

PROJECT MANUAL

Pau-Wa-Lu Middle School

701 Long Valley Road
Gardenerville, NV 89460

Fan Coil Units Replacement

Douglas County School District

1638 Mono Avenue
Minden, NV 89423

Submittal, January 27, 2017



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SECTION 00002 - PROJECT DIRECTORY

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SECTION 23 05 10 - MECHANICAL GENERAL PROVISIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. References.
- B. Description of Work.
- C. Drawings and Specifications.
- D. Industry Standards and Codes.
- E. Permits, Fees and Utility Connections.
- F. Coordination of Work.
- G. Progress of Work.
- H. Submittals
- I. Operation and Maintenance Manuals.
- J. Project Record Documents.
- K. Warranty.
- L. Quality and Care.
- M. Starting Equipment and Systems.

1.02 RELATED SECTIONS

- A. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
- B. The requirements of this Section apply to all Work of Division 23.

1.03 REFERENCES

- A. ANSI - American National Standards Institute.
- B. ASTM - American Society for Testing Materials.
- C. NEC - National Electric Code.
- D. NEMA - National Electric Manufacturers' Association.
- E. NFPA - National Fire Protection Association.
- F. OSHA - Occupational Safety and Health Act.
- G. UL - Underwriters' Laboratories.
- H. See detailed References that are listed in individual sections.

1.04 DESCRIPTION OF WORK

- A. The work included in this division of the specifications consists of furnishing labor, tools, equipment, supplies and materials, unless otherwise specified, and in performing operations necessary for the installation of the complete Mechanical System as required by these specifications or shown on the Drawings, subject to the terms and conditions of the Contract Agreement.
- B. The work shall also include the completion of details of mechanical work not mentioned or shown which are necessary for the successful operation of mechanical systems described on the drawings or required by these specifications. Furnish and install any incidental work not shown or specified which is required to provide a complete and operational system.

1.05 DRAWINGS AND SPECIFICATIONS

- A. Drawings are schematic and diagrammatic. Drawings indicate the general arrangement of equipment, piping, ductwork and other mechanical work. Use judgement and care to install

mechanical work to fit the job conditions within the building construction and finishes, and to function properly.

- B. The Contractor shall investigate the building conditions affecting the Work and shall arrange his work accordingly providing offsets, fittings, valves and accessories to fit the actual job conditions. The Contractor shall be responsible to field measure and confirm new and existing mechanical systems locations with respect to other architectural, structural, and electrical work, existing and new. Do not scale distances off of the mechanical drawings. Use actual building dimensions.
- C. The drawings and specifications are complimentary each to the other. What is required by one shall be as binding as if called for by both.
- D. Examine all drawings and specifications prior to bidding the Work. Report any discrepancies to the Engineer.

1.06 INDUSTRY STANDARDS AND CODES

- A. The Mechanical Contractor shall comply with the latest provisions of all codes, regulations, laws and ordinances applicable to the work involved. This does not relieve the Contractor from furnishing and installing work shown or specified which may exceed the requirements of such codes, regulations laws and ordinances.
- B. All materials, products, devices, fixtures forms or types of construction included in this project shall meet or exceed the published requirements of the publications listed below. These publications form a part of this specification.
 - 1. International Building Code - 2012.
 - 2. Uniform Mechanical Code - 2012.
 - 3. Uniform Plumbing Code - 2012.
 - 4. National Electrical Code - 2011.
 - 5. International Fire Code - 2012.
 - 6. Nevada State Fire Marshal.
 - 7. Occupational Safety and Health Administration, including CAL-OSHA.
 - 8. International Energy Conservation Code - 2009.
 - 9. Other applicable state laws.
- C. Nothing in the Drawings or Specifications shall be construed to permit work that does not conform these codes. When Contract Documents differ from governing codes, furnish and install to the higher standard required at no extra charge. The Contract Documents are not intended to repeat the code requirements except where necessary for clarity.
- D. No material or product installed as a part of the Work shall contain asbestos in any form.

1.07 SITE EXAMINATION

- A. Contractor shall examine the site, verify dimensions and locations with Drawings, check utility connection locations, and familiarize himself with the existing conditions and limitations. No extras will be allowed because of the Contractor's misunderstanding of the amount of work involved or his lack of knowledge of any site condition which may affect his work. Any apparent variance of the drawings or specifications from the existing conditions at the site shall be called to the attention of the Engineer immediately.

1.08 PERMITS, FEES AND UTILITY SERVICES

- A. Contractor shall pay for and obtain all permits and service required in the installation of this work.
- B. Contractor shall arrange for all required inspections and will secure approvals from authorities having jurisdiction.

1.09 COORDINATION OF WORK

- A. It is recognized that the contract documents are diagrammatic in showing certain physical relationships which must be established within the mechanical work, and in its interface with other work and that such establishment is the exclusive responsibility of the contractor.
- B. The Contractor shall give careful consideration to the work of the General, Electrical and other contractors on the job and shall organize his work so that it will not interfere with the work of other trades. He shall consult the drawings and specifications for work of other trades for correcting information, and the pertinent drawings for details and dimensions.
- C. Arrange mechanical work in a neat, well-organized manner with the piping, conduit, and similar services running parallel and/or perpendicular to primary lines of the building construction. Locate operating and control equipment properly to provide easy access, and arrange entire mechanical work with adequate access for operation and maintenance.
- D. Verify the location of all equipment, and devices, etc. and if interference develops, the Owner/Engineer's decision will be final and no additional compensation will be allowed for the moving of misplaced air devices or equipment.

1.10 PROGRESS OF WORK

- A. This Contractor shall organize his work so that the progress of the mechanical work will conform to the progress of the other trades, and shall complete the entire installation as soon as the conditions of the building will permit. Any cost resulting from defective or ill timed work performed under this section shall be borne by this Contractor.

1.11 STRUCTURAL DESIGN REQUIREMENTS AND SEISMIC RESTRAINTS

- A. Mechanical systems and equipment shall be anchored and seismically braced in accordance with all applicable codes and industry standards.
- B. Mechanical systems and equipment shall include, but are not limited to, all piping, heating and ventilating equipment, electrical and control panels, conduits and other components.
- C. Supports, anchorage and restraints, including attachments to building structure, for all piping and ductwork for standard installation details that comply with the latest edition of the Mason Industries "Seismic Restraint Guidelines", the latest edition of the SMACNA "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems", or equal, shall be used wherever possible. The Contractor shall provide all supporting documentation required for the Engineer and the reviewing authorities. If compliance with one of these standards is demonstrated, separate structural calculations are not required.

1.12 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Organize submittals in sequence according to Specification Section. Submit in bound document with tabs identifying each Specification Section. Provide a Table of Contents identifying the Specifications Sections being submitted and the contents within each tabbed section. Prepare Submittals in multiple volumes if required. Provide a complete Submittal package at one time. Do not submit individual Sections piecemeal.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.
- D. Indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

- E. Furnish, upon request, installation instructions for all equipment and materials to Inspector of Record prior to installation.
- F. Maintain a copy of the fire and smoke damper installation instructions on site for use by the Inspector of Record.

1.13 SUBSTITUTION PROCEDURES

- A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.
- B. LP Consulting Engineers, Inc. will consider requests for substitutions only within 7 days after date of Agreement.
- C. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- D. Failure by the Contractor to order materials or equipment in a timely manner will not constitute justification for a substitution.
- E. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- F. A request for substitution constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty for the substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Douglas County School District.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse Douglas County School District and LP Consulting Engineers, Inc. for review or redesign services associated with reapproval by authorities including obtaining reapproval by authorities.
- G. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- H. If excessive review, as judged by the Engineer, is required caused by complicated, numerous or repetitive requests, Contractor shall reimburse Engineer and its Consultants for such review at their standard billing rates.
- I. Substitution Submittal Procedure:
 - 1. Submit electronic copies of request for substitution for consideration. Limit each request to one proposed substitution.
 - 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
 - 3. The LP Consulting Engineers, Inc. will notify Contractor in writing of decision to accept or reject request.
 - 4. Present each substitution individually. If a proposed substitute is not found to be acceptable, then the specified item shall be supplied.

1.14 OPERATION AND MAINTENANCE MANUALS

- A. Provide operating and maintenance instructions, diagrams and parts lists for all components of all mechanical systems and each piece of equipment furnished under these specifications.
- B. Operating and maintenance instructions shall be furnished for the following equipment and systems:
 - 1. Air Conditioning Systems.
 - 2. Piping Systems.
 - 3. Temperature Controls Systems.

4. Motors.
5. Hydronic Balance and Test Reports.
- C. Provide manufacturer's model number, design data, capacities, etc. for each piece of mechanical equipment furnished as a part of the Work.
- D. The operating instructions shall include procedures for starting, stopping and emergency manual operation for all equipment and systems.
- E. Provide maintenance instructions of each item of individual equipment including applicable maintenance data as recommended by the manufacturer, including frequency of lubrication, lubricants, inspections required, adjustment procedures, belt and pulley sizes, etc.
- F. Provide manufacturer's parts bulletins with part numbers for each item of equipment included in the Work. Parts bulletins shall be specific to the equipment provided. Extraneous information that does not apply to the equipment provided shall be eliminated from the literature.
- G. Include copies of test reports (startup, check, etc.) and inspections performed for each piece of equipment provided in the Work.
- H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Douglas County School District's name and registered with manufacturer.
- I. Provide supplier and manufacturer contacts, telephone numbers and addresses in the front portion of the operation and maintenance manual.

