



City of Houston
Convention & Entertainment
Facilities Department

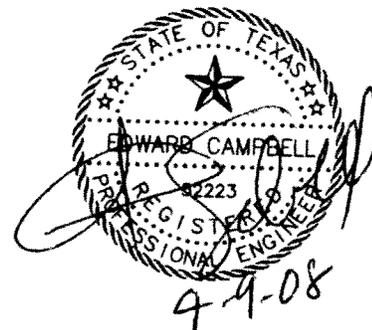
PROJECT MANUAL
HOUSTON CENTER FOR THE ARTS FIRE ALARM UPGRADE
3201 Allen Parkway

VOLUME NO. 1 OF 1

Divisions 00 through 16

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Hunt & Hunt Engineering Corp.
P.O. Box 771294
Houston, Texas 77215-1294
713-780-9554



SECTION 01110 - SUMMARY OF WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Summary of the Work including work by City, City furnished products, Work sequence, future Work, Contractor use of Premises, and City occupancy.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. It is the intent of this specification to provide a complete non-coded, zoned/addressable electrically supervised fire alarm system to be installed, connected and left in first class operating condition. The entire installation shall conform to all applicable national, state and local codes. In particular, National Fire Protection Association Standard No.72, NFPA Code 101, Chapter 6, Texas Revised Civil Statutes and the National Electrical Code. All equipment shall be the product of a single manufacturer and bear the U.L. or F.M. Label.
- B. The fire alarm and detection Contractor shall design, size and install all, manual pull stations, photoelectric type smoke detectors, duct detectors, heat detectors, horns and strobe units, associated conduit and wiring, fire alarm control panel or any other equipment essential for a complete and operational installation of the fire alarm and detection system as required by NFPA, City of Houston and State Fire Marshall.
- C. The Contractor shall cut, patch, replace and or repair existing walls and ceilings as necessary to accommodate the fire alarm system installation. Repair or replace work as necessary to match existing conditions and to comply with the required visual effect.
- D. Restore site to original condition.

1.03 CASH ALLOWANCES

- A. Include the following specific Cash Allowances in the Contract Price under provision of General Conditions Paragraph 3.9:
 - 1. None

1.04 CITY FURNISHED PRODUCTS

A. Items Furnished by City for Final Connection by Contractor:

1. None

B. Contractor's Responsibilities:

1. Arrange and pay for product delivery to site.
2. Receive and unload products at site; jointly with City, inspect for completeness or damage.
3. Handle, store, install, and finish products.
4. Repair or replace damaged items.
5. Provide owner's manuals and train City personnel on the operation and maintenance of fire alarm system equipment.

1.05 WORK SEQUENCE

- A. Construction work must be completed within the construction period, coordinate construction schedule and operations with City.

1.06 CONTRACTOR USE OF PREMISES

- A. Confine access and operation and storage areas to City of Houston property. Make arrangements with City for lay-down areas and site access.
- B. Utility Outages and Shutdown: Provide notification to the City and private utility companies (when applicable) a minimum of 48 hours, excluding weekends and holidays, in advance of required utility shutdown. Coordinate all work as required.

1.07 WARRANTY

- A. Comply with warranty requirements in accordance with Section 16721.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 16000 - GENERAL PROVISIONS FOR ELECTRICAL WORK

PART 1 GENERAL

1.01 DESCRIPTION

- A. General: This Division covers electrical materials and electrical workmanship. The electrical drawings delineate materials, physical arrangement, details and schedules.

1.02 SCOPE OF WORK

- A. The Electrical Contractor and his sub-contractors for the work of this section shall fully inform themselves of the extent of each part of the project that encompasses work by that trade and shall furnish all necessary equipment, tools, labor, materials, transportation, services and facilities required for the complete installation of all electrical work as shown on the plans or outlined in these specifications. The work shall include all materials, accessories, and apparatus not specifically mentioned herein or noted on the plans, but which are necessary for installation of all systems specified.

Work consists of, but is not limited to:

1. Electrical service entrances.
2. Distribution Panels, Lighting and Power Panels.
3. Power distribution system, (277/480 V and 120/208 V).
4. Lighting fixtures, lamps poles etc.
5. Miscellaneous outlets, devices and disconnects.
6. Obtain and pay for all required electrical permits and fees.

1.03 REFERENCE STANDARD

- A. Refer to individual sections.
- B. If general statements in the specifications should appear to conflict with specific notations in the specifications or drawings, the specific shall govern.

1.04 QUALITY ASSURANCE

A. Applicable Standards

1. Codes: All electrical work shall conform with the requirements and recommendations of the 2005 edition of the National Electrical Code and all local codes and ordinances. In conflicts between codes, the more stringent requirements shall govern.
2. Standards: The specifications and standards of the following organizations are by reference made a part of these specifications and all electrical work, unless otherwise indicated, shall comply with their requirements and recommendations wherever applicable:

Association of Edison Illuminating Companies (A.E.I.C.)

Institute of Electrical and Electronic Engineers (I.E.E.E.)

American National Standards Institute (A.N.S.I.)

American Society of Testing Materials (A.S.T.M.)

Certified Ballast Manufacturers (C.B.M.)

Electrical Testing Laboratories (E.T.L.)

Insulated Power Cable Engineers Association (I.P.C.E.A.)

National Bureau of Standards (N.B.S.)

National Electrical Contractors Association (N.E.C.A.)

National Electrical Manufacturer's Association (N.E.M.A.)

National Fire Protection Association (N.F.P.A.)

Reflector Luminaire Manufacturers (R.L.M.)

Underwriter's Laboratories, Inc. (U.L.)

- B. Requirements of Regulatory Agencies: The requirements and recommendations of the latest edition of the Occupational Safety and Health Act are by reference made a part of these specifications and all electrical work shall comply with their requirements and recommendations wherever applicable.

- C. Interferences: Electrical Drawings are generally of a diagrammatic nature. Except where dimensioned locations are shown, plan and coordinate the work to eliminate interferences with other trades. Provide all fixture and equipment locations and provide all supporting materials required for a planned, coordinated and neat installation. Where interferences occur, the Owner's authorized representative will decide which items must be relocated regardless of which was installed first.
 - D. Electrical Workmanship: Provide workmanship of the highest quality. Sub-standard work will not be accepted. Use only personnel skilled in the trades involved.
 - E. Electrical Materials: Provide all materials used in this work, unless particularly specified otherwise, that are new and free from flaws or imperfections.
 - F. Excavation, Trenching, Backfilling and Compaction: Execute all excavation, trenching, backfilling and compaction required for this work in accordance with applicable section of specification.
 - G. Cutting and Patching: Execute all cutting and patching required for this work in accordance with applicable section of specification.
 - H. Sleeves and Inserts: Furnish and locate all sleeves and inserts required for this work as required.
 - I. Painting: Limit painting of factory-finished equipment to touching up unless specified otherwise.
 - J. Testing: In addition to testing required under these specifications, Owner reserves the right to conduct independent acceptance tests on such portions of the installation as he sees fit. Acceptance tests will be to determine fulfillment of contract requirements and will be conducted in the presence of authorized representative of Contractor and Designer. Timely notification of acceptance tests will be given. Correct all deficiencies in materials and workmanship revealed by the acceptance tests.
- 1.05 CONTRACTOR QUALIFICATIONS
- A. An acceptable contractor must have experience to provide a practical working system and employ skilled craftsmen.
- 1.06 APPLICABLE PROVISIONS
- A. The general provisions of the contract, including General and Supplementary conditions and General Requirements, apply to the work specified in this section.

1.07 UTILITY SERVICES

- A. Before beginning work on the services, review the work with the local power and telephone companies. Comply with all their requirements whether shown on the drawings or not. Extend services as required. All costs for utility services are to the Contractor's account.

1.08 CONTRACT DRAWINGS

- A. Intent: The intent of the drawings is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system. Electrical drawings are generally diagrammatic and show approximate location and extent of work. Install the work complete, including minor details necessary to perform the function indicated. In case of doubt as to work intended, or if amplification or clarification is needed, request instructions from the Engineer.
- B. Discrepancies: Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Engineer for his interpretation.
- C. Outlet and Equipment Locations: Coordinate the actual locations of electrical outlets and equipment with building features and mechanical equipment as indicated on Architectural, Structural and Mechanical drawings. Review with the Engineer any proposed changes in outlet or equipment location. Remove and relocate outlets placed in an unsuitable location, when so requested by the Engineer.

1.09 REGULATIONS AND PERMITS

- A. Regulations: Work, materials and equipment must comply with the latest rules and regulations of the following where standards exist.
 - 1. National Electrical Code (NEC).
 - 2. National Electrical Safety Code (NESC).
 - 3. Occupational Safety and Health Act (OSHA).
 - 4. City of Houston, Texas.
 - 5. State and Federal codes, ordinances and regulations.
- B. Discrepancies: The drawings and specifications are intended to comply with listed codes, ordinances, regulations and standards. Where discrepancies occur, immediately notify the Engineer in writing and ask for an interpretation. Should installed materials or workmanship fail to comply, the contractor is responsible for correcting the improper

installation. Additionally, where sizes, capacities, or other such features are required in excess of minimum code or standards requirements, provide those specified or shown.

