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#### ELECTRICAL

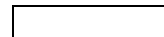
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**SECTION 26 00 00**

**ELECTRICAL**

**PART 1 - GENERAL**



- A. The work to be done under this section is generally shown on Drawings E001, E100, E601, E601, ED100 AND FA100..

## 1.2 GENERAL PROVISIONS

- A. The GENERAL REQUIREMENTS, DIVISION 1, and BIDDING AND CONTRACT REQUIREMENTS, DIVISION 0, are hereby made a part of this Specification Section.
- B. Examine all drawings and all sections of the specifications and requirements and provisions affecting the work of this section.
- C. The work listed in the following sections shall be made part of this Specification Section:  
  
26 30 12                      Fire Alarm Modification

## 1.3 SCOPE OF WORK

- A. This project includes the upgrade of existing mechanical equipment. Selective demolition of existing systems shall be required.
- B. Refer to the specific requirements for this project included in the "Narrative Report for Compliance with the Fire Protection and Life Safety Systems Section of the Massachusetts State Building Code (780CMR) – Fire Protection Construction Documents", which shall be considered part of these specifications. Include all associated testing and certifications necessary for compliance and any required remedial actions and retest due to failure.
- C. The work under this section shall include the furnishing of all materials, labor, equipment and supplies and the performance of all operations to provide complete working systems, in general, to include the following items:
  - 1. Identification
  - 2. Raceways and Conduit
  - 3. Wire and Cable (600V)
  - 4. Junction Boxes, Pull Boxes and Wireways
  - 5. Safety Disconnect Switches
  - 6. Sleeving
  - 7. Fire Seal and Fireproof Sealant
  - 8. Supervision and Approval
  - 9. Electrical Connections to HVAC equipment.
  - 10. Shop drawings
  - 11. Record (as-built) drawings
- D. Work of this section is generally shown on the Electrical Drawings.

## 1.4 RELATED WORK

- A. Principal classes of Work related to the Work of this section are listed in the Specification Table of Contents, and are specified to be performed under the indicated sections of the

specifications. Refer to the indicated sections for description of the extent and nature of the indicated Work, and for coordination with related trades. This listing may not include all related Work items. It is the responsibility of the Contractor to coordinate and schedule the Work of this section with that of all other trades.

- B. The following work is not included in this section and will be provided under other sections:
1. Furnishing and installation of motors.
  2. Structural supports necessary to distribute loading from equipment to roof or floor except as specified.
  3. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing. Refer to Division 1, General Conditions.
  4. Flashing of roof and wall penetrations.
  5. Painting, except as specified herein.

## 1.5 DEFINITIONS

- A. As used in this section, the following items are understood to have the following meaning:
1. *"Contractor or Subcontractor"*, unless otherwise qualified, shall mean the installer of the work specified under this section.
  2. *"Furnish"* shall mean purchase and deliver to the project site, complete with every necessary appurtenance.
  3. *"Install"* shall mean unload at the delivery point at the site and perform all work necessary to establish secure mounting and proper operation at the proper location in the project.
  4. *"Provide"* shall mean "Furnish" and "Install".
  5. *"Work"* shall mean all labor, materials, equipment, apparatus, controls, accessories and all other items required for a proper and complete installation.
  6. *"Concealed"* shall mean hidden from sight in chases, furred-in spaces, shafts, hung ceilings, embedded in construction or in a crawl space. Areas to be concealed as part of tenant alterations to the building shall also be considered in this definition.
  7. *"Exposed"* shall mean not installed underground or concealed as defined above.
  8. *"Furnished by Others"* shall mean materials or equipment purchased under other sections of the general contract and installed by this section of the specifications by this trade Contractor.
  9. *"Owners Representative"* shall be the party responsible to make decisions regarding all contractual obligations in reference to the Scope of Work for the Owner.
  10. *"Date of Substantial Completion"* shall indicate the date where the work has been formally accepted as evidenced by completed final punch list or where the work has reached the stage that the Owner obtains beneficial use and commences utilization of the installed systems for business or occupancy purposes. The GENERAL REQUIREMENTS, DIVISION 1, shall supersede this definition where specifically defined.

## 1.6 CODES, REFERENCES AND PERMITS

- A. Materials, installation of systems and equipment provided under this section shall be done in strict accordance with the Department of Public Safety, Department of

Environmental Protection, State Building Code and any other Codes and Regulations having jurisdiction including but not limited to:

1. All Applicable NFPA Standards
  2. National Electrical Code (NEC).
  3. Occupational Safety and Health Administration (OSHA)
  4. State and Local Building Codes
  5. Underwriters' Laboratories, Inc. (UL)
- B. Unless otherwise specified or indicated, materials, workmanship and equipment performance shall conform with the latest governing edition of the following standards, codes, specifications, requirements, and regulations, except when more rigid requirements are specified or are required by applicable codes but not limited to:
1. American National Standards Institute (ANSI)
  2. American Society of Mechanical Engineers (ASME).
  3. American Society of Testing and Materials (ASTM)
  4. Illuminating Engineering Society (IES)
  5. Institute of Electrical and Electronics Engineers (IEEE)
  6. Insulated Cable Engineers Association (ICEA)
  7. National Electrical Contractors Association (NECA)
  8. National Electric Manufacturers Association (NEMA)
  9. Thermal Insulation Manufacturers Association (TIMA)
- C. Codes, laws and standards provide a basis for the minimum installation criteria acceptable. The drawings and specifications illustrate the scope required for this project, which may exceed minimum codes, laws and standards.
- D. Give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from authorities having jurisdiction. Deliver all certificates of inspection to the authorities having jurisdiction. No work shall be covered before examination and approval by the Owner's Representative, inspectors, and authorities having jurisdiction. Replace imperfect or condemned work to conform to requirements, satisfactory to Owner's Representative, and without extra cost to the Owner. If work is covered before inspection and approval, this Contractor shall pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

## 1.7 GENERAL REQUIREMENTS

- A. Nameplates
1. Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment.
- B. Equipment Guards
1. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto shall be completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

## 1.8 MATERIAL AND EQUIPMENT STANDARDS

- A. Where equipment or materials are specified with the name of a manufacturer, such specification shall be deemed to be used for the purpose of establishing a standard for that particular item. No equipment or material shall be used unless previously approved by the Owner's Representative.
- B. Substitutions may be offered for review provided the material, equipment or process offered for consideration is equal in every respect to that indicated or specified. The request for each substitution must be accompanied by complete specifications together with drawings or samples to properly appraise the materials, equipment or process. The Contractor shall highlight and list all applicable specification requirements which the substituted material deviates from.
- C. If a substitution of materials or equipment in whole or in part is made, this Contractor shall bear the cost of any changes necessitated by any other trade as a result of said substitution.
- D. All materials, equipment and accessories provided under this section shall be new and unused products of recognized manufacturers as approved.