1.15 PROJECT RECORD DOCUMENTS

- A. Provide red-lined drawings accurately showing location of equipment and devices and size and routing of piping. Include notes explaining installed condition for complete understanding.

1.16 QUALITY ASSURANCE

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from LP Consulting Engineers, Inc. before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

1.17 WARRANTY

- A. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 QUALITY AND CARE

- A. All materials shall be new and in perfect condition when installed unless specifically indicated otherwise. Materials shall be tested within the Continental United States by an independent, nationally recognized testing agency and shall be listed in accordance with testing agency requirements. When not otherwise specified, all material shall conform to applicable National Standards (ANSI).
- B. All capacities, sizes and efficiency ratings shown on the drawing are minimum.

- C. Each category of material or equipment shall be of the same brand or manufacturer throughout the Work wherever possible.
- D. The quality of materials and equipment to be provided is defined by the brand names, manufacturers, model and catalog numbers listed on the Drawings and in the Specifications. Contractor shall provide each item listed, of the quality specified, or equal.
- E. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.
- F. Inspect and report concealed damage to carrier within their required time period.
- G. Store materials in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect from dirt, water, construction debris, and traffic.
- H. Equipment which has been damaged, exposed to weather or is, in the opinion of the Engineer or Owner, otherwise unsuitable because of improper fabrication, storage or installation shall be removed and replaced by this Contractor at his expense.

PART 3 EXECUTION

3.01 INSTALLATION

3.02 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with the requirements within this section.
- B. Test all piping with no leak or loss in pressure in accordance with the requirements within this section.

3.03 GENERAL TESTING REQUIREMENTS FOR MECHANICAL AND PLUMBING SYSTEMS

- A. Contractor shall assign a responsible person to be an independent representative to witness testing and to sign as witness of times, pressure and losses of testing media for all hydronic piping and duct testing.
 - 1. Test all piping as noted below with no leak or loss of pressure. Repair or replace defective piping until tests are accomplished successfully.
 - 2. Submit to the Engineer for review a log of all tests made which shall include time, temperature, pressure, water makeup and other applicable readings, necessary to indicate the systems have been operated and tested in the manner outlined in the construction documents.
 - 3. After producing the specified test pressure, disconnect the pressurizing source; do not introduce further pressure for the duration of the test period, repair leaky piping and retest. Repeat the procedure until the entire system is proven tight.
- B. Test the following systems with the medium listed to the pressure indicated for the time period listed:
 - 1. Hydronic Piping: Pressure=system pressure / Medium= Water / Visual Inspecton.

3.04 CUTTING AND PATCHING

- A. Submit written request in advance of cutting or alteration which affects:
 - 1. Structural integrity of any element of Project.
 - 2. Efficiency, maintenance, or safety of any operational element.
 - 3. Visual qualities of sight exposed elements.
 - 4. Work of Douglas County School District or separate Contractor.
- B. Execute cutting and patching to complete the work, to uncover work to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit Products together to integrate with other work.
- C. Execute work by methods to avoid damage to other work, and which will provide appropriate surfaces to receive patching and finishing.

- D. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- E. Restore work with new Products in accordance with requirements of Contract Documents.
- F. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- G. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Code requirements , to full thickness of the penetrated element.
- H. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.05 PRIMING AND PAINTING

- A. Apply primer to all exposed ferrous metals that are not factory primed, factory finished, galvanized, stainless steel or anodized. Exposed black steel piping shall be primed and finish painted to match Architectural finish requirements.
 - 1. Primer shall be as recommended by the paint manufacturer for each specific application.
 - 2. Acceptable Products include: Fuller O'Brien Blox-Rust Metal All Purpose Primer, equivalent Rust-Oleum product, or equal. See Section 092216 for other acceptable products.
- B. Apply two coats of primer to metal surfaces of items to be insulated or jacketed, except ductwork and piping, or factory primed or finished.
- C. Preparation:
 - 1. Do not start work until surfaces to be finished are in proper condition to produce finished surfaces of uniform, satisfactory appearance.
 - 2. Stains and Marks: Remove completely, if possible, using materials and methods recommended by coating manufacturer; seal stains and marks which cannot be completely removed using Devoe KILSTAIN primers, shellac, or other coating acceptable to paint manufacturer any marks or defects that might bleed through paint finishes.
 - 3. Remove or protect hardware, electrical plates, mechanical grilles and louvers, lighting fixture trim, and other items not indicated to receive coatings which are adjacent to surfaces to receive coatings.
 - 4. Remove mildew from impervious surfaces by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water and allow substrate to thoroughly dry.
 - 5. Uncoated Steel And Iron Surfaces:
 - a. Remove grease, rust, scale, and dust from steel and iron surfaces using solvent in accordance with SSPC-SP 1.
 - b. Where heavy coatings of scale or contaminants are evident, hand tool clean in accordance with SSPC-SP 2 or use other approved SSPC SP method as needed.
 - 6. Shop Primed Steel Surfaces: Remove loose primer and dust. Sand and feather edges to smooth surface. Clean areas with solvent and spot prime bare metal surfaces with appropriate Devoe MIRROLAC metal primer or primer recommended by manufacturer.
- D. Application:
 - 1. Apply each coat to uniform coating thickness in accordance with manufacturer's instructions, not exceeding manufacturer's specified maximum spread rate for indicated surface; thins, brush marks, roller marks, orange-peel, or other application imperfections are not permitted.
 - 2. Allow manufacturer's specified drying time, and ensure correct coating adhesion, for each coat before applying next coat.
 - 3. Remove dust and other foreign materials from substrate immediately prior to applying each coat.

3.06 STARTING EQUIPMENT AND SYSTEMS/COMMISSIONING

- A. Start equipment and systems in accordance with manufacturer's written instructions..

- B. Provide manufacturer's field representative to prepare and start equipment and systems.
- C. Adjust for proper operation within manufacturer's published tolerances.
- D. Demonstrate proper operation of equipment to Douglas County School District's designated representative.
- E. Description:
 - 1. Comply with all start up of mechanical and electrical equipment systems as required in the various sections and herein.
 - 2. Coordinate all testing and startup procedures with all other trades so that all non-mechanical and non-electrical work is completed and operational so that the specified testing can be performed.
- F. Preliminary Work:
 - 1. Prior to the startup, the Contractor shall ensure that the systems are ready to operate, and the following items have been completed and checked including but not limited to:
 - a. Proper motor and pump rotation.
 - b. Flushing and cleaning of the system.
 - c. Wiring
 - d. Auxiliary connections
 - e. Lubrication.
 - f. Venting.
 - g. Controls.
 - h. Installation of filters and strainers.
 - 2. All electrical testing must be completed and test results submitted before equipment startup to avoid power interruptions during mechanical equipment startup and testing.
 - 3. The Contractor shall submit at least 10 days in advance a schedule listing the date of completion of his work as it will be ready for equipment startup of Electrical/Mechanical equipment. This schedule shall include work on a system by system, floor by floor basis.
 - 4. One week prior to the startup of any major equipment, the Contractor shall certify in writing that the systems will be complete and ready for startup. Completeness shall not only include physical installation of individual pieces of equipment, but all related elements of other crafts to make all equipment operate as a system.
 - a. The startup checklist will cover all related crafts, e.g., controls, electrical, mechanical, and a clean environment for equipment startup.
 - 5. Equipment of systems should not be started until systems and associated subsystems are completed. Verify that other continuing work could not possibly damage completed systems if they are in operation. Furnish signed off prestartup check sheet.
- G. Startup and Commissioning:
 - 1. System Startup and Operation:
 - a. The Contractor shall provide all labor, materials and services necessary for the initial startup and operation of all systems and equipment furnished and installed under this section.
 - b. The Contractor shall provide for the services of qualified factory representatives for all major equipment prestart setup, startup and initial operation. Such periods shall be sufficient to insure the proper operation of systems and equipment. Major equipment to include, but not limited to all HVAC equipment, temperature controls, chillers, pump sets, electrical systems, etc.
 - c. After initial startup and operation of systems, the Contractor shall submit a report, showing proper operation before commencement of the final "Operation Test".
 - d. During initial operation of the system and until substantial completion, qualified personnel shall be provided and designated for maintaining the equipment and systems in good running order. Items such as strainers, cleanouts, filter replacement, bearing lubrication, packing replacement, and other consumables shall be provided

without cost to the Owner. Failure of equipment during this period due to lack of proper supervision is the responsibility of the Contractor and continued failures shall be grounds for the Owner to provide such services with back charges to the Contractor. Submit written schedule of completed maintenance to the Engineer.

H. System Acceptance:

1. General: The system installation shall be complete and tested for proper operation prior to acceptance testing "Operation Test" for the Owners authorized representative. A letter shall be submitted to the Engineer requesting system acceptance. This letter shall certify that all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing shall commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Owner's representative and pass, the system will be accepted. The warranty period may begin at this time.