- C. Permits: Obtain certificates of inspection and other permits required as a part of the work.

PART 2 PRODUCTS

2.01 SHOP DRAWINGS AND PRODUCT DATA

- A. Data Required: Submit shop drawings and product data as specified in Division 1 - General Requirements. Submittal data must show published ratings or capacity data, detailed equipment drawing for fabricated items, panel diagrams, wiring diagrams, installation instructions and other pertinent data.
- B. Form of Submittal: Submit data for review before placing purchase orders. Organize data in a 3-ring binder indexed by specification reference. Show any revisions to equipment layout required by use of selected equipment.
- C. Submittal Items: Submittals are required for, but are not limited to, the following items:
 - 1. Shop Drawings, and/or product data.
 - a. Catalog cuts of all lighting fixtures, identified by assigned type designation.
 - b. List of low voltage insulated wire and cable with each type identified by manufacturer's designation.
 - c. Lighting and receptacle type panelboards.
 - d. Power distribution panelboards.
 - e. Power distribution switchboards.
 - f. Circuit breakers and fuses.
 - g. Control panels.
 - h. Continuous rigid cable supports.
 - i. Wiring devices, time clocks, conductors, and photocells.
 - j. Grounding materials and equipment.
 - 2. Warranty: Copy of specific warranty per equipment or system.
 - 3. Maintenance: Copy of specific service or maintenance policy per equipment or system.

2.02 PRODUCT REQUIREMENTS

- A. Condition: Materials and equipment provided under these specifications must be new products of manufacturers regularly engaged in production of such equipment. Provide the manufacturer's latest standard design for the type of equipment specified.
- B. Labels: Products must conform to requirements of the National Electric Code. Where Underwriters' Laboratories have set standards, listed products and issued labels, products used must be listed and labeled by UL.
- C. Underground marking tape: Tape shall be polyethylene, .004 inches thick, 6 inches wide.
- D. Space Limitations: Equipment selected must conform to the building features and must be coordinated with them. Do not provide equipment which will not suit arrangement and space limitations.
- E. Factory Finish: Equipment must be delivered with a hard surface, factory-applied finish so that no additional field painting is required.

2.03 SUBSTITUTIONS

- A. Substitute Provision: If contractor proposes to substitute any product for that specified, he must provide pertinent data in the products list for the Architect's/Engineer's consideration prior to bid refer to Section 01630.
 - 1. Requests for substitution are understood to mean that the Contractor will, at his own expense, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.
 - 2. Substitutions will not be considered if a substantial revision of the contract documents is required.

PART 3 EXECUTION

3.01 EXECUTION

- A. Moisture: During construction, protect motors, control equipment, and other items from moisture. Protect metallic components from corrosion. Apply protection immediately on receiving the products and maintain continually.
- B. Clean: Keep products clean by elevating above ground or floor and by using suitable coverings.

- C. Damage: Take such precautions as are necessary to protect apparatus and materials from damage. Failure to protect materials is sufficient cause for rejection of the apparatus or material in question.
- D. Finish: Protect factory finish from damage during construction operations and until acceptance of the project. Satisfactorily restore or replace any finishes that become stained or damaged.

3.02 INSTALLATION

- A. Cooperation with Other Trades: Cooperation with trades of adjacent, related or affected materials or operations, and of trades performing continuations of this work under subsequent contracts, is considered a part of this work in order to effect timely and accurate placing of work and to bring together, in proper and correct sequence, the work of such trades.
- B. Workmanship: Work must be performed by workmen skilled in their trade. The installation must be complete, whether the work is concealed or exposed.
- C. Setting of Equipment: Equipment must be leveled and set plumb. In sufficient time to be coordinated with work of others, provide drawings and layout work showing exact size and location of sleeves, openings or inserts for electrical equipment in slabs, walls, partitions and chases.
- D. Motors: Electrical work includes the electrical connection of motors, except those which are wired as a part of equipment.
- E. Concealed Work: Conceal electrical work in walls, floors, chases, under floors, underground and above ceilings, except where shown or specified to be exposed.
- F. Application: Unless otherwise indicated, power will be utilized as follows:
 - 1. 480 volts, 3 phase: Motors 3/4 horsepower and larger, unless otherwise indicated.
 - 2. 120 volts, single phase: Motors smaller than 3/4 horsepower, unless otherwise indicated.
 - 3. 120 volts, single phase: Incandescent lighting, convenience outlets, special outlets and control.
 - 4. 120 volts and 277 volts, single phase: Lighting.

3.03 EQUIPMENT AND DEVICE MARKING

- A. Nameplates: Externally mark electrical equipment by means of suitable nameplates identifying each and the equipment served.
- B. Nameplate Information: In general, the following information is to be provided for the types of electrical equipment as listed.
 - 1. For each branch circuit protective device, identify the load served.
 - 2. Panelboards: Identify the service source, panelboard designation and voltage characteristics.
- C. Panelboards: Prepare a neatly typed circuit directory behind clear heat-resistant plastic for each panelboard. Identify circuits by equipment served and by room numbers. Indicate spares and spaces with light, erasable pencil marking.
- D. Boxes and Small Equipment: Pull boxes, individually mounted disconnect switches, motor starters and similar items shall be labeled with 2-color laminated plastic identification nameplates secured with cement and bolts or screws. Plates shall be 3/32 inch thick by 1 inch high and have 1/4 inch letters.
- E. Power Receptacles: Use nameplates to identify power receptacles where the normal voltage between any pair of contacts is greater than 150 volts with circuit number, voltage and phases. Use permanent laminated name plates secured with cement and bolts or screws.
- F. Wall Switches: Label switch plates of wall switches controlling equipment which is not in sight of the control switch. Use permanent laminated name plates secured with cement and bolts or screws.
- G. Location of underground conduit shall be marked by use of underground warning tape, colored with printed message. Tape to be buried directly over pipe, 6" below finished grade. Underground warning tapes to be as follows:
 - 1. Electrical conduit - Red, legend "Electric Line Buried Below", Seton No. 210 ELE or approved equal.
 - 2. Telephone conduit - Orange, legend "Telephone Line Buried Below", Seton No. 210 TEL or approved equal.
 - 3. Main service entrance conduit to be enclosed in red concrete.

3.04 TESTING

- A. Testing Conditions: Place circuits and equipment into service under normal conditions, collectively and separately, as may be necessary to determine satisfactory operation. Perform specified tests in the presence of the Engineer. Furnish all instruments, wiring, equipment and personnel required for conducting tests. Demonstrate that the equipment operates in accordance with requirements of the drawings and specifications.

3.05 WARRANTY

- A. Warranty: The Contractor shall be held responsible for the manufacturers warranted equipment for a period of one year minimum.
- B. Should any equipment become defective during the warranty period, the Contractor shall respond in a timely manner and in turn shall require the manufacturer to correct the deficiency promptly.
 - 1. This includes all electrical items that require change out, inspection or preventative maintenance such as switchgear, bulbs, ballast, controls, panels, etc.
 - 2. The owners personnel must be in attendance at each replacement.

3.06 O & M MANUALS

- A. O & M Manuals: Refer to General Condition for requirements of O & M manuals. Owner shall withhold 5% until final review and approval.

END OF SECTION

SECTION 16050 - TESTS

PART 1 GENERAL

1.01 GENERAL

- A. The Contractor shall inspect, check, adjust, calibrate and test all electrical equipment, materials, and work performed. The Contractor shall provide all labor, materials, equipment and test instruments to perform the requirements of this specification. The inspecting, checking, adjusting, calibrating and testing shall be performed by competent and qualified workmen. The materials, equipment and test instruments used shall be suitable and proper for the purposes of this specification. The procedures and methods used shall be recognized, standard practices for the purposes of this specification. All damaged, defective, deficient and malfunctioning equipment and material furnished by the Contractor shall be promptly reported to the City Engineer for proper disposition prior to proceeding with the work. All damaged, defective, deficient, malfunctioning and otherwise unacceptable materials, equipment and work performed due to any cause shall be replaced or repaired at the Contractor's expense. Repairs, adjustments and other work of a corrective nature having a compromising or questionable result unsatisfactory to City Engineer shall not be an acceptable alternate to the complete replacement or reworking.

1.02 APPLICABLE PROVISIONS

- A. The general provisions of the contract including General and Supplementary conditions and General Requirements apply to the work specified in this section.

1.03 RECORDS

- A. The City Engineer shall be given reasonable advance notice to witness at his discretion all inspections, checks, adjustments, calibrations and tests required by this specification. The results, readings, settings, measurements and data of all inspections, checks, adjustments, calibrations and tests shall be recorded by the Contractor and submitted to City Engineer in acceptable form.

1.04 POWER DISTRIBUTION CABLE

- A. The conductor insulation of the power distribution cable shall be tested after all the terminations have been completed and prior to the final connections and energizing of the cable. A continuity test shall be made for each phase conductor and each grounding conductor. The conductor insulation shall be tested with a 1000 volt insulation tester. The test results and conditions shall be recorded and submitted to City Engineer.

