond screening. Equipment will not be accepted that does not readily conform to space conditions. Prepare and submit layout drawings for all proposed equipment (different than scheduled units) showing actual job conditions, required clearances for proper operation, maintenance, etc.
3. Ratings:
   a. Gas: Gas burning equipment shall be furnished with 100% safety gas shut-off, intermittent pilot ignition, and be CSA (US) certified, except that boilers shall be CSA (US) certified or UL listed.
   b. Electrical: Electrical equipment shall be in accordance with NEMA Standards and UL or ETL listed where applicable standards have been established.
4. Piping: Each item or assembly of items shall be furnished completely piped for connection to services. Control valves and devices shall be provided.
5. Electrical:
   a. General: Each item or assembly of items shall be furnished completely wired to individual terminal blocks for connection to single branch electrical circuit. All electrical accessories and controls required by equipment shall be furnished. Provide terminal blocks for controls and interlocks not included in equipment package. Manual and magnetic starters shall have ambient compensating running overcurrent protection in all ungrounded conductors. Magnetic starters shall be manual reset, shall have H-O-A

switches and auxiliary contacts. Controllers and other devices shall be in NEMA 1 or 3R enclosures as applicable.

b. Wiring: Conductors, conduit, and wiring shall be in accordance with Electrical Specifications. Individual items within assembly shall be separately protected with dead front, fused disconnect, fuse block, or circuit breaker for each ungrounded conductor, all accessible on operating side of equipment. Switches, contacts and other devices shall be in ungrounded conductors.

c. Motors: Shall be rated, constructed and applied in accordance with NEMA and ANSI Standards without using service factor. Single-phase motor shall be of type to suit application. Three-phase motors shall be open drip proof, NEMA B design on pumps and fans, NEMA C on reciprocating equipment, sealed ball bearing, three-phase induction unless otherwise noted. Design shall limit starting inrush current and running current to values shown on drawings. Motors 1 horsepower and larger shall be the premium efficiency type, tested according to IEEE Standard 112, Method B. Motors exposed to weather shall be TEFC. Motors in a fan air stream shall be TEFC or TEAO. Vertical motors outdoors shall be ODP or TEFC and shall have rain caps.

d. Starters: Motor starters shall be furnished for all equipment except where starter is in a motor control center as designated on the electrical drawings. Deliver starter to Electrical Contractor for installation and wiring.

e. Control Voltage: Equipment connected to greater than 240 volts shall be provided with 120 volt control circuit from integral protected transformer if separate source is not indicated on plans. 240 volt control is acceptable if confined within control panel.

f. Submittals: Included in shop drawings shall be internal wiring diagrams and manufacturer's recommended external wiring.

6. Fan Selection - Static Pressure: Unless otherwise noted, pressure scheduled as external static pressure (ESP) includes all ductwork and accessory losses external to the unit housing. Unless otherwise noted, pressure scheduled as total static pressure includes all ductwork, filter, coil, cabinet, damper and other accessory losses. Unless otherwise noted, pressure scheduled as duct static pressure includes all supply and return ductwork and accessory losses external to the unit housing and plenum (as applicable). The allowance for filter losses is 0.3" WC, unless otherwise noted. Submit itemized static pressure losses for all components.

7. Filters:

a. General: Tested and rated in accordance with ASHRAE Standard 52.2 and Title 24, C.C.R. Furnish and install one complete change of all filters after air balance is completed and prior to acceptance.

b. Filter Media: 2" media. MERV-13. Clean filter resistance 0.41" water at 500 fpm. Throw-away frame. Class 2. Camfil AP-Thirteen..

8. Screens: All duct or louver openings to the outside shall be covered with 1/2", 16-gage, galvanized wire mesh screen.

9. Mixing Dampers: Opposed blade, 16-gage. Six-inch maximum blade width, 48" maximum length. Nylon or oil impregnated bronze bearings. One-half inch diameter pin shaft. 16-gage channel frame. One percent maximum leakage at 4" WC in accordance with AMCA 500 for outside air dampers. Actuating rod out of air stream. Arrow.

10. Sound Ratings: Shall be in accordance with ASHRAE 36 - 72. Sound ratings shall not exceed scheduled values.

11. Drives: Unless noted as direct connected, drives shall be V-belt, rated at 150% of motor horsepower. Multiple drive belts shall be matched set. Drive sheaves shall be dynamically balanced, adjustable, range +/- 10%, selected at mid-range. Adjustable relative movement shall be lockable to shaft. Belts shall be aligned within 1-1/2 degrees at all times. Open drives shall be provided with OSHA approved open mesh belt guards. Belt guards exposed to weather shall be weatherproof enclosure with louvered face for adequate ventilation. Driving motor

shall be mounted on adjustable rails. T.B. Woods, Browning. Submit RPM range of driven machine with drive selection.

B. Packaged DOAS Heat Pump:
1. General: Self-contained unit designed for outdoor installation. Factory assembled and tested. Refer to Paragraph 2.5A for general requirements. Provide all starters and relays required for operation. 24-volt control circuit from integral transformer. Weatherproof cabinet, galvanized steel with enamel finish. Indoor air section fully insulated. Outside air inlet. Drain pan. Multivane centrifugal supply fan. ARI certified. Greenheck RV.
2. Construction: 2-inch double-wall cabinet with R13 injected foam insulation. R13 foam insulation thermally broken. Permatector™ (2,500 hr/salt spray rating under ASTM B117 testing conditions)
3. Plenum Supply Fan: Direct drive plenum fan. Neoprene isolation. Factory provided variable frequency drive.
4. Cooling Section: Packaged direct expansion (PDX) – Optional modulating head pressure control (EC motor on the lead condenser fan or all condenser fan(s)). Compressor shall be Quiet operating hermetic, digital scroll-type.
5. Heating Section: Indirect gas-fired furnace – 5 to 1 turndown furnace - Stainless steel heat exchanger.
6. Filters: Supply filters (pre-coil) - 2-inch MERV 13.
7. Outdoor Air and Recirculated Air Dampers: Low leakage, modulating actuator.
8. Weatherhood: Aluminum mesh filters,wind-driven rain prevention.
9. Control Center: 24 VAC control voltage. Control transformer. Non-fused disconnect switch. UL Listed, Recognized, or Classified electrical components. Factory prewired for single point power connection. Phase and brownout protection (PDX).
10. Optional Accessories:
    - BACNetMSTP
    - Dirty Filter Sensor
    - Roof Curbs
    - Service Lights
    - Service Receptacle
    - Smoke Detectors
    - Ultraviolet Germidical Irradiation (UVGI)

C. Exhaust Fan:
1. General: All exhaust fans shall be tested and rated in accordance with AMCA Standard 210. Fans exposed to weather shall have ventilated weatherproof housing over motor and drive assembly. Refer to Paragraph 2.5A for general requirements. All direct drive fans shall be provided with unit mounted speed controllers. All exhaust fans shall have a disconnect switch. All motors 1 horsepower and larger shall be the premium efficiency type.
2. Kitchen Hood Fan: Spun aluminum, roof mounted, direct driven, upblast centrifugal exhaust ventilator. Fan shall be UL 762 listed. Fan shall be of bolted and welded construction utilizing corrosion resistant fasteners and stainless steel fasteners on cap. Spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure. Aluminum base shall have a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. Windband shall have a rolled bead for added strength. A two piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Unit shall bear an engraved aluminum nameplate. Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. An aerodynamic aluminum inlet cone shall be provided for maximum performance and efficiency. Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure. Exhaust fan

shall have roof curb and hinged base with lock hasp and galvanized aircraft cable supports. Weep hole. Greenheck.

PART 3: - EXECUTION

3.1 PIPING INSTALLATION:

A. General:

1. Piping Layout: Piping shall be concealed in walls, above the ceilings, or below grade unless otherwise noted. Exposed piping shall run parallel to room surfaces; location to be approved by Architect. No structural member shall be weakened by cutting, notching, boring or otherwise, unless specifically allowed by structural drawings and/or specifications. Where such cutting is required, reinforcement shall be provided as specified or detailed. All piping shall be installed in a manner to ensure unrestricted flow, eliminate air pockets, prevent any unusual noise, and permit complete drainage of the system. All piping shall be installed to permit expansion and contraction without strain on piping or equipment. Vertical lines shall be installed to allow for building settlement without damage to piping. Lines shall be adequately braced against vertical and lateral movement. Pipe sizes indicated on the drawings are nominal sizes unless otherwise noted. Pipe sizes shall not decrease in direction of flow, unless otherwise noted.
2. Joints:
   a. Threaded: Pipe shall be cut square, and reamed to full size. Threads shall be in accordance with ANSI B2.1. Joint compound or tape suitable for conveyed fluid shall be applied to male thread only. Joints shall be made with three threads exposed.
   b. Brazed: Filler rod shall be of suitable or the same alloy as pipe. Brazing filler metal shall have a minimum melting point of 1100ºF. Brazing shall be performed by a Certified Welder or Brazer as certified by an organization/institution that uses standards recognized by the American Welding Society (AWS) and meets the requirements of the ASME Boiler and Pressure Vessels Code, Section 9.
   c. Open Ends: Open ends of piping shall be capped during progress of work to preclude foreign matter.
   d. Electrical Equipment: Piping shall not be run over electrical panels, motor control centers or switchboards.
3. Fittings and Valves:
   a. Standard Fittings: All joints and changes in direction shall be made with standard fittings. Close nipples shall not be used.
   b. Reducers: Pipe size reduction shall be made with bell reducer fittings. Bushings shall not be used.
   c. Unions: A union shall be installed on the leaving side of each valve, at all sides of automatic valves, at equipment connections, and elsewhere as necessary for assembly or disassembly of piping.
   d. Valves: All valves shall be full line size. Provide shut-off valve for each building and each equipment connection. Provide shut-off valve at each point of connection to existing piping. At equipment connections, valves shall be full size of upstream piping, except that gas valves within 18" of the point of connection to the equipment may be the same size as the equipment connection.
   e. Valve Accessibility: All valves shall be located so that they are easily accessible. Valves located above ceilings shall be installed within 24" of the ceiling. For situations where this is not practical or where valves are greater than 10' above the floor, chain wheel operators shall be provided. Chain shall extend down to 7' above the floor. All such installations must have prior review by the Engineer.
4. Pipe Support:
   a. General: Hangers shall be placed to support piping without strain on joints or fittings. Maximum spacing between supports shall be as specified

below. Actual spacing requirements will depend on structural system. Side beam clamps shall be provided with retaining straps to secure the clamp to the opposite side of the beam. Vertical piping shall be supported with riser clamp at 20' on center (maximum). Support pipe within 12" of all changes in direction. Support individual pipes with pipe hanger. Copper piping systems which protrude through a surface for connection to a fixture stop or other outlet shall be secured with a drop ell, Nibco 707-3-5, to a Holdrite Model #SB1 bracket; nipple through surface shall be threaded brass.

(1) Pressure Pipe:

Pipe Size (Inches)	Maximum Spacing* Between Supports (ft.)	
	Copper	Sch. 40 steel
1/2	6	6
3/4	6	8
1	6	8
1-1/4	6	10
1-1/2	6	10
2	10	10
2-1/2	10	10
3	10	10
4	10	10

*Based on straight lengths of pipe with couplings only. Provide additional supports for equipment, valves or other fittings. Seismic requirements may reduce maximum spacing.

(2) Gravity Drain Pipe: Piping shall be supported at each length of pipe or fitting, but in no case at greater spacing than indicated above for pressure pipe.

b. Trapeze: Trapeze hangers of construction channel and pipe clamps may be used. Submit design to Engineer for review.

5. Miscellaneous:

a. Escutcheons: Provide chrome plated escutcheons where piping penetrates walls, ceilings, or floors in finished areas.

b. Pipe Sleeves: All piping passing through concrete or concrete block shall be provided with pipe sleeves. Allow 1" (nominal) clearance between sleeve and pipe or pipe insulation.

c. Pipes Passing through Fire Rated Surfaces: Pipes passing through fire rated walls, floors, ceilings, partitions, etc. shall have the annular space surrounding the pipe or pipe insulation sealed with fire rated materials in accordance with the requirements of 2019 CBC Section 714.

B. Drain Piping (Including Condensate): Install with constant pitch to receptacle, 1/4" per foot where possible, otherwise 1/8" per foot minimum. Provide TEE with clean-out plug at all changes of direction. Provide trap at each air handling unit to prevent air leakage. Only equipment mounted on vibration isolators shall be connected with flexible connection. Piping not concealed in wall structure, above ceilings or below floors shall be chrome plated brass, except in equipment rooms, piping shall be galvanized steel. P&T relief and water heater drain piping shall be galvanized steel. Provide secondary drain piping where required.

D. Gas Piping: Installation shall comply with CPC and NFPA 54 (National Fuel Gas Code). Shall be pitched to drain to drip legs at low points where other than dry gas conditions exist. No unions shall be installed except at connections to equipment. Provide shutoff and dirt leg (sediment trap) at each equipment connection. Only equipment mounted on vibration isolators shall be connected with flexible connectors. Under floor piping shall be sleeved and vented.

Odor Fade Warning – The odorant in propane (LP) and natural gas is colorless and the intensity of its odor can fade under some circumstances. Contact the utility company for more information.

3.2 DUCTWORK INSTALLATION:

A. General:
1. Standards: Unless otherwise noted, all ductwork shall be constructed and installed in accordance with current SMACNA Standards. Ductwork shall be built to a pressure classification equal to or greater than the maximum operating pressure at that point in the ductwork. A copy of these standards shall be maintained at the job site at all times. Duct work and accessories shall be installed in a manner to prevent vibration and rattling.
2. Access: Provide duct access doors as required to adjust equipment and dampers. Provide wall or ceiling access panels, or remote actuators as required where equipment and dampers are not otherwise accessible. Ventlok 666 concealed remote actuator with zinc finish on cover.
3. Flanges and Escutcheon: Where ductwork penetrates walls, ceilings, or floors, furnish and install flange or escutcheon of same material as duct.