#### 1.9 SUBMITTALS

- A. Conform to the requirements of Division 1, General Conditions, for schedule and form of all submittals unless specifically noted otherwise in this section. Coordinate this submittal with submittals for all other finishes. Shop drawings and design layouts shall be prepared by licensed installing Contractor s and shall note the name(s), license number(s) and license expiration date(s) of the Contractor (s) installing electrical systems.
- B. Definitions:
  - 1. Shop Drawings are information prepared by the Contractor to illustrate portions of the work in more detail than indicated in the Contract Documents.
  - 2. Acceptable Manufacturers: The mechanical design for each product is based on the single manufacturer listed in the schedule or shown on the drawings. In Part 2 of the specifications, certain Alternate Manufacturers are listed as being acceptable. In addition, the MATERIAL AND EQUIPMENT STANDARDS paragraph potentially allows for substitutions as being acceptable. These are acceptable only if, as a minimum, they:
    - a. Meet all performance criteria listed in the schedules and outlined in the specifications. For example, to be acceptable, an emergency generator must deliver equal kW / KVA at equal or greater efficiency using equal or less fuel as the emergency generator listed in the schedules.
    - b. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings, and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean the Engineer has determined that the manufacturer's products will fit within the available space – this determination is solely the responsibility of the Contractor.
    - c. For rooftop mounted equipment and equipment mounted in areas where structural matters are a concern, the products must have a weight no greater than the product listed in the schedules or specifications.

- d. Products must adhere to all architectural considerations including, but not limited to; being of the same color as the product scheduled or specified, fitting within the architectural enclosures and details, and for lighting – being the same size and of the same physical appearance as scheduled or specified products.

C. Submittal Procedures, Format and Requirements

1. Review submittal packages for compliance with Contract Documents and then submit to Owner's Representative for review. Submit enough sets of shop drawings such that, after review, two (2) sets will be kept by the reviewer, with only the remaining sets returned with reviewer's marks and comments.
2. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate on cover sheet, the following information:
  - a. Title
  - b. Equipment number
  - c. Name and location of project
  - d. Names of Owner, Engineer and Seller
  - e. Names of manufacturers, suppliers, vendors, etc.
  - f. Date of submittal
  - g. Whether original submittal or resubmitted
3. Shop Drawings showing manufacturer's product data shall contain detailed dimensional drawings (minimum ¼ inch – 1 foot scale) including plans and sections (where physical clearance could be an issue). Provide larger scale details as necessary.
4. Submit accurate and complete description of materials of construction, manufacturer's published performance characteristics, sizes, weights, capacity ratings (performance data, alone, is not acceptable), electrical requirements, starting characteristics, wiring diagrams, and acoustical performance for complete assemblies. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.
5. Provide Shop Drawings showing details of piping connections to all equipment. If connection details are not submitted and connections are found to be installed incorrectly, this Contractor shall reinstall them within the original contract price.
6. Provide complete data for all auxiliary services and utilities required by submitted equipment. This shall include fuel, cooling and exhaust requirements and points of connections.
7. Provide a complete description of all controls and instrumentation required including electrical power connection drawing for all components and interconnection wiring to starters, detailed information on starters, control diagrams, termination diagrams, and all control interfaces with a central control system.
8. Provide installation and erection information including; lifting requirements, and any special rigging or installation requirements for all equipment.
9. The Owner's Representative shall approve all materials before commitment for materials is made.

D. Specifications and Schedule Compliance Statement

1. The manufacturer shall submit a point by point statement of compliance with each specification criteria listed in each paragraph for those submittals listed in Paragraph E: Product Data that are noted with an asterisk (\*).

2. The statement of compliance shall consist of a list of all paragraphs (line by line) identified in Part 2 and applicable Part 3 of the specification for which the submitted product in the opinion of the manufacturer complies, deviates, or does not meet.
  3. Where the proposed submittal complies fully, the word “comply” shall be placed opposite the paragraph number.
  4. Where the proposed submittal does not comply, or accomplishes the stated function in a manner different from that described, a full description of the deviation shall be provided.
  5. Verify each field of the associated schedule where associated technical data is presented on the drawings. Where the submitted material does not “comply” provide the value the submitted equipment will achieve based upon the specified conditions.
  6. Where a full description of a deviation is not provided, it shall be assumed that the proposed system does not comply with the paragraph in question and the product will be rejected.
  7. Submissions which do not include a point by point statement of compliance as specified shall be disapproved.
- E. Product Data: Submit complete manufacturer’s product description and technical information including:
1. Identification
  2. Raceways and Conduit
  3. Wire and Cable (600V)
  4. Junction Boxes, Pull Boxes and Wireways
  5. Safety Disconnect Switches
- F. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in a single submittal.
1. Access panel shop drawings shall be submitted to the Construction Supervisor for approval.
  2. Do not submit multiple product information in a single bound manual.
  3. Three-ring binders shall not be accepted.
- G. Deviations:
1. Concerning deviations other than substitutions, proposed deviations from Contract Documents shall be requested individually in writing whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of Shop Drawings which flags the deviation to the attention of the Owner’s Representative.
  2. Without letters flagging the deviation to the Owner’s Representative, it is possible that the Engineer may not notice such deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Owner’s Representative, the Seller shall hold the Engineers, his consultants and the Owner harmless for any and all adverse consequences resulting from the deviations being implemented. This shall apply regardless of whether the Engineer has reviewed or approved shop drawings containing the deviation, and will be strictly enforced.
  3. Approval of proposed deviations, if any, will be made at discretion of Engineer.
- H. Schedule: Incorporate shop drawing review period into construction schedule so that Work is not delayed. This Contractor shall assume full responsibility for delays caused by

not incorporating the following shop drawing review time requirements into his project schedule. Allow at least ten (10) working days, exclusive of transmittal time, for review each time shop drawing is submitted or resubmitted with the exception that twenty (20) working days, exclusive of transmittal time are required for the following:

1. Coordination drawings.
2. If more than five (5) shop drawings of a single trade are received in one (1) calendar week.

I. Responsibility

1. Intent of Submittal review is to check for capacity, rating, and certain construction features. The Contractor shall ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction; and for coordination of work of this and other sections. Work shall comply with approved submittals to extent that they agree with Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor the shop drawing errors or deviations from requirements of Contract Documents. The Engineer's noting of some errors while overlooking others will not excuse the Contractor from proceeding in error. Contract Documents requirements are not limited, waived nor superseded in any way by review.
2. Inform Contractor, manufacturers, suppliers, etc. of scope and limited nature of review process and enforce compliance with contract documents.