1.05 MOTORS AND MOTOR CONTROLS

- A. All motor power and control wiring shall be checked, inspected and tested for insulation resistance, circuit continuity, wiring connections and proper grounding. The wiring insulation shall be tested from line to line, and from each line to ground with 1000 volt minimum test instrument. Test shall be made prior to energizing circuits. All motor starters and control devices shall be checked, inspected and tested for proper operation. The Contractor shall record the complete nameplate data of all motors and verify the selection and application of all motor overload relay heaters. The overload relay heaters furnished with the equipment shall not be considered correct by virtue of the fact that the heaters were so furnished and installed.

1.06 LIGHTING SYSTEM

- A. Test the insulation resistance and continuity of all lighting branch circuits. All luminaries shall be properly aimed, aligned and lamped.

1.07 SPECIAL SYSTEMS

- A. Exercise care in the checking and testing of all electrical systems so as not to damage special, electronic or instrument circuits. Only qualified personnel shall install and test special systems.

1.08 MISCELLANEOUS

- A. All systems under electrical section shall be tested as specified and recommended by manufacturers to meet all codes. Make adjustments and correct defects as required to put systems in perfect operating conditions. Work shall include furnishing instruments, materials and the cost of replacement and/or repairs of damage due to failure under test.
- B. After the installation of the 277/480 volt service and feeder conductors is complete, prior to energizing them test each conductor with a 600 volt meter. Provide all conductors to be free from short circuits and from grounds other than as provided in Article 250 or the National Electrical Code.
- C. Record feeder load currents and line voltages at each panelboard. Adjust single phase load connections to balance feeder loads. Record load currents of each electrical motor 1/4 H. P. and larger. Provide the City Engineer with a complete copy of all initial load records.
- D. Cable Tests
 - 1. The insulations resistance of all service and feeder conductors shall be tested. Each conductor shall have its insulation resistance tested after its installation is

completed and all splices, taps and connections are made except the connections to or into its source and point (or points) of termination.

2. The insulation resistance of conductors which are to operate at 600 volts or less shall be tested by using a Biddle (or approved equal) megger of not less than 1,000 volts DC. Resistance shall be measured by connecting one terminal of megger to the conductor and the other terminal to the conduit in which the conductor is installed. Readings shall be observed after one minute operation of the megger at slip speed. The insulation resistance of conductors rated at 600 volts shall be not less than the following for the wire sizes based on Section 6.15 of ICEA-S-66-524:

$$R = K \log_{10} D/d$$

Where:

R = Insulation resistance in megohms – 1,000 feet

(R = 10,000 for XHHW insulations)

(R = 2,000 for THHW/THHN insulation)

K = Constant for the insulation (see Part 3)

D = Diameter over the insulation

d = Diameter under the insulation.

3. Conductors that do not equal or exceed the insulation resistance values listed above shall be replaced. The tests shall be performed in the presence of the Architect and Owner. The Contractor shall furnish all instruments and personnel required for the tests, shall tabulate the readings observed, and shall forward to the Architect two copies of the test readings

END OF SECTION

SECTION 16060 - ELECTRICAL DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES:

- A. Electrical Demolition.

1.02 REFERENCES

- A. Temporary wiring of systems to maintain operation of facilities while undergoing modifications and demolition shall be provided in accordance with:
 - 1. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), No. 70 - National Electrical Code (NEC), Article No. 305 - Temporary Wiring

1.03 SUBMITTALS

- A. Annotate existing drawings to sequence the demolition of systems, equipment removal and temporary hook-ups.
- B. Schedule with Owner Representative for required shut-downs to accommodate system demolition and installation of temporary facilities.

1.04 QUALITY ASSURANCE

- A. Verify that field measurements and circuiting arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Drawings are based on visual field observation and existing record documents. Report discrepancies to Owner Representative before disturbing existing installation.
- D. By beginning demolition, installer accepts existing conditions and warrants that he will maintain service to equipment and items not scheduled or indicated for removal, and that he will return to the Owner all items and systems in good operating condition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT:

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

2.02 DESIGN AND CONSTRUCTION:

- A. The temporary electrical wiring and facilities shall be designed and constructed in strict compliance with NEC - Article No. 305.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate utility service outages with Utility Company to provide continuous service to operating equipment.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- C. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from the Owner at least one week before partially or completely disabling system. Minimize outage duration.

3.02 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove abandoned wiring to source of supply.
- B. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- C. Disconnect and remove abandoned panelboards and distribution equipment.
- D. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to existing installations, which remain active. Modify installation or provide access panel as appropriate.

- G. Extend existing installations using materials and methods as specified for new work.

3.03 DISPOSAL AND SALVAGE

- A. Salvage electrical and instrumentation equipment removed from existing facilities for reuse as applicable.
- B. Material and equipment, which can be reused or salvaged, remains the property of the Owner unless specifically indicated in the Specifications or Drawings or as designated by the Owner.
- C. Materials and equipment, which cannot be reused or salvaged, will be removed and disposed of by the Contractor.

3.03 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment, which remain or are to be reused.
- B. Panelboards: 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

SECTION 16111 - CONDUIT, FITTINGS AND BODIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specification for conduit, fittings and bodies.

1.02 REFERENCES

- A. American National Standards Institute (ANSI).
 - 1. ANSI C80.1: Rigid Steel Conduit - Zinc Coated.
 - 2. ANSI C80.4: Fittings for Rigid Metal Conduit.
- B. Federal Specifications.
 - 1. W-C-58C: Conduit Outlet Boxes, Bodies Aluminum and Malleable Iron.
 - 2. W-C-1094: Conduit and Conduit Fittings Plastic, Rigid.
 - 3. WW-C-566C: Flexible Metal Conduit.
 - 4. WW-C-581D: Coatings on Steel Conduit.
- C. National Electrical Manufacturers Association (NEMA).
 - 1. NEMA RN1: Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.
 - 2. NEMA TC2: Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
 - 3. NEMA TC3: PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- D. National Fire Protection Association (NFPA), ANSI/NFPA 70 - National Electrical Code (NEC).
- E. Underwriters' Laboratories (UL).
 - 1. UL 1: Flexible Metal Electrical Conduit.
 - 2. UL 6: Electrical Rigid Metal Conduit - Steel.

CONDUIT, FITTINGS AND BODIES

3. UL 514B: Fittings for Cable and Conduit.
4. UL 651: Schedule 40 and 80 Rigid PVC Conduit.
5. UL 651A: Type EB and A Rigid PVC Conduit and HDPE Conduit.
6. UL 886: Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
7. UL797: Electrical Metallic Tubing.
8. UL467: Grounding and Bonding Equipment.

1.03 SUBMITTALS

A. Submit the following under the provisions of Section 01330 - Submittal Procedures:

1. Manufacturer's cut sheets, catalog data, with selected products clearly marked.
2. Installation, terminating and splicing procedure.
3. Instruction for handling and storage.
4. Dimensions and weight.
5. Code compliance certificate.
6. Conformance certificate.

1.04 QUALITY ASSURANCE

A. Tests:

1. Rigid steel conduit shall pass the bending, ductility, and thickness of zinc coating tests described by ANSI C80.1.
2. Flexible conduit shall pass the tension, flexibility, impact, and zinc coating test described by UL 1.
3. Nonmetallic conduit and fittings shall pass the test requirements of NEMA TC2, UL 651 and 651A and Federal Specification W-C-1094A.

1.05 DELIVERY STORAGE AND HANDLING

- A. Package conduit in 10-foot bundles maximum with conduit and coupling thread protectors suitable for indoor and outdoor storage. Package fittings in manufacturer's standard quantities and packaging suitable for indoor storage. Package plastic-coated rigid conduit, fittings, and bodies in such a manner as to protect the coating from damage during shipment and storage.
- B. Store conduit above ground on racks to prevent corrosion and entrance of debris.
- C. Protect plastic conduit from sunlight.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Rigid Steel Conduit:
 - 1. Allied Tube and Conduit
 - 2. Triangle Wire and Cable, Inc.
 - 3. Wheatland Tube Company
- B. Electrical Metallic Tubing (EMT):
 - 1. Allied
 - 2. E.T.P
 - 3. Republic or equivalent
- C. Flexible Metal Conduit:
 - 1. Appleton
 - 2. Crouse-Hinds
 - 3. Raco
 - 4. Steel City or equivalent

D. Liquid Tight Flexible Conduit:

1. Anamet, Inc.
2. Electriflex Company
3. Triangle Wire and Cable, Inc.

E. PVC Coated Steel Conduit:

1. Occidental Coating Company (O-Cal Blue)
2. Robroy Industries, Inc. (Rob-Roy Red)

F. PVC Rigid Conduit:

1. Cantex
2. Carlon Industries, Inc.
3. Robroy Industries, Inc.
4. Triangle.

G. Conduit Fittings and Bodies:

1. Appleton Electric
2. Crouse-Hinds
3. Killark Electric Manufacturing Company
4. O-Z/Gedney
5. Raco
6. Steel City.

2.02 MATERIALS AND EQUIPMENT

- A. Design Conditions: Use electrical conduit, fittings, and bodies designed for service in areas as specified in Section 16000 - General Provisions for Electrical Work and this section to form a continuous support system for power, control, and instrument cables.

