

Addendum No. 1

Dosker Manor Fire Alarm Replacement

TO: All Plan Holders

FROM: Sherman Carter Barnhart Architects
2405 Harrodsburg Road
Lexington, Kentucky 40504

DATE: June 3, 2022

The purpose of this Addendum is to clarify further the requirements of the plans and specifications.

The bidders are governed by the information in this Addendum as if included in the plans and specifications.

This Addendum does hereby become a part of the Contract Documents.

Each bidder shall acknowledge receipt of this Addendum in the space provided in the Bid Form.

This Addendum consists of (84) eighty-four, 8-1/2"x11" pages.

This Addendum is being made available to all plan holders through online Housing Agency Market Place.

A. General (All Bidders are advised of the following)

1. Revised bid date to June 14, 2022 at 10:00am.

B. The following specification sections were missing from the original Project Manuals and are attached to this addendum.

1. Electrical Specification Index
2. Section 260501 – General Provisions
3. Section 260502 – Electrical Scope of Work
4. Section 260503 – Shop Drawings, Literature, Manuals, Parts Lists and Special Tools
5. Section 260504 – Sleeving, Cutting, Patching and Repairing
6. Section 260505 – Demolition, Restoration and Salvage
7. Section 260508 – Coordination Among Trades, Systems Interfacing and Connection of Equipment Furnished by Others
8. Section 260519 – Conductors, Identifications, Splicing Devices and Connectors
9. Section 260526 – Grounding and Bonding
10. Section 260529 – Hangers and Supports for Electrical Systems
11. Section 260531 – Cabinets, Outlet Boxes and Pull Boxes
12. Section 260533 – Raceways and Fittings
13. Section 260553 – Identifications
14. Section 284600 – Addressable Fire Alarm Systems

End of Addendum

SPECIFICATION INDEX

SECTION

- 260501- General Provisions
- 260502- Scope of the Electrical Work
- 260503- Shop Drawings, Literature, Manuals, Parts Lists, and Special Tools
- 260504- Sleeving, Cutting, Patching and Repairing
- 260505- Demolition, Restoration and Salvage
- 260508- Coordination Among Trades, Systems Interfacing and Connection of
Equipment Furnished by Others
- 260519- Conductors, Identifications, Splicing Devices and Connectors
- 260526- Grounding and Bonding
- 260529- Hangers and Supports for Electrical Systems
- 260531- Cabinets, Outlet Boxes and Pull Boxes
- 260533- Raceways and Fittings
- 260553- Identifications
- 284600- Addressable Fire Alarm Systems

SECTION 26 0501

GENERAL PROVISIONS

1. GENERAL

- A. The Instructions to Bidders, General and Special Conditions, and all other contract documents shall apply to the Contractor's work as well as to each of his Sub Contractor's work. Each Contractor is directed to familiarize himself in detail with all documents pertinent to this Contract. In case of conflict between these General Provisions and the General and/or Special Conditions, the affected Contractor shall contact the Engineer for clarification and final determination.
- B. The Contractor shall be governed by any alternates, unit prices and Addenda or other contract documents insofar as they may affect his part of the work.
- C. The work included in this division consists of the furnishing of all labor, equipment, transportation, supplies, material and appurtenances and performing all operations necessary for the satisfactory installation of complete and operating electrical systems indicated on the drawings and/or specified herein.
- D. Any materials, labor, equipment or services not mentioned specifically herein which may be necessary to complete or perfect any part of the electrical systems in a substantial manner, in compliance with the requirements stated, implied, or intended in the drawings and specifications, shall be included as part of this Contract. The Contractor shall give written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted a minimum of ten days prior to bid. In the absence of such written notice and by the act of submitting his bid, it shall be understood that the Contractor has included the cost of all required items in his bid, and that he will be responsible for the approved satisfactory functioning of the entire system without extra compensations.
- E. It is not the intent of this section of the specifications (or the remainder of the contract documents) to make any specific Contractor, other than the Contractor holding the prime contract, responsible to the Owner, Architect and Engineer. All transactions such as submittal of shop drawings, claims for extra costs, requests for equipment or materials substitution, shall be done through the Contractor to the Architect (if applicable), then to the Engineer.
- F. This section of the Specifications or the arrangement of the contract documents shall not be construed as an attempt to arbitrarily assign responsibility for work, material, equipment or services to a particular trade Contractor or Sub-Contractor. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be the responsibility of the Contractor holding the prime contract.
- G. It is the intent of this Contract to deliver to the Owner a "like new" project once work is complete. Although plans and specifications are complete to the extent possible, it shall be responsibility of the Contractors involved to remove and/or relocate or re-attach any existing or new systems which interfere with new equipment or materials to be installed by other trades without additional cost to the Owner.

- H. In general, and to the extent possible, all work shall be accomplished without interruption of the existing facilities' operations. Each Contractor shall advise the Architect, Owner and Engineer (as applicable) in writing at least one week prior to the deliberate interruption of any services. The Owner shall be advised of the exact time that interruption will occur and the length of time the interruption will occur. Failure to comply with this requirement may result in complete work stoppage by the Contractors involved until a complete schedule of interruptions can be developed.
- I. Whenever utilities are interrupted, either deliberately or accidentally, the Contractor shall work continuously to restore said service. The Contractor shall provide tools, materials, skilled journeymen of his own and other trades as necessary, premium time as needed and coordination with all applicable utilities, including payment of utility company charges (if any), all without request for extra compensation to the Owner, except where otherwise provided for in the contract document.
- J. The Contractor shall be responsible for maintaining existing fire alarm, paging, access control, intrusion detection, CCTV, nurse call systems, etc., in occupied spaces in renovation and addition projects. The Contractor shall be required to disconnect and remove all existing devices in renovated areas (where directed as such) without affecting system operations. All costs associated with said work shall be borne by the Contractor.