J. In the event that the Contractor fails to provide Shop Drawings for any of the products specified herein:

1. The Contractor shall furnish and install all materials and equipment herein specified in complete accordance with these specifications.
2. If the Contractor furnishes and installs material and/or equipment that is not in complete accordance with these specifications, he shall be responsible for the removal of this material and/or equipment. He shall also be responsible for the replacement of this material and/or equipment with material and/or equipment that is in complete accordance with these specifications, at the direction of the Owner's Representative.
3. Removal and replacement of materials and/or equipment that is not in complete compliance with these specifications shall be done at no extra cost to the Owner.
4. Removal and replacement of materials and/or equipment that is not in complete compliance with these specifications shall not be allowed as a basis for a claim of delay of completion of the Work.

K. Mark dimensions and values in units to match those specified.

L. Submit Material Safety Data Sheets (MSD) on each applicable product with submittal.

1.10 COORDINATION

- A. Refer to Division 1, General Conditions, for coordination requirements applicable to this section, unless specifically noted otherwise in this section.
- B. Materials and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly when and as required.

- C. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other sections. Any conflicts shall be referred immediately to the Owner's Representative for decision to prevent delay in installation of work. All work and materials placed in violation of this clause shall be readjusted to the Owner's Representative's satisfaction at no expense to the Owner.
- D. Where work of this section will be installed in close proximity to work of other sections or where there is evidence that the work of this section may interfere with work of other sections, assist in working out space conditions to make satisfactory adjustment. Prepare and submit for approval 3/8" scale or larger working drawings and sections, clearly showing how the work is to be installed in relation to the work of other sections. If the work of this section is installed before coordinating with other trades or so as to cause interference with work of other trades, make changes necessary to protect conditions without extra charge.
- E. Keep fully informed as to the shape, size and position of all openings required for all apparatus, conduit, cable, sleeves, etc., and give information in advance to allow construction of required openings. Furnish all sleeves, pockets, supports and incidentals, and coordinate with the General Contractor for the proper setting of same.
- F. All distribution systems which require pitch or slope such as condensate drains and water piping shall have the right of way over those which do not. Confer with other trades as to the location of pipes, ducts, lights and apparatus and install work to avoid interferences.
- G. Make reasonable modifications in the work as required by structural interferences, or by interference with work of other trades, or for proper execution of the work without extra charge.

#### 1.11 RECORD DRAWINGS

- A. Refer to DIVISION 1, General Conditions, for record drawings and procedures to be provided under this section, unless specifically noted otherwise in this section.
- B. Record Drawings (red-line drawings) will be updated by this Contractor daily for review with the monthly requisition. The record drawing shall be an accurate depiction of the systems as completed, including dimensions (vertical/horizontal) of concealed components off fixed building elements.
- C. The Electrical Foreman shall maintain complete and separate set of prints of Contract Drawings at job site at all times and shall record work completed and all changes from original Contract Drawings clearly and accurately including work installed as a modification or addition to the original design.
- D. At completion of work the Electrical Contractor shall prepare a complete set of record drawings on AutoCAD showing all systems as actually installed. The background AutoCAD files will be made available for the Contractor's copying, at his expense, to serve as backgrounds for the drawings. The Electrical Contractor shall transfer changes from field drawings onto AutoCAD drawings and submit copy of files and three sets of prints to Owner's Representative for comments as to compliance with this section. CADD layering as established by the design team shall be maintained with any and all changes done by the Contractor.

- E. The Engineer is not granting to the Contractor any ownership or property interest in the CADD Drawings by the delivery of the CADD Disks to the Contractor. The Contractor's rights to use the CADD disks and the CADD Drawings are limited to use for the sole purpose of assisting in the Contractor's performance of its contractual obligations under its contract with respect to the Project. The Engineer is granting no further rights. Any reuse or other use by the Contractor will be at the Contractor's sole risk and without liability to the Engineer. The Contractor hereby waives and releases any losses, claims, damages, liabilities of any nature whatsoever, and costs (including attorney fees) arising out of, resulting from, or otherwise related to the use of the CADD Disks and CADD Drawings by the Contractor. The Contractor, to the maximum extent permitted by law, hereby agrees to indemnify, defend and hold the Engineer harmless from all losses, claims, damages, liabilities, and costs (including attorney fees) arising out of, resulting from, or otherwise related to the use of the CADD Disks and CADD Drawings by the Contractor.
- F. Record Drawings, shall show "as-built" condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer and model numbers of final equipment installation.
- G. The Electrical Contractor shall submit the record set for approval by the engineer a minimum of four (4) weeks prior to seeking the permanent certificate of occupancy.

#### 1.12 WARRANTIES

- A. Submit manufacturer's standard replacement warranties for material and equipment furnished under this section. Such warranties shall be in addition to and not in lieu of all liabilities which the manufacturer and the Electrical Contractor may have by law or by provisions of the Contract Documents.
- B. All materials, equipment and work furnished under this section shall be guaranteed against all defects in materials and workmanship for a minimum period of one-year (1) commencing with the Date of Substantial Completion. Where individual equipment sections specify longer warranties, provide the longer warranty. Any failure due to defective material, equipment or workmanship which may develop, shall be corrected at no expense to the Owner including all damage to areas, materials and other systems resulting from such failures.
- C. Guarantee that all elements of each system meet the specified performance requirements as set forth herein or as indicated on the drawings.
- D. Upon receipt of notice from the Owner of the failure of any part of the systems during the warranty period, the affected parts shall be replaced. Any equipment requiring excessive service shall be considered defective and shall be replaced.

#### 1.13 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

- A. It is the intention of the specifications and drawings to call for complete, finished work, tested and ready for continuous operation. Any apparatus, appliance, material or work not shown on the drawings, but mentioned in the specifications or vice-versa, or any incidental accessories necessary to make the work complete in all respects and ready for

operation, even if not particularly specified, shall be provided by this Contractor without additional expense to the Owner.

- B. The drawings are generally diagrammatic. The locations of all items that are not definitely fixed by dimensions are approximate only. The exact locations must be determined at the project and shall have the approval of the Owner's Representative before being installed. This Contractor shall follow drawings, including his shop drawings, in laying out work and shall check the drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions. Where space conditions appear inadequate, notify the Owner's Representative before proceeding with the installation. This Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.
- C. Any requests for information (RFI) for resolving an apparent conflict or unclarity, or a request for additional detail, shall include a sketch or equivalent description of Contractor's proposed solution.
- D. Size of conduits, cable trays, raceways and methods of running them are shown, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered. To carry out the true intent and purpose of the drawings, all necessary parts to make complete approved working systems ready for use, shall be furnished without extra charge. All work shall be installed in an approved workmanlike manner.