B. Conduit and Fittings:

1. Rigid Steel Conduit and Fittings.

- a. Conduit: Hot dipped galvanized rigid steel conduit (RSC) with zinc-coated threads and an outer coating of zinc chromate.
- b. Fittings: Threaded, malleable iron, either cadmium plated or hot dipped galvanized.
- c. Rigid steel conduit, rigid steel conduit bends, nipples, and bodies shall be hot-dipped galvanized and shall comply with the latest ANSI C80.1, UL 6, Federal Specification WW-C-581D, and NEC Article 344.
- d. Mild steel tubing shall be used for conduit, nipples, and couplings, and shall be free of defects on both the inner and outer surfaces.
- e. Fittings, bodies, and covers for rigid steel conduit shall be steel or cast-iron and shall comply with ANSI C80.4, UL 514B, and Federal Specification W-C-58C.

2. Electric Metallic Tubing:

- a. Conduit: Galvanized electrical steel tubing.
- b. Fittings: Compression type, malleable iron either cadmium plated or hot-dipped galvanized
- c. EMT, with compression fittings, can be used in the "office area" only balance of the building shall be rigid of galvanized steel.

3. Flexible Metal Conduit: Use flexible conduit to all recessed lighting fixtures within 6' maximum. Also, to all motors inside the building for motor connections exposed to the weather, use liquid-tight. Maximum length of flex to motors is three (3) feet.

- a. Conduit: Spiral wound, square-locked, hot dipped galvanized steel strip.
- b. Fittings: Two-screw, double-clamp malleable iron, either cadmium plated or hot dipped galvanized steel.

4. Flexible and Liquid-tight Flexible Metal Conduit and Fittings:

- a. Use liquid-tight flexible metal conduit manufactured in accordance with UL 1 and Federal Specification WW-C-566C.
- b. Fittings used with liquid-tight flexible metal conduit shall be the PVC-coated type and of such design as to thoroughly ground the conduit to the fittings, and through it to the box or enclosure to which it is attached.
- c. Flexible couplings and fittings for use in hazardous areas shall comply with UL 886, NEC Article 501.140, and Federal Specification W-C-586C.
- d. Conduit: Spiral-wound, square-locked, hot-dipped galvanized steel strip plus a bonded outer jacket of PVC.

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- e. Fittings: Compression type, malleable iron, with insulated throat, either cadmium plated or hot-dipped galvanized.
- 5. PVC Conduit and Fittings: Use PVC conduit, bends, and fittings, which comply with NEMA TC2, W-C-A, and NEC Article 352 for above ground and underground installation. Conduit shall be schedule 40 or schedule 80. When crossing under the streets, conduits shall be PVC conduit Schedule 80.
- 6. Polyvinyl Chloride Conduit (PVC):
 - a. Conduit: Schedule 40 heavy wall.
 - b. Fittings: Schedule 40 PVC.
 - c. Adapters: Threaded for transition to rigid steel elbows.
 - d. Acceptable Conduit and Fittings Manufacturers: Carlon, Triangle or approved equal.

PART 3 EXECUTION

3.01 PREPARATION

- A. Confirm submittal of shop drawing with conduit and conduit fitting, sizes, types and routing shown.
- B. Ensure that the conduit system to be installed is sized properly for the cable and wire requirements.
- C. Verify the actual physical conduit route from the conduit plan drawings and prepare the conduit support system.
- D. Verify the equipment locations to which the conduit will be connected and determine detail requirements for connections.

3.02 INSTALLATION

- A. Install PVC-coated conduits in all outdoor locations; inside valve vaults; in wet well slabs; and in corrosive and wet environments.
- B. Install rigid galvanized steel (RGS) conduits in dry inside locations only.
- C. Install PVC conduits in duct banks. For stub-ups, use PVC-coated rigid steel elbows.
- D. Run exposed conduit parallel or perpendicular to walls, ceilings or main structural members. Group multiple conduits together where possible. Do not install conduit where it interferes with the use of passageways, doorways, overhead cranes, monorails,

CONDUIT, FITTINGS AND BODIES

- equipment removal areas or working areas. In no case shall conduit routing present a safety hazard or interfere with normal plant operating and maintenance procedures. Maintain a minimum overhead clearance of 8'-0" in passageways.
- E. Installation and support of conduit shall be from steel or concrete structures in accordance with the standard detail drawings. Furnish necessary conduit straps, clamps, fittings and support for the conduit in accordance with the standard details and consistent with the grade and type of conduit being installed.
 - F. Identify conduit at termination points like MCC, light fixtures, control panels, receptacles, and junction boxes.
 - G. Not more than 3 equivalent 90 degree bends will be permitted between outlets. Provide bonded expansion fittings at building expansion joints.
 - H. Install conduit runs so that they are mechanically secure, mechanically protected from physical harm, electrically continuous, and neat in appearance. The interiors of conduit shall provide clean, smooth raceways through which conductors may be drawn without damage to the insulation. Make threaded connections wrench tight.
 - I. Cut conduit square with a power saw or a rotary type conduit cutter designed to leave a flat face. Do not use plumbing pipe cutters for cutting conduit. Ream the cut ends of conduit with a reamer, designed for the purpose to eliminate rough edges and burrs. Cut threads with standard conduit dies providing 3/4-inch taper per foot, allowing the proper length so that joints and terminals may be made up tight and the ends of the conduit not deformed. Keep dies sharp and use a good quality threading oil continuously during the threading operation. Remove metal cuttings and oil from the conduit ends after the threads are cut and paint threads before connections are made. Use zinc rich, brush-on compound on the threads of steel conduit before connections are made. Use only tools specifically made for bending and installing PVC-coated or PVC conduit when installing these materials.
 - J. Use strap wrenches only to tighten joints in plastic coated rigid steel conduit. Replace all conduit and fittings with damage to the plastic coating, such as cuts, nicks and threader chuck jaw marks.
 - K. Make up changes in direction of conduit using elbows or fittings. Do not use pull boxes to make direction changes unless specifically designated otherwise.
 - L. Field fabricated bends shall be free of indentations or elliptical sections. The radius of the bend shall not be less than 6 times the smallest diameter of the raceway.
 - M. Protect all conduit terminations from mechanical injury. Prevent the entry of moisture and foreign mater into the conduit system by properly capping terminations.

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- N. Avoid trapped runs of conduit, if possible. When they are necessary, provide drainage using a "tee" conduit equipped with a drain. Conduit is likely to pass through areas with a temperature differential of 20 degrees F or more. Seal penetrations with a proper seal fitting at the wall or barrier between such areas. For conduit passing through walls separating pressurized areas from non-pressurized areas, install sealing fittings at the wall on the non-pressurized side.
- O. Fit conduit crossing building or structure expansion joints with approved expansion fittings, except that fittings will not be required when conduit crossing an expansion joint is supported on trapeze hangers in such a way that at no time will the conduit be under stress due to expansion. Install bonding jumpers around expansion joint fittings.
- P. Where conduit terminates in sheet metal enclosures and where no threaded hubs are provided, fit the conduit with double locknuts and bushings. Sheet metal enclosures located outside or in any other wet, damp or corrosive areas shall be furnished with threaded hubs. Restrict side penetrations to the lower one third of the enclosure.
- Q. Provide flexible metallic conduit where necessary to allow for movement or to localize sound or vibration, at transformers, at motors and any other rotating equipment unless shown otherwise on Drawings.
- R. Seal openings or holes where conduits pass through walls or floors. When conduits are passing through a firewall or fire-rated floor into different rooms, cabinets, or enclosures, use a fire-rated seal as shown in the typical detail included in the Drawings. Certain walls, as indicated on the Drawings, require environmental (air-tight) seals; seal as shown.
- S. Install explosion-proof seals in conduit runs crossing or entering a hazardous classified area, as shown on Drawings. Install type CSBE removable sealing fittings to seal pump cables in the wet well and at the first junction box outside the well. Fuel dispensers to have UL approved flex minimum 10" long.
- T. Unless otherwise indicated on the Drawings, install expansion fittings every 300 feet within a straight conduit run and where conduit crosses building expansion joints, using bonding straps to ensure ground continuity.
- U. Parallel runs of conduit may be supported by structural steel racks. When two or more racks are arranged one above the other, provide vertical separation of not less than 12 inches between racks, unless otherwise indicated on the Drawings. Space conduits on the racks at least enough to provide 1/4-inch clearance between hubs on adjacent conduits at terminations and to allow room for fittings.
- V. Fill conduit racks no more than 75 percent of their capacity, providing usable space for future conduit. To ensure this, conduits leaving the rack horizontally shall be offset up or down so that future conduits may be installed in the space remaining. Construct

CONDUIT, FITTINGS AND BODIES

conduit racks to permit access for wire or cable pulling at all pull points, even when future conduits are added to fill the racks.