I. Operation Test:

1. Provide all labor, equipment, and materials required to perform test.
2. The test shall occur after all major equipment startup and balance services have been performed as specified. The purpose is to demonstrate that individual pieces of equipment and all related elements operate as one complete system and not to identify incomplete or defective work.
3. All equipment is to be run in an automatic operating position and exercised for 72 hours to verify that they perform in accordance with the specified sequence of operation and designed operation logic.
4. The Engineer's representative shall be notified and may be present for the initiation of the test.
5. A log shall be prepared by the Contractor, to be submitted to the Engineer, of all tests including, but not limited to: time, temperatures, pressures, and other readings to prove all equipment is operating as specified.
6. All temperatures, pressures, status indication, etc., shall be verified by at least one other means of measurement or visual verification of condition.
7. Change set points and simulate conditions as directed to demonstrate:
 - a. Ability to control to new set point.
 - b. Interface between systems, fire alarm/fire sprinkler systems.
 - c. Proper sequence and operation.
 - d. Equipment safety systems and all automatic changeover/backup systems and alarms are functioning or will function.
8. If unsatisfactory performance or a system failure is experienced for any reason, the test shall be repeated until 72 hour consecutive hours are achieved. The Engineer's representative shall make all final decisions of a satisfactory test.

END OF SECTION

SECTION 23 05 19 - METERS AND GAGES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Test Plugs.

1.02 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping.

1.03 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; The American Society of Mechanical Engineers; 2013.
- B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi; The American Society of Mechanical Engineers; 2007.
- C. ASTM E1 - Standard Specification for ASTM Thermometers; 2013.
- D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2007.
- E. UL 404 - Gages, Indicating Pressure, for Compressed Gas Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 RELATED SECTIONS

- A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.
- B. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
- C. The requirements of this Section apply to all Work of Division 23.

1.05 SUBMITTALS

- A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- B. Project Record Documents: Record actual locations of components and instrumentation.

1.06 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Locate test plugs where indicated and where indicated.

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Stencils.
- B. Pipe Markers.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

1.03 RELATED SECTIONS

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1.04 SUBMITTALS

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Product Data: Provide manufacturers catalog literature for each product required.
- C. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Stencilled painting.
- B. Piping: Pipe markers.

2.02 MANUFACTURERS

- A. Brady Corporation: www.bradycorp.com.
- B. Seton Identification Products: www.seton.com/aec.

2.03 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. Ductwork and Equipment: 2-1/2 inch high letters.

2.04 PIPE MARKERS

- A. Color: Conform to ASME A13.1.
- B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- C. Color code as follows:
 - 1. Heating, Cooling, and Boiler Feedwater: Green with white letters.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

- B. Install ductwork with stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.

1.02 REFERENCE STANDARDS

- A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council; 2002.
- B. ASHRAE Std 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2008.
- C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems; National Environmental Balancing Bureau; 2005, Seventh Edition.
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association; 2002.

1.03 SUBMITTALS

- A. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component and include controls contractor to assist in testing, adjusting, and balancing procedures. Submit plan for each phase.
 - 1. Submit to LP Consulting Engineers, Inc..
 - 2. Submit two weeks prior to starting the testing, adjusting, and balancing work.
 - 3. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the LP Consulting Engineers, Inc. and other installers to sufficiently understand the design intent for each system.
 - 4. Include at least the following in the plan:
 - a. List of all water flow measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Identification and types of measurement instruments to be used and their most recent calibration date.
 - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.
 - f. Expected problems and solutions, etc.
 - g. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - h. Specific procedures that will ensure that water side is operating at the lowest possible pressures and methods to verify this.
 - i. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
- B. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

- C. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Submit to LP Consulting Engineers, Inc. within 5 days after completion of testing, adjusting, and balancing.
 - 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for LP Consulting Engineers, Inc. and for inclusion in operating and maintenance manuals.
 - 3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 5. Units of Measure: Report data in I-P (inch-pound) units only.
 - 6. Test Reports: Indicate data on AABC MN-1 forms, forms prepared following ASHRAE Std 111, or NEBB forms.
 - 7. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Project Engineer.
 - g. Project altitude.
 - h. Report date.
- D. Test and balance shall be performed by an independent test and balance agency.
- E. Perform total system balance in accordance with AABC MN-1, ASHRAE Std 111, or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
- F. TAB Agency Qualifications: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years documented experience certified by AABC or NEBB.
- G. Perform Work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor experienced in performance of this Work and licensed at the Nevada.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC MN-1, AABC National Standards for Total System Balance.
 - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
 - 4. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
- B. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- C. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of five years documented experience.
 - 3. Certified by one of the following:

- a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
- b. NEBB, National Environmental Balancing Bureau: www.nebb.org.
- c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org.

D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 TESTING, ADJUSTING, AND BALANCING AGENCIES

A. RS Analysis, 916-358-5673.

3.03 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

- 1. Systems are started and operating in a safe and normal condition.
- 2. Temperature control systems are installed complete and operable.
- 3. Proper thermal overload protection is in place for electrical equipment.
- 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
- 5. Fans are rotating correctly.
- 6. Duct system leakage is minimized.
- 7. Hydronic systems are flushed, filled, and vented.
- 8. Proper strainer baskets are clean and in place.
- 9. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.04 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to LP Consulting Engineers, Inc. to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.05 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total airflow to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 5 percent of design.

3.06 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:

- 1. Running log of events and issues.
- 2. Discrepancies, deficient or uncompleted work by others.
- 3. Contract interpretation requests.
- 4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Douglas County School District.

3.07 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities .
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

3.08 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

3.09 SCOPE

- A. Test, adjust, and balance the following:
 - 1. Air Handling Units.
 - 2. Air Inlets and Outlets.

3.10 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
 - 1. Manufacturer
 - 2. Model/Frame
 - 3. HP/BHP
 - 4. Phase, voltage, amperage; nameplate, actual, no load
 - 5. RPM
 - 6. Service factor
 - 7. Starter size, rating, heater elements
 - 8. Sheave Make/Size/Bore
- B. Cooling Coils:
 - 1. Identification/number.
 - 2. Location
 - 3. Service
 - 4. Manufacturer
 - 5. Water flow, design and actual

6. Water pressure drop, design and actual
- C. Heating Coils:
 1. Identification/number
 2. Location
 3. Service
 4. Manufacturer
 5. Air flow, design and actual
 6. Water flow, design and actual
 7. Water pressure drop, design and actual
- D. Air Moving Equipment:
 1. Location
 2. Manufacturer
 3. Model number
 4. Serial number
 5. Arrangement/Class/Discharge
 6. Air flow, specified and actual
 7. Return air flow, specified and actual
 8. Outside air flow, specified and actual
 9. Total static pressure (total external), specified and actual
 10. Inlet pressure
 11. Discharge pressure
 12. Sheave Make/Size/Bore
 13. Number of Belts/Make/Size
 14. Fan RPM
- E. Return Air/Outside Air/Exhaust Air:
 1. Identification/location
 2. Design air flow (determined by initial test)
 3. Actual air flow
 4. Design return air flow (determined by initial test)
 5. Actual return air flow
 6. Design outside air flow (determined by initial test)
 7. Actual outside air flow
- F. Air Distribution Tests:
 1. Air terminal number
 2. Room number/location
 3. Terminal type
 4. Terminal size
 5. Design air flow
 6. Test (final) air flow
 7. Percent of design air flow

END OF SECTION

SECTION 23 07 13 - DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Duct insulation.
- B. Duct Liner.

1.02 RELATED REQUIREMENTS

- A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
- B. Section 23 05 53 - Identification for HVAC Piping and Equipment.

1.03 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.
- B. ASTM C553 - Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
- D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2013.
- E. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 RELATED SECTIONS

- A. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
- B. The requirements of this Section apply to all Work of Division 23.

1.05 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum 5 years of experience .

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
 - 1. Owens-Corning Fiberglas; Model [All Service Faced Duct Wrap].
 - 2. Knauf Insulation: www.knaufusa.com.
 - 3. Johns Manville Corporation: www.jm.com.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. 'K' value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Duct Application: 2" thick, 3/4 pound density.
 - 3. Maximum Water Vapor Sorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.029 ng/Pa s m (0.02 perm inch), when tested in accordance with ASTM E96/E96M.
 - 3. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

2.03 DUCT LINER

- A. Manufacturers:
 - 1. Knauf Insulation: www.knaufusa.com.
 - 2. Johns Manville Corporation: www.jm.com.
 - 3. Owens Corning Corp: www.owenscorning.com.
- B. Insulation: Incombustible glass fiber complying with ASTM C 1071; flexible blanket; impregnated surface and edges coated with acrylic polymer shown to be fungus and bacteria resistant by testing to ASTM G 21.
 - 1. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
 - 2. Duct Application (Indoors): 1" thick, 1-1/2 pound density.
 - 3. Service Temperature: Up to 250 degrees F.
 - 4. Acoustical Requirements
 - a. Sound absorption coefficients of the material (with and/or without erosion resistive coating) shall be greater than or equal to the coefficients listed in the specifications when tested under the specified conditions.
 - b. All acoustical measurements shall be performed in accordance with ANSI/ASTM C423 and shall be performed in the ASTM E795 mounting configuration as indicated.
 - c. An independent acoustical laboratory shall perform the tests.
 - d. The sound absorption coefficient provided by the material shall meet or exceed the following values in each octave band listed:
 - 5. Thickness, 1 inch Hz/Coefficient: 125/.05, 250/.20, 500/.65, 1k/.90, 2k/.95, 4k/.95.
- C. Liner Fasteners: Galvanized steel, welded with integral head.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that ducts have been tested before applying insulation materials.

- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Insulated ducts conveying air below ambient temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. Insulated ducts conveying air above ambient temperature:
 - 1. Provide with or with standard vapor barrier jacket.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

3.03 SCHEDULES

- A. Supply and Return Ducts: Insulate all supply and return ducts including all fiber-free lined ductwork, except ducts exposed in conditioned spaces.