#### 1.14 INSPECTION OF SITE CONDITIONS

- A. Prior to submission of bid, visit the site and review the related construction documents to determine the conditions under which the Work has to be performed and send a report, in writing, to the Owner's Representative, noting any conditions which might adversely affect the Work of this section of the specifications.

#### 1.15 SURVEY AND MEASUREMENTS

- A. Base all required measurements, horizontal and vertical, from referenced points established WITH the Owner's Representative. The Electrical Contractor shall be responsible for correctly laying out the Work required under this section of the specifications.
- B. In the event of discrepancy between actual measurements and those indicated, notify the Owner's Representative in writing and do not proceed with the related work until instructions have been issued.

#### 1.16 DELIVERY, STORAGE AND HANDLING

- A. No materials shall be delivered or stored on site until corresponding Shop Drawings have been approved.
- B. All manufactured materials shall be delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.

- C. Protect materials against dampness. Store off floors, under cover and adequately protected from damage.
- D. Inspect all equipment and materials, upon receipt at the job site, for damage and conformance to approved shop drawings.

#### 1.17 PROTECTION OF WORK AND PROPERTY

- A. This Contractor shall be responsible for the care and protection of all work included under this section until the completion and final acceptance of this Contract.
- B. Protect all equipment and materials from damage from all causes including, but not limited to, fire, vandalism and theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment at no additional cost to the Owner.
- C. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen under this section and make good damage thus caused.
- D. Damaged materials are to be removed from the site; no site storage of damaged materials will be allowed.

#### 1.18 SUPERVISION

- A. Supply the service of a competent Supervisor with a minimum of five (5) years of experience in Electrical construction supervision who shall be in charge of the Electrical work at the site.

#### 1.19 SAFETY PRECAUTIONS

- A. Life safety and accident prevention shall be a primary consideration. Comply with all of the safety requirements of the Owner and OSHA throughout the entire construction period of the project.
- B. Furnish, place and maintain proper guards and any other necessary construction required to secure safety of life and/or property.

#### 1.20 SCHEDULE

- A. Construct work in sequence under provisions of Division 1 and as coordinated with the Owner's Representative.

#### 1.21 HOISTING, SCAFFOLDING AND PLANKING

- A. The work to be done under this section of the specifications shall include the furnishing, set-up and maintenance of all derricks, hoisting machinery, cranes, helicopters, scaffolds, staging and planking as required for the work.

## 1.22 CUTTING AND PATCHING

- A. Include all coring, cutting, patching, and fireproofing necessary for the execution of the work of this section. Structural elements shall not be cut without written approval of the Architect. This Contractor shall be responsible for taking all precautions required to identify hidden piping, conduits, etc. before any core drilling and/or cutting of slabs commences, including X-raying the affected slabs. Provide fire stopping to maintain the fire rating of the fire resistance-rated assembly. All penetrations and associated fire stopping shall be installed in accordance with the fire stopping manufacturer's listed installation details and be listed by UL or FM.
- B. All work shall be fully coordinated with all phases of construction, in order to minimize the requirements for cutting and patching.
- C. Form all chases or openings for the installation of the work of this section of the specifications, or cut the same in existing work and see that all sleeves or forms are in the work and properly set in ample time to prevent delays. Be responsible that all such chases, openings, and sleeves are located accurately and are of the proper size and shape and consult with the Owner's Representative and all other trades concerned in reference to this work. Confine the cutting to the smallest extent possible consistent with the work to be done. In no case shall piers or structural members be cut without the approval of the Owner's Representative.
- D. Fit around, close up, repair, patch, and point around the work specified herein to match the existing adjacent surfaces and to the satisfaction of the Owner's Representative.
- E. Fill and patch all openings or holes left in the existing structures by the removal of existing equipment which is part of this section of the specifications.
- F. All of this work shall be carefully done by workmen qualified to do such work and with the proper and smallest tools applicable.
- G. Any cost caused by defective or ill-timed work required by this section of the specifications shall be borne by this Contractor.
- H. When, in order to accommodate the work required under this section of the specifications, finished materials of other trades must be cut or fitted, furnish the necessary drawings and information to the trades whose materials must be cut or fitted.

## 1.23 SLEEVES, INSERTS AND ANCHOR BOLTS

- A. Coordinate with other trades the location of and maintaining in proper positions, sleeves, inserts and anchor bolts to be supplied and/or set in place under this section of the specifications. In the event of incorrectly located preset sleeves, inserts and anchor bolts, etc., all required cutting and patching of finished work shall be done under this section of the specifications.
- B. All pipes passing through floors, walls, ceilings or partitions shall be provided with fire stopping to maintain the fire rating of the structure. All penetrations and associated fire stopping shall be installed in accordance with the fire stopping manufacturer's listed installation details. Provide sleeves for all penetrations where required by the listed

detail, for the penetration of all mechanical room floors and where specifically required on the drawings.

- C. Field drilling (core drilling), when required, shall be performed under this section of the specifications, after receipt of approval by the Owner's Representative.
  - 1. When coring cannot be avoided, provide ¼ inch pilot hole prior to coring. When coring through floor or slab, verify location of core on floor below and protect and piping, ductwork, wiring, furniture, personnel, etc., below the location of the core.

#### 1.24 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS

- A. Provide all supplementary steel, factory fabricated channels and supports required for the proper installation, mounting and support of all Electrical equipment, piping, etc., required by the specifications.
- B. Supplementary steel and factory fabricated channels shall be firmly connected to building construction in a manner approved by the Owner's Representative as shown on the drawings or herein specified.
- C. The type and size of the supporting channels and supplementary steel shall be determined by the Contractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.
- D. All supplementary steel and factory fabricated channels shall be installed in a neat and workmanlike manner parallel to the walls, floors and ceiling construction. All turns shall be made with 90 degree and 45 degree fittings, as required to suit the construction and installation conditions.
- E. All supplementary steel including factory fabricated channels, supports and fittings shall be galvanized steel, aluminum or stainless steel where exposed or subject to rust producing atmosphere. Factory fabricated channels shall be manufactured by Unistrut, H-strut, Powerstrut or approved equal.

#### 1.25 HAZARDOUS MATERIALS

- A. Where it has been identified that asbestos-containing material exists within the scope limits, refer to the Asbestos Abatement specification section for requirements.

#### 1.26 ACCESSIBILITY

- A. All work provided under this section of the specification shall be installed so that parts requiring periodic inspection, maintenance and repair are accessible. Work of this trade shall not infringe upon clearances required by equipment of other trades, especially code required clearances to electrical gear. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made prior to written approval from the Owner's Representative.