- W. Where conduit racks are supported on rods from beam clamps or by some other non-rigid suspension system, install rigid supports at no more than 50-foot intervals to give lateral stability to the rack.
- X. Conduit racks or hangers must in no way interfere with machinery (or its operation), piping, structural members, process equipment, or access to anticipated future equipment. Refer to architectural, structural, equipment layout and piping drawings to ensure that this requirement is met. Label high voltage conduit with the circuit phase-to-phase voltage by means of a firmly attached tag or label of approved design at each conduit termination, on each side of walls or barriers pierced and at intervals not exceeding 200 feet along the entire length of the conduit.
- Y. Support conduit sizes 2 inches and larger at spacings not exceeding 10 feet and conduit sizes 1-1/2 inches and smaller at spacings not exceeding 8 feet.
- Z. The means of fastening conduit to supports shall be: By one hole malleable iron conduit straps secured by wood screws to wood and by bolts with expansion anchors to concrete or masonry; by "Korn" clamps or U-bolts to other surfaces. Use "clamp backs" when strapping conduits to walls, column faces, or other such surfaces.
- AA. Support conduit runs with conduit clamps, hangers, straps and metal framing channel attached to structural steel members. Conduits of 1-1/2 inch size or less may be supported by one-hole conduit straps on concrete, tile or steel work, but for larger size conduit, use 2-hole straps. Use clamps of galvanized malleable iron for rigid galvanized conduit and PVC-coated or stainless steel for PVC-coated conduit. Metal framing channel straps used for PVC-coated conduit shall be type 3/16 stainless steel.
- BB. Install conduits supported from building walls with at least 1/4-inch clearance from the wall to prevent the accumulation of dirt and moisture behind conduit.
- CC. EMT shall be run inside walls. BX flex is not allowed to feed switch legs, convenience outlets and similar devices. Control wiring for HVAC system to be run in EMT.

END OF SECTION

SECTION 16120 - 600-VOLT BUILDING WIRE AND CABLE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specifications for 600-volt building wire and cable.

1.02 REFERENCES

- A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA 70 - National Electrical Code (NEC), Article 310 - Conductors for General Wiring.
- B. Underwriter's Laboratories (UL):
 - 1. UL 83: Thermoplastic Insulated Wires and Cables
 - 2. UL 1063: Machine Tool Wires and Cables
- C. American Society for Testing and Materials (ASTM):
 - 1. ASTM B3: Soft or Annealed Copper Wires
 - 2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft
- D. Insulated Cable Engineers Association (ICEA) ICEA-S-95-658/NEMA WC70: non-shielded 0-2KV cables, (ICEA S-61-402: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5) is now with drawn.)

1.03 SUBMITTALS

- A. Submit the following under the provisions of Section 01330 - Submittal Procedures:
 - 1. Manufacturer's cut sheets and catalog data
 - 2. Instruction for handling and storage
 - 3. Dimensions and weight
 - 4. Conformance certificate

1.04 QUALITY ASSURANCE

- A. Tests: Cable shall meet all the requirements of ICEA S-95-658/NEMA WC70.
- B. Conformance Certificate and Quality Assurance Release: Submit a conformance certificate signed by the person responsible for product quality. The certificate shall specifically identify the purchased material or equipment; such as by the project name and location, purchase order number, supplements, and item number where applicable, including materials and services provided by others. The certificate shall indicate that requirements have been met and identify any approved deviations.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Ship wire and cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by using manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. American Insulated Wire Corporation
- B. Carol Cable Company, Inc.
- C. General Cable Company
- D. Okonite Company
- E. Rome Cable Company
- F. Triangle Wire and Cable, Inc.

2.02 MATERIALS AND EQUIPMENT

- A. Design: Provide cable designated as THWN/THHN or XHHW single conductor type and UL 83 and UL 1063 listed, rated 600 volts and certified for continuous operation at maximum conductor temperature of 90 degrees C in dry locations and 75 degrees C in wet locations while installed in underground duct, conduit or in control panels (MTW).

- B. Conductors: Provide conductors which are Class B, concentric stranded, annealed uncoated copper with physical and electrical properties complying with ASTM B3 and B8 and of ICEA S-95-658/NEMA WC70.
- C. Insulation: Each conductor shall be PVC insulated and nylon jacketed to meet the requirements of ICEA S-95-658 WC70. The insulation thickness shall match the dimensions listed in NEC Table 310.13 for type THHN and THWN wire.
- D. Wire Marking:
1. Wire marking shall be in accordance with NEC Article 310.11 and shall be printed on the wire insulation at 2-foot intervals.
 2. The printing method used shall be permanent and the color shall sharply contrast with the jacket color.
- E. The single conductor color coding shall be as follows:

<u>System Voltage</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Neutral</u>
120/208 Volt 3Ph/4w	Black	Red	Blue	White
120/240 Volt 3Ph/4w	Black	Orange	Blue	White
277/480 Volt 3Ph/4w	Brown	Purple	Yellow	Grey
Motor Control	1	Black		
	2	Red		
	3	Blue		
Ground	Green		

PART 3 EXECUTION

3.01 PREPARATION

- A. Complete the cable raceway systems and underground duct banks before installing cables.
- B. Verify sizing of raceways and pullboxes to ensure proper accommodation for the cables.
- C. Check the length of the cable raceway system against the length of cable on the selected reel.
- D. Clean conduits of foreign matter before cables are pulled.

3.02 INSTALLATION

A. Wiring Methods:

1. Use wiring methods indicated on the Drawings.
2. In general, use THHN/THWN or XHHW building wire for lighting, power and control wiring, where conductors are enclosed in raceways such as above ground conduit system, underground duct banks, or inside control panels.
3. Do not use solid conductors.
4. Use conductors not smaller than No. 12 AWG stranded for lighting circuits.
5. Use conductors not smaller than No. 14 AWG for control circuits, except when part of a multiconductor cable or internal panel wiring.
6. In general, do not splice conductors unless approved by the City Engineer.
7. Splices associated with taps for lighting and control circuits are allowed without approval.
8. Make splices in accessible junction boxes.
9. Use wire nuts with insulated caps for lighting wiring splices. Splice control circuit with insulated crimp connectors.

B. Single Conductor in Conduit and Ductbank:

1. Install cables in accordance with the manufacturer's instructions and NEC Chapter 3 - Wiring Methods and Materials. Do not exceed maximum wire tension, maximum insulation pressure and minimum bending radius.
2. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation.

C. Preparation for Termination:

1. Terminal lugs and connectors on busbars for all sizes of conductors shall be compression crimp-on type.
2. For size 1/0 AWG and larger, crimp-on lugs shall have the long barrel with 2-hole compression crimp-on type except in places where termination space is limited.

D. Tests:

1. In general, test insulation integrity of the wiring system before terminating.
2. Make sure to disconnect sensitive electronic equipment before testing insulation.
3. Use a 500 VDC megohmmeter and perform the wire system insulation test in accordance with the operating instructions.

E. Termination:

1. After the 600-volt wiring system has been tested with satisfactory results, reconnect wire.

END OF SECTION

SECTION 16131 - DEVICE, PULL AND JUNCTION BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specifications for device, pull and junction boxes.

1.02 REFERENCES

- A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA):

- 1. FB1 - Fittings and Support for Conduits and Cable Assemblies
- 2. 250 - Enclosures for Electrical Equipment (1000 volts maximum)

- B. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA70 - National Electrical Code (NEC) - Outlet Device, Pull and Junction Boxes, Conduit Bodies and Fittings.

- C. Underwriters Laboratories (UL):

- 1. 50 - Enclosures for Electrical Equipment
- 2. 508 - Industrial Control Equipment
- 3. 514B - Fittings for Cable and Conduit
- 4. 886 - Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations

1.03 SUBMITTALS

- A. Submit the following under provisions of Section 01330 – Submittal Procedures:

- 1. Manufacturer's cut sheets, catalog data
- 2. Instruction for handling and storage
- 3. Installation instructions
- 4. Dimensions and weights

1.04 DELIVERY, STORAGE AND HANDLING

- A. Pack and crate boxes to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Sheet Metal Boxes:

1. Hoffman Industrial Products
2. Pauluhn Electric Manufacturing Company
3. Hennessy
4. Tanco
5. Tejas
6. Circle A.W.

B. Cast Device Boxes:

1. Appleton Electric Company
2. Crouse-Hinds, Division of Cooper Industries
3. Killark Electric Manufacturing Company

2.02 MATERIALS AND EQUIPMENT

A. Sheet Metal Boxes:

1. Provide UL-approved junction boxes and pull boxes manufactured from stainless steel sheet metal and meeting requirements of NEMA 4X for corrosive and wet area, NEMA 250 and NEC.
2. Provide boxes with a stainless steel continuous hinge, closure hasps and all- stainless steel hardware.
3. Furnish the door with neoprene gasket and provision for padlock.