B. Low Velocity-Low Pressure (up to 2,000 ft/min and up to 2.0 in water):
1. Sheet Metal Ductwork:
a. Ells: Ells with less than standard radius and square ells shall be fitted with turning vanes.
b. Tees: Tees in supply ductwork shall be straight tap-in with extractor or 45 degree take-off as shown on drawings. Grilles or branches in supply ductwork shall be a minimum of 8 duct diameters downstream of tees.
c. Duct Joints and Seams: All joints and seams which are not exposed to weather shall be sealed airtight with duct sealant. All joints and seams exposed to weather shall be sealed air and water tight with silicone sealant. (See Part 2 of this Specification).
d. Dampers: Install volume control damper and damper regulator in all branch ducts.
2. Grease Bearing Exhaust Ductwork: Horizontal portions of the duct shall slope down towards the hood at 1/4" per foot (min.) unless the total horizontal length exceeds 75 feet, then the slope shall be 1" per foot (min.). Provide access panels at changes of direction as required by CMC. Drains shall be provided at low points in horizontal ducts per 2019 CMC 510.1.3. Horizontal ducts shall be provided with access in accordance with 2019 CMC Section 510.3.3.

3.3 AIR TERMINALS AND DUCT FITTINGS INSTALLATION:

A. General: Unless otherwise noted, all air terminals and duct fittings shall be installed in accordance with current SMACNA Standards. Terminals and fittings shall be installed in a manner to prevent vibration and rattling. Metal surfaces exposed to view behind grilles and registers shall be painted flat black.

3.4 DUCTWORK INSULATION INSTALLATION:

A. General: Insulate all sheet metal supply, return and outside air intake ductwork except as noted below. Insulation shall be continuous through walls and floors except at fire dampers.

B. Where Insulation Is Not Required: Do not insulate factory-insulated ducts or casings, acoustic lined ducts, fibrous glass ducts, underground ductwork, supply or return ductwork exposed to view in the space that it serves, or exhaust ductwork.

C. Acoustic Lining: Unless otherwise indicated, all supply and return ductwork in equipment rooms, all ductwork exposed to weather and other ducts as indicated on drawings, shall have acoustic lining. Do not acoustic line outside air intakes. Where acoustic lining is installed, increase each sheet metal dimension to accommodate lining and maintain clear inside duct dimensions shown on drawings. Apply lining with bonding adhesive in

accordance with manufacturer's recommendations and also secure with mechanical fasteners in accordance with SMACNA Standards. Seal exposed edges of lining with bonding adhesive.

D. Fire Resistive Wrapped Ducts: Where indicated on drawings, ductwork shall be covered with fire resistive duct wrap. Install in accordance with it's UL or Omega Point Laboratories Design number (as applicable) and the Manufacturer's Installation Instructions.

3.5 EQUIPMENT INSTALLATION:

A. General: It shall be the responsibility of the equipment installer to ensure that no work done under other specification sections shall in any way block or otherwise hinder the equipment. All equipment shall be securely anchored in place. All equipment shall be installed level.

B. Connections to Equipment: Where size changes are required for connections to equipment, they shall be made immediately adjacent to the equipment and, if possible, inside the equipment cabinet.

3.6 TESTS AND ADJUSTMENTS:

A. General: Unless otherwise directed, tests shall be witnessed by a representative of the Architect. Work to be concealed shall not be enclosed until prescribed tests are made. Should any work be enclosed before such tests, the Contractor shall, at his expense, uncover, test and repair all work to original conditions. Leaks and defects shown by tests shall be repaired and entire work retested.

B. Gravity Systems:
1. Drains (Including Condensate): All ends of the drain system shall be capped and lines filled with water to the top of the highest point, 10' above grade minimum. This test shall be made before any equipment has been connected. Test shall be maintained until all joints have been inspected, but no less than 2 hours.

C. Pressure Systems:
1. General: There shall be no drop in pressure during test except that due to ambient temperature changes. All components of system not rated for test pressure shall be isolated from system before test is made.
2. Gas Piping: Maintain 100 psig air pressure for 4 hours.

3.7 SYSTEM ENERGY BALANCE:

A. Scope: Provide the services of an independent test and balance agency to test, adjust and balance, retest and record performance of the system to obtain design quantities as specified. The agency must prove that they have no affiliation with any equipment manufacturer, design engineer, installing contractor, or any other party which might lead to a conflict of interest, in order to provide an unbiased, third party system balance and report.

B. Qualifications: Prior to commencing work, the agency shall be reviewed by the Engineer and shall be certified by the Associated Air Balance Council, National Environmental Balancing Bureau or Testing, Adjusting and Balancing Bureau. The agency shall provide documentation of having successfully completed at least five projects of similar size and scope.

C. Instruments: All instruments shall be accurately calibrated; calibration histories shall be available for examination. Application of instrumentation shall be in accordance with AABC, NEBB or TABB standards.

D. Submittals: Include in shop drawings copies of forms to be used for testing and balancing showing all data which is to be recorded. Three copies of completed balance report shall be

submitted to and reviewed by the Mechanical Engineer prior to the final mechanical construction review.

E. Procedure - General: Procedure shall be in accordance with Associated Air Balance Council's "National Standards for Field Measurements and Instrumentation - Total System Balance", Volume Two, No. 12173, or equivalent NEBB or TABB standards. System shall be in full, continuous operation during test. Balanced quantities shall be plus 10%, minus 0% of design quantities. All nameplate data, manufacturer, model and serial numbers shall be recorded for each item tested.

F. Extended Warranty: The test and balance agency shall include an extended warranty of 90 days after completion of test and balance work, during which time the Engineer, at his discretion, may request a recheck or resetting of any item or items in test report. The agency shall provide technicians to assist the Engineer in making any tests he may require during this period of time.

G. Air Balance Procedure (For Each Air Handling System):
1. All air filters shall be clean when air balance is performed.
2. Provide a sketch of the equipment showing exactly where all pressure readings were taken.
3. Adjust blower RPM to design requirements.
4. Record motor full load amperes.
5. Make pitot tube traverse of main supply and return ducts and obtain design CFM at fans.
6. Record system static pressures, inlet and discharge.
7. Record filter quantity, size(s) and pressure drop across filter(s) at each filter bank.
8. Adjust system for design CFM recirculated air.
9. Adjust system for design CFM outside air.
10. Record entering air temperatures. (DB heating, DB and WB cooling.)
11. Record leaving air temperatures. (DB heating, DB and WB cooling.)
12. Adjust all main supply and return air ducts to design CFM.
13. Adjust all zones to design CFM, supply and return.
14. Adjust all diffusers, grilles and registers to plus 10%, minus 0% of design requirements.
15. Adjust CFM at all exhaust fans, make-up units, etc. (high and low speed, where applicable). Record applicable data from items 1 through 11 above.
16. Each grille, diffuser and register shall be identified as to location.
17. Verify proper diffusion pattern for all ceiling grilles and that all sidewall grilles are set for 5 degrees upward deflection unless otherwise noted. Make a notation of any that are not set properly.
18. Size, type and manufacturer of diffusers, grilles, registers and all tested items shall be identified and listed. Manufacturer's ratings shall be used to make required calculations on all items.
19. Readings and tests of diffusers, grilles, and registers shall include required FPM velocity and test resultant velocity, required CFM and test resultant CFM after adjustments.
20. In cooperation with the control manufacturer's representative, set adjustments of automatically operated dampers to operate as specified. Testing agency shall check all controls for proper calibrations and list all controls requiring adjustment by control installers.
21. All diffusers, grilles and registers shall be adjusted for required air patterns and to minimize drafts.
22. As a part of the work of this contract, THE AIR CONDITIONING CONTRACTOR shall make any changes in pulleys, belts and dampers or the addition of dampers required for correct balance as recommended by air balance agency, at no additional cost to Owner.
23. Set, test and adjust packaged heating/cooling unit economizer operation in cooperation with controls contractor. Record minimum and maximum outside and exhaust airflows.

3.8 DIRECT DIGITAL CONTROL AND ENERGY MANAGEMENT SYSTEM:

A. Scope: The control system includes control panels, control devices, line and low voltage control and interlock wiring, conduit and related equipment as required for proper operation of all controlled systems. Control and interlock wiring includes wiring to controllers, switches, timers, relays, etc. Power wiring and disconnect switches are included in the Electrical Specifications except that power wiring required for control devices such as thermostats, VAV boxes, valves, etc., is included in the control system.

B. Type of system: The control system shall be pneumatic//electric//direct digital. **Johnson Metasys, without substitution, to match existing.**

C. Contractor Qualifications: All controls shall be furnished and installed by a Contractor who is licensed, certified or contracted by the controls manufacturer for design, installation, start-up and service of their product. The Contractor must have factory supplied training and support. The Contractor must have sufficient personnel to respond to a trouble call at the site within two hours. The Contractor's local manager shall have a minimum of five years' experience in the design, installation, start-up and service of similar systems. The Contractor shall submit a list of at least five projects which are similar in size, scope and contract value to this project. This list shall include the Owner's contact person, phone number and controls contract value.

D. Submittals: Submittals shall include the following:
   1. Contractor qualifications. Manufacturer licenses, contracts or certifications for the installer shall be submitted on manufacturer's letterhead.
   2. Manufacturer's data for all devices.
   3. Manufacturer's data for all software.
   4. Diagrams showing control schematics. Diagrams shall include all sensors, terminal strips, panels and control devices. Locations of all devices shall be indicated.
   5. Sequence of operation.
   6. Site plan showing trench and pullbox locations.

E. System Components:
   1. Wall Switches: Plates for all wall switches and timers shall match those specified in Division 26.
   2. Labels: All labels, signs, etc. shall be engraved, laminated plastic, white on black background, 1/8" high lettering, minimum.
   3. Temperature Sensors:
      a. Sensor Type: All temperature sensors shall be made of a highly stable, precision thermistor material accurate to within +/- 0.36 Degrees F. Identify each temperature sensor with a "Lamicoid" label keyed to the control system as-built drawings.
      b. Room Sensor: Room temperature sensor shall have Executive Decorator housing with programmable visible temperature indication. Housing shall include an occupancy override, temperature setpoint adjustment and a service tool jack.
      c. Vandal Resistant Room Sensor: Where noted, shall be a blank stainless steel wall plate with the sensing element bonded to the back side. The plate back shall be insulated to reduce wall temperature influence.
      d. Duct Sensor: Duct temperature sensor shall be a probe type element with 9 inch insertion length. Element shall be installed where air mixture provides a true temperature indication. Where adequate mixing is not practical, the duct temperature sensor shall have an averaging type thermistor element, installed across the entire cross section of the duct.
      e. Outdoor Air Sensor: Outdoor air temperature sensor shall be a probe type element mounted in a ventilated, treated white PVC sun shield to minimize radiant energy effects. The sensor and sun shield shall be mounted on a weatherproof outlet box for outdoor installation.

f. Low Differential Air Pressure Applications (0" to 5" W.C.): The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points. Non-interactive zero and span adjustments, adjustable from the outside cover. (0.00 - 1.00" to 5.00") W.C. input differential pressure ranges. 4-20 mA output. Maintain accuracy up to 20 to 1 ratio turndown. Reference Accuracy: +0.2% of full span.

4. Temperature Control Panels: Each panel and each control device or readout on the front of the panel shall be identified with a laminated plastic label with 1/4" high engraved lettering, white on black background. Pilot lights shall be the push to test type.
5. Status Sensor: Current sensing status sensor (with sensitivity adjustment for belt loss detection).

F. System Shall Function as Follows:
1. Makeup Air Unit, Kitchen Hood and Exhaust Fans: See Equipment Schedules on Drawings and Detail G/M-4. Unit shall be interlocked with kitchen hood through DDC/EMS.

G. Installation: All electrical work shall be in accordance with the California Electrical Code and the Electrical Specification Sections. All electric/electronic systems shall be hardwired in conduit. Wiring shall be concealed in walls, above the ceilings, or below grade unless otherwise noted. Exposed wiring shall run parallel to room surfaces; location shall be approved by the Architect. No structural member shall be weakened by cutting, notching, boring or otherwise. Provide a 120 volt circuit for each device requiring external power. Dedicated circuits shall be provided where required. Any devices or wiring exposed to the weather shall be protected in weatherproof enclosures such as NEMA 3R and weatherproof conduit. Set, test and adjust the system for proper operation.

H. Programming: The Contractor shall be responsible for programming the system and shall coordinate the scheduling (on/off times) with the Owner.

I. Training: Prior to final acceptance, the Contractor shall provide operational training to the Owner's personnel. The training sessions shall include a complete demonstration of the system. Dates and times of the training sessions shall be coordinated through the Owner not less than one week prior to session. A total of 16 hours of instruction shall be provided - 8 hours initially, and 8 hours to be spread throughout the first year of operation. The Contractor shall maintain a log of training sessions including dates, times and names/titles of those attending. The Contractor shall submit a copy of this log on request.

J. Testing and Acceptance: The Contractor shall furnish a complete and operating system. The Contractor shall also verify, in the presence of the Owner, the system accuracy and proper function of each controlled device and sensor. The following items shall be successfully demonstrated prior to acceptance by the Owner:
1. All system outputs including controllers, relays, and other control devices shall be addressed and start/stop functions demonstrated.
2. All inputs shall be displayed and all event-initiated functions shall be demonstrated.
3. Demonstrate program integrity and power restore sequence during and after a power failure and restoration.
4. Deliver all As-Built drawings, wiring diagrams, equipment specifications, Operation and Maintenance Manuals and other documentation as required to describe the system.
5. Complete operator training in the use, programming, and operation of the system.

L. Operation and Maintenance Manuals: Furnish Operating and Maintenance Manuals for all components. These manuals shall contain full documentation which shall include, without being limited to, the following:
1. General description and specifications.
2. Installation and initial checkout procedures.

3. Principles and theory of operation.
4. Complete trouble-shooting procedures and diagrams.
5. Complete alignment and calibration procedures for all components.
6. Preventative maintenance requirements.
7. Detailed schematics and assembly drawings.
8. Complete recommended spare parts lists including unit prices.