#### 1.27 SEISMIC RESTRAINT REQUIREMENTS

- A. Submit working plans and calculations reviewed, signed and stamped by a professional engineer who is registered in the State where the project is located and has specific experience in seismic calculations, certifying that the plans meet all seismic requirements established by authorities having jurisdiction over the project.
- B. For each seismic restraint, provide certified calculations to verify adequacy to meet the following design requirements:
  - 1. Ability to accommodate relative seismic displacements of supported item between points of support.
  - 2. Ability to accommodate the required seismic forces.
- C. For each respective set of anchor bolts provide calculations to verify adequacy to meet combined seismic-induced shear and tension forces.
- D. For each weldment between structure and item subject to seismic force, provide calculations to verify adequacy.
- E. Restraints shall maintain the restrained item in a captive position without short circuiting the vibration isolation.

#### 1.28 PROJECT CLOSEOUT

- A. Construction Observations By The Engineer
  - 1. The engineer shall make progress site visits during construction and one (1) substantial completion (punch list) site visit for determining substantial completion.
  - 2. The Trade Contractors and the General Contractor are required to inspect their own work and make any corrections to the work to comply with the specifications and the contract documents. It is not the responsibility of the engineer to develop lists of incomplete work items.
  - 3. Progress Site Visits
    - a. The purpose of the progress site visit by the engineer is to observe if the work is proceeding in accordance with the contract documents.
    - b. The engineer will prepare a field report which will note in general the work completed since the last observation visit, work found not to be in accordance with the contract documents and work not corrected since the previous observation visit.
- B. Substantial Completion
  - 1. When the Contractor considers the Work under this section is substantially complete, the Contractor shall submit written notice, through the General Contractor, with a detailed list of items remaining to be completed or corrected and a schedule of when each remaining work item will be completed. Should the engineer determine the list of remaining work does not constitute substantial completion the engineer will notify the Architect and/or Owner and he will not make a substantial completion site visit.
  - 2. The following items shall be completed prior to the written request for substantial completion site visit:
    - a. Certification of successful operation of all systems.
    - b. Training of the Owner's personnel in the operation of the systems.

- c. Record Drawings in accordance with the contract specifications.
    - d. Operation and Maintenance manuals.
    - e. Testing reports.
    - f. Manufacturer's certificates of approvals.
    - g. Emergency contact list for reporting of malfunctioning equipment during the warranty period.
    - h. Contractors Project Completion certificate.
  - 3. Should the Engineer, during the substantial completion visit, observe that the Work is substantially complete, s/he will provide a written listing of the observed deficiencies referred herein as the Punch List. The Punch List will provide for a place for the Contractor and General Contractor to sign off and date each item individually indicating that the observed deficiency item has been corrected.
  - 4. Should the Engineer, during the substantial completion site visit, observe that the Work is not substantially complete, s/he will provide, a written list of the major deficiencies and a reason for the work not being considered substantially complete.
  - 5. If the work is found not to be substantially complete then the engineer shall be reimbursed for his time to reobserve the work. A reobservation fee shall be charged to the Contractor through the contractual agreement for any further observations by the engineer.
  - 6. The Contractor shall remedy all deficiencies listed in the punch list within the time frame required by the contract.
- C. Engineer's Construction Completion Certification
- 1. Where required by the applicable code, the Engineer's Construction Completion Certification will be issued by NV5 when all life safety and health related issues are complete, all required functional tests are complete and all reports are complete. The following is a minimum listing of the required systems to be tested with reports generated indicating they are complete and ready for use:
    - a. Fire Alarm System
  - 2. There shall be NO outstanding items identified on the punch list for scope within any of these categories.
- D. Final Completion
- 1. The following items shall be submitted prior to the written request for Final completion:
    - a. Revised Substantial Completion items to be resubmitted in accordance with the review process comments.
    - b. Warranties commencing the date of Substantial completion
    - c. Individual Signed and dated Punch List acknowledging completion of all punch list items
  - 2. When the Contractor considers all of the punch list work items complete, the Contractor shall submit written notice through the General Contractor that all Punch List items are complete and resolved and the work is ready for final observation site visit. The signature lines for completion of each punch list item shall be signed by the Contractor indicating the work is complete and signed by the General Contractor indicating s/he has inspected the work and found it to be complete. Should the Engineer find the work to be finally complete and all Punch List items are complete the Engineer will make a recommendation to the Architect or Owner. If the Engineer has found the punch list work to be

incomplete during final inspection a written listing of the observed deficiencies will be prepared by the Engineer.

3. If the work is not fully complete then the engineer shall be reimbursed for his time to reobserve the work. A reobservation fee shall be charged to the Contractor through the contractual agreement for any reobservations by the Engineer.

E. Re-observation Fees

1. The re-observation fee shall be \$1200.00 per visit.

F. Contractor's Project Completion Certificate

1. Upon completion of work and prior to request for Certificate of Occupancy, each Trade Contractor and the General Contractor shall issue a certificate stating that work has been installed generally consistent with construction documents and all applicable codes. NV5 can furnish a blank Contractor's certificate form upon request. The certificate shall certify:
  - a. Execution of all work has been in accordance with the approved construction documents.
  - b. Execution and control of all methods of construction was in a safe and satisfactory manner in accordance with all applicable local, state and federal statutes and regulations.
2. The certificate shall include the following information:
  - a. Project.
  - b. Permit Number.
  - c. Location.
  - d. Construction Documents.
  - e. Date on Plans and specifications submitted for approval and issuance of the Building Permit.
  - f. Addendum(a) and Revision Dates.
3. The certificate shall be signed by the Contractor and include the following:
  - a. Signature.
  - b. Date.
  - c. Company.
  - d. License Number.
  - e. License Expiration Date.

## PART 2 - PRODUCTS

### 2.1 NOT USED

### 2.2 IDENTIFICATION

A. Nameplates

1. Nameplates shall be laminated black Bakelite with minimum ¼ inch high white recessed letters.
2. Nameplates shall be securely attached to the equipment. Utilize mechanical fasteners such as galvanized steel or brass screws for exterior applications. High strength adhesives or cements may be used for interior applications.

## 2.3 RACEWAYS AND CONDUIT

### A. Rigid Galvanized Steel (RGS) Conduit

1. RGS shall be zinc-coated steel that conforms to ANSI C80.1, UL Specification No. 6 and Federal Specification WW-C-581e by Allied Tube and Conduit, Republic Steel, Wheatland Tube or approved equal.
2. RGS fittings shall be threaded. Split couplings or non-threaded fittings shall not be used.
3. Nipples and Close Nipples shall be RGS, length as noted or as required to conform to field conditions.