B. Device Boxes

1. Provide UL-approved metal boxes (no plastic allowed) designed and manufactured to house electrical devices like receptacles and switches, and in conformance with NEMA FB1 and NEC.
2. Supply only boxes that are hot-dip galvanized on cast iron suitable for corrosive and wet atmosphere.

C. Hardware:

1. Mounting Hardware: Stainless steel
2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

PART 3 EXECUTION

3.01 PREPARATION

- A. Review the drawings and determine how many boxes of each kind are required and check if supplied quantity is sufficient.

3.02 INSTALLATION

- A. Boxes described in this specification shall be used both in dry and wet, corrosive areas, both inside and outside locations.
- B. Install boxes in accordance with NEC in locations indicated on the Drawings.
- C. Install junction and pull boxes in readily accessible places to facilitate wire pulls, maintenance and repair.
- D. Plug, seal and label unused conduit openings.
- E. Make conduit connections to sheet metal boxes with watertight conduit connectors.

END OF SECTION

SECTION 16195 - ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specification for electrical identification including:
 - 1. Nameplates and labels
 - 2. Wire and cable markers
 - 3. Conduit markers
 - 4. Cable tray markers
 - 5. Underground warning tape
 - 6. Warning labels

1.02 REFERENCES

- A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - 1. No. 70 - National Electrical Code (NEC)
 - a. Article 110 - Requirements for Electrical Installation
 - b. Article 450 - Transformers and Transformer Vaults
- B. City of Houston Building Code
- C. Other applicable Codes and Standards as referenced in other Sections.
- D. Underwriters Laboratories. U.L. Standards No. 224 - Extruded Insulated Tubing

1.03 SUBMITTALS

- A. Submit the following under the provisions of Section 01330 – Submittal Procedures:
 - 1. Manufacturer's cut sheets and catalog data
 - 2. Description of materials used

3. Label or nameplate dimensions
4. Engraving or imprint legends
5. Instruction for handling and storage
6. Installation instructions

1.04 DELIVERY, STORAGE AND HANDLING

- A. Pack materials to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Almetek Industries Incorporated
- B. Brady U.S.A. Incorporated
- C. Ideal Electric Company
- D. Raychem Corporation
- E. 3M Electrical Products Division
- F. Thomas & Betts
- G. Tyton Corporation

2.02 MATERIALS AND EQUIPMENT

- A. Nameplates and Labels
 1. Provide an identification tag for each item of electrical equipment showing its item number and service or application. Use the description shown on the electrical Drawings.
 2. For nameplates, use 3-ply phenolic material engraved to show black lettering on a white background. Size the nameplates approximately 1 inch wide and 3 inches long for 3 lines of 3/16 inch - 16 letters with a 0.8 condensed factor.

ELECTRICAL IDENTIFICATION

3. Generally, provide large pieces of equipment with engraved nameplates; provide additional nameplates at pushbuttons and other local devices; as detailed. Provide identification for all other electrical equipment, device or enclosure not furnished with readily noticeable tag, nameplates or other means of identification.
4. Install nameplates on the front cover of transformers stating the transformer service location number or identification number, the panelboard or device served, and main breaker feeding the transformer (MCC No. and compartment), and the drawing number on which the transformer schematic is shown.
5. Furnish equipment, such as motor starters, safety switches, welding receptacles and circuit breakers, with 1" x 3" plastic nameplates stating description of item served ("FED FROM" if not readily evident).
6. Provide nameplates for motors giving the driven equipment description, the service location number, and the MCC number with compartment number when applicable. Nameplates will normally be mounted adjacent to the motor at the motor pushbutton when one is furnished.
7. Install nameplates on the doors of circuit breaker panelboards (i.e., lighting, instrument or receptacle panels). State the panelboard name, the drawing number on which the panelboard schedule shows, and the main breaker feeding the panel (MCC No. and compartment).
8. Type panelboard directories and insert them inside the panelboard doors.
9. Place a large nameplate approximately 3"x 1 1/2" on control panels, relay panels, junction boxes or enclosures with electrical devices, mounted outside of the enclosure indicating the purpose of the cabinet.
10. Provide a nameplate on MCC motor starter doors duplicating motor nameplate data.

B. Wire and Cable Markers

1. Use pre-printed tubular type wire and cable markers.
2. Select markers manufactured so that the heat-shrink process makes the imprint permanent and solvent-resistant.
3. Use markers that are self-extinguishing, conforming to U.L. Standard No. 224 for print performance, heat shock and flammability.
4. Provide marker material that is flexible, radiation cross-linked polyolefin with 3 to 1 shrink ratio, rated 600 volts, and white in color.

C. Conduit Markers

1. Provide conduit markers made of plastic adhesive tags approximately 2 inches x 1 inch x 19 gage.
2. Stamp the caption on the tag and have it black filled.
3. Punch tags for tie fasteners. Fasten tags to the conduits with stainless steel braided wire.

D. Cable Tray Markers

1. For high visibility and contrast, use cable tray markers that are yellow with black legend.
2. Use markers made of vinyl impregnated cloth, suitable for exposure to corrosive, wet and abrasive environment.
3. Make markers of pre-cut individual letters or numbers with pressure sensitive adhesive backing.
4. Size legend characters to 4 inches high on a total marker height of approximately 5 inches, suitable for applying to 6-inch side rails of a cable tray.

E. Underground Warning Tape

1. Provide warning tape made of 4 mil thick polyolefin film, 3 inches wide, suitable for direct burial and resistant to alkalis, acids and other common soil substances.
2. Use red tape with black legend printed in permanent ink.

F. Warning Labels

1. Place OSHA safety labels on enclosures and boxes 100 cubic inches or more containing electrical equipment or terminations.
2. Provide OSHA color codes for the labels. Use labels made from 4 mil vinyl with pressure sensitive adhesive backing.
3. The warning label caption is DANGER - 480 VOLTS or as indicated on the Drawings.
4. Size labels either 5 inches x 3-1/2 inches or 10 inches x 7 inches, or as indicated on the Drawings.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces where adhesive labels will be applied.
- B. Drill holes for nameplates to be fastened with stainless screws.
- C. Prepare the cable ends for termination and conductor markings.
- D. Identify conduits at terminating points and select tags accordingly.

3.02 INSTALLATION

- A. Install nameplates and labels in accordance with the manufacturer's instructions and the Drawings.
- B. Apply wire and cable markers in accordance with manufacturer's instructions using a heat gun with properly sized nozzle for the application. Tag the wires at both ends with the same notation.
- C. Tag conduits at junction boxes, pull boxes and at other termination points.
- D. Identify cable trays at the time of installation with the alphanumeric number shown on the Drawings. Label cable trays on the outside rail. Place the tray identifier at each point where the tray designation changes and at 200 foot intervals in between, but not less than two per run.
- E. Identify underground conduits, cables or duct banks using the underground warning tape. The underground grounding grid, including the laterals. Also use underground warning tape. Install one tape per trench at 12 inches below grade or as indicated on the Drawings. For wide trenches or duct banks, install one warning tape per 24 inch width.
- F. Apply the properly sized warning labels to disconnect switches, panelboards, terminal boxes, and similar devices in accordance with manufacturer's instruction and the Drawings. Apply the properly sized warning labels to larger control panel enclosures, motor control centers and to entrance doors to buildings containing electrical power and control equipment.

END OF SECTION

SECTION 16475 - LOW VOLTAGE FUSES

PART 1 GENERAL

1.01 GENERAL

- A. The general provisions of the Contract, including General and Special Conditions, the General Conditions for Electrical Work and General Requirements (if any) apply to the work specified in this section.

1.02 DESCRIPTION OF WORK

- A. Scope: This section specifies the furnishing and installation of low voltage fuses rated 600 volts and below, 6000 amperes and below.

1.03 REFERENCES

- A. ANSI C97.1 - Standard for Low Voltage Cartridge Fuses 600 volts and less.
- B. UL 198.2 - High Interrupting Capacity Current-Limiting Fuses.
- C. NEMA FU 1 - Low Voltage Cartridge Fuses.
- D. UL 198.3 - High Interrupting Capacity Class K Fuses.
- E. UL 198.4 - Class R Fuses.

1.04 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of low voltage fuses, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. Installer: A firm with at least three (3) years of successful installation experience on projects with low voltage fuses work similar to that required for project.
- C. Acceptable Manufacturers: Bussmann, Eagle Electric Mfg. Co., Inc., Gould, Inc. or approved equal.

1.05 SUBMITTALS

- A. Data: Submit time current characteristics curves on all types and sizes of fuses to be used on the job, for approval prior to purchase.
- B. Spares: Upon completion of buildings, provide Owner with spare fuses as shown below:
 - 1. Three fuses each rating installed, 601 to 6000 amperes.
 - 2. 10% of each type and rating installed, 0 to 600 amperes (minimum of 3).