END OF SECTION

SECTION 26 00 00

GENERAL ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.1 SECTION INCLUDES

This section includes general requirements specifically applicable to Divisions 26, 27, & 28; all included 409400, 409500, & 409600 series sections; including requirements form Division 1.

1.2 RELATED SECTIONS

A. All included sections under Division 1
B. All included sections under Division 26
C. All included sections under Division 27
D. All included sections under Division 28
E. All included sections under Division 40
F. Plans
G. Manufacturers' manuals, product bulletins, etc.

1.3 REFERENCE STANDARDS AND CODES

A. Standards
   1. AEIC – Association of Edison Illuminating Companies
   2. ANSI – American National Standards Institute
   3. ASTM – American Society of Testing and Materials
   4. CBM – Certified Ballast Manufacturers Association
   5. EIA – Electronic Industry Association
   6. ICEA – Insulated Cable Engineers Association
   7. IEEE – Institute of Electrical and Electronics Engineers
   8. NEMA – The Association of Electrical and Medical Imaging Equipment Manufacturers
   9. FM - Factory Mutual
   10. UL – Underwriter's Laboratory's, Inc., Standards for Safety
B. Local codes and authorities having jurisdiction
   1. City codes
   2. County codes
   3. Local fire department
C. State codes and authorities having jurisdiction
   1. CBC – California Building Code
   2. CEC – California Electrical Code
   3. State of California Codes
D. National codes and authorities having jurisdiction
   1. NESC – National Electrical Safety Code
   2. OSHA – Occupational Safety and Health Act
E. Utilities
   1. Local cable company
   2. Local electrical company
   3. Local telephone company
F. Code compliance
   1. All work and materials shall comply with the latest rules, codes and regulations, including, but not limited to the following:
      a. Occupational Safety and Health Act Standards (OSHA).
      b. CCR, Title 24, Part 3: California Electrical Code (CEC)
      c. All other applicable Federal, State and Local laws and regulations.

2. Code compliance is mandatory. Nothing in these Drawings and Specifications permits work not conforming to National, State, and Local electrical and building codes. Where work is shown to exceed minimum code requirements, comply with Drawings and Specifications.
3. No work shall be concealed until after inspection and approval by proper authorities. If work is concealed without inspection and approval, the Contractor shall be responsible for opening the concealed areas, making any required corrections and/or modifications to his work, and restoring the area to its previous condition.

1.4 DEFINITIONS (APPLICABLE TO DRAWINGS AND SPECIFICATIONS)

A. Provide: To supply, install, and connect complete and ready for safe and regular operation of work referred to unless specifically otherwise noted
B. Install: To erect, mount and connect complete with related accessories
C. Supply: To purchase, procure, acquire, and deliver complete with related accessories
D. Work: Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation
E. Wiring: Raceway, fittings, wire, boxes, related items, and connection
F. Concealed: Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces or in enclosures.
G. Exposed: Either visible or subject to mechanical or weather damage, indoors or outdoors, including areas such as mechanical and storage rooms; in general, any item that is directly accessible without removing panels, walls, ceiling, or other parts of structure.
H. Indicated, Shown, or Noted: As indicated, shown, or noted on drawings or specifications
I. Above Grade: Not buried in ground or embedded in concrete slab on ground
J. Below Grade: Buried in ground or embedded in concrete slab on ground
K. Underground: Buried in ground, including under building slabs
L. Connect: Complete hookup of item with required services, including conduit, wire, and other accessories
M. Furnish: Supply and deliver complete
N. Similar or Equal: Of base bid manufacturer, equal in materials, weight, size, design, and efficiency of specified product; equivalent to Base Bid Manufacturer's product
O. Reviewed, Satisfactory, Accepted, or Directed: As reviewed, satisfactory, accepted, or directed by or to engineer
P. Contractor: Electrical Sub Contractor unless stated otherwise
Q. Use (verb): Furnish and install as defined above

1.5 LICENSES, FEES AND PERMITS

Pay for all City, County, or State electrical licenses, fees, and permits. Arrange for all required inspections by agencies or authorities having local jurisdiction. The owner shall pay for all inspection fees and permits.

1.6 CONDITIONS AT SITE

A. A visit to the site is required of all bidders prior to submission of bid. All will be held to have familiarized themselves with all discernible conditions and no extra payment will be allowed for work required because of these conditions, whether specifically mentioned or not.
B. Underground or overhead lines or other services that are damaged as a result of this work shall promptly be repaired at no expense to the Owner and to complete satisfaction of the Owner.

1.7 DRAWINGS AND SPECIFICATIONS

A. All Drawings and all Divisions of these Specifications shall be considered as a whole and work of this Division shown anywhere therein shall be furnished under this Division.

B. The Contract Drawings are diagrammatic and indicate the general arrangement of equipment and wiring. Most direct routing of conduit and wiring is not assured. Exact requirements shall be governed by architectural, structural, and mechanical conditions of the job. Consult all other Drawings in preparation of the bid. Extra lengths of wiring or addition of pull or junction boxes, etc., necessitated by such conditions shall be included in the bid. Check all information and report any apparent discrepancies before submitting bid.

C. Right is reserved to make change up to ten (10) feet in location of any outlet, device, or equipment prior to roughing in without increasing contract cost.

D. Equipment and fixtures shall be connected to provide circuit continuity in accordance with applicable codes, whether or not each piece of conductor, conduit, or protective device is shown between items of equipment or fixtures and the point of circuit origin.

1.8 SAFETY AND INDEMNITY

A. Safety: The Contractor shall be solely and completely responsible for conditions of the job site, including safety of all people and property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours.

B. No act, service, drawing review, or construction review by Owner, Architect, Engineers, or their Consultants is intended to include review of the adequacy of the Contractor's safety measures in, on, or near the construction site.

1.9 RECORD DRAWINGS

A. Submit record Drawings under provisions of Section 013000.

B. Submit prior to final acceptance inspection, one complete marked-up set of reproducible engineering design Drawings.

1. Fully illustrate revisions made by crafts in course of work.
2. Include field changes, adjustments, variances, substitutions, and deletions, including Change Orders.
3. Indicate exact location of raceways, equipment, and devices.
4. Indicate exact size and location of underground and under floor raceways, grounding conductors, and duct banks.
5. The record Drawings shall show all the work actually constructed and originally shown on the Drawing based upon the field construction by the Contractor.

C. These Drawings shall be for record purposes for Owner's use and are not considered Shop Drawings.

1.10 MANUFACTURER'S INSTRUCTIONS

A. Where the Specifications call for an installation to be made in accordance with manufacturer's recommendations, a copy of such recommendations shall continuously be kept in the job superintendent's office and shall be available to the Owner's representative.

B. Follow manufacturer's instructions where they cover points not specifically indicated on Drawings and Specifications. If they are in conflict with the Drawings and Specifications, obtain clarification from the Architect or Engineer before starting work.
C. One (1) set of equipment manufacturer's Drawings shall be submitted to the Engineer for their record.

1.11 OPERATING AND MAINTENANCE MANUALS

A. Operating and maintenance manuals and close-out documents are used interchangeably
B. Submit operating and maintenance manuals of equipment in the following format. Owner shall decide which format they prefer.
   1. Three (3) hardcopy sets
   2. PDF format
C. For specific requirements, see the sections in which the equipment is specified.

1.12 QUALITY ASSURANCE

A. Provide a meaningful quality assurance program. To assist the Contractor in this program, the Specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other quality assurance measures to obtain a complete operating facility within the scope of this project.
B. The Contractor shall ensure that workmanship, materials employed, required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.

1.13 GUARANTEE

Guarantee the installation free from defects of workmanship and materials for a period of one (1) year after Date of Certificate of final payment and promptly remedy any defects developing during this period, without charge.

1.14 BIDDING

A. The contractor shall bid on the plans, specifications, etc. that constitute the contract documents.
B. The contractor shall not attempt to modify the contract documents without the approval of the electrical engineer.
C. All “value engineering” proposals shall be submitted to the electrical engineer in writing.
D. If the contractor makes changes to the contract documents not approved by the electrical engineer, the contractor will still be responsible for installing all devices, conductors, conduits, etc. the contract documents call for.

1.15 ABBREVIATIONS

AES	Advanced Encryption Standard
AIC	Amps interrupting capability
ALS	Assistive listening system
ANSI	American National Standards Institute
ASTM	ASTM International, formerly American Society for Testing and Materials
ATC	Astronomical time clock

ATS	Automatic transfer switch
CAD	Computer aided design
CATV	Cable television
CBC	California Building Code
CCTV	Closed circuit television
CEC	California Electrical Code
CFC	California Fire Code
CFL	Compact fluorescent lamp
CFR	Code of Federal Regulations
CMC	California Mechanical Code
CPC	California Plumbing Code
CSFM	California State Fire Marshal
DCS	Distributed control system
DPDT	Double pole, double throw
DPST	Double pole, single throw
DSA	Digital signature algorithm
DSA	Division of the State Architect
DVR	Digital video recorder
EIA	Electronic Industries Association
EMT	Electrometallic conduit
EOR	Engineer of record
EPA	Effective projected area
FACP	Fire alarm control panel
FIPS	Federal Information Processing Standards
FMC	Flexible metallic conduit
GRS	Galvanized, rigid steel conduit
HC	Horizontal cross connect
HCAI	Department of Health Care Access and Information
HID	High intensity discharge
HMI	Human machine interface
HPS	High pressure sodium
HVR	Hybrid video recorder
ICC-ES	International Code Council Evaluation Service
ICS	Industrial control system
ICS-CERT	Industrial Control Systems Cyber Emergency Response Team
IDF	Intermediate data frame
IEC	International Electrotechnical Commission
IED	Intelligent electronic device
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society of North America
IGBT	Insulated Gate Bipolar Transistor
IMC	Intermediate metallic conduit
I/O	Input/output
IOR	Inspector of record
IP	Internet protocol
ISA	International Society of Automation
ISO	International Organization for Standardization
LAN	Local area network
LCD	Liquid crystal display
LCP	Lighting control panel/lighting relay panel
LED	Light emitting diodes
LPI	Lightning Protection Institute
LPS	Low pressure sodium
LRP	Lighting control panel/lighting relay panel

MC	Main cross connect
MDF	Main data frame
MH	Metal halide
MMI	Man machine interface
MTS	Manual transfer switch
NEC	National Electrical Code
NEMA	Association of Electrical Equipment and Medical Imaging Manufacturers
NERC	North American Electric Reliability Corporation
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
NICET	National Institute for Certification in Engineering Technologies
NIST	National Institute of Standards and Technology
OCPD	Overcurrent protection device
OSHPD	Office of Statewide Health Planning and Development
P&ID	Process and instrumentation diagram
PCS	Process control system
PDF	Portable document format
PFD	Process flow diagram
PG&E	Pacific Gas and Electric
PID	Proportional, integral, derivative control
PLC	Programmable logic controller
PQM	Power quality monitor
PTZ	Pan, tilt, zoom
PVC	Polyvinyl chloride
SAN	Server area network
SCADA	Supervisory control and data acquisition
SCCR	Short circuit current rating
SCE	Signal current expander
SCE	Southern California Edison
SHA	Secure Hash Algorithm
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SPD	Surge protective device
SPDT	Single pole, double throw
SPST	Single pole, single throw
SSCP	Secure SCADA Communications Protocol
TFT	Thin film transistor
THD	Total harmonic distortion
TIA	Telecommunications Industries Association
TVSS	Transient voltage surge suppression/suppressor
UL	Underwriters' Laboratories
US-CERT	United States Computer Emergency Readiness Team
USB	Universal series bus
UPS	Uninterruptable power supply
VFD	Variable frequency drive
VFD	Vacuum fluorescent display
VOIP	Voice over Internet protocol
VPN	Virtual private network
WAN	Wide area network

PART 2 – PRODUCTS

2.1 MATERIAL APPROVAL

A. All materials must be new and bear Underwriters' Laboratories label. Materials that are not covered by UL testing standards shall be tested and approved by an independent testing laboratory or a governmental agency.
B. Material not in accordance with these Specifications may be rejected either before or after installation.
C. Materials or equipment specified by:
    1. Name of manufacturer.
    2. Brand or trade name.
    3. Catalog reference.

2.2 SUBSTITUTIONS

A. Base the bid on use of materials specified.
B. Equipment other than specified will be considered for approval provided it meets previous items A through C and the following is submitted in writing by the Contractor to the Engineer to allow approval at least 14 days before the bid date:
    1. The request for permission to substitute shall be accompanied with a statement of the amount of money to be returned to the contract if the substitution is permitted.
    2. Return a completed request for substitution form.
C. The engineer is the sole judge of acceptability of preferred substitutions.
D. If a substitute is permitted, and any re design effort is thereby necessitated, the required re design shall be at the Contractor's expense.

2.3 SUBMITTALS

Submit to architect, or engineer if no architect is involved, seven (7) copies of complete Shop Drawings and materials lists, as noted below, for review within thirty (35) days after award of contract. All proposed deviations from Specifications must be clearly listed and submitted separately under a prominent heading entitled "Substitutions."

A. Fire Alarm Systems
B. Communication Systems
C. Pull Boxes and Cabinets
D. Conduit and Wire
E. Service and distribution
F. Transformers

2.4 OPERATING AND MAINTENANCE MANUALS

Submit Operating and Maintenance Manuals of equipment as specified under Division 1. Verify exact quantity with architect, or engineer if no architect is involved.

2.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Equipment shall be shipped in its original packages, to prevent damaging or entrance of foreign matter. Handling and shipping shall be performed in accordance with manufacturer's recommendations. Provide protective covering during construction.
B. Replace at no expense to Owner, equipment or material damaged during the storage or handling, as directed by the engineer.
C. Equipment shall be tagged with a weatherproof tag identifying equipment by name and purchase order number. Packing and shipping lists shall be included.

PART 3 – EXECUTION

3.1 CLEARANCE

Minimum code required clearances for electrical equipment shall not be violated.