### B. Intermediate Metal Conduit (IMC)

1. IMC shall be zinc-coated steel that conforms to ANSI C80.6, UL Standard No. 1242 and Federal Specification WW-C-581e by Allied Tube and Conduit, Wheatland Tube or approved equal.
2. IMC fittings shall be threaded.

### C. Electrical Metallic Tubing (EMT)

1. EMT shall be zinc-coated steel that conforms to ANSI C80.3, UL Standard No. 797 and Federal Specification WW-C-563 a by Republic Steel, Allied Tube and Conduit or approved equal.
2. EMT fittings shall be zinc plated pressed steel gland and ring compression up to two (2) inches and zinc plated pressed steel double set screw from two (2) inches and up

### D. Miscellaneous Conduit Fittings

1. Elbows shall be standard radius unless noted otherwise. Where Large Radius elbows are specified, provide forty-eight (48) inch radius unless noted otherwise.
2. Bushings shall be threaded pressed steel hot dipped galvanized with conduit end stop and integrally molded noncombustible phenolic insulated surface rated for 150°C.
3. Bonding bushings shall be threaded pressed steel hot dipped galvanized with conduit end stop and integrally molded noncombustible phenolic insulated surface rated for 150°C with a lay-in tin plated copper grounding lug.
4. Exposed conduit expansion fittings shall be hot-dipped galvanized malleable iron with external bonding jumper equal to O.Z./Gedney Type EX for RGS or Type TX for EMT (four (4) inch maximum expansion).
5. Provide water-tight gland sealing assemblies with pressure bushings equal to OZ/Gedney Type WSK for new cast-in-place installations or Type CSCM for retrofit (core drilling of existing walls) as required for below grade wall and floor penetrations.

### E. Flexible Metallic Conduit

1. Liquidtight Metal Conduit shall be UL Listed fabricated from a spiral wound strip of heavy gauge, corrosion resistant, hot dipped galvanized steel equal to Electriflex Company Type LA. The jacket shall be flame retardant, sunlight resistant PVC extruded over the spiral wrap. Sizes through 1 ¼ inch shall have an integral copper bonding strip.
2. Liquidtight fittings shall be UL listed zinc plated insulated throat.

3. Flexible metal conduit shall be UL Listed non-jacketed steel fabricated from a spiral wound strip of heavy gauge, corrosion resistant, hot dipped galvanized steel equal to Electri-flex Company Type BR.
- F. Wireways shall be minimum 16-gauge steel with all straight runs having hinged spring-latched covers. Finish shall be painted over a corrosion resistant phosphate pretreatment to protect against corrosion. Interior parts shall be smooth and free of sharp edges and burrs. Provide wireway as identified on the drawings for NEMA 1, 3R or 12 service. Wireways shall be equal to Square D and UL Listed.

## 2.4 WIRE AND CABLE (600V)

- A. Provide single-conductor, annealed copper wire and cable with insulation rated for 600 V, of sizes specified and scheduled on drawings, by General Electric, Southwire, Okonite or approved equal, for secondary service, feeders, branch and system wiring. Wire sizes shown and specified are American Wire Gauge for copper conductors.
- B. The use of aluminum conductors is not allowed.
- C. Wire #10 and larger shall be stranded; #12 and smaller shall be solid. Wire and cable shall have THWN-THHN or XHHW insulation for branch circuit and feeder conductors.
- D. Conductor Color-coding
  1. Service entrance, branch circuit and feeder conductors shall be color-coded. Conductors #12 and #10 shall be colored with a factory applied solid or striped compound coating (black, red, blue, brown, orange or yellow). Neutrals and equipment grounds shall have solid compound or solid color coating (white, gray and green), except that neutrals with colored stripe shall be used where required by code. Phase conductors #8 and larger with stripes, bands or hash marks shall have background color other than white, green and gray.
  2. Alternative field-applied color coding methods may be used for wire #8 or larger, with color code as specified in other sections of this specification. Coloring shall be applied by the use of flame-retardant vinyl tape, equal to 3M Scotch 35.
- E. Cable
  1. Flexible Metal Clad (MC) cable shall be UL Listed with THHN insulated conductors with an insulated grounding conductor within galvanized steel or aluminum interlocked armor. Connectors shall be provided with lock nut connection to the termination point enclosure.
  2. Flexible Metal Clad (MC) cable utilized for Fire Alarm service shall be identified with a factory applied tracer along the entire length.
- F. Splices and Terminations
  1. Ampacity and temperature rating of splices and connectors shall be equal to or greater than those of associated wires and cables.
  2. Make splices in branch circuit or feeder wiring from #12 to #10 with UL-listed, solderless screw on connectors rated 600 V.
  3. Make splices in branch circuit or feeder wiring above #10 with UL-listed 90°C, 600V, compression butt splice barrel equal to Burndy YS-L HYLINK.

4. Conductor terminations shall be standard bolt-on lugs with hex screws listed for attachment of copper wire and cable to panelboards, switchboards, disconnect switches and other electrical equipment.
  5. Make terminations for stranded conductors on screw terminals with UL Listed 105°C, 600V PVC insulated barrel compression locking fork tongue terminal equal to Burndy TP-LF VINYLUG.
  6. Make bus terminations for conductors #6 and larger with UL-listed 90°C, 600V, compression standard barrel length lugs equal to Burndy YA-L for conductor sizes to #4/0. Connectors for cable 250 KCMil and larger shall be with UL-listed 90°C, 600V, compression long barrel length two hole lugs equal to Burndy YA-2N. Lugs shall be high conductivity seamless copper electro-tin plated for corrosion protection.
- G. Wire management shall be provided by self-extinguishing self-locking nylon ties with -65 to 350°F. range for bundling conductors.
- H. Cable pulling compounds shall be UL Listed and be suitable for use with the specified cable insulation system. The compound shall reduce the coefficient of friction, while not adding any long term issues to the installation such as premature aging of the insulation system, added flammability or drying in such a manner as to stick the cable in place in the raceway.

## 2.5 JUNCTION AND PULL BOXES

- A. Provide galvanized steel junction and pull boxes where indicated and as necessary to facilitate installation. Steel shall be minimum 16 gauge. Junction and pull boxes shall be of code required dimensions. Cover shall be of the same type and thickness material as the box construction.
- B. Junction and pull boxes intended for dry interior locations shall be NEMA 1 enclosures with accessible, removable screw-on covers. Covers shall be secured with corrosion-resistant screws with keyhole slots to accommodate easy removal.
- C. Junction and pull boxes intended for wet or exterior locations shall be NEMA 3R enclosures with hinged gasketed covers. Interior and exterior shall be finished with a gray enamel powder coat over the galvanized metal. Hinge shall be galvanized steel with stainless steel pin. Covers shall be secured with corrosion-resistant zinc plated lockable pull catches.
- D. Custom fabricated medium to large junction and pull boxes shall have internal structural steel bracing welded to form a rigid assembly adequate to maintain alignment and shape in shipment and installation.