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide all fuses of the same manufacturer, having characteristics to insure retention of positive selective coordination as designed, and of sizes shown on one line diagrams and where indicated on drawings. Provide fuses of required size and type for proper operation of the equipment protected.
- B. Any proposed changes in manufacturer of fuse type shall be accompanied by complete short circuit and coordination study.
- C. Construct fuses, 601 ampere to 6000 ampere, using silver links with a fusing alloy soldered to link for low temperature overload operation. An "O" ring seal shall be utilized to assure a positive fit between the end-bell and fuse tube to prevent loss of arc quenching sand filler. Design shall provide time-delay of not less than four (4) seconds at 500% of ampere rating and 45 seconds at 300% of ampere rating. Interrupting rating shall be 200,000 amperes RMS symmetrical. Peak let-thru currents (I_p) and energy let-thru values (I^2t) shall not exceed values established by Underwriters' Laboratories Standard for Class L Fuses. Provide Bussmann KRP-C Fuses.
- D. Fuses protecting circuit breakers of circuit breaker panelboards shall be silver-sand, fast-acting, current-limiting UL Class K-1 and R for amperages 0-600 and UL Class L for amperages 601-6000. Provide Bussmann Limitron KTS-R.
- E. Fuses rated 600 amperes or less or all general power circuits shall be dual-element, UL Class R time-delay type. Fuses, 1/10 ampere to 600 amperes, shall be of a true dual-element construction, incorporating a thermal overload element using a 280 F melting point alloy to provide thermal protection or fuse and fuseholder and separate short-circuit element. Design shall provide time-delay of not less than (10) seconds at 500% of ampere rating. Interrupting rating shall be 200,000 amperes RMS symmetrical. Peak let-thru current (I_p) and energy let-thru values (I^2t) shall not exceed values established

LOW VOLTAGE FUSES

by Underwriters' Laboratories Standard for Class K-5 Fuses. Provide Busmann Fusetron Dual-Element FRS-R Fuses.

- F. Fuses installed in individual motor circuits shall be sized at 125% of motor nameplate current rating or the next standard fuse size. Where excessive ambient temperature, high inertia motor loads or frequent "on-off" cycling requires larger fuses, consult manufacturer. Use fuse reducers where fuse gaps are larger than fuse dimension.
- G. Provide all ballast-controlled lighting fixtures, including fluorescent fixtures, with individual protection on line side of ballast. Mount fuse and holder in a location convenient for changing fuses. Mount holder in protected location or in an in-line waterproof holder. Size and type of fuse shall be recommended by ballast manufacturer or as indicated on Drawings. Busmann KTK, FNQ; Holder HEB, HEX.
- H. Install a fuse identification label, showing type and size, inside the door of each switch.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Fuses shall not be installed until the installation is complete and final tests and inspection have been made prior to energizing the equipment, including thorough cleaning, tightening of all electrical connections, inspection of all ground and grounding conductors and a megger test for adequate insulation to ground on all circuits.
- B. Install fuses to comply with manufacturer's instructions.
- C. Fuse Clips - Check fasteners on fuse clips for tightness when installing fuses.
- D. Labels - Install fuses so label is in an upright, readable position. Fuses without labels are not acceptable.

END OF SECTION

SECTION 16721 - FIRE ALARM SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections and the General Provisions for Electrical Work apply to this Section.

1.02 SUMMARY OF WORK

- A. The fire alarm and detection Contractor shall design, size and install all, manual pull stations, photoelectric type smoke detectors, duct detectors, heat detectors, horns and strobe units, associated conduit and wiring, fire alarm control panel or any other equipment essential for a complete and operational installation of the fire alarm and detection system as required by NFPA, City of Houston and State Fire Marshall.
- B. The Contractor shall cut, patch, replace and or repair existing walls and ceilings as necessary to accommodate the fire alarm system installation. Repair or replace work as necessary to match existing conditions and to comply with the required visual effect.
- C. Contractor shall provide as an alternate, price deduct, for providing plenum rated cable to all ceiling mounted devices located in the acoustical tile ceiling areas.

1.03 DEFINITION

- A. FACP: Fire Alarm Control Panel.
- B. BPSP: Booster Power Supply Panel.

1.04 SYSTEM DESCRIPTION

- A. It is the intent of this specification to provide a complete non-coded, zoned/addressable electrically supervised fire alarm system to be installed, connected and left in first class operating condition. The entire installation shall conform to all applicable national, state and local codes. In particular, National Fire Protection Association Standard No.72, NFPA Code 101, Chapter 6, Texas Revised Civil Statutes and the National Electrical Code. All equipment shall be the product of a single manufacturer and bear the U.L. or F.M. Label.
- B. The system shall have the capability to employ analog "Intelligent" smoke detectors and addressable interface devices capable of being recognized and annunciated at the main control panel on an individual basis and grouped as required. All zoning/device location information shall be totally field programmable to exact site requirements.

- C. The control panel shall be modular in design utilizing distributed solid state microprocessors and be capable of future expansion, including the associated warehouse. The microprocessor based CPU shall be completely field programmable. Network communications protocol shall be based on a standard, non-proprietary technology.
- D. Install all wiring systems, except telephone cable above the ceiling, in conduit. All exposed conduit shall be painted to match the existing building.

1.05 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of system component specified including dimensioned plans and elevations showing minimum clearances and installed features and devices. Include list of materials and Nationally Recognized Testing Laboratory (NRTL)-listing data.
- C. Shop Drawings showing details of graphic annunciator.
- D. Point-to-point wiring diagrams from manufacturer differentiating clearly between factory- and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Make all diagrams specific to this Project and distinguish between field and factory wiring.
- E. System operation description covering this specific Project, including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are unacceptable.
- F. Operating instructions for mounting at the FACP and BPSF.
- G. Product certificates signed by manufacturers of fire alarm system components certifying that their products comply with specified requirements.
- H. Maintenance data for fire alarm systems to include in the operation and maintenance manual specified in Division 1. Include data for each type of product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the site. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.
- I. Record of field tests of system.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced factory-authorized Installer to perform work of this Section. Installer shall be licensed and registered by the State Fire Marshall to sell, install and service fire detection and alarm systems. Supplier shall have been actively installing similar systems in the area for a minimum of five (5) years.
- B. Single-Source Responsibility: Obtain fire alarm components from a single source who assumes responsibility for compatibility of system components.
- C. Compliance with Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements for the authorities having jurisdiction.
- D. Comply with NFPA 70.
- E. Comply with NFPA 72.
- F. Listing and Labeling: Provide systems and equipment specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electric Code, Article 100.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufactures: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. FCI, Inc.
 - 2. Honeywell, Inc.
 - 3. Notifier; Pitway Corp. Div.
 - 4. Simplex Time Recorder Co.
 - 5. Johnson Control
 - 6. Edwards Systems Technology

2.02 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. Include the following system functions and operating features plus those additional functions and features required by the authorities having jurisdiction:
1. **Priority of Signals:** Accomplish automatic response functions by the first zone initiated. Alarm functions resulting from initiation by the first zone are not altered by subsequent alarms. The highest priority is an alarm signal. Supervisory and trouble signals have second - and third-level priority. Higher-priority signals take precedence over signals of lower priority, even though the lower-priority condition occurred first. Annunciate all alarm signals regardless of priority or order received.
 2. **Non-interfering:** Zone, power, wire, and supervise the system so a signal on one zone does not prevent the receipt of signals from any other zone. All zones are manually re-settable from the FACP after the initiating device or devices are restored to normal. Systems that require batteries or battery back-up for the programming function are unacceptable.
 3. **Fire Alarm Control Panel (FACP) Response:** The manual or automatic operation of an alarm-initiating or supervisory-operating device causes the FACP to transmit an appropriate signal including the following:
 - a. General alarm.
 - b. Fire-suppression system operation alarm.
 - c. Smoke or heat detector alarm.
 4. **Transmission to Remote Central Station:** Automatically route alarm, supervisory, and trouble signals to a remote central station service. FACP shall have the capability to provide Remote Access through a Dial-Up Service Modem using the public switched telephone system of a private switched telephone system.
 5. **Silencing at the FACP:** Switches provide capability for acknowledgment of alarm, supervisory, trouble, and other specified signals at the FACP; and capability to silence the local audible signal and light a light-emitting diode (LED). Subsequent zone alarms cause the audible signal to sound again until silenced by switch operation. Restoring alarm, supervisory, and trouble conditions to normal extinguishes the associated LED and causes the audible signal to sound again until restoration is acknowledged by switch operation.
 6. **Loss of primary power** sounds a trouble signal at the FACP. The FACP indicates when the fire alarm system is operating on an alternate power supply.

7. Annunciation: Manual and automatic operation of alarm-and supervisory-initiating devices are annunciated both on the FACP and on the annunciator, indicating location and type of device.
8. General Alarm: A system general alarm includes the following:
 - a. Indicating the general alarm condition at the FACP and the annunciator.
 - b. Identifying the device that is the source of the alarm (or its zone) at the FACP and the annunciator.
 - c. Initiating audible and visible alarm signals throughout the building.
 - d. Shutdown all air handling and HVAC units.
 - e. Initiating transmission of alarm signal to remote central station.
9. Manual station alarm operation initiates a general alarm.
11. Smoke detection initiates a general alarm.