3.2 WORKMANSHIP AND CONTRACTOR'S QUALIFICATIONS

A. Only quality workmanship will be accepted. Haphazard or poor installation practice will be cause for rejection of work.
B. The Electrical Contractor shall provide a Superintendent in charge of this work at all times to direct the quality of the installation.

3.3 COORDINATION

A. Coordinate work with other trades to avoid conflict and to provide correct rough in and connection for equipment furnished under other trades and requiring electrical connections. Inform Contractors of other trades of the required access to and clearances around electrical equipment to maintain serviceability and code compliance.
B. Verify equipment dimensions and requirements with provisions specified under this Section. Check actual job conditions before fabricating work. Report necessary changes in time to prevent needless work. Changes or additions subject to additional compensation and agreed price shall be at Contractor's risk and expense.
C. Provide temporary feeds and connections to areas and equipment as required to allow phased construction and operation.

3.4 CUTTING AND PATCHING

All cutting and patching required for work of this Division is included herein. Coordination with General Contractor and other trades is imperative. Contractor shall bear the responsibility for and bear the added expense of adjusting for improper holes, supports, etc.

END OF SECTION

REQUEST FOR SUBSTITUTION

To: _____

A. _____ submits for your consideration the following product instead of the specified item:

1. Project: _____
2. Section or Sheet: _____, Article or Paragraph: _____
3. Specified Item: _____
4. Proposed Substitution (Mfg., Type, Model, etc.): _____
   _____

B. Complete all of the following:

1. Does this substitution off the Owner a cost credit (including costs for changes by other trades)? _____ How much? _____
2. Does this substitution offer earlier delivery or less construction time? _____
   How much? _____ How so? _____
3. How does the substitution affect any dimensions, layout, or details of other trades as shown on the Drawings? _____
   _____
   _____
4. What are the specific differences between this substitution and the specified item?
   _____
   _____
   _____

C. Attach the following items.

1. Manufacturer's technical data _____
2. Laboratory test or performance results _____
3. Drawings and wiring diagrams of the proposed product _____
4. Drawings and description of changes required by other trades _____
5. Manufacturer's guarantee and maintenance instructions _____

D. The undersigned agrees to pay for all additional review, design, testing, changes in contract documents, and construction as a result of the acceptance of this substitution, at no cost to the Owner.

E. Submitted by (Firm) _____

Print name _____

Signature_____ Date _____

Accepted ☐ Rejected ☐ Revise and Resubmit ☐ See Attached ☐

END OF REQUEST FOR SUBSTITUTION

SECTION 26 05 00

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 – GENERAL

1.1 SECTION INCLUDES

Materials, equipment fabrication, installation, and tests in conformity with applicable codes and authorities having jurisdiction, for the following:

A. Conduit and raceways
B. Wire and cables
C. Outlet boxes
D. Junction boxes
E. Pull boxes
F. Grounding

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Division 1
   1. Section 013000: Administrative Requirements
   2. Section 013300: Submittal Procedures
   3. Section 014000: Quality Requirements
   4. Section 016000: Product Requirements
   5. Section 017000: Execution and Closeout Requirements
   6. All other included sections under Division 1
B. All included sections under Division 26
C. All included sections under Division 27
D. All included sections under Division 28
E. All included sections under Division 40
F. Plans
G. Manufacturers' manuals, product bulletins, etc.

1.3 REFERENCE STANDARDS AND CODES

Published specification standards, tests or recommended methods of trade, industry or government organizations apply to work in this section as cited in Section 260000.

A American Society for Testing and Materials
   1. ASTM B3: Standard Specification for Soft or Annealed Copper Wire
   2. ASTM B33: Standard Specification for Tin-Coated or Annealed Copper Wire for Electrical Purposes
   3. ASTM B738: Standard Specification for Fine-Wire Bunch-Stranded and Rope-Lay Bunch-Stranded Copper Conductors for Use as Electrical Conductors
   4. ASTM B355: Standard Specification for Nickel-Coated, Soft or Annealed Copper Wire
   5. ASTM D412: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
B. California Electrical Code (CEC)
C. Institute of Electrical and Electronic Engineers (IEEE)
   1. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
   2. IEEE 82: Standard Test Procedure for Impulse Voltage Tests on Insulated Conductors
   3. IEEE 95: Standard Test Procedure for Impulse Voltage Tests on Insulated Conductors
   4. IEEE 141: Recommended Practice for Electric Power Distribution for Industrial Plants

5. IEEE 142: IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
6. IEEE 241: Recommended Practice for Electric Power Systems in Commercial Buildings
7. IEEE 242: Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book)
8. IEEE 399: Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book)
9. IEEE 442: Guide for Soil Thermal Resistivity Measurements
10. IEEE 576: Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications
11. IEEE 1185: Recommended Practice for Cable Installation in Generating Stations and Industrial Facilities
12. IEEE 1584: Guide for Performing Arc Flash Hazard Calculations
13. IEEE 1584a: Guide for Performing Arc-Flash Hazard Calculations--Amendment 1
14. IEEE 1584b: Guide for Performing Arc-Flash Hazard Calculations--Amendment 2: Changes to Clause 4

D. Underwriters' Laboratories
1. UL 1: Flexible Metal Conduits
2. UL 4: Armored Cable
3. UL 5: Surface Metal Raceways and Fittings
4. UL 5A: Nonmetallic Surface Raceways and Fittings
5. UL 5B: Standard for Strut-Type Channel Raceways and Fittings
6. UL 5C: Standard for Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits
7. UL 6: Electrical Rigid Metal Conduit – Steel
8. UL 6A: Electrical Rigid Metal Conduit – Aluminum, Red Brass, and Stainless Steel
9. UL 13: Power Limited Circuit Cables
10. UL 44: Thermoset-Insulated Wires and Cables
11. UL 83: Thermoplastic Insulated Wires and Cables
12. UL 310: Electrical Quick-connect Terminals
13. UL 360: Liquid Tight Flexible Steel Conduit
14. UL 444: Communications Cables
15. UL 467: Grounding and Bonding Equipment
16. UL 486A: Wire Connectors
17. UL 486B: Wire Connectors
18. UL 486C: Splicing Wire Connectors
19. UL 486D: Sealed Wire Connector Systems
20. UL 486E: Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
21. UL 493: Thermoplastic Insulated Underground Feeder and Branch Circuit Cables
22. UL 510: Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
23. UL 514A: Metallic Outlet Boxes
24. UL 514B: Conduit, Tubing, and Cable Fittings
25. UL 514C: Nonmetallic Outlet Boxes, Flush-device Boxes, and Covers
26. UL 514D: Cover Plates for Flush-mounted Wiring Devices
27. UL 568: Nonmetallic Cable Tray System
28. UL 635: Insulating Bushings
29. UL 651: Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
30. UL 797: Electrical Metallic Tubing – Steel
31. UL 854: Service Entrance Cables
32. UL 870: Wireways, Auxiliary Gutters, and Associated Fittings
33. UL 969: Marking and Labeling Systems

34. UL 1063: Machine Tool Wires and Cables
35. UL 1242: Standard for Electrical Intermediate Metal Conduit - Steel
36. UL 1277: Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
37. UL 1332: Organic Coatings for Steel Enclosures for Outdoor Use Electrical Equipment
38. UL 1446: Systems of Insulating Materials – General
39. UL 1479: Fire Tests of Through Penetration Firestops
40. UL 1565: Position Devices (includes cable ties and clamps)
41. UL 1581: Reference Standard for Electrical Wires, Cables, and Flexible Cords
42. UL 1652: Flexible Metallic Tubing
43. UL 1685: Vertical-tray Fire Propagation and Smoke Release Test for Electrical and Optical Fiber Cables
44. UL 1773: Standard for Termination Boxes
45. UL 1977: Component Connectors for Use in Data, Signal, Control, and Power Applications
46. UL 2024: Standard for Signaling, Optical Fiber and Communications Raceways and Cable Routing Assemblies
47. UL 2029: Gas/Vapor Blocked Cable Classified for Use in Class 1 Hazardous (Classified) Locations
48. UL 2062: Enclosures for Use in Hazardous (Classified) Locations
49. UL 2196: Test for Fire Resistive Cables
50. UL 2225: Cables and Cable Fittings for Use in Hazardous (Classified) Locations
51. UL 2237: Multi-point Interconnection Power Cable Assemblies for Industrial Machinery
52. UL 2238: Standard for Cable Assemblies and Fittings for Industrial Control and Signal Distribution
53. UL 2239: Hardware for the Support of Conduit, Tubing, and Cable
54. UL 2250: Standard for Instrumentation Tray Cable
55. UL 2256: Nonmetallic Sheathed Cable Interconnects
56. UL 2257: Identification Tests for Jacket and Insulation Materials Used in Plenum Cables
57. UL 2273: Festoon Cable
58. UL 2277: Flexible Motor Supply Cable and Wind Turbine Tray Cable
59. UL 2459: Insulated Multi-pole Splicing Wire Connectors
60. UL 2556: Wire and Cable Test Methods

1.4 QUALITY ASSURANCE

A. Equipment and accessories shall be the product of a manufacturer regularly engaged in its manufacture.
B. Supply equipment and accessories new, free from defects.
C. Equipment and accessories in compliance with the applicable standards listed in Article 1.3 of this section and with applicable national, state, and local codes.
D. Items of a given type shall be the products of the same manufacturer.
E. Deliver, store, and protect products under provisions of Section 016000.
F. Ship equipment in its original packages, to prevent damaging or entrance of foreign matter. Perform handling and shipping in accordance with manufacturer's recommendations. Provide protective covering during construction.
G. Replace at no expense to Owner, equipment or material damaged during storage or handling, as directed by the engineer.
H. Tag items with a weatherproof tag identifying equipment by name and purchase order number. Include packing and shipping lists.

1.5 SUBMITTALS

A. Submit under provisions of Section 013000 or 013300.
B. Submittals shall include the following:
    1. Table of contents
    2. A complete set of detailed manufacturer's specifications describing and illustrating all standard and special components and materials
    3. Part numbers
    4. Evidence of compliance with the applicable standards listed under Article 1.3 of this section
    5. Maintenance instructions and intervals
    6. Calibration procedures and intervals
    7. A complete set of drawings for any special items
    8. Wiring diagrams
C. Electronic submittals shall be searchable.
D. Seismic Restraint and Anchorage: Provide complete seismic anchorage and bracing for the lateral and vertical support of conduit and electrical equipment in accordance with CBC, Title 24, Part 2, Section 1616A.1 and ASCE 7-10 Section 13.6, and all provisions of this Section.
    1. Submit calculations prepared and signed by a Structural Engineer licensed in the State of California, showing compliance with the above for all electrical equipment weighing more than 50 pounds, excepting items corresponding exactly in configuration and weight to those specified and detailed. Where anchorage details are not shown on drawings, the field installation shall be subject to the approval of the Electrical Engineer.
    2. All equipment mounted on concrete shall be secured with post-installed concrete requiring a drilled hole. Power driven anchors are not acceptable. Minimum spacing shall be 10 times the diameter center to center and 5 diameters center to edge of concrete. Maximum allowable loads for tension and shear shall be as determined in compliance with ACI 318-14 Chapter 17 and the anchor's ICC or IAPMO evaluation report. Acceptable manufacturers are Hilti, Red Head, and Simpson Strong Tie.
    3. Conduit and suspended equipment shall be provided with supports and seismic restraints in accordance with Unistrut, Inc. Seismic Bracing Guide, or Super Strut Inc., Seismic Restraint System guide. Support requirements shall e based upon similar equipment, i.e., water piping as equivalent to conduit with wire fill. A copy of the guide shall be on the job site during construction.
E. The submittal shall be substantially complete for all items and equipment furnished under this section.
F. Individual drawings and data sheets submitted at random intervals will not be accepted for review.
G. Substitutions: Items of same function and performance shall be submitted in conformance with Division 1.

1.6 OPERATION AND MAINTENANCE MANUALS

A. Submit operation and maintenance manuals in accordance with Section 260000.
B. The manuals shall, at minimum, include the following:
    1. Table of contents
    2. Manufacturer (including contact information)
    3. Model number
    4. Voltage ratings
    5. Current ratings
    6. List of capabilities

7. Environmental ratings
8. NEMA enclosure type
9. Maintenance instructions and intervals
10. Calibration procedures and intervals
11. Installation instructions
12. Repair instructions (where applicable)
13. As-built drawings

C. Provide manuals in one of the following formats.
1. Three hardcopies
2. PDF

PART 2 – PRODUCTS

2.1 CONDUIT AND OTHER RACEWAYS

A. Rigid Conduit, also referred to as Galvanized Rigid Steel Conduit (GRS)
1. Material: High strength steel
2. Coating
a. All uses: hot-dipped galvanized
b. Underground or corrosive areas
1. 40-mil, UV stabilized PVC coated
2. Coating shall conform to NEMA RN-1
3. Fittings shall be threaded.
4. Conduit shall be UL-6 listed.

B. Intermediate Metal Conduit (IMC)
1. Material: Steel
2. Coating
a. All uses: hot-dipped galvanized
b. Underground or corrosive areas
1. 40-mil, UV stabilized PVC coated
2. Coating shall conform to NEMA RN-1
3. Conduit shall be UL-1242 listed.

C. Electrical Metallic Tubing (EMT)
1. Material: Steel
2. Coating
a. All uses: hot-dipped galvanized
b. Underground or corrosive areas
1. 40-mil, UV stabilized PVC coated
2. Coating shall conform to NEMA RN-1
3. Fittings shall be threaded.
4. Connectors and couplings
a. Watertight, steel compression type exterior and in wet locations. Use ETP Fittings InspectoRidge or approved equal when possible.
b. Steel set screw type in interior, dry locations.

D. Non-metallic conduit
1. Conduit shall be schedule 40 PVC (minimum)
2. Approved for use as non-metallic raceway with 90°C conductors
3. Comply with NEMA TC-2 and NEMA TC-3

E. Flexible Metallic Conduit
1. Material: High strength, hot-dipped galvanized steel
2. Construction: Interlocked
3. Conduits in damp, wet, or corrosive areas shall be liquid tight type with PVC jacket extruded over the steel conduit.