END OF SECTION

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2012.
- B. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
- D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2013.
- E. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 RELATED SECTIONS

- A. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
- B. The requirements of this Section apply to all Work of Division 23.

1.05 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 5 years of experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.08 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER

- A. Manufacturers:
 - 1. Knauf Insulation; Model 1000, ET Batt 1000: www.knaufusa.com.
 - 2. Johns Manville Corporation; Model _____: www.jm.com.
 - 3. Owens Corning Corp; Model _____: www.owenscorning.com.
 - 4. CertainTeed Corporation; _____: www.certainteed.com.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. "K" value: ASTM C 177:
 - a. 0.24 to 0.28 at 100 degrees mean rating temperature.
 - b. 0.25 to 0.29 at 125 degrees mean rating temperature.
 - c. 0.27 to 0.30 at 150 degrees mean rating temperature.
 - d. 0.29 to 0.31 at 200 degrees mean rating temperature.
 - e. 0.32 to 0.34 at 250 degrees mean rating temperature.
 - 2. Maximum service temperature: 1000 degrees F.
 - 3. Maximum moisture absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- D. Vapor Barrier Lap Adhesive:
 - 1. Compatible with insulation.

2.03 JACKETS

- A. PVC Plastic.
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil.
 - e. Connections: Brush on welding adhesive.
- B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with PVC fitting covers.
- C. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with vapor barrier, factory-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive.
 - 2. Insulate flanges, unions, and valves with canvas insulation blanket with wire ties for easy removal.

- D. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert location: Between support shield and piping and under the finish jacket.
 - 4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert material: Pipe saddle.
- E. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.
- F. Chilled and heating pipe : Finish with fitting covers.

3.03 SCHEDULE

- A. Heating Systems:
 - 1. Heating Water Supply and Return:
 - a. Pipe Size Range: 2 inches and smaller.
 - 1) Thickness: 1-1/2 inch.
 - b. Pipe Size Range: 2-1/2" and larger.
 - 1) Thickness: 1-1/2 inch.
- B. Cooling Systems:
 - 1. Chilled Water:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: 2-1/2" and larger.
 - (a) Thickness: 1-1/2 inch.

END OF SECTION

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Chilled water piping, above grade.
- D. Pipe hangers and supports.
- E. Unions, flanges, mechanical couplings, and dielectric connections.
- F. Valves:
 - 1. Ball valves.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.
- B. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- C. Section 23 07 19 - HVAC Piping Insulation.
- D. Section 23 21 14 - Hydronic Specialties.
- E. Section 23 25 00 - HVAC Water Treatment: Pipe cleaning.

1.03 REFERENCE STANDARDS

- A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; The American Society of Mechanical Engineers; 2013.
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2012 (ANSI B16.18).
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; 2013.
- D. ASME B31.9 - Building Services Piping; 2011 (ANSI/ASME B31.9).
- E. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2009).
- F. ASTM B32 - Standard Specification for Solder Metal; 2008.
- G. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2009.
- H. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2013).
- I. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.
- J. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.

1.04 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- C. Use non-conducting dielectric connections whenever jointing dissimilar metals in open and closed systems.
- D. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.

- E. Use ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- F. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

1.05 RELATED SECTIONS

- A. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
- B. The requirements of this Section apply to all Work of Division 23.

1.06 SUBMITTALS

- A. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.
- B. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- C. Project Record Documents: Record actual locations of valves.
- D. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum five years of experience.
- C. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.
- D. Coupling Manufacturer:
 - 1. Perform on-site training by factory-trained representative to the Contractor's field personnel in the proper use of grooving tools and installation of grooved joint products.
 - 2. Periodic job site visits by factory-trained representative to ensure best practices in grooved joint installation.
- E. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

1.08 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
- C. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:

1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 2. Use non-conducting dielectric connections whenever joining dissimilar metals.
 3. Grooved mechanical joints are required in accessible locations and not permitted in other locations.
 - a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by LP Consulting Engineers, Inc..
 - b. Use rigid joints unless otherwise indicated.
 4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges or unions to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections as shown on plans and as required.
1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.
- D. Valves: Provide valves where indicated:
1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.
 2. For shut-off and to isolate parts of systems or vertical risers, use ball valves.

2.02 HEATING WATER PIPING, ABOVE GROUND

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
 2. Joints: For sizes 1-1/2" and smaller, Solder, lead free, ASTM B 32, 95-5 tin-antimony, or tin and silver.
 3. Joints: For sizes 2" and larger, AWS A5.8, BCuP-5 silver braze.

2.03 CHILLED WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), hard drawn; using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22, solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
 2. Joints: For sizes 1-1/2" and smaller, For sizes 1-1/2" and smaller, For sizes 1-1/2" and smaller,
 3. Joints: For sizes 2" and larger, AWS A5.8, BCuP-5 silver braze.

2.04 EQUIPMENT DRAINS, OVERFLOWS, COOLING TOWER RECIRCULATION PIPING

- A. Copper Tube (1 inch and smaller): ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

2.05 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon steel, adjustable swivel, split ring.
- C. Hangers for Pipe sizes 2 inches as over: Carbon steel, adjustable, clevis.
- D. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- E. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- F. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.06 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe 1-1/2 Inches and Under:
 1. Ferrous Piping: 150 psig malleable iron, threaded.
 2. Copper Pipe: Bronze, soldered joints.
- B. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 1. Dimensions and Testing: In accordance with AWWA C606.
 2. Mechanical Couplings: Comply with ASTM F1476.
 3. Housing Material: Ductile iron complying with ASTM A536.
 4. Gasket Material: EPDM suitable for operating temperature range from -30 degrees F to 230 degrees F.
 5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
 6. When pipe is field grooved, provide coupling manufacturer's grooving tools.

2.07 BALL VALVES

- A. Manufacturers:
 1. Milwaukee Valve Company.
 2. Hammond.
 3. Stockham.
- B. Up To and Including 2 Inches:
 1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.
- C. Over 2 Inches:
 1. Ductile iron body, chrome plated stainless steel ball, teflon, Virgin TFE, or _____ seat and stuffing box seals, lever handle, gear operated, or _____, flanged ends, rated to 800 psi.
 2. Bronze two piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union., 150 PSI saturated steam, 600 PSI non-shock cold water

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment using jointing system specified.

- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- F. After completion, fill, clean, and treat systems. See Pipe Cleaning Sequence below for additional requirements.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install chilled water and heating water piping to ASME B31.9 requirements.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and to avoid interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipe passing through partitions, walls and floors.
- G. Slope piping and arrange to drain at low points.
- H. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 19.
- J. Install valves with stems upright or horizontal, not inverted.

END OF SECTION

SECTION 23 21 14 - HYDRONIC SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Strainers.
- B. Pressure-temperature test plugs.
- C. Balancing valves.

1.02 RELATED REQUIREMENTS

- A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
- B. Section 23 21 13 - Hydronic Piping.

1.03 REFERENCE STANDARDS

1.04 RELATED SECTIONS

- A. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
- B. The requirements of this Section apply to all Work of Division 23.

1.05 SUBMITTALS

- A. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.
- B. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- C. Project Record Documents: Record actual locations of flow controls.
- D. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 STRAINERS

- A. Manufacturers:
 - 1. Bailey.
 - 2. Armstrong International, Inc: www.armstronginternational.com.
- B. Size 2 inch and Under:
 - 1. Screwed brass for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

2.02 PRESSURE-TEMPERATURE TEST PLUGS

- A. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.
- B. Application: Use extended length plugs to clear insulated piping.

2.03 CALIBRATED BALANCE VALVES

- A. Manufacturers:
 - 1. Armstrong International; Model _____: www.armstronginternational.com
 - 2. ITT Bell & Gossett: www.bellgossett.com.
- B. All valves to be of bronze body/brass ball construction with glass and carbon filled TFE seat rings. Valves to have differential pressure read-out ports across valve seat area. Read-out ports to be fitted with internal EPT insert and check valve. Valve bodies to have 1/4" NPT tapped drain/purge port.
- C. Valves shall have a memory stop feature to allow valve to be closed for service and then reopened to setpoint without disturbing balance position.
- D. All valves to have calibrated nameplate to assure specific valve setting.
- E. Valves to be leak-tight at full rated working pressure.
- F. All valves to be provided with molded insulation to permit access for balance and read-out.
- G. Construction: Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain.
- H. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Provide manual air vents at system high points and as indicated.
- C. Provide valved drain and hose connection on strainer blow down connection.

END OF SECTION

SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal ductwork.

1.02 RELATED REQUIREMENTS

- A. Section 230713 - Duct Insulation.
- B. Section 23 33 00 - Air Duct Accessories.
- C. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.
- C. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association; 2012.
- D. SMACNA (DCS) - HVAC Duct Construction Standards; 2005.
- E. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication & Installation Guidelines; 2001.
- F. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 RELATED SECTIONS

- A. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
- B. The requirements of this Section apply to all Work of Division 23.

1.05 SUBMITTALS

- A. Product Data: Provide data for duct materials.
- B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of experience.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 5 years of documented experience.

1.07 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

2.02 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

2.03 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. Round ductwork shall be spiral lockseam, 24 gauge minimum. Round ductwork exposed within occupied spaces shall be spiral lockseam, 20 gauge minimum.
- D. Rectangular ductwork exposed within occupied spaces shall be 20 gauge minimum.
- E. Ductwork exposed within occupied spaces shall be internally sealed to provide a clean exterior appearance.
- F. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- G. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards.
- H. Fittings shall be spot welded and internally sealed.
- I. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards.
- B. Indoor Applications: Seal all standing seams and transverse joints in all sheetmetal ductwork with Hardcast "Iron Grip" premium flexible water based duct sealant.
- C. Use double nuts and lock washers on threaded rod supports.