2.03 MANUAL PULL STATIONS

- A. Description: Addressable double-action type, fabricated of metal, and finished in red with molded, raised-letter operating instructions for contrasting color.
 1. Break-Glass Feature: Stations requiring the breaking of a glass panel are unacceptable. Stations requiring the breaking of a concealed glass rod are acceptable.
 2. Protective Shield: Where required provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations. When shield is lifted to gain access to the station, a battery powered piercing warning horn shall be activated. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.
 3. Station Reset: Key or wrench operated, double pole, double throw, switch rated for the voltage and current at which it operates. Stations have screw terminals for connections.

2.04 SMOKE DETECTORS

- A. General: Comply with UL 268. Include the following features:
 1. Factory Nameplate: Serial number and type identification.
 2. Operating Voltage: 24-V dc, nominal.

3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 4. Plug-in Arrangement: Detector and associated encapsulated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. The plug connection requires no springs for secure mounting and contact maintenance. Terminals in the fixed base accept building wiring.
 5. Integral Visual Indicating Light: Connect to indicate detector has operated.
 6. Remote Controllability: Individually monitor detectors at the FACP for calibration, sensitivity, and alarm condition, and individually adjust for sensitivity from the FACP.
- B. Type Smoke Detector: Smoke sensors shall be of the photoelectric or combination photoelectric / heat type. Where acceptable per manufacturer specifications, ionization type sensors may be used.
- C. Duct Smoke Detector: Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor shall include relay, rated to interrupt fan motor-control circuit, as required for fan shutdown.
1. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.
 2. Compact duct housing shall have a transparent cover to monitor for the presence of smoke.
 3. Duct housing shall provide a relay control trouble indicator Yellow LED and a magnetic test area with a RED sensor status LED.
 4. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover. Each duct sensor shall have a Remote Test Station with an alarm LED and test switch.
- 2.05 OTHER DETECTORS
- A. Heat Detector: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting, except as indicated.
- B. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.

2.06 ALARM-INDICATING DEVICES

- A. General: Equip alarm-indicating devices for mounting as indicated. Provide terminal blocks for system connections.
- B. Horns: Electric-vibrating-polarized type, operating on 24-V dc, with provision for housing the operating mechanism behind a grille. Horns produce a sound-pressure level of 90 dB, measured 10 feet from the source.
- C. Visual Alarm Devices: Xenon strobe lights with clear or nominal white polycarbonate lens. Mount lenses on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch high letters on the lens.
 - 1. Devices have adjustable flash intensities of 15cd, 30cd, 45cd, 75cd and 110cd light output levels.
 - 2. Strobe Leads: Factory connected to screw terminals.
 - 3. Combination devices consist of factory-combined, audible and visual alarm units in a single mounting assembly.
- D. Voice/Tone Speakers: Comply with UL 1480.
 - 1. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.
 - 2. High-Range Speaker Units: Rated 2 to 15 W.
 - 3. Low-Range Speaker Units: Rated 1 to 2 W.
 - 4. Speaker Mounting: Flush, semirecessed, surface, or surface-mounted bidirectional as indicated.

2.07 CENTRAL FIRE ALARM CONTROL PANEL (FACP)

- A. General: Comply with UL 864.
- B. Cabinet: Lockable steel enclosure capable of future expansion. Arrange panel so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control panel, provide exactly matching modular unit enclosures. Accommodate all components and allow ample gutter space for interconnection of panels and field wiring. Identify each enclosure by an engraved, red laminated, phenolic-resin nameplate. Lettering on the enclosure's nameplate shall not be less than 1 inch high. Identify individual components and modules within the cabinets with permanent labels.

- C. Systems: Alarm and supervisory systems are separate and independent in the FACP. The alarm-initiating zone boards in the FACP consist of plug-in cards. Construction requiring removal of field wiring for module replacement is unacceptable.
- D. Control Modules: Types and capacities required to perform all functions of the fire alarm systems. Local, visible, and audible signals announce alarm, supervisory, and trouble conditions. Each type of audible alarm has a different sound.
- E. Indicating Lights: Provide individual LED devices for each zone. An LED test switch for each FACP section illuminates all LED devices on that section of the control panel. Manual toggle test switches or push test-buttons do not require a key to operate. Alarm and supervisory signals light a red LED of the associated zone. Trouble signals light an amber LED for the associated zone.
- F. Resetting: Provide the necessary controls to prevent the resetting of any alarm, supervisory or trouble signal while the alarm or trouble condition still exists.
- G. A minimum of 5 auxiliary form C auxiliary relays and 2 Class B output zone modules plus 5 spares.

2.08 EMERGENCY POWER SUPPLY

- A. General: Components include valve-regulated, recombinant lead acid battery, charger, and an automatic transfer switch. Battery nominal life expectancy is 10 years, minimum.
- B. General: Components include nickel-cadmium-type battery, charger, and an automatic transfer switch. Battery nominal life expectancy is 20 years, minimum.
- C. Battery capacity is adequate to operate the complete alarm system in normal or supervisory (nonalarm) mode for a period of 24 hours. At the end of this period, the battery has sufficient capacity to operate the system, including alarm-indicating devices in either alarm or supervisory mode, for a period of 15 minutes.
 - 1. Magnetic door holders are not served by emergency power. Magnetic door holders are released when normal power fails.
- D. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150 percent of the connected system load while maintaining the batteries at full charge. In the event batteries are fully discharged, the charger recharges them completely within 4 hours. Charger output is supervised as part of system power supply supervision.
- E. Integral Automatic Transfer Switch: Transfers the load to the battery without loss of signals or status indications when normal power fails.

2.09 WIRE

- A. Wire: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation. Wiring gauge shall be as recommended by manufacturer:
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum.
- B. All wiring shall be in conduit and rated for fire alarm use.

2.10 SUPPLY AND INSTALLATION OF EQUIPMENT

- A. Provide and install equipment and devices as shown on Approved Shop Drawings.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Install system according to NFPA standards referenced in Parts 1 and 2 of this Section.

3.02 EQUIPMENT INSTALLATION

- A. Manual Pull Stations: Mount semi-flush in recessed back boxes with operating handles 48 inches above the finished floor or lower as indicated.
- B. Smoke Detectors: Install ceiling-mounted detectors not less than 4 inches from a side wall to the near edge. Install detectors located on the wall at least 4 inches, but not more than 12 inches, below the ceiling. For exposed solid-joist construction, mount detectors on the bottom of the joists. On smooth ceilings, install detectors not over 30 feet apart in any direction. Install detectors no closer than 60 inches from air registers.
- C. Audible Alarm-Indicating Devices: Install not less than 90 inches above the finished floor nor less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille or as indicated. Combine audible and visual alarms at the same location into a single unit.
- D. Visual Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and not more than 80 inches above the finished floor and at least 6 inches below the ceiling.
- E. FACP: Surface mount with tops of cabinets not more than 72 inches above the finished floor.
- F. BPSP: Surface Mount in rooms as shown on the drawing. Connect BPSP to FACP.

- G. Surface mounted fire alarm devices shall have recessed mounted trim kits (no exposed junction boxes at devices).

3.03 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceway according to Division 16 Section Raceways, Boxes, and Cabinets. Conceal raceway except in unfinished spaces and as indicated. All wiring shall be supported from the structure.
- B. Wiring within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- C. Cable Taps: Use numbered terminal strips in junction, pull or outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- D. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and a different color code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visual alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

3.04 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals according to Division 16 Section "General Provisions for Electrical Work."

3.05 GROUNDING

- A. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding.

3.06 FIELD QUALITY CONTROL

- A. Pretesting: After installation, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

- B. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.
- C. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing. A representative of the Fire Chief/Fire Marshall shall witness this testing.
- D. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72. Minimum required tests are as follows:
 - 1. Verify the absence of unwanted voltages between circuit conductors and ground.
 - 2. Test all conductors for short circuits using an insulation-testing device.
 - 3. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the record drawings.
 - 4. Verify that the control unit is in the normal condition as detailed in the manufacturer's operation and maintenance manual.
 - 5. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent for the initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
 - 6. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
 - 7. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications.
 - 8. Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the period and in the manner specified.
- E. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

- F. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests. Deliver to the City Engineer a statement from licensed installer that the installation operates satisfactorily and complies with all applicable State and NFPA requirements.
- G. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

3.07 CLEANING AND ADJUSTING

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

3.08 DEMONSTRATION

- A. Startup Services: Engage a factory-authorized service representative to provide startup service and to demonstrate and train Owner's maintenance personnel as specified below.
 - 1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of 4 hours' training.
 - 2. Training Aid: Use the approved final version of the operation and maintenance manual as a training aid.
 - 3. Schedule training with Owner with at least 7 days' advance notice.

3.09 GUARANTEE

- A. The Contractor shall guarantee all equipment and wiring free from inherent mechanical or electrical defects for one year from date of substantial completion.
- B. The installer shall furnish, gratis to the Owner, a one-year maintenance contract effective from the date of substantial completion for maintenance. The maintenance contract shall include four (4) on-site adjustment visits to assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions.

END OF SECTION