F. Fittings and accessories
   1. Fittings and accessories for all conduit types shall be approved for the purpose and equal in all respects to the conduit or raceway.
   2. Fittings and accessories for metallic conduits shall be made of ferrous metal and galvanized after fabrication.

G. Pull lines
   1. Pull line shall be 1/8” diameter, yellow color.
   2. Pull lines shall be Tubbs Cordage "Polyline" or approved equal.

H. Wireways
   1. NEMA type
      a. NEMA-1 for dry locations
      b. NEMA-3R or NEMA-4 for damp and wet locations
      c. NEMA-4X for corrosive locations
   2. Metal type
      a. Non-corrosive locations: mild steel
      b. Corrosive locations: stainless steel
   3. Thicknesses
      a. 6”x6” cross-section and smaller: 16 gauge
      b. 8”x8” cross-section and larger: 14 gauge
   4. Finish: The entire enclosure shall be finished as follows:
      a. Degreasing
      b. Cleaning
      c. Phosphatizing
      d. Electrostatic deposition of polymer polyester powder coating followed by baking to produce a hard, durable finish.
         1. The average thickness of the paint film shall be 2.0 mils.
         2. Paint film shall be uniform in color and free from blisters, sags, flaking and peeling.
      e. Finish shall conform to UL 50 and UL 50E.
      f. Color shall match surrounding area.
   5. Covers
      a. Wireways shall have hinged covers.
      b. NEMA 3R, 4 and 4X wireways shall be a gasket on the inside of the cover to seal the wireway when cover is closed.
      c. Covers shall have latches to secure the cover in the closed position.
   6. Wireways shall be UL listed.

I. Cable Trays
   1. Material: High strength steel
   2. Coating
      a. All uses: hot-dipped galvanized
      b. Underground or corrosive areas: 40-mil, UV stabilized PVC coated, coating shall conform to NEMA RN-1
   3. Construction
      a. Trays shall be ladder type unless otherwise noted.
      b. Maximum distance between cross-members shall be 12 inches.
   4. Trays shall meet NEMA VE-1 standards.

J. Raceways shall be UL listed.

2.2 WIRE AND CABLE

A. Conductors for power and lighting systems 600V or less:
   1. Conductors shall be 90°C rated.
   2. Conductors size #12 AWG and larger shall be stranded copper.
   3. Type:

a. THWN for wet or underground locations
b. THHN for dry locations.
c. 90°C rated

4. Minimum conductor size for voltage drop:
   a. Minimum size shall be per CEC Tables 310.15(B)(16), 310.15(B)(2)(a), and 310.15(B)(2)(b) for runs 50 feet or less for 208/120V systems or 100 feet or less for 480/277V systems
   b. Increase conductor size by one method below:
      1. One size for each additional 50 feet for 208/120V systems or 100 feet for 480/277V systems.
      2. Calculate voltage drop and size as directed by CEC Voltage Drop Restrictions.
   c. Underground circuits shall be #8 AWG minimum wire, unless otherwise noted.
   d. Once the contractor has determined conductors' route, calculate the minimum size to meet maximum voltage drop allowed per CEC using $D_{min}=C*P*L*I/(V_D*N)$.
      1. D_{min} is the minimum diameter (circular mills)
      2. C=12 for copper, C=19.5 for aluminum
      3. P=2 for single phase, P=$\sqrt{3}$ for three-phase
      4. L is conductor length (feet)
      5. I is the current (amps)
      6. V_D is the maximum allowable voltage drop (volts)
      7. N is the quantity of parallel conductors per phase
5. Minimum size conductors for OCPD shall be determined from CEC Table 310.16 with ampacity corrected for 115°F. Derate ampacity for more than three current carrying conductors per the CEC.
6. Conductor size shall be the largest size to meet maximum voltage drop (2.2 A 4) and to meet CEC ampacity requirements (2.2 A 5).

B. For Signal and Communication Circuits:
1. Special Cables: As specified on Drawings.
2. Conductors for general communications use: Stranded copper conductor, #16 AWG minimum, with THWN insulation for underground or wet locations and THHN insulation for dry locations.
3. Ends of stranded conductors shall be tinned.

2.3 OUTLET BOXES, JUNCTION BOXES, AND PULL BOXES

A. Above ground locations
1. Outlet Boxes
   a. Hot-dipped galvanized after fabrication
   b. Of required size, minimum 4 inches square, for flush mounted devices and lighting fixtures
   c. Cast type with gasketed covers for outdoor or wet locations.
   d. Device and fixture back boxes shall be 2-1/4" deep, minimum.
2. Junction and Pull Boxes
   a. Use outlet boxes with appropriate covers as junction boxes wherever possible.
   b. Larger junction and pull boxes
      1. Sheet steel, hot dipped galvanized after fabrication, finished gray baked enamel
      2. Sized according to code
      3. Screw-on covers.

B. In-ground pull boxes, handholes, and manholes

1. Precast concrete type with required extension collars.
2. Covers
    a. Lids shall be steel or reinforced concrete, as shown on plans. Pull box lids in traffic areas or large grassy areas subject to mowing by riding mowers shall traffic rated.
    b. Covers shall include hold down bolts.
    c. Top of cover shall be flush with top of box.
    d. Covers shall be identified as ELECTRICAL, SIGNAL, or COMMUNICATIONS unless otherwise specified.
3. Size boxes as indicated on Drawings. If size is not indicated on Drawings, use CEC as a minimum requirement.
4. Boxes shall have 2” thick (minimum), reinforced concrete bottoms with 1” diameter drain hole over 12” of crushed rock.
5. Boxes shall have approved cable supports.
6. Concrete encased stubs for handholes extending five (5) feet beyond handhole.
7. All pull boxes shall be no smaller than a Christy N-9.
8. All pull boxes shall be set flush to finished grade and shall have an 8” wide by 3” thick concrete mow strip poured around it.
9. Manufacturer shall be Brooks Products, Oldcastle Enclosure Solutions (Christy), Jensen Precast, or approved equal.
10. All sections between box, extension rings, etc. and penetrations shall be sealed with mortar.

C. Floor Boxes
1. Provide Walker or equal Modulink non-metallic floor box for concrete areas.
2. Provide quantity of boxes required to accommodate each device.
3. Provide Walker Wood Floor Boxes at wood floors provide quantity required to accommodate each device.
4. Provide brass flip cover lids.

D. Outlet boxes, junction boxes, pull boxes, etc. recessed in a concrete wall shall be deep masonry boxes.

2.4 CONDUIT AND EQUIPMENT SUPPORTS

A. Conduit supports
1. For Individual conduit runs not directly fastened to the structure: Rod hangers
2. For multiple conduit runs: Trapeze type conduit support designed for maximum loading deflection not exceeding manufacturer's recommendations.

B. Materials
1. All materials not otherwise noted:
    a. Steel with the finished part hot dipped galvanized
    b. Stainless steel for corrosive or damp environments
2. All bolts and nuts shall be stainless steel.

C. Supports anchored to earth shall be anchored in a concrete base per details.

D. Manufacturers shall be Caddy, Unistrut, Powerstrut, or approved equal.

E. All exposed channels shall have end caps made by the channel manufacturer and designed for use with the channel.

2.5 WIRE CONNECTORS

A. For wire size #8 AWG and smaller: Insulated, screw type, rated 105°C, 600V for building wiring and 1000V for fixtures; Scotchlok, Ideal, or approved equal.

B. For wire size #6 AWG and larger: T&B or approved equal screw type with 3M "#33+" or Plymouth "Slipknot Gray" tape insulation.

C. Underground wire splices

1. Connect ends of conductors with copper compression connectors, 3M Scotchlok or approved equal.
2. Seal splice with inline resin splice kit approved for weather exposure, direct burial, and wet locations, 3M Scotchcast or approved equal.

D. Only set screw, compression type connectors may be used for MC cables. Fishhook/open tang connectors are prohibited.

2.6 GROUNDING

A. Ground Rods
1. 3/4" diameter
2. Copper weld type
3. 10’-0” in length

B. Ground Wire: Conductors shall be medium-hard drawn, copper, and stranded, with sizes as shown on drawings.

C. Utilize CADWELD Multi-System Exothermic Welding for below grade ground connections.

D. Bolts, nuts, and washers shall be bronze, cadmium plated steel, or other corrosion resistant material approved for the purpose.

2.7 MISCELLANEOUS MATERIALS

All screws, bolts, nuts, and washers on equipment outdoors or in wet or corrosive environments shall be stainless steel.

2.8 SEALANTS

A. General purpose sealant: One part polysulfide or polyurethane, Federal Standard TT-S-00230c or two-part polyurethane, Federal Standard TT-SS-227E of Mameco Vulkem 116 or 227 or approved equal product manufactured by Products Research and Chemical Corporation. Pecora, Sika, Sonneborn, or Tremco may be substituted under provisions of Section 016000.

B. Conduit sealant
1. Two part, self curing urethane
2. Non-sagging
3. Liquid and gas tight
4. Chemically stable once cured
5. Compatible with conduit and conductor materials
6. Designed for use as conduit seal

C. Fire retardant sealant: Dow Corning Company, Type 3-6548 silicone RTV foam sealant, closed cell, 18 lb. density, 2-part system with UL certification. Type 96-081 one-part sealant shall be used for small spaces and cracks. 3M Fire Barrier Caulk CP25 is also acceptable.

2.9 IDENTIFICATION

A. Nameplates:
1. White, acrylic plastic suitable for indoor or outdoor use
2. Face colored as below with engraved, white, 3/16” minimum, Arial or similar font characters
   a. Equipment on normal systems: Black face
   b. Equipment on emergency systems: Red face
3. Clear plastic overlay suitable for indoor or outdoor use that can be replaced if vandalized.

4. Sign shall include device name, voltage, and size.
5. Outdoor nameplates shall be UV stable and fade resistant.

B. Pull line identification tags:
1. Aluminum plate
2. 1/8” tall (minimum), Arial (or similar) font, identifying text stamped on plate
3. Tags shall describe conduit’s length, source, and destination.

PART 3 – EXECUTION

3.1 GENERAL

A. Electric system layouts indicated on the Drawings are generally diagrammatic but shall be followed as closely as actual construction and work of other trades will permit. Govern exact routing of cable and wiring and the locations of outlets by the structure and equipment served. Dimensions shall be taken from Architectural Drawings.

B. Consult all other Drawings. Verify scales and report any dimensional discrepancies or other conflicts to architect, or engineer if no architect is involved, before submitting bid.

C. Home runs to panelboards are indicated as starting from the outlet nearest the panel and continuing in the general direction of that panel. Continue such circuits to the panel as though the routes were completely indicated. Terminate homeruns of signal, alarm, and communications system in a similar manner.

D. Avoid cutting and boring holes through structure or structural members wherever possible. Obtain prior approval of Architect and conform to structural requirements when cutting or boring the structure is necessary or permitted.

E. Furnish and install necessary hardware, hangers, blocking, brackets, bracing, runners, required for equipment specified under this section.

F. Provide necessary backing required to insure rigid mounting of outlet boxes.

G. Install pull line in all conduits to remain that will have their conductors removed.

3.2 INSTALLATION OF CONDUIT

A. Run conduit concealed unless otherwise noted or shown on Drawings.

B. Run exposed conduit parallel to or at right angles to center lines of columns and beams.

C. Run no conduit in concrete slabs or floors except at point of penetration. Penetrations shall be at right angles to slab surfaces.

D. Install conduit above ceilings to avoid obstructing removal of ceiling tiles, lighting fixtures, air diffusers, etc.

E. Conduit shall not cross any duct shaft or area designated as future duct shaft. Coordinated with mechanical work to avoid any conflict.

F. Install pull line in empty conduit installed under this contract. Provide and install labels as describe in “Identification” sub-section.

G. Spare conduits shall be capped to prevent intrusion of moisture and foreign objects.

H. Minimum conduit size shall be 1/2" when installed above ground and 3/4" when installed underground or under building slabs. Increase conduit size as required for wiring. Size for conduit, unless specifically shown otherwise, shall be determined from Table 3 for all conductors, Chapter 9 of latest National Electric Code.

I. Conduit shall be rigid conduit, IMC, EMT, or plastic as follows:
1. Above ground and dry locations: Use rigid conduit, IMC or EMT.
a. Wet locations: Rigid conduit, IMC.
b. Locations subject to mechanical injury: Rigid conduit or IMC only.
c. In concrete walls or block walls: Rigid steel conduit or IMC only.
d. Dry locations and not subject to mechanical injury: EMT (interior locations only), IMC, or rigid conduit.

2. Underground: Use wrapped rigid steel or plastic.
    a. Schedule 40 PVC: For use underground where protected by concrete slabs, asphaltic pavement, or concrete walkways. Use steel elbows for plastic conduit runs penetrating floor slabs. Bends in plastic conduit other than normal long sweeps shall be made only with factory formed ells or curved segments. Heat bending may not be used. Sections of rigid steel conduit runs are required where direction changes. In all cases where use of plastic conduit is allowed or specified, Contractor may, at his option, use rigid steel conduit.
    b. Underground conduits shall have red 4” wide identifying caution tape reading "CAUTION ELECTRICAL LINE BELOW”, length as required and installed 12” above all conduits runs.
    c. Do not install plastic conduit in rock base.
    d. Underground conduit entering building shall be provided with one (1) 10-foot section of rigid steel conduit at point of penetration of foundation, footing or basement wall, with approximately equal lengths inside and outside building line, unless otherwise noted.
3. Bends
    a. Make risers to grade with rigid steel long radius sweep conduit and rigid steel elbow fittings only.
    b. Minimum radius of sweeps shall be 24”.

J. Burial depth of conduit shall be as follows:
1. Concrete encased: 24” minimum for 600V or lower systems to top of concrete encasement.
2. Conduit without concrete encasement or cap: 24” minimum to top of conduit.
3. When installed under buildings, the above minimum depth shall be 18” below bottom of floor slab.