END OF SECTION

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flexible duct connections.

1.02 RELATED REQUIREMENTS

- A. Section 23 31 00 - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.
- B. SMACNA (DCS) - HVAC Duct Construction Standards; 2005.

1.04 RELATED SECTIONS

- A. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
- B. The requirements of this Section apply to all Work of Division 23.

1.05 SUBMITTALS

- A. Product Data: Provide for shop fabricated assemblies including hardware used. Include electrical characteristics and connection requirements.

1.06 PROJECT RECORD DOCUMENTS

- A. Record actual locations of access doors and test holes.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- B. Flexible Duct Connections (Indoors): Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
 - a. Net Fabric Width: Approximately 3 inches wide.
 - 2. Metal: 3 inches wide, 24 gage thick galvanized steel.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards. Refer to Section 23 31 00 for duct construction and pressure class.

- B. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

END OF SECTION

SECTION 26 01 10 - GENERAL REQUIREMENTS, ELECTRICAL

PART 1 GENERAL

1.01 CONTRACT PROVISIONS

- A. The requirements of this Section are in addition to the requirements of Division 1, General Conditions and Supplementary Conditions.

1.02 SUMMARY

- A. This section describes the requirements for the electrical work includes, among others, the furnishing and installation of the following:
 - 1. Wiring systems including power wiring to plumbing and HVAC and other misc. appliances and equipment.
 - 2. Testing and commissioning.
- B. Furnish and install all electrical equipment and systems as shown on the Drawings and as described in this Division of the Specifications to provide a complete and functional electrical installation. This work includes but is not limited to all material and labor required for installation of electrical and special systems complete as described herein this specification and drawings; and connections (and installation where not otherwise provided for) of electrical equipment furnished by others. Provide and install all items of equipment, devices, supports, etc., which are incidental to the major components shown on the Drawings or described in these Specifications.

1.03 RELATED WORK INCLUDED IN OTHER DIVISIONS

- A. Finish painting except factory applied finishes and repair of factory finishes shall be provided in accordance with appropriate sections of this Specification. Coordinate "painting" requirements of this Division with other trades as required to assure timely and satisfactory completion of required work. In finished areas, all exposed raceway, boxes, galvanized steel box covers (where allowed), and other electrical "structure" shall be finished to match adjacent structures. Verify that all raceway openings are closed and box covers are in place prior to finishing work done by others.
- B. Examine the drawings and specification for mechanical equipment and provide electrical installation for applicable heating, ventilation and air conditioning equipment, motors, pumps and associated motor starters and controls as described in Division 23.
- C. Provide and install, as part of the work described in this Division, all power and control wiring fed from a source of 30 Volts or more (i.e. all wiring except temperature control wiring) for mechanical equipment described in Division 23.

1.04 APPLICATION OF OTHER DIVISIONS

- A. Where carpentry, masonry, concrete work, painting, etc., is required in the installation of equipment specified under this Division, the work shall be done in accordance with the applicable Division of these Specifications. This work could include for example: work associated with panel board installation, equipment pads or bases, support structures, etc.

1.05 DRAWINGS AND SPECIFICATIONS

- A. The information presented in these Specifications and on the Drawings is intended to describe the utilitarian and physical aspects of the systems shown as well as the quality of the entire installation. All information is as complete and thorough as possible, but every condition or situation cannot be anticipated. Exact locations, dimensions, elevations, etc. must be determined "on the job" with careful attention to the "intent" of the Drawings and Specifications.
- B. The above paragraph shall not be construed as to allow significant deviation from either the Drawings or Specifications without prior approval of the engineer, but minor changes in conduit

routing or equipment locations may be required or desired due to specific conditions encountered. This work shall be accomplished in accordance with these Specifications and no "extra charges" are to be created for any unanticipated labor or material.

- C. Any error or omissions of detail in either the drawings or the specifications shall not relieve the Contractor from correctly installing all materials necessary for complete and operating electrical systems.
- D. Contractor shall inspect the site and verify all measurements and conditions. No extra compensation will be allowed because of differences between work shown on the drawings and measurements at the site.
 - 1. The Drawings are diagrammatic in nature, but the locations of devices, equipment, and outlets are shown approximately where installations are intended. Mechanical, and other drawings shall be examined, noting all conditions that may affect this work. Report conflicting conditions to the Engineer for adjustment before proceeding with the work. Should the Contractor proceed with work without reporting the matter, he does so on his own responsibility and shall alter work if directed by the Engineer at his own expense.
- E. Examine the mechanical, and manufacturer's drawings for various equipment in order to determine exact routing and final terminations for all conduits and cables. Conduits shall be stubbed up as near as possible to equipment enclosure.
- F. Where conduits cannot be run concealed in wall and/or ceiling space, the Contractor shall coordinate with the Engineer for installing and routing of exposed conduits.
- G. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The District reserves the right to require minor changes in location of outlets or equipment, prior to rough in without incurring any additional cost or changes.
- H. If significant departures from the Drawings or Specifications are considered necessary by the Contractor, details of the changes and the reasons therefore shall be submitted to the Engineer as within thirty days after award of contract. Prior written acceptance of the Engineer is required for these departures.
- I. Clarification of plans and specifications for the purpose of facilitating construction, but not involving additional labor and materials, may be prepared during construction by the Engineer. Said revised plans and specifications shall become a part of the contract. The Contractor shall conform to the revised plans and specifications at no additional cost to the District.
- J. Where existing underground or otherwise concealed facilities are indicated on the Drawings, these are located as well as can be determined from available information. The Contractor is required to verify actual locations as necessary for this construction.

1.06 CODES, STANDARDS, RULES AND REGULATIONS

- A. All work and materials shall be in full accordance with the latest rules, codes, and/or regulations and not limited to the following:
- B. NFPA 70 - National Electrical Code (NEC).
- C. NFPA 101 - Life Safety Code
- D. NFPA 72 - Fire Alarm Code
- E. International Building Code (IBC)
- F. City or County Electrical Code as applicable.
- G. Utility rules and regulations.
- H. Any applicable additional codes and regulatory documents effective at the project site.
- I. Nothing on the Drawings or in the Specifications shall be construed to allow work not in conformance with these rules, codes, and regulations.

- J. The Drawings and/or Specifications shall take precedence where work and material described therein exceeds that required by rules, codes, or regulations.

1.07 MANUFACTURER'S INSTRUCTIONS

- A. Follow the manufacturer's instructions when specific installation or connection details are not indicated or specified on the contract documents.
- B. Notify the Engineer of conflicts between the manufacturer's instructions and installation or connection details prior to the installation of materials.

1.08 WORKMANSHIP

- A. High quality workmanship shall be evidenced in the installation of all electrical equipment and materials. Use the National Electrical Contractors Association's "Standard of Installation" as a guide to the workmanship required. Be prepared to replace or repair any material or equipment damaged by or installed in a manner exhibiting evidence of poor workmanship.

1.09 COORDINATION WITH OTHER TRADES

- A. Examine the Electrical Drawings and refer to the Drawings and Specifications describing other work to be accomplished. Verify and coordinate prior to bid. Continue to coordinate work planning and all work in the field to avoid conflicts, errors, and/or delays. No compensation will be allowed for extra work necessitated by lack of coordination.

1.10 AUTHORITY OF THE ENGINEER

- A. As used in this paragraph only, the word "Engineer" shall mean the Engineer of record or his designated representative.
- B. The authority of the Engineer shall be absolute with respect to all performance under this Specification. In case of dispute, the decision of the Engineer shall be final.
- C. Where optional materials, methods, or installation techniques are allowed under the provisions of this Specification, they may be used at the discretion of the Engineer. The Engineer may require specific materials, methods, or techniques to be used in specific situations where use of other materials, methods, or techniques might in his judgment result in loss of aesthetics, accidental damage, life safety hazard, or loss of utility over the system design lifetime.
- D. No additional charges will be allowed for work or material require to be supplied under the conditions of this paragraph unless the need for such material or work could not have been anticipated by thorough study of the site, Drawings, and Specifications and knowledge of all applicable codes, laws, and ordinances.

1.11 EXAMINATION OF THE SITE

- A. The contractor is required to visit the site of construction prior to bid to determine existing conditions and their effect upon the work he will be required to perform. No additional compensation will be allowed for any extra expenses incurred by failure to detect and evaluate all existing conditions that will affect his work to be included in the bid to accomplish this contract document's goal.

1.12 STRUCTURAL REQUIREMENTS

- A. Secure all anchors for electrical equipment in a manner, which will not decrease the structural value of any structure to an unsafe level. Install all equipment, fixtures, and etc. to resist seismic movements. Inform the Engineer in advance and provide drawings of any proposed modifications to the structure that involves cutting or patching of concrete, masonry, steel, or wood in this project.

1.13 PERMITS, FEES, AND INSPECTIONS

- A. Obtain all permits and licenses as required and pay all fees incidental to construction.
- B. All required utility fees and extension charges shall be determined and itemized for payment by the owner as required. A complete itemized list of these fees and charges shall be provided

with the bid including the amounts to be paid where these amounts can be determined prior to the bid.