## 2.6 SAFETY DISCONNECT SWITCHES

- A. Switches shall be three-pole heavy-duty type rated for 600V in NEMA 1 (interior dry applications) and NEMA 3R (exterior applications) enclosures unless noted otherwise on the drawings. All switches shall be horsepower rated and suitable for service entrance use. Provide with solid neutral where four wire circuits are indicated and with 200% solid neutral where neutrals are sized for 200% full load ampacity.

1. Operating mechanisms shall be quick-make/quick-break. Current-carrying parts shall be high-conductivity copper. Contacts shall be silver-tungsten or plated. Provide positive pressure fuse clips and switch operating mechanism suitable for continuous use at rated capacity without auxiliary springs in current path. Switches shall withstand available fault current or let-through current before operating, without damage or rating change.
  2. Terminations shall be suitable for copper or aluminum conductors 60°/75° C rated. Clear shielding shall prevent accidental contact with energized line terminals.
  3. The cover shall be mechanically interlocked to prevent access unless the disconnect is in the OFF position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect. Padlocking facilities shall be provided to positively lock the disconnect in the OFF position with from one (1) to three padlocks with the door open or closed.
  4. The enclosure shall be given a phosphatizing pretreatment. The paint finish shall be manufacturer's standard color and shall pass 600 hours of corrosion resistance testing per ASTM B 117.
- B. Fused switches shall have short circuit ratings no less than 100,000 amperes RMS, with capabilities to 200,000 amperes when used with Class J, L or R fuses at 480V from 400A to 1200A.

### **PART 3 - EXECUTION**

#### **3.1 DEMOLITION**

##### **A. General**

1. Refer to the drawings for demolition scope applicable to the project.

#### **3.2 IDENTIFICATION**

##### **A. Nameplates**

1. Provide nameplates on all equipment listed in other sections of this specification including but not limited to switchboards, substations, panelboards, transformers, junction and pull boxes, disconnect switches, motor starters and motor control centers, contactors, time clocks, remote control stations, fire alarm panels, smoke detector remote test/alarm stations and fire alarm annunciators.
2. Nameplates shall designate equipment tag number as defined on the drawings, system voltage where applicable, circuit number, device controlled and system function. Refer to typical nameplate detail on the drawings for additional requirements.
3. Submit a complete list of proposed nameplates prior to order to ensure conformance to design criteria. Submittal shall include nomenclature, size and layout of each tag.
4. Samples of stickers together with color schedules shall be submitted during the submittal phase of this project.

##### **B. Equipment Identification**

1. Equipment identification designations shall be taken from equipment schedules and coordinated with the Owner's facility group to assure designations match up with Owner's maintenance management system identification database.

### 3.3 RACEWAYS AND CONDUIT

#### A. General

1. Unless specified or shown on drawings otherwise, install raceways and conduits concealed. Raceways and conduits may be run exposed on unfinished walls and basement ceilings with exposed structure, in mechanical rooms, electric rooms, attics and roof spaces.
2. Run concealed raceways and conduits in as direct lines as possible with minimum number of bends of longest possible radius. Install exposed raceways and conduits parallel to or at right angles to building lines.
3. Raceway and conduit runs shall be mechanically and electrically continuous from supply to outlet. Conduit shall enter and be secured to metallic enclosures with lock nut and bushing inside. Provide additional exterior lock nut for RGS connections. Bushings shall be the bonding type for conduit connections to metallic enclosures with concentric or eccentric knockouts. Lock nuts and bushings will not be required where conduits are screwed into threaded hubs.
4. Size raceways and conduits as required by NEC unless oversized raceways and conduits are shown on the drawings. Raceways and conduits shall be ¾ inch minimum.
5. Install conduit systems complete before installation of conductors. Blow through and swab after plaster is finished and dry, and before conductors are installed.
6. Raceways and conduits supports shall be rigidly attached to the building structure utilizing corrosion resistant components suitable for use with the selected raceway or conduit. Refer to the seismic restraint sections of this specification for any additional requirements.
7. Field bending, cutting and threading shall be executed with the proper tools, resulting in bends and shortened conduits and raceways that are equivalent to factory fabricated and purchased components.
8. Provide standoff clips for conduits on exterior and wet location walls.
9. Protect all vertical conduit runs from the entrance of foreign material before installation of conductors and the final closure of the raceway system. All spare conduits (vertical and horizontal runs) shall be sealed with a bushing and appropriate insert to prohibit entrance of debris or vermin. Affix a label that indicates "Spare Conduit to \_\_\_\_\_" at each seal. Label shall be in accordance with the labeling section of this specification.

#### B. Rigid Galvanized Steel (RGS) Conduit

1. RGS may be used for all raceway applications outlined for EMT and PVC. RGS shall be used in locations where subject to accidental damage or abuse and for all above grade exterior applications unless other wiring methods are specified on the drawings. All circuit conductors in excess of 600 V shall be installed in RGS.
2. RGS shall not be used in corrosive environments.
3. All RGS fittings shall be threaded. Utilize Erickson couplings where joining two (2) threaded conduits that cannot be rotated.

#### C. Intermediate Metal Conduit (IMC) may be used in any application, with same requirements, where RGS is allowed except for circuits operating at more than 600 V.

D. Electrical Metallic Tubing (EMT)

1. EMT may be used for lighting and receptacle branch circuits, telephone, fire alarm, communications, signal and instrumentation circuits and for control circuits. EMT may be used in masonry walls, above hung ceilings, in equipment rooms, in mechanical and electrical chases and closets, in exposed locations along ceilings or walls above normal traffic level and where not subject to accidental damage or abuse.
2. EMT shall not be used in exposed applications below eight (8) feet above finished floor or in exterior or damp/wet/corrosive locations. Electrical, telephone and communications closets are considered exempt from this restriction and EMT may be installed below 8' AFF in this application only. EMT shall not be installed underground, in slabs on grade, in exterior locations, in hazardous areas, or for circuits operating at more than 600 V.