K. Use flexible steel conduit in the following applications:
1. Recessed lighting fixtures.
2. Motor connections.
3. Connection between fan plenum and structure.
4. At expansion joints.
5. At transformers and other equipment which produce vibration.

L. Provide junction boxes/pull boxes as required to limit any power system conduit run to a maximum of four (4) 90° bends (two (2) 90° bends for signal communication system conduit runs) or to avoid "U" bends.

M. Conduit Supports:
1. Support conduit with Underwriters' Laboratories listed conduit support intervals required by the California Electric Code.
2. Wire or sheet metal strips are not acceptable for conduit not directly fastened to structure or for multiple conduit runs.
3. Individual conduit 1/2" and 3/4" size may be supported from ceiling support wire with Caddy clips only if acceptable to local code. Only one conduit is permitted to be attached to any ceiling support wire. Hang such conduit so as not to affect level of ceiling.
4. Avoid attaching conduit to fan plenums. When it is necessary to support conduit from fan plenum, provide a length of flexible conduit between the section attached to the fan plenum and other sections. Provide a length of flexible conduit between the portion attached to the building to minimize transmission of vibration to the building structure.

N. Conduit penetration of roof, walls, floors, and ceilings shall be sealed to preserve the integrity of waterproofing, fire rating and soundproofing for which the roof, wall, floor, or ceiling is designed. Materials and methods used shall conform to that specified under Architectural sections.

O. Underground conduit and ducts 2” and larger shall be proven clear by pulling through a mandrel 1/4" smaller than the inside diameter.
P. Where flush branch circuit panelboards or terminal cabinets are shown on walls, stub a minimum of four (4) 1” empty conduit into overhead ceiling spaces and four (4) 1” empty conduit into space below floor (if any) in addition to conduit required for circuit wiring.
Q. Paint all exposed conduit to match its surroundings.
R. Plastic conduits exposed to sun light shall be UV stabilized.
S. Where rigid steel conduit runs in direct contact with the earth, conduit shall have factory applied PVC coating.
T. Label all conduits at each terminus, pull box, and junction box.
U. All conduits shall have a minimum of one pull line.
V. All pull lines shall be tagged at both ends to indicate the length of the conduit run, source, and the destination.

3.3 INSTALLATION OF WIRE

A. Install all wiring in raceway unless specifically shown or noted otherwise.
B. Pull no wire into any portion of the conduit system until construction work which may damage the wire has been completed.
C. Install wire continuous from outlet to outlet or terminal to terminal. Splices in cables when required shall be made in handholes, pull boxes or junction boxes. Make branch circuit splices in outlet boxes with 8 inches of correctly color-coded tails left in the box.
D. Make splices in wires and cables utilizing specified materials and methods.
E. Cables and wires passing through handholes shall be full looped inside the handhole (360°) and supported on galvanized steel racks, beginning 10” above the bottom of the handhole. Leave handhole in clean condition with debris removed.
F. Make ground, neutral, and line connections to receptacle and wiring device terminals as recommended by manufacturer. Provide ground jumper from outlet box to ground terminal of devices when the device is not approved for grounding through the mounting screws.
G. Provide Brady wire markers where number of conductors in a box exceed four (4).
H. Wiring shall be tested for continuity (600V and below). All systems shall be entirely free from grounds, short circuits, and any or all defects.
I. Measure and record the insulation resistance of 600V insulated conductors size #4/0 AWG and larger using a 500 volt megger for one minute. Make tests with circuits isolated from source and load.
J. All conductor bends must have a radius greater than or equal to the manufacturer’s listed bending radius.
K. Label all conductors at each terminus, pull box, and junction box.

3.4 WIRE COLOR CODE

A. Color code conductors. Wire sized #8 AWG and smaller shall have integral color coded insulation. Wire sizes #6 AWG and larger may have black insulation but shall be identified by color coded electrical tape at junction, splice, pull and termination points. Apply color tape with 1/2 width overlap to at least 6” of the conductor.
B. Color code wire as follows:

Conductors	208/120V	480/277V
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	White or Gray (consistent throughout facility)
Ground	Green	Green

3.5 CONNECTIONS TO EQUIPMENT

A. General:
   1. Furnish and install required power supply conduit and wiring to equipment. See below for other wiring required.
   2. Furnish and install a disconnect switch immediately ahead of and adjacent to each magnetic motor starter or appliance unless the motor or appliance is located adjacent to and within sight of the serving panelboard, circuit breaker or switch. Verify equipment nameplate current ratings prior to installation.
   3. Mount motor starters including those furnished under other sections or specifications and provide power wiring to them.
   4. Install rough-in work for equipment from approved shop drawings to suit the specific requirements of the equipment.
   5. Furnish and install magnetic motor starters that are shown on the Drawings or specified under other divisions to be furnished under this division of work. Verify equipment nameplate ratings prior to installation and furnish adequately rated starters for the loads.
   6. Furnish and install manual thermal protection for motors not integrally equipped with thermal protection.
   7. Furnish and install 120V power to each control panel and time switch requiring a source of power to operate.

B. Heating, ventilating, and air conditioning equipment:
   1. Coordinate with mechanical contractor for sizes, locations and details of motors, heating units, and control requirements.
   2. Provide required power supply conduit and wiring to equipment.
   3. Provide a suitable means of disconnect switch immediately ahead of and adjacent to each motor and appliance unless the motor or appliance is located adjacent and within sight of the service panelboard, circuit breaker or switch at a distance allowed by codes. Verify equipment nameplate current ratings prior to installation. Provide a disconnect means at each magnetic motor starter.
   4. Provide magnetic motor starters required under this division of work.
   5. Provide manual thermal protection for motors not integrally equipped with thermal protection.
   6. Line and low voltage temperature control and interlock wiring, conduit, and required connections are a part of other divisions unless specifically shown or noted on the Drawings as to be furnished under this section.
   7. Provide 120V power supply to control panels, time switch furnished and installed under other divisions of work.
   8. Furnish and install 120V power to each duct detector scheduled for operation of fire dampers or shut down of mechanical equipment. Coordinate the exact quantity and locations with the mechanical drawings.

C. Plumbing and other contractor-furnished and Owner-furnished equipment:
   1. Required power and control conduit, wiring and connections are included under this section of the work. Control sensing and alarm devices will be furnished under the respective section of the contract supplying the equipment unless noted otherwise. These devices will be in pipes, ducts, vessels, tanks, etc., and will be mounted in a place by the Contractor furnishing the devices. Other devices shall be mounted under this section of the work.
   2. Control panels for packaged equipment will be furnished under the respective section of the contract supplying the equipment unless otherwise noted. Installation and connection of the control panels are under this section of the work.

3.6 SYSTEM NEUTRAL GROUND

A. Ground the neutral conductor of each transformer to limit the maximum potential above ground due to normal operating voltage and limit the voltage level due to abnormal conditions.
B. Ground transformers with secondary voltage 600V class or less as follows: 3 phase, 4 wire wye connected: ground neutral point.
C. For transformers 75kVA size or lower with primary voltage 480V or lower, the primary equipment ground conductor may be used for grounding the secondary neutral provided it is adequately sized in accordance with CEC system ground conductor size.

3.7 EQUIPMENT GROUND

A. Ground non-current carrying metal parts of electrical equipment enclosures, frames, or conductor raceways 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. Equipment ground conductor shall be electrically and mechanically continuous from the electrical circuit source to the equipment to be grounded. Size ground conductors per CEC 250.95 unless otherwise 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 enclosure device.
C. Install metal raceway couplings, fittings, and terminations secure and tight to ensure good ground continuity. Provide grounding bushing and bonding jumper where metal raceway is not directly attached to equipment metal enclosure and at concentric knockouts.
D. Lighting fixtures shall be securely connected to equipment ground conductors. Outdoor lighting standards shall have a factory installed ground 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.

3.8 STRUCTURAL GROUND

A. Concrete encased electrode shall be 2 inches above the bottom of concrete footing where shown on drawings. See drawings for details.
B. Domestic, chilled, and hot water mains and fire protection metallic water pipes shall be connected to the ground bus with #4/0 AWG bare copper conductor at a minimum of two points.
C. Miscellaneous metal objects including piping, vessels, and structural shapes within six feet of metallic objects connected to the ground system and which are not interconnected mechanically with the grounding system, shall be interconnected with a minimum #6 AWG bare copper conductor.

3.9 IDENTIFICATION

A. Provide and install nameplates on all switchboards, distribution boards, panels, motor starters, VFDs, transformers, safety switches/disconnects, push buttons, selector switches, pilot lights, and other similar devices. Fasten nameplates to equipment with one sheet metal screw at each corner.
B. Provide and install labels on lighting switches and convenience and special purpose receptacles to show panel and circuit number to which the device is connected.
C. Provide and install identification tags on all conduit pull ropes.
D. Provide label meeting ANSI Z535 standards on motors reading:

WARNING

AUTOMATIC EQUIPMENT
MAY START AT ANY TIME

3.10 CIRCUIT BREAKER ELECTRICAL COORDINATION STUDY

A. If required, contractor shall provide a coordination study to determine trip settings of circuit breakers.
B. Contractor may elect to have the engineer of record provide such services at the contractor's expense.

3.11 ARC FLASH STUDY

A. If required, contractor shall provide a study to determine potential arc flash energy.
B. Contractor may elect to have the engineer of record provide such services at the contractor's expense.

END OF SECTION

SECTION 25 05 26

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

Materials, equipment fabrication, installation and tests in conformity with equipment applicable to this project, applicable codes and authorities having jurisdiction, for grounding

1.2 RELATED SECTIONS

A General requirements specifically applicable to Division 16, in addition to Division 16, in addition to Division 1 provision.

B Related Sections Under Division 16:

1 Section 16000 – Electrical

2 Section 16050 – Basic Materials and Methods.

3 Section 16080 – Electrical Testing

4 Section 16400 – Low Voltage Distribution.

1.3 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or government organizations apply to work in this section as cited in Section 16000.

1.4 QUALITY ASSURANCE

A Equipment and accessories shall be the product of a manufacturer regularly engaged in its manufacture.

B Supply equipment and accessories new, free from defects.

C Supply equipment and accessories in compliance with the applicable standards listed in Article 1.3 of this section and with applicable national, state and local codes.

D Items of a given type shall be the products of the same manufacturer.

1.5 SUBMITTALS

A Submit under provisions of Section 01330. Provide detailed description of items supplied, including specifications, performance characteristics, materials, wiring diagrams and schedules.

1 Submit evidence that products satisfy seismic requirements for the State of California.

2 Submit evidence of compliance with the applicable standards listed under Article 1.3 of this section.

B Manufacturer's Instructions: Submit manufacturer's installation instructions.

C Product Data: Submit manufacturer's descriptive literature.

D Shop Drawings: Submit complete fabrication details, elevations and sections of switchboard, dimensions, space available for conduit, rating, short circuit withstand ability of bus and lowest rated device, circuit schedule showing circuit number, device description, device frame ampere rating and trip, fuse clip ampere rating, termination lug size, feeder and circuit identification, conductor ratings and one-line and wiring diagrams. Include both elementary diagram and terminal to terminal wiring diagrams.

E Substitutions: Items of same function and performance shall be in conformance with Division 1.

F Submit field test and operations check report for circuit breakers and motor starters under provisions of Section 16080.

1.6 OPERATION AND MAINTENANCE DATA

A Submit operation instructions, maintenance and repair data under provisions of Division 1.

B Ship equipment in its original packages to prevent damaging or entrance of foreign matter. Perform handling and shipping in accordance with manufacturer's recommendations. Provide protective covering during construction.

C Replace at no expense to Owner, equipment or material damaged during storage or handling, as directed by the engineer.

D Tag items with a weatherproof tag identifying equipment by name and purchase order number. Include packing and shipping lists.

PART 2 - PRODUCTS

2.1 GROUND RODS

Ground rods shall be:

A. 3/4 inch diameter

B. Copper weld type

C. 10 feet in length.

2.2 BARE COPPER GROUND WIRE

Conductors shall be medium-hard drawn, copper, and stranded, with sizes as shown on drawings.

2.3 BELOW GRADE GROUND CONNECTIONS

Utilize CADWELD Multi-System Exothermic Welding.

2.4 HARDWARE

Bolts, nuts and washers shall be bronze, cadmium plated steel, or other non-corrosive material, approved for the purpose.

PART 3 - EXECUTION

3.1 SYSTEM NEUTRAL GROUND

A Ground the neutral conductor of each transformer to limit the maximum potential above ground due to normal operating voltage and limit the voltage level due to abnormal conditions.

B Ground transformers with secondary voltage 600V class or less as follows: 3-phase, 4-wire wye connected: ground neutral point.

C For transformers 75kVA size or lower with primary voltage 480V or lower, the primary equipment ground conductor may be used for grounding the secondary neutral provided it is adequately sized in accordance with CEC system ground conductor size.

3.2 EQUIPMENT GROUND

A Ground non-current carrying metal parts of electrical equipment enclosures, frames, or conductor raceways 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. Equipment ground conductor shall be electrically and mechanically

continuous from the electrical circuit source to the equipment to be grounded. Size ground conductors per CEC 250-95 unless otherwise 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 enclosure device.

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 knockouts.

D Lighting fixtures shall be securely connected to equipment ground conductors. Outdoor lighting standards shall have a factory installed ground 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.

3.3 STRUCTURAL GROUND

A Concrete encased electrode shall be 2 inches above the bottom of concrete footing where shown on drawings. See drawings for details.

B Domestic, chilled and hot water mains and fire protection metallic water pipes shall be connected to the ground bus with #4/0 AWG bare copper conductor at a minimum of two points.

C Miscellaneous metal objects including piping, vessels and structural shapes within six feet of metallic objects connected to the ground system and which are not interconnected mechanically with the grounding system, shall be interconnected with a minimum #6 AWG bare copper conductor.

3.4 CIRCUIT BREAKER ELECTRICAL COORDINATION STUDY

A If required, contractor shall provide a coordination study to determine trip settings of circuit breakers.