- C. Inspections required by Utilities, prevailing Local Authorities, and/or ordinances, shall be coordinated and arranged by the contractor. Provide the Engineer with a schedule of inspections, where applicable, and submit all certificates of inspection to the Engineer.
- D. The Contractor shall cooperate with the Engineer and shall provide assistance at all times for the inspection of the electrical work. Remove covers, operate equipment, or perform any reasonable work, which, in the opinion of the Engineer, will be necessary to determine the quality or adequacy of the work. Work shall not be closed in or covered before inspection and approval by the Engineer. Cost of uncovering and making repairs where un-inspected work has been closed in shall be borne by the Contractor. If any material does not conform with these specifications the Contractor shall, within three days after being notified by the Engineer, remove the materials from the premises.

1.14 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable to District. Secure material from weather or accidental damage.

1.15 OPERATING INSTRUCTIONS

- A. Instruct the District as to function, operation, maintenance, and adjustment of each system and piece of equipment provided.

1.16 RECORD DRAWING

- A. The Contractor shall keep a separate set of Electrical Drawings at the job site to be used as RECORD Drawings. These Drawings are to be kept current and in a neat and clean condition at all times. They are to be available for inspection by the Engineer at any time during site visitations. These Drawings shall be "red lined" to indicate all changes in equipment, device, and outlet locations; and to indicate the true locations of all concealed or underground work where different from that shown on the Drawings. Each sheet of this set shall be clearly and permanently marked "RECORD DRAWINGS".
- B. Upon completion of the project and prior to final payment, transfer all RECORD DRAWINGS information to the provided original drawings. All information shall be clearly drawn with "RED" ink. The drawings shall be scanned, 100% edited, and converted into an AutoCAD ".dwg" version 2002 (or higher) electronic file. Deliver the original, final sets, and electronic files (CD) to the Engineer for review and delivery to the District.

1.17 GUARANTEE

- A. All electrical work, material, and equipment shall be guaranteed to be free from defects in workmanship or material for a period of two (2) year from the date of final acceptance. Repair or replace all such defects in a timely manner and any damage to the owner's property resulting from such defect or repair thereof. All equipment and material provided and all work accomplished under the requirements of this section shall be at no expense to the District.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Unless specifically indicated otherwise, all material shall be new and free from defects; it shall be listed by Underwriters' Laboratories where applicable. Like items shall be of the same manufacturer.
- B. Except as noted otherwise, where material of a particular manufacturer is specified, the intent is to describe the quality and function of the item. The term "...or acceptable equal" is implied. A substitution of any of these items will require that the item be presented in a submittal whether

specifically listed in the "Submittals" paragraph below or not.

2.02 SUBMITTALS

- A. Material submittals shall be complete and submitted all at the same time. The individual groups of submittal types (e.g.: wiring devices, conduit, etc.) MUST be prefaced with a list of contents identifying each item by it's project name or symbol, manufacturer, and complete catalog number. Each copy of each submittal group shall have the list of contents attached. These lists will be used to report submittal comments. The Contractor is responsible for submitting this information in a timely manner so that material may be ordered early enough to meet the construction schedule. If material is not ordered in time for whatever reason, pay such premium prices and special handling charges as are required to meet the construction schedule. No substitution of an "accepted" item will be allowed due to failure to plan for adequate material procurement lead time.
- B. Shop drawings shall be drawn to scale or completely dimensioned and shall give all information required to completely describe the item. The Contractor shall carefully check all the shop drawings for compliance with these specifications and the Plans.
- C. If the shop drawings show variations from the Contract requirements because of standard shop practice or other reasons, the Contractor shall make specific mention of such variations in order that if (acceptable) suitable action may be taken for proper adjustment of the Contract. The Contractor will not be relieved of the responsibility for executing the work in accordance with the Contract, even though the shop drawings have been reviewed.
- D. Work requiring shop drawings shall not be started before receipt of the Engineer's review and acceptance.
- E. The Engineer's review of the submitted materials, items and shop drawings are for general compliance with the plans and specifications and general design and arrangement only. Therefore, it shall not relieve the Contractor from responsibility for errors of any sort in the materials, items, shop drawings or schedules. The Contractor shall verify all dimensions and job site conditions affecting the work, and shall be responsible for furnishing and installing the proper materials required by the Contract, whether or not indicated on the drawings and specifications.
- F. As a minimum, submittals are required for the following items:
 - 1. RACEWAY COMPONENTS
 - 2. WIRE AND CABLE
 - 3. WIRING DEVICES
 - 4. PULL BOXES
 - 5. SAFETY SWITCHES, DISCONNECTS AND CIRCUIT BREAKERS

2.03 SUBSTITUTIONS

- A. Specific brand names and catalog numbers are used to describe materials in order to establish of performance and quality.
- B. Only one substitution will be considered for any item. Substitute materials must be equal in quality and function to that specified. Allowance of a substitution does not permit any reduction of system performance or utility, and the Contractor is responsible for additional costs incurred due to use of a substituted item. If the proposed substitute item is "rejected", the specified item shall be provided (re-submittal required) without further discussions or delay.
- C. Any Contractor's proposed substitution of material, article, or method in the opinion of the Engineer are equal to that specified will be accepted, provided the Contractor submits a single written requests, in triplicate, to the Engineer, with the following information for each item:
 - 1. Name of Manufacturer or supplier.

2. Trade or brand names.
 3. Type, model, style, and/or catalog number.
 4. Size or capacity rating.
- D. After receipt of a written request from the contractor, the engineer of record will review product substitutions fourteen (14) days prior to the bid date. If system substitutions are submitted after the award of the project contract, the analysis for the whole system substitution will be charged to the contractor at senior engineer hourly rates.
- E. The decision of the Engineer shall govern as to what is equal to the item specified in the plans and specifications. Equality will be judge on the basis of the following:
1. Conformance with description or performance required.
 2. Equal in quality.
 3. Comparable in appearance and artistic effect where these are in considerations.
 4. Comparable operation, maintenance and performance.
 5. Equal in longevity and service under conditions of climate and usage.
 6. Conformance with space allocations and requirements for operations from in details and construction of related work.
 7. Conformance with all applicable codes and regulations.
- F. If the Engineer considers it necessary, tests to determine the quality of the proposed materials shall be made, at the expense of the Contractor, by an unbiased laboratory, satisfactory to the Engineer.

2.04 ENCLOSURES

- A. Provide enclosures suitable for the specific type of location in which they are installed.
1. Provide NEMA 1 or NEMA 12 boxes and enclosures for dry locations. Dry locations are all indoor areas that do not fall within the definitions below for wet or damp locations.
 2. Provide NEMA 3R boxes and enclosures for wet locations. Wet locations are all locations exposed to weather, whether under a roof or not.
 3. Provide NEMA 4 boxes and enclosures for damp locations. Damp locations are all indoor spaces wholly or partially underground or any area subject to water spray.

PART 3 EXECUTION

3.01 INSTALLATION

- A. All equipment shall be set square and plumb, securely mounted, adequately supported, and permanent. Provide workspace around items of electrical equipment as required by National Electrical Code (NEC). In general, equipment is to be installed in accordance with manufacturer's instructions; but the requirements of these specifications shall take precedence where conflicts exist.

3.02 WIRING METHODS: THE CABLES AND CONDUCTORS OF ALL SYSTEMS SPECIFIED IN THE SPECIFICATION ARE REQUIRED TO BE INSTALLED IN RACEWAY.

3.03 ELECTRICAL WORK FOR EQUIPMENT PROVIDED UNDER OTHER SECTIONS

- A. Install power conductors and terminate on equipment provided under other specification sections. Verify specific requirements.
- B. Install and terminate electrical controls as described on the Electrical Drawings (For mechanical equipment specified in Division 23).
- C. Line voltage control wiring of exhaust fans is to be accomplished under this Division. The

controlling device may be specified elsewhere.

- D. Provide and install all disconnect/safety switches and motor starters except those devices specified to be furnished with equipment specified elsewhere.
- E. Unless provided for in another Division, install all items of electrical equipment provided by others.
- F. Assist others in equipment testing to verify that wiring and connections made under this Division are correct.

3.04 EQUIPMENT IDENTIFICATION

- A. Nameplates shall be installed on all items of electrical equipment as follows: motor control center(s), circuit breakers and motor starters, panelboards, contactors, motor control switches, wall switches (where noted on the Drawings), motor starters provided under this Division where the function is not immediately obvious, and safety switches.
- B. The nameplate shall identify the item by Drawing name where applicable and describe its use or function in this installation.
- C. Nameplate information may be engraved directly on device plates where noted on the Drawings or be provided on an engraved phenolic nameplate. Minimum letter size is 3/16" for use on wall plates, manual motor starters, pushbutton stations, etc., and 1/4" high for use on larger equipment.
- D. The engraved plastic nameplates shall be black with white letters (lamine layer). Nameplates shall be secured to equipment with plated self-tapping screws; bolts, nuts, and locking washers. Nameplates secured with contact cement only, will NOT be acceptable.
- E. Permanently mark all utility outlets to show source of power panel and circuit breaker number.

3.05 SEALING PENETRATIONS

- A. Flash and counter flash roof and wall penetrations with equipment manufactured for the purpose and as described in other Divisions of these Specifications or as Directed by the Engineer. Apply mastic as required to seal absolutely watertight.
- B. Conduits penetrating floor slabs or block or concrete walls shall be grouted and sealed watertight.