E. Miscellaneous Conduit Fittings

1. Expansion/Deflection Fittings: Raceways and conduit buried or secured rigidly on opposite sides of building expansion joints and long runs of exposed conduit subject to expansion and contraction due to variations in temperature shall have expansion fittings. Raceways and conduit shall cross building expansion joints at right angles. Provide separate external copper bonding jumper secured with grounding straps on each end of fitting. Fittings shall safely deflect and/or expand/contract to twice the distance of potential movement.
2. Penetrations of all below grade exterior walls and flooring shall require approval by the Engineer and Architect. Submit proposed penetration points, size openings and penetration methods to Engineer and Architect. Penetrations shall utilize sealing fittings appropriately sized for the application. Duct bank penetrations are excluded from this requirement.
3. Sealing Fittings shall be installed wherever conduits pass from warm to cold locations to minimize condensation within the conduit. Sealing fittings shall be installed with RGS penetration of the wall and terminate in a suitably sized junction box.
4. Refer to other specification sections for requirements pertaining to sealing for hazardous atmospheres.

F. Flexible Metallic Conduit

1. Provide flexible metallic conduits for connections to electrical equipment and to equipment furnished under other Divisions that are subject to movement, vibration or misalignment and/or where noise transmission must be eliminated or reduced.
2. Flexible metallic conduit shall be liquid-tight under the following conditions:
  - a. Exterior locations
  - b. Moisture or humidity-laden atmospheres
  - c. Environments where seepage or dripping of water, grease, oil or other fluids is possible. All mechanical equipment rooms and penthouses, kitchens and;
  - d. Corrosive atmospheres

- G. Wireways shall be provided where specifically shown on the drawings or where the group mounting of controllers, disconnects, enclosures, etc warrant the use for elimination of multiple short conduit runs. Wireways shall be provided complete with all required appurtenances necessary to have a totally enclosed system rated for the environment.

Wireways shall not be installed in any location where subject to accidental damage or abuse.

### 3.4 WIRE AND CABLE (600V)

- A. Homerun designations on the drawings are diagrammatic only. Install branch circuits and feeders from the power source to the attachment point as required for a complete system. Provide slack wire for connections to equipment installed by others. Refer to schedules and risers where specific conductor and associated raceway sizes are not indicated on the floor plans.
- B. Connect branch circuit homerun with two (2) or three (3) circuits and common neutral only where specifically shown on the drawings. Circuits with common neutrals shall not be connected to the same phase to ensure cancellation of the return current in the neutral conductor.
- C. Install wires and cable in raceways as specified. All conductor sizing is based upon no greater than three (3) current carrying conductors in a conduit. Installation of up to six (6) circuits (no greater than twelve current carrying conductors) in a single conduit will be allowed if the conductor sizing is increased to the required ampacity to accommodate de-rating factors required by the NEC and NFPA 70.
- D. The minimum wire size shall be #12 unless #14 specifically allowed on the drawings for wiring of controls. Branch circuits longer than 75 feet for 120 V from panel to last outlet shall be increased a minimum of one (1) size above that shown on the drawings to minimize voltage drop to less than 3%.
- E. Conductors shall be identified at all accessible locations in the following manner:
  - 1. Color code secondary service, feeders and branch circuit conductors as follows:

| <u>208/120 Volts</u> | <u>Phase</u> |
|----------------------|--------------|
| Black                | A            |
| Red                  | B            |
| Blue                 | C            |
| White                | Neutral      |
| Green                | Ground       |
  - 2. Provide nonferrous wire markers, embossed or printed to correspond with the drawings. Labels shall be permanently marked so that the source of the branch circuit or feeder may be readily identified. Hand written labels are not acceptable. Embossed tag equal to 3M Scotch Code STL-TAG or SCS-TM shall be applied with two (2) miniature cable ties or slipped through both end holes. Heat bonded tag equal to 3M Scotch Code SCS-HB shall be permanently affixed with a heat gun.
- F. Cable
  - 1. Flexible Metal Clad (MC) cable may be used in concealed locations for branch circuit wiring.
  - 2. Conductor color code shall comply with identification requirements as indicated in this section.

G. Splices and Terminations

1. No more than twelve splices of current carrying conductors or six (6) circuits, whichever is greater, shall be allowed in a single enclosure or junction box.
2. Splices and terminations shall be sized to the specified conductor. The insulation shall be cut back with the appropriate tools such that the conductors are not nicked or damaged.
3. The compression tool shall be appropriate for the installation of the provided lug or butt splice to ensure pressure necessary for a proper connection is applied.
4. Terminations shall not be stacked or bent unless specifically listed for the application.

H. Cable Pulling

1. Pull cables that share conduit at same time into completely installed raceway. Conductors shall not be pulled in raceways with existing wiring.
2. Submit cable pulling calculations for engineers' approval prior to all mechanically assisted pulls. Attach pull ropes to conductors with basket-weave grips on pulling eyes. Provide means to measure tension during entire pull. Utilize pulling compounds to lessen friction in accordance with the manufacturer's recommendations.
3. Mechanically assisted pulls shall utilize equipment specifically designed for the purpose such as ropes, electric wench, pulleys, etc. The use of a motorized vehicle to assist in a cable pull is prohibited.

3.5 JUNCTION AND PULL BOXES

- A. Junction box covers shall be accessible. Do not install junction boxes above suspended ceilings except where ceiling is removable or where an access panel is provided.
- B. Pull boxes connected to concealed conduits shall be mounted with covers flush with finished wall or ceiling.
- C. Pull boxes exposed to rain or in damp/wet locations shall be weatherproof NEMA 3R unless noted otherwise on the drawings.
- D. No pull box shall be within two (2) feet of another.
- E. Provide clamps, grids, cable ties and other non-conductive or combustible appurtenances to secure cables. No cable shall be unsupported for more than thirty (30) inches. Cables shall not touch or be unsupported within one (1) inch of the box cover.
- F. Each junction and pull box shall have a suitable laminated plastic nameplate with white cut letters identifying power source, voltage and driven load of the associated branch circuits or feeders.
- G. Submit box sizing calculations to confirm all box dimensions are in accordance with code requirements with product data prior to installation.

3.6 SAFETY DISCONNECT SWITCHES

- A. Provide safety disconnects as required and indicated on the drawings. Each motor shall be provided with a local disconnecting means in accordance with code requirements.
- B. Manual motor starters may be used for 120, 208, 240, or 277V, single-phase motors up to 1 HP. Switches shall disconnect all ungrounded conductors. Overload heating elements shall be properly sized and coordinated for the associated motor in accordance with code and manufactures recommendations.
- C. Disconnect switches for all applications with available fault current in excess of 10,000 amperes RMS symmetrical shall be fusible. Fuses shall be Class J, L or R and rejection clips shall be installed in the fuse holders to prohibit the installation of non-current limiting fuses.
- D. Each disconnect switch shall have a suitable laminated plastic nameplate with white cut letters identifying power source, voltage and driven load.

END OF SECTION 26 00 00