B Contractor may elect to have the engineer of record provide such services at the contractor's expense.

3.5 GROUND RESISTANCE TEST

A Building ground electrode resistance testing shall be accomplished with a ground resistance, direct reading, single test meter utilizing the Fall-of-Potential method and two (2) referenced electrodes. Perform test prior to interconnection to other grounding system. Orient the concrete encased ground electrode to be tested and the two referenced electrodes in straight line spaces fifty (50) feet apart. Drive the two (2) reference electrodes ten (10) feet deep.

B Test results shall be in writing, and shall show temperature, humidity and condition of the soil at the time of the tests. In the case where the ground resistance exceeds 25 ohms, add an additional ground rod and retest. Add additional ground rods when necessary in order to bring the ground resistance below 25 Ohms. All testing shall be done prior to concrete pour and in the presence of the inspector of record. Provide test results for engineer review.

END OF SECTION

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A Testing in conformity with equipment applicable to this project, applicable codes and authorities having jurisdiction

B Test equipment requirements listed in this section shall apply to testing required by all other sections in Division 26, Division 27, and Division 28.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A Division 1
   1 Section 013000: Administrative Requirements
   2 Section 013300: Submittal Procedures
   3 Section 014000: Quality Requirements
   4 Section 016000: Product Requirements
   5 Section 017000: Execution and Closeout Requirements
   6 All other included sections under Division 1

B All included sections under Division 26

C All included sections under Division 27

D All included sections under Division 28

E Plans

F Manufacturers' manuals, product bulletins, etc.

1.3 REFERENCE STANDARDS AND CODES

A Published specifications standards, tests or recommended methods of trade, industry or government organizations apply to work in this section as cited in Section 260000.

B California Electrical Code

C International Electrical Testing Association (NETA)
   1 NETA ATS: for Acceptance Testing Specifications for Electrical Power Equipment and Systems

D Institute of Electrical and Electronic Engineers
   1 IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
   2 IEEE 82: Standard Test Procedure for Impulse Voltage Tests on Insulated Conductors
   3 IEEE 95: Standard Test Procedure for Impulse Voltage Tests on Insulated Conductors
   4 IEEE 112: Standard Test Procedure for Polyphase Induction Motors and Generators
   5 IEEE 114: Standard Test Procedure for Single-Phase Induction Motors
   6 IEEE 115: IEEE Guide for Test Procedures for Synchronous Machines Part I—Acceptance and Performance Testing Part II—Test Procedures and Parameter Determination for Dynamic Analysis
   7 IEEE 141: Recommended Practice for Electric Power Distribution for Industrial Plants
   8 IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems
   9 IEEE 241: Recommended Practice for Electric Power Systems in Commercial Buildings

10 IEEE 242: Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book)
11 IEEE 252: Standard Test Procedure for Polyphase Induction Motors Having Liquid in the Magnetic Gap
12 IEEE 259: Standard Test Procedure for Evaluation of Systems of Insulation for Dry-Type Specialty and General-Purpose Transformers
13 IEEE 389: Recommended Practice for Testing Electronics Transformers and Inductors
14 IEEE 393: Test Procedures for Magnetic Cores
15 IEEE 399: Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book)
16 IEEE 400: Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above
17 IEEE 442: Guide for Soil Thermal Resistivity Measurements
18 IEEE 495: Guide for Testing Faulted Circuit Indicators
19 IEEE 576: Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications
20 IEEE 1188: Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications
21 IEEE 1234: Guide for Fault Locating Techniques on Shielded Power Cable Systems
22 IEEE 1415: Guide for Induction Machinery Maintenance Testing and Failure Analysis
23 IEEE 1458: Recommended Practice for the Selection, Field Testing, and Life Expectancy of Molded Case Circuit Breakers for Industrial Applications

E National Institute of Standards and Technology (NIST)

F Underwriters' Laboratories
1 UL 1244: Electrical and Electronic Measuring and Testing Equipment
2 UL 1436: Outlet Circuit Testers and Similar Indicating Devices
3 UL 61010-2-030: Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-030: Particular requirements for testing and measuring circuits
4 UL 61010B-1: Electrical Measuring and Test Equipment – Part 1: General Requirements
5 UL 61010B-2-031: Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2: Particular Requirements for Hand-Held Probe Assemblies for Electrical Measurement and Test
6 UL 61010B-2-032: Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2: Particular Requirements for Hand-Held Current Clamps for Electrical Measurement and Test

1.4 QUALITY ASSURANCE

A The Contractor shall engage and pay for the services of a recognized independent testing laboratory for the purpose of performing inspections and tests as herein specified.
B The testing laboratory shall provide all material, equipment, labor and technical supervision to perform switch tests and inspections.
C It is the intent of these tests to assure that all electrical equipment, both Contractor and Owner supplied, is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications.
D The tests and inspections shall determine the suitability for energizing.
E Schedule tests and give a minimum of two weeks advance notice to the Owner.

1.5 SUBMITTALS

A List of tests preformed
B Test procedures
C Test results
D The submittal shall be substantially complete for all items and equipment furnished under this section.
E Individual drawings and data sheets submitted at random intervals will not be accepted for review.

1.6 QUALIFICATIONS OF TESTING AGENCY

The testing agency shall meet federal OSHA criteria for accreditation of testing laboratories, Standard Number 1910.7 (Definition and Requirements for a nationally recognized testing laboratory). International Electrical Testing Association (NETA) accreditation constitutes proof of meeting such criteria.

1.7 TEST INSTRUMENT TRACEABILITY

A The testing laboratory shall have a calibration program which maintains all applicable test instrumentation within rated accuracy.
B The accuracy shall be traceable to the National Institute of Standards and Technology (NIST) in an unbroken chain.
C Instruments shall be calibrated in accordance with the following frequency schedule:
  1 Field instruments: 6 months maximum.
  2 Laboratory instruments: 12 months.
  3 Leased specialty equipment: 12 months
D Dated calibration labels shall be visible on all test equipment.

1.8 FINAL SETTINGS

A The test report shall include the following: summary of project, description of equipment tested, description of test, list of test equipment used in calibration and calibration date, test results, conclusions and recommendations, and appendix, including appropriate test forms.
B The test report shall be bound and its contents certified.
C Submit three copies of the completed report to the architect, or engineer if no architect is involved, no later than fifteen (15) days after completion of test, unless otherwise directed.

1.9 FAILURE TO TEST

A Any system material or workmanship which is found defective on the basis of acceptance tests shall be reported directly to the architect or engineer if no architect is involved.
B Contractor shall replace the defective material or equipment and have test repeated until test proves satisfactory without additional cost to the Owner.

PART 2 – PRODUCTS: [NOT USED]

PART 3 – EXECUTION

3.1 GROUND RESISTANCE TEST

A Building ground electrode resistance testing shall be accomplished with a ground resistance, direct-reading, single test meter utilizing the Fall-of-Potential method and two (2) referenced electrodes. Perform test prior to interconnection to other grounding system. Orient the concrete-encased ground electrode to be tested and the two referenced

electrodes in straight line spaces fifty (50) feet apart. Drive the two (2) reference electrodes ten (10) feet deep.

B Test results shall be in writing, and shall show temperature, humidity and condition of the soil at the time of the tests. In the case where the ground resistance exceeds 25 ohms, add an additional ground rod and retest. Add additional ground rods when necessary in order to bring the ground resistance below 25 Ohms. All testing shall be done prior to concrete pour and in the presence of the inspector of record. Provide test results for engineer review.

3.2 MISCELLANEOUS TESTING

A Functional and operational testing to the fire alarm, security system, telephone system, paging/intercom system, and all electrical components upon completion of electrical work.

B Perform an insulation resistance test on all switchboard busses, bus ducts; feeder conductors, including neutrals, using a megohmeter. Minimum value for each conductor shall be 20 megohms.

3.3 ELECTRICAL DISTRIBUTION EQUIPMENT OPERATIONAL CHECK

A Electrical distribution equipment operational check includes main switchboards, distribution boards, panelboards, panels, switchgear, etc.

B Verify proper operating condition of all equipment mechanically and electrically including, but not limited to verifying operation of each circuit breaker trip device with a rating of 100A or more using an accurately metered timed instrument (by passing 300% rated current through each pole).

C If any equipment is found defective during operational check, it shall be replaced by the Contractor without cost to the Owner. The tests shall be repeated by the Contractor without cost to the owner until satisfactory results are obtained.

END OF SECTION

SECTION 28 31 00

FIRE DETECTION AND ALARM

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete system.

B. The intent of drawings and specifications is to result in a complete and functional Fire Alarm System as described herein. The Contractor shall provide all control panels, initiation devices, notification appliances, controls, supervisory devices, and any other device necessary to accomplish this intent, whether or not specifically shown or specified.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A Division 1
- 1 Section 013000: Administrative Requirements
- 2 Section 013300: Submittal Procedures
- 3 Section 014000: Quality Requirements
- 4 Section 016000: Product Requirements
- 5 Section 017000: Execution and Closeout Requirements
- 6 All other included sections under Division 1

B All included sections under Division 26
C All included sections under Division 27
D All included sections under Division 28
E Plans
F Manufacturers' manuals, product bulletins, etc.

1.3 REFERENCE STANDARDS AND CODES

A. Published specifications standards, tests, or recommended methods of trade, industry or government organizations apply to work in this section as cited here and in Section 260000.

B. National Fire Protection Association (NFPA) :
1. NFPA 70 National Electrical Code (NEC) w/ State Amendments (CEC)
2. NFPA 72 National Fire Alarm and Signaling Code
3. NFPA 101 Life Safety Code

C. Underwriters Laboratories Inc. (UL):
1. UL 38 Manually Actuated Signaling Boxes.
2. UL 50: Enclosures for Electrical Equipment, Non-environmental Considerations
3. UL 50E: Enclosures for Electrical Equipment, Environmental Considerations
4. UL 268 Smoke Detectors for Fire Protective Signaling Systems
5. UL 268A Smoke Detectors for Duct Applications.
6. U; 346 Water flow Indicators for Fire Protective Signaling Systems.
7. UL 464 Audible Signaling Appliances.
8. UL 521 Heat Detectors for Fire Protective Signaling Systems
9. UL 753: Alarm Accessories for Automatic Water Supply Control Valves for Fire Protection Service
10. UL 864 Control Units for Fire Protective Signaling Systems
11. UL 1425: Standard for Cables for Non-Power-Limited Fire-Alarm Circuits
12. UL 1480: Speakers for Fire Alarm, Emergency, and Commercial and Professional Use
13. UL 1481: Power Supplies for Fire Protective Signaling Systems

14. UL 1711: Amplifiers for Fire Protective Signaling Systems
15. UL 1712: Tests for Ampacity of Insulated Electrical Conductors Installed in the Fire Protective System
16. UL 1971 Visual Notification Appliances for the hearing impaired.

D. State building codes, including but not limited to:
1. California Building Code
2. California Electric Code
3. California Fire Code

E. All requirements of the Authority Having Jurisdiction (AHJ).

1.4 QUALITY ASSURANCE

A. The FACP, initiation devices, monitoring devices, control devices, and annunciators shall:
1. Be the product of a single U.S. manufacturer regularly engaged in its manufacture
2. Share a common communications protocol

B. All signaling devices shall be the product of a single U.S. manufacturer regularly engaged in its manufacture.

C. All equipment and accessories shall be new and free from defects.

D. Equipment and accessories in compliance with the applicable standards listed in Article 1.3 of this section and with applicable national, state and local codes.

E. Provide surge suppression, refer to Section 264300.

F. All components shall be UL listed.

G. All components shall be CSFM listed.

H. The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

I. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems, California Electric Code, California Fire Code, and all other state codes. The system shall be electrically supervised and monitor the integrity of all conductors.

J. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final checkout and to ensure the systems integrity.

1.5 SUBMITTALS

A. Submit under provisions of Section 013000 or 013300.

B. Submittals shall include the following:
1. Table of contents
2. A complete set of detailed manufacturer’s specifications describing and illustrating all standard and special components and materials
3. Part numbers
4. Evidence of compliance with the applicable standards listed under Article 1.3 of this section
5. Maintenance instructions and intervals
6. A complete set of drawings for any special items
7. A single line block diagram showing exactly the manner in which the contractor proposes to layout the system.
8. Wiring diagrams
9. Illustrations and scale drawing of the racks, equipment layouts etc.
10. Drawings shall include designations, dimensions, operating controls, instruments, riser diagrams, routing diagrams etc.

C. The shop drawing submittal shall include the following:
1. Plans, scale shall match scales of the approved plans
a. Site Plan
b. Floor Plans
(1) Identifying each room's use or occupancy

(2) Show device locations
(3) Show circuit routing

2. Diagram of the power circuit.
3. Riser Diagram, break down by zone or circuit.
4. Point-to-Point diagram for all devices.
5. Type of wire being used and that the wire is being run in conduit or FPL rated.
6. Cut sheets for all devices, highlight actual devices to be used and their amp draw in stand-by and alarm modes.
7. Current California State Fire Marshall listing sheets
8. Battery Calculations: Calculations for 24 hours supervisory and 15 minute alarm.
9. Voltage-Drop Calculations.
10. Indicate all the California State applicable codes relating to the fire alarm system:
    a. Section 2-809 and Ch2-72, T-24 CBC.
    b. Article 3-760, T-24 CEC.
    c. 2016 Edition of NFPA 72.
11. Provide documentation from Local Fire Jurisdiction approving Zone breakdown and location of any Fire Alarm Annunciators.

D. Electronic submittals shall be searchable

E. The submittal shall be substantially complete for all items and equipment furnished under this section.

F. Individual drawings and data sheets submitted at random intervals will not be accepted for review.

G. Substitutions
1. Items of same function and performance shall be submitted in conformance with Division 1.
2. All proposed substitutions shall be listed with the California State Fire Marshal.
3. All proposed substitutions shall require approval of the Division of the State Architect.

1.6 OPERATION AND MAINTENANCE MANUALS

A Submit operation and maintenance manuals in accordance with Section 260000.