3.06 EQUIPMENT ANCHORING

- A. Seismic Withstand Requirements: Freestanding or wall-hung equipment shall be anchored in place by methods, which will meet the requirements of the Uniform Building code for seismic loads. The CONTRACTOR shall submit calculations in accordance with "Contractor Submittals", for the design of the anchoring systems for all equipment, including panels, transformers, etc. in excess of 250 pounds. Calculations shall be performed, signed and stamped by a Structural Engineer or a Civil Engineer experienced in structural design and licensed in the State of California. The calculation shall provide an analysis of lateral and overturning forces and shall include a factor of safety against overturning equal to 1.5. The calculation shall also provide an analysis of both the anchoring system and the foundation or wall system to receive the anchor loads and shall show that the foundation is capable of resisting all anchor loads. Submittal shall include data on attachment hardware and methods that will satisfy withstand criteria.
- B. Seismic bracing for light fixtures cable or pendant suspended from ceiling or roof structure shall be seismically braced to prevent fixture from swaying 45 degree in either direction of suspension point. Contractor shall use same cable used to suspend light fixture. Where pendants are use the contractor shall use air craft light fixture suspension cable. Submittal shall include data on attachment hardware and methods that will satisfy withstand criteria referred to in above paragraph.

3.07 PROTECTION CLEANING AND REPAIRS

- A. All electrical equipment shall be protected from damage or degradation during construction. Electrical equipment stored or installed shall be protected from dust, water, or damage from other sources.
- B. After all other work has been accomplished, such as plastering, painting, etc., and prior to final review by the Engineer; all electrical equipment, especially equipment enclosures and motor control centers shall be thoroughly cleaned (inside and out) of all dirt, water, grease, plaster, paint, or other construction debris. All surfaces shall be clean and in "new" condition. All scratches, dents, marks, cracks, etc., shall be repaired to the satisfaction of the Engineer or the equipment shall be replaced at no additional cost.

3.10 ELECTRICAL EQUIPMENT DELIVERABLES

- A. Retain and safeguard all detachable and spare devices, equipment, and literature (O&M manuals, instruction books, wiring diagrams, test reports, keys, fixtures, etc.) until completion of work. At this time, all items will be delivered to the District as directed by the Engineer.

3.11 TESTS

- A. Prior to energization of equipment, check the insulation resistance of listed circuits, with a 500 volt "Megger".
- B. Take precaution during the testing period to insure the safety of personnel and equipment.
- C. Test all wiring for continuity and grounds before any equipment are connected. Where such tests indicate faulty installation or other defects, the fault(s) shall be located and repaired at the Contractor's expense. The repaired installation shall then be retested.
- D. Verify rotation of all three phase motors and reconnect if necessary.
- E. Verify the resistance of the grounding electrode system(s).
- F. Balance all loads on each panel board and all other types of distribution equipment as applicable.

END OF SECTION 260110

SECTION 260501 - MINOR ELECTRICAL DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical demolition.

1.02 RELATED REQUIREMENTS

- A. Section 017000 - Execution and Closeout Requirements: Additional requirements for alterations work.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation and existing record documents.
- D. Report discrepancies to Douglas County School District before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- E. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- F. Repair adjacent construction and finishes damaged during demolition and extension work.
- G. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- H. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or that are to be reused.
- B. Motor Control Centers: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

END OF SECTION 260501

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 V AND LESS)

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wire and cable for 600 volts and less.
- B. Wiring connectors and connections.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 260553 - Identification for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association.
- B. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency.
- D. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.
- E. Project Record Documents: Record actual locations of components and circuits.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify LP Consulting Engineers and obtain direction

before proceeding with work.

- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
- C. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 WIRING REQUIREMENTS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Metal-clad cable is not permitted.
- E. Concealed Dry Interior Locations: Use only building wire in raceway.
- F. Exposed Dry Interior Locations: Use only building wire in raceway.
- G. Above Accessible Ceilings: Use only building wire in raceway.
- H. Wet or Damp Interior Locations: Use only building wire in raceway.
- I. Exterior Locations: Use only building wire with Type THWN insulation in raceway.
- J. Underground Installations: Use only building wire with Type THWN insulation in raceway.
- K. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- L. Use stranded conductors for control circuits.
- M. Use conductor not smaller than 12 AWG for power and lighting circuits.
- N. Use conductor not smaller than 16 AWG for control circuits.
- O. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.
- P. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
- Q. Conductor sizes are based on copper unless indicated as aluminum or "AL".

2.02 WIRE MANUFACTURERS

- A. Cerro Wire Inc: www.cerrowire.com.
- B. Industrial Wire & Cable, Inc: www.iewc.com.
- C. Southwire Company: www.southwire.com.
- D. Or Equal.
- E. Substitutions: See Section 016000 - Product Requirements.

2.03 ALL CONDUCTORS AND CABLES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- C. Provide new conductors and cables manufactured not more than one year prior to installation.
- D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- E. Comply with NEMA WC 70.

- F. Comply with FS A-A-59544 where applicable.
- G. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.

2.04 BUILDING WIRE

- A. Manufacturers:
 - 1. Copper Building Wire:
 - a. Cerro Wire LLC: www.cerrowire.com.
 - b. Encore Wire Corporation: www.encorewire.com.
 - c. Southwire Company: www.southwire.com.
 - d. Or accepted equal..
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
- D. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
 - a. Size 4 AWG and Larger: Type XHHW-2.
 - b. Installed Underground: Type XHHW-2.
 - c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.
- E. Conductor: Copper.
 - 1. For Sizes Smaller Than 4 AWG: Copper.
 - 2. For Sizes 4 AWG and Larger: Copper.
- F. Insulation Voltage Rating: 600 volts.
- G. Insulation: NFPA 70, National Electrical Code, Type THW.

2.05 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- C. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
 - 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less

than required for the rating of the overcurrent protective device.

4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
7. Conductors for Control Circuits: Use crimped terminals for all connections.

2.06 WIRING ACCESSORIES

- A. Electrical Tape:
 1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 2. Vinyl Insulating Electrical Tape: Complying with ASTM D 3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
- B. Wire nuts for joints, splices, and taps for conductors No. 8 and smaller shall consist of a cone shaped expandable coil spring insert, insulated with a Teflon or plastic shell. Threaded or crimp types will not be accepted. Use "Skotchlock", "Hydent", or equal.
- C. Terminals for stranded conductors No. 8 and smaller shall be a pre-insulated crimp type.
- D. Lugs and connectors for conductors No. 6 and larger shall be compression types of one-piece tubular construction with flat rectangular tongues. Two hole lugs shall be used for sizes 4/0 and larger. Fittings for copper conductors shall be tin-plated aluminum, factory filled with a corrosion inhibiting oxide penetrating compound.
- E. Electrical tape shall be UL approved plastic.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that raceway installation is complete and supported.
- E. Verify that field measurements are as indicated.

3.02 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.03 INSTALLATION

- A. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.
- B. Route wire and cable as required to meet project conditions.
 1. Wire and cable routing indicated is approximate unless dimensioned.
 2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
 3. Include wire and cable of lengths required to install connected devices within 10 ft of

location shown.

- C. Use wiring methods indicated.
- D. Pull all conductors into raceway at same time.
- E. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- F. Protect exposed cable from damage.
- G. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
- H. Use suitable cable fittings and connectors.
- I. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- J. Clean conductor surfaces before installing lugs and connectors.
- K. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- L. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- M. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- N. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- O. Identify and color code wire and cable under provisions of Section 260553. Identify each conductor with its circuit number or other designation indicated.

3.04 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 014000.
- B. Inspect and test in accordance with NETA STD ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

END OF SECTION 260519

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Conduit and equipment supports.
- B. Anchors and fasteners.

1.02 REFERENCE STANDARDS

- A. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2009.
- B. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2010
- C. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.
- D. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Thomas & Betts Corporation: www.tnb.com.
- B. Threaded Rod Company: www.threadedrod.com.
- C. Substitutions: See Section 016000 - Product Requirements.

2.02 SUPPORTS

- A. Pipe hangers for individual conduits shall be factory made, consisting of a pipe ring and threaded suspension rod. The pipe ring shall be malleable iron, split and hinged, or shall be springable wrought steel. Rings shall be bolted to or interlocked with the suspension rod socket.
- B. Pipe racks for groups of parallel conduits shall be constructed of galvanized structural steel preformed channels of length as required, suspended on threaded rods and secured thereto with nuts above and below the cross bar.
- C. Factory made pipe straps shall be one hole malleable iron or two hole galvanized clamps.
- D. Supporting rods shall be at least 3/8" diameter and channel shall be at least 3/4" deep. Supporting hardware shall be galvanized steel.

2.03 MATERIALS

- A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
- B. Supports: Fabricated of structural steel or formed steel members; galvanized.

- C. Anchors and Fasteners:
- D. Concrete Structural Elements: Use precast inserts, expansion anchors, powder-actuated anchors, or preset inserts.
- E. Steel Structural Elements: Use beam clamps, steel spring clips, steel ramset fasteners, or welded fasteners.
- F. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
- G. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
- H. Solid Masonry Walls: Use expansion anchors or preset inserts.
- I. Sheet Metal: Use sheet metal screws.
- J. Wood Elements: Use wood screws.
- K. Fastener Types:
 - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 - 5. Other Types: As required.
- L. Formed Steel Channel:
- M. Substitutions: See Section 016000 - Product Requirements.
- N. Powder-Actuated Anchors:
- O. Substitutions: See Section 016000 - Product Requirements.
- P. Steel Spring Clips:
- Q. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
 - 1. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
 - 2. Obtain permission from the Engineer before drilling or cutting structural members.
- B. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- C. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- D. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1 inch off wall.
- E. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION 260529

SECTION 260534 - CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Conduit, fittings and conduit bodies.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems.
- E. Section 260537 - Boxes.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT).
- C. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC).
- D. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association.
- E. NECA 101 - Standard for Installing Steel Conduit (Rigid, IMC, EMT); National Electrical Contractors Association.
- F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association.
- G. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; National Electrical Manufacturers Association.
- H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit; National Electrical Manufacturers Association.
- I. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing; National Electrical Manufacturers Association.
- J. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, nonmetallic conduit, fittings, and conduit bodies.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept conduit on site. Inspect for damage.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

PART 2 PRODUCTS

2.01 CONDUIT REQUIREMENTS

CONDUIT

260534-1

- A. Conduit Size: Comply with NFPA 70, National Electrical Code (NEC).
 - 1. Minimum Size: 3/4 inch unless otherwise specified.
- B. Underground Installations:
 - 1. More than 5 Feet from Foundation Wall: Use plastic coated conduit or thickwall non-metallic conduit.
 - 2. Within 5 Feet from Foundation Wall: Use rigid steel conduit.
 - 3. In or Under Slab on Grade: Use plastic coated conduit or thickwall non-metallic conduit.
 - 4. Minimum Size: 1 inch.
- C. Outdoor Locations Above Grade: Use rigid steel conduit or intermediate metal conduit.
- D. In Slab Above Grade:
 - 1. Use intermediate metal conduit or thickwall nonmetallic conduit.
 - 2. Maximum Size Conduit in Slab: 3/4 inch; 1/2 inch for conduits crossing each other.
- E. Wet and Damp Locations: Use rigid steel conduit or intermediate metal conduit.
- F. Dry Locations:
 - 1. Concealed: Use electrical metallic tubing.
 - 2. Exposed: Use rigid steel conduit or intermediate metal conduit.

2.02 METAL CONDUIT

- A. Manufacturers:
 - 1. Allied Tube & Conduit: www.alliedtube.com.
 - 2. Beck Manufacturing, Inc: www.beckmfg.com.
 - 3. Wheatland Tube Company: www.wheatland.com.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Intermediate Metal Conduit (IMC): Rigid steel.
- D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.03 PVC COATED METAL CONDUIT

- A. Manufacturers:
 - 1. Allied Tube & Conduit: www.alliedtube.com.
 - 2. Thomas & Betts Corporation: www.tnb.com.
 - 3. Robroy Industries: www.robroy.com.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NEMA RN 1; rigid steel conduit with external PVC coating.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.04 FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc: www.afcweb.com.
 - 2. Electri-Flex Company: www.electriflex.com.
 - 3. International Metal Hose: www.metalhose.com.
 - 4. Substitutions: See Section 016000 - Product Requirements.

- B. Description: Interlocked steel construction.
- C. Fittings: NEMA FB 1.

2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc: www.afcweb.com.
 - 2. Electri-Flex Company: www.electriflex.com.
 - 3. International Metal Hose: www.metalhose.com.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: Interlocked steel construction with PVC jacket.
- C. Fittings: NEMA FB 1.

2.06 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Allied Tube & Conduit: www.alliedtube.com.
 - 2. Beck Manufacturing, Inc: www.beckmfg.com.
 - 3. Wheatland Tube Company: www.wheatland.com.
- B. Description: ANSI C80.3; galvanized tubing.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron compression type.

2.07 NONMETALLIC TUBING SHALL NOT BE USED FOR THIS PROJECT, NO EXCEPTIONS.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

- A. Install conduit securely, in a neat and workmanlike manner, as specified in NECA 1.
- B. Install steel conduit as specified in NECA 101.
- C. Arrange supports to prevent misalignment during wiring installation.
- D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- E. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- F. Fasten conduit supports to building structure and surfaces under provisions of Section 260529.
- G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- H. Do not attach conduit to ceiling support wires.
- I. Arrange conduit to maintain headroom and present neat appearance.
- J. Route exposed conduit parallel and perpendicular to walls.
- K. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- L. Route conduit in and under slab from point-to-point.
- M. Maintain adequate clearance between conduit and piping.

- N. Cut conduit square using saw or pipecutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.
- P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- Q. Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations.
- R. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one shot bender to fabricate bends in metal conduit larger than 2 inch size.
- S. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- T. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic.
- U. Provide suitable pull string in each empty conduit except sleeves and nipples.
- V. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- W. Ground and bond conduit under provisions of Section 260526.
- X. Identify conduit under provisions of Section 260553.

3.03 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

END OF SECTION 260534

SECTION 260537 - BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall and ceiling outlet boxes.
- B. Pull and junction boxes.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 262716 - Electrical Cabinets and Enclosures.
- C. Section 262726 - Wiring Devices: Wall plates in finished areas.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.
- B. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2007.
- C. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association; 2008.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.
- E. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Project Record Documents: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Provide products listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Contractor shall size all boxes and enclosures per applicable Electrical Code(s), U.L. listed, and suitable for the conditions of installation. Each box and enclosure shall be provided having sufficient volume, proper dimensions, and geometry for the device(s) to be installed and the number of wires and conduits at that location.
- D. Provide boxes and enclosures suitable for the specific type of location in which they are installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Appleton Electric: www.appletonelec.com.
- B. Arc-Co./Division of Arcade Technology: www.arc-co.com.
- C. Unity Manufacturing: www.unitymfg.com.
- D. Or equal..
- E. Substitutions: See Section 016000 - Product Requirements.

2.02 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
2. Concrete Ceiling Boxes: Concrete type.
- B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasket cover by box manufacturer. Provide threaded hubs.
- C. Wall Plates for Finished Areas: As specified in Section 262726.

2.03 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 262716.
- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
 1. Material: Galvanized cast iron.
 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify locations of floor boxes and outlets prior to rough-in.

3.02 INSTALLATION

- A. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.
- B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70, National Electrical Code (NEC).
- C. Coordinate installation of outlet boxes for equipment connected under Section 262717.
- D. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- E. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
 1. Adjust box locations up to 10 feet if required to accommodate intended purpose.
- F. Orient boxes to accommodate wiring devices oriented as specified in Section 262726.
- G. Maintain headroom and present neat mechanical appearance.
- H. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- I. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- J. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- K. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- L. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- M. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- N. Use flush mounting outlet box in finished areas.
- O. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- P. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in fire-rated and acoustic rated walls.
- Q. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

- R. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- S. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- T. Use adjustable steel channel fasteners for hung ceiling outlet box.
- U. Do not fasten boxes to ceiling support wires.
- V. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.
- W. Use gang box where more than one device is mounted together. Do not use sectional box.
- X. Use gang box with plaster ring for single device outlets.
- Y. Use cast outlet box in exterior locations exposed to the weather and wet locations.
 - AA. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.04 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused box openings.

3.05 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION 260537

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers.
- D. Field-painted identification of conduit.

1.02 RELATED REQUIREMENTS

- A. Section 099000 - Painting and Coating.

1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Conduit: Conduit markers.
- B. Junction Box Load Connections: Wire markers.
- C. Outlet Box Load Connections: Wire markers.
- D. Panel Gutter Load Connections: Wire markers.
- E. Pull Box Load Connections: Wire markers.

2.02 MANUFACTURERS

- A. Brady Corporation: www.bradycorp.com.
- B. Seton Identification Products: www.seton.com/aec.
- C. HellermannTyton: www.hellermanntyton.com.
- D. Or equal.
- E. Substitutions: See Section 016000 - Product Requirements.

2.03 NAMEPLATES AND LABELS

- A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
- B. Locations:
 - 1. Each electrical distribution and control equipment enclosure.
 - 2. Communication cabinets.
- C. Letter Size:
 - 1. Use 1/8 inch letters for identifying individual equipment and loads.
 - 2. Use 1/4 inch letters for identifying grouped equipment and loads.
- D. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use only for identification of individual wall switches and receptacles, control device stations.

2.04 WIRE MARKERS

- A. Description: Vinyl cloth type self-adhesive wire markers.
- B. Description: Cloth type wire markers.
- C. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.
- D. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
 - 2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on drawings.

2.05 CONDUIT MARKERS

- A. Location: Furnish markers for each conduit longer than 6 feet.
- B. Spacing: 20 feet on center.
- C. Color:
 - 1. Fire Alarm System: Red.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels.

3.02 INSTALLATION

- A. Install nameplates and labels parallel to equipment lines.
- B. Secure nameplates to equipment front using screws.
- C. Secure nameplates to inside surface of door on panelboard that is recessed in finished locations.
- D. Identify underground conduits using underground warning tape. Install one tape per trench at 3 inches below finished grade.

END OF SECTION 260553

SECTION 262717 - EQUIPMENT WIRING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

- A. Section 260534 - Conduit.
- B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables (600 V and Less).
- C. Section 260537 - Boxes.
- D. Section 262726 - Wiring Devices.

1.03 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2005).
- B. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2002 (R2008).
- C. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Conform to NEMA WD 1.
 - 2. Cord Construction: NFPA 70, with current amendments of the California Electrical Code (CEC), Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As described and in individual equipment sections.
- C. Wiring Devices: As specified in Section 262726.

- D. Flexible Conduit: As specified in Section 260534.
- E. Wire and Cable: As specified in Section 260519.
- F. Boxes: As specified in Section 260537.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 262717