B The manuals shall, at minimum, include the following:
1 Manufacturer (including contact information)
2 Model number
3 Programming manual (where applicable)
4 Wiring diagrams
5 Trouble-shooting guidelines (where applicable)
6 Voltage ratings
7 Current ratings
8 Calibrated range (where applicable)
9 List of capabilities
10 Environmental ratings
11 NEMA enclosure type
12 Maintenance requirements
13 Installation instructions
14 Repair instructions (where applicable)

C Provide manuals in one of the following formats
1 Three hardcopies
2 PDF

1.7 WARRANTY

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The

full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

1.8 SUBSTITUTIONS

A. For any proposed substitution a complete description, technical and cost comparison, and test report package shall be submitted to the Owner for review fifteen (15) working days prior to the bid date. Final approval of the substitution item shall be at the option of the Owner, and written notice of the status of the proposed alternative will be supplied to all bidders prior to the final bid date. The Owner or its representative must approve any proposed substitution item in writing. The Owner reserves the right to require a complete sample of any proposed equal item and may, if necessary, request a sample tested by an independent testing consultant to prove equality. The decision of the Owner regarding equality of proposed equal items will be final.

B. Approved equal status does not imply final acceptance. The Owner prior to the award of bid shall make final acceptance of a substitution item to the successful Contractor, after reviewing the bid information.

C. If a substitution item is given final acceptance by the Owner, the Contractor shall reimburse the Architect for any additional engineering charges and shall pay all charges of the other trades resulting from the substitution, at no cost to the Owner. This reimbursement shall include all costs required to obtain re-approval from DSA, as the currently specified fire alarm system has been approved in its entirety by DSA.

D. If a substitution item is given final acceptance by the Owner, the Contractor shall pay all charges (including travel, lodging, meals, etc.) required to provide factory certification, equal to that of a Factory Authorized Distributor of the substituted item, for two (2) selected Owners representatives. This training shall occur at the primary factory of the substituted item in question and shall allow the selected Owners representatives to provide any and all Factory/Manufacturer Approved repairs, services, software upgrades, etc. without affecting any available or applicable Manufacturer Warranties.

E. All of the equipment in this specification shall be furnished and installed by the Authorized Factory Distributor of the equipment with the most current software package available at the time of installation. At the time of Owner Acceptance of the installation, all equipment shall include any and all updated software revisions. In addition, when the software is available in disk format, a backup copy of the most up to date revision, in disk format, shall be handed to the Owner at the completion of the project.

1.9 POST CONTRACT MAINTENANCE

A. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty.

B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, tests, and repairs described below. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

C. Maintenance and testing shall be on a semiannual basis or as required by the AHJ. A preventive maintenance schedule shall be provided by the contractor describing the protocol for preventive maintenance. The schedule shall include:
   1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, waterflow switches and all accessories of the fire alarm system.
   2. Each circuit in the fire alarm system shall be tested semiannually.

3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72 Chapter 14.

1.10 POST CONTRACT EXPANSIONS

A. The contractor shall have the ability to provide parts and labor to expand the system specified, if so requested, for a period of five (5) years from the date of acceptance.
B. As part of the submittal, include a quotation for all parts and material, and all installation and test labor as needed to increase the number of intelligent or addressable devices by ten percent (10%). This quotation shall include intelligent smoke detectors, intelligent heat detectors, addressable manual stations, addressable monitor modules and addressable modules equal in number to one tenth of the number required to meet this specification (list actual quantity of each type).
C. The quotation shall include installation, test labor, and labor to reprogram the system for this 10% expansion. If additional FACP hardware is required, include the material and labor necessary to install this hardware.
D. Do not include cost of conduit or wire or the cost to install conduit or wire except for labor to make final connections at the FACP and at each intelligent addressable device. Do not include the cost of conventional peripherals or the cost of initiating devices or notification appliances connected to the addressable monitor/control modules.
E. Submittals that do not include this estimate of post contract expansion cost will not be accepted.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL

A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.
B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.
D. Fire alarm control panel: The contractor shall furnish and install all FACP accessories needed for the FACP to perform the following.
   1. Connect to all initiation and notification circuits shown on plans
   2. Network with other FACPs, annunciators, etc.
   3. Communicate with remote monitoring station
E. Refer to plans for manufacturer(s), devices types and models to be used.

2.2 (EXISTING)FIRE ALARM CONTROL PANEL (FACP)

A All fire alarm systems shall have one main FACP. Systems with more than one FACP will have main FACP indicated on plans. If it is not on plans, it is FACP in administration building.
B All satellite FACPs shall include the following equipment:
   1 Central processing unit
   2 Signaling line circuit (addressable initiation devices) interface(s)
   3 Notification appliance circuit interface(s)

4 Network communications module(s)
5 User interface
a 80 character, backlit LCD display
b Buttons
1 Acknowledge
2 Signal Silence
3 Drill
4 System Reset
5 Lamp Test
c QWERTY keyboard
6 Power supply (sized for all loads)
7 Battery charger (sized for all loads)
8 Batteries (sized for all loads)
9 All accessories necessary for a fully functional system

C The main FACP shall include the following in addition to satellite FACP requirements.
1 User interface
a LCD display shall be 640 characters.
b Additional buttons
1 Fire Alarm Scroll/Display
2 Security Scroll/Display
3 Supervisory Scroll/Display
4 Trouble Scroll/Display
5 Other Event Scroll/Display
6 Print Screen
7 Next/Previous Section
8 Battery Level
c If the fire alarm system has a remote annunciator meeting user interface, the main FACP's user interface may be same as satellite FACP requirements.
2 Digital alarm communicator transmitter
3 Internet Protocol media access card
4 Computer interface software or firmware

D The FACP and all accessories shall be housed in a cabinet size for all equipment.

2.2.1 FIRE ALARM DEVICES

A Intelligent Photoelectric Smoke Detector: The intelligent photoelectric smoke detector shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density. Refer to the fire alarm drawings fire alarm symbols list for device manufacture and model number.

B Addressable Multi-Criteria Photo/CO Detectors: UL 268 7th edition standard for smoke detection and UL 2075 standard for system-connected life safety carbon monoxide detection. B200S series intelligent sounder bases generate either Temp 3 patter for fire or a Temp 4 pattern for CO alarm. Refer to the fire alarm drawings fire alarm symbols list for device manufacture and model number.

A Intelligent Thermal Detectors: The intelligent thermal detectors shall be addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. A high heat thermal detector rated at 190 degrees Fahrenheit shall also be available. The thermal detectors shall connect via two wires to the fire alarm control panel signaling line circuit. Refer to the fire alarm drawings fire alarm symbols list for device manufacture and model number.

B Intelligent Addressable Reflected Beam Detector. The intelligent single-ended reflected beam smoke detector shall connect with two wires to the fire alarm control panel signaling line circuit (SLC). The detectors shall consist of a transmitter/receiver unit and

a reflector and shall send data to the panel representing the analog level of smoke density. The detector shall be capable of being tested remotely via a keyswitch. Refer to the fire alarm drawings fire alarm symbols list for device manufacture and model number.

C Addressable Manual Fire Alarm Box (manual station)
1 Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the address-able communication module status. They shall use a key operated test-reset lock and shall be designed so that after actual emergency operation, they cannot be restored to normal use except using a key. Refer to the fire alarm drawings fire alarm symbols list for device manufacture and model number.
2 All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
3 Manual fire alarm boxes shall have clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

D Addressable Dry Contact Monitor Module: Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs. Refer to the fire alarm drawings fire alarm symbols list for device manufacture and model number.

E Addressable Relay Module
1 Addressable Relay Modules shall be available for HVAC control and other network building functions; Refer to the fire alarm drawings fire alarm symbols list for device manufacture and model number.
2 The module shall provide two form C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.
3 The relay coil shall be magnetically latched to reduce wiring connection requirements, and to ensure that 100% of all auxiliary devices energize at the same time on the same pair of wires.

F Speaker Strobes: The speaker strobe shall be listed to UL 1971 and UL 1480 and be approved for fire protective signaling systems. It shall be a dual-voltage transformer speaker strobe capable of operation at 25.0 or 70.7 nominal Vrms. The speaker strobe shall have power taps (from ¼ watt to 2 watts). The strobe shall feature selectable candela output and be fully synchronized. The strobe shall comply with NFPA 72 and the Americans with Disabilities Act requirement for visible signaling appliances. Refer to the fire alarm drawings fire alarm symbols list for device manufacture and model number.

G Strobes: Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and be fully synchronized. The strobe shall feature selectable candela output. Refer to the fire alarm drawings fire alarm symbols list for device manufacture and model number.

H Speaker-Weatherproof
1 Provide low profile weatherproof speakers at the locations shown on the drawings. Refer to the fire alarm drawings fire alarm symbols list for device manufacture and model number.
2 A factory supplied back box shall be supplied for weatherproof applications.
3 The speaker output shall be switch selectable from ¼ watt to 2 watts.

I Annunciator: The annunciator shall communicate to the fire alarm control panel via an EIA 485 (multi-drop) two-wire communications loop. Refer to the fire alarm drawings fire alarm symbols list for device manufacture and model number.

J Communicator: A communicator with backup battery option shall be available to interface to the UDACT and be capable of transmitting signals over the internet/intranet or Cellular network to a compatible receiver. Refer to the fire alarm drawings fire alarm symbols list for device manufacture and model number.

2.3 CONDUIT AND WIRE

A. Conduit

1. Conduit shall be in accordance with The California Electrical Code (CEC), local and state requirements.
2. Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per CEC Article 760-55.
4. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
6. Conduit shall be 3/4-inch (19.1 mm) minimum.

B. Wires/Cables
1. All fire alarm system wiring shall be new.
2. Wiring shall be in accordance with local, state and national codes (e.g., CEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 12 AWG.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in CEC (e.g., FPLR).
5. Wiring used for the multiplex communication circuit (SLC) shall be twisted and unshielded and support a minimum wiring distance of 12,500 feet. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit.
6. All field wiring shall be electrically supervised for open circuit and ground fault.
7. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs). Systems that do not allow or have restrictions in, for example, the amount of t-taps, length of t-taps etc., are not acceptable.
8. All wires shall be listed by the California State Fire Marshal (CSFM).

C. Terminal Boxes, Junction Boxes and Cabinets. All boxes and cabinets shall be UL listed for their use and purpose.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

E. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

F. All fire alarm cables shall be listed with the California State Fire Marshal for use in a fire alarm system.

2.4 BATTERIES

A. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 15 minutes of alarm upon a normal AC power failure.

B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

C. If necessary to meet standby requirements, external battery and charger systems may be used.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the CEC, NFPA 72, and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.2 ON-SITE START-UP

A. System Check: Prior to energizing any part of this system, the factory authorized representative shall check thoroughly the installation, and perform pre-start checks. This representative shall check all points, fire alarm panels and complete network to ensure proper operation, and make any needed repairs and/or replacements required. Sufficient time shall be included in the project bid to cover all required start-up assistance and testing.

B. Testing: The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 14.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
3. Verify activation of all waterflow switches.
4. Open initiating device circuits and verify that the trouble signal actuates.
5. Open and short signaling line circuits and verify that the trouble signal actuates.
6. Open and short notification appliance circuits and verify that trouble signal actuates.
7. Ground all circuits and verify response of trouble signals.
8. Check presence and audibility of tone at all alarm notification devices.
9. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
10. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
11. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

12. The completed smoke detection system shall be tested to insure that it is operating properly. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a ninety (90) day test period without any unwarranted alarms. Should an unwarranted alarm(s) occur, the contractor shall readjust or replace the detector(s) and begin another ninety (90) day test period. As required by the architect, the contractor shall recheck the detectors after each readjustment or replacement of detectors. This test shall not start until the owner has obtained beneficial use of the building under tests.

C. All test and report costs shall be in the contract price. A checkout report shall be prepared by the installation technicians and submitted in triplicate, one copy of which will be registered with the equipment manufacturer. The report shall include, but not be limited to:
   1. A complete list of equipment installed and wired.
   2. Indication that all equipment is properly installed and functions and conforms with these specifications.
   3. Test of individual zones as applicable.
   4. Serial numbers, locations by zone and model number for each installed detector.
   5. Voltage (sensitivity) settings for each ionization and photoelectric detector as measured in place with the HVAC system operating.
   6. Response time on thermostats and flame detectors (if used).
   7. Technician's name, certificate number and date.
   8. NFPA Certification shall be completed, signed and submitted.

D. The completed fire alarm system shall be tested to insure that it is operating properly. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a ninety (90) day test period without any unwarranted alarms. Should an unwarranted alarm(s) occur, the contractor shall readjust or replace the detector(s) and begin another ninety (90) day test period. As required by the architect, the contractor shall recheck the detectors after each readjustment or replacement of detectors. This test shall not start until the owner has obtained beneficial use of the building under tests.

3.3 FINAL INSPECTION

A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.4 INSTRUCTION

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

C. Appropriate quantities of installation and operation manuals shall be provided and used for instructional purposes.

3.5 RECORD DRAWINGS AND OPERATING MANUALS

A. After completion of all the tests and adjustments listed above, the contractor shall submit the following information to the architect:
   1. "As-built" conduit and cable layout diagrams including wire color code and/or tag number.
   2. Complete "as-built" site plans, floor plans, wiring diagrams, and calculations

3. Detailed catalog data on all installed system components.
4. Copy of the test report.

B. Operating Manual:
1. Before final acceptance of work, the contractors shall deliver five copies of a composite "Operating and Shop Maintenance Manual." Each manual shall contain, but not be limited to: a statement of guarantee including date of installation and name and phone number of the person to be called in the event of equipment failure.
2. Individual factory issued manuals shall contain all technical information on each piece of equipment installed. In the event such manuals are not obtainable from the factory, it shall be the responsibility of the contractor to compile and include them. Advertising brochures or operational instructions shall not be used in lieu of the required technical manuals.

C. Upon completion and testing of the fire alarm system, provide the NFPA certificate to the owner, local fire official, architect, and DSA.

END OF SECTION