K. Definitions:

- (1) Prime Contractor - The Contractor who has been engaged by the Owner in a contractual relationship to accomplish the work.
- (2) Electrical Contractor - Any Contractor whether bidding or working independently or under the supervision of a General Contractor, that is: the one holding the Prime Contract and who installs any type of Electrical work, such as: power, lighting, television, telecommunications, data, fiber optic, intercom, fire detection and alarm, security, video, underground or overhead electrical, etc.

Note: Any reference within these specifications to a specific entity, i.e., "Electrical Contractor" is not to be construed as an attempt to limit or define the scope of work for that entity or assign work to a specific trade or contracting entity. Such assignments of responsibility are the responsibility of the Contractor or Construction Manager holding the prime contract, unless otherwise provided herein.

- (3) Electrical Sub-Contractor - Each or any Contractor contracted to, or employed by, the Electrical Contractor for any work required by the Electrical Contractor.
- (4) Engineer - The Consulting Electrical Engineers, either consulting to the Owner, Architect, other Engineers, etc.
- (5) Architect - The Architect of Record for the project, if any.
- (6) Furnish - Deliver to the site in good condition.

- (7) Provide - Furnish and install in complete working order.
- (8) Install - Install equipment furnished by others in complete working order.
- (9) Contract Documents - All documents pertinent to the quality and quantity of all work to be performed on the project. Includes, but not limited to: Plans, Specifications, Addenda, Instructions to Bidders, (both General and Sub-Contractors), Unit Prices, Shop Drawings, Field Orders, Change Orders, Cost Breakdowns, Construction Manager's Assignments, Architect's Supplemental Instructions, Periodical Payment Requests, etc.

2. INTENT

- A. It is the intent of these specifications and all associated drawings that the Contractor provide finished work, tested, and ready for operation. Wherever the word "provide" is used, it shall mean "furnish and install complete and ready for use."
- B. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.

3. ELECTRICAL DRAWINGS AND SPECIFICATIONS

- A. The drawings are diagrammatic only and indicate the general arrangement of the systems and are to be followed insofar as possible. If deviations from the layouts are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted in writing to the Engineer for review before proceeding with the work. The Contract Drawings are not intended to show every vertical or horizontal offset which may be necessary to complete the systems. Contractors shall, however, anticipate that additional offsets may be required and submit their bid accordingly.
- B. The drawings and specifications are intended to supplement each other. No Contractor or supplier shall take advantage of conflict between them, or between parts of either, but should this condition exist, the Contractor or supplier shall request a clarification of the condition at least ten days prior to the submission of bids so that the condition may be clarified by Addendum. In the event that such a condition arises after work is started, the interpretation of the Engineer shall be the determining factor. In all instances, unless modified in writing and agreed upon by all parties thereto, the Contract to accomplish the work shall be binding on the affected Contractor.
- C. The drawings and specifications shall be considered to be cooperative and complimentary and anything appearing in the specifications which may not be indicated on the drawings or conversely, shall be considered as part of the Contract and must be executed the same as though indicated by both.
- D. The Contractor shall make all his own measurements in the field and shall be responsible for correct fitting. He shall coordinate this work with all other branches of work in such a manner as to cause a minimum of conflict or delay.

- E. The Engineer shall reserve the right to make minor adjustments in location of conduit, fixtures, outlets, switches, etc., where he considers such adjustments desirable in the interest of concealing work or presenting a better appearance.
- F. The Contractor shall evaluate ceiling heights called for on Architectural Plans. Where the location of Electrical equipment may interfere with ceiling heights, the Contractor shall call this to the attention of the Engineer in writing prior to making the installation. Any such changes shall be anticipated and requested sufficiently in advance so as to not cause extra work on the part of the Contractor or unduly delay the work.
- G. Special Note: Always check ceiling heights indicated on Drawings and Schedules and insure that these heights may be maintained after all mechanical and electrical equipment is installed. If a conflict is apparent, notify the Engineer in writing for instructions.
- H. Should overlap of work between the various trades become evident, this shall be called to the attention of the Engineer. In such event neither trade shall assume that he is to be relieved of the work which is specified under his branch until instructions in writing are received from the Engineer.
- I. The drawings are intended to show the approximate location of equipment, materials, etc. Dimensions given in figures on the drawings shall take precedence over scaled dimensions and all dimensions whether given in figures or scaled shall be verified in the field. In case of conflict between small and large scale drawings, the larger scale drawings shall take precedence.
- J. The Contractor and his Sub Contractors shall review all drawings in detail as they may relate to his work (architectural, etc.). Review all drawings for general coordination of work, responsibilities, ceiling clearances, wall penetration points, chase access, fixture elevations, etc. Make any pertinent coordination or apparent conflict comments to the Engineers at least ten days prior to bids, for issuance of clarification by written addendum.
- K. Where on any of the drawings a portion of the work is drawn out and the remainder is indicated in outline, or not indicated at all, the parts drawn out shall apply to all other like portions of the work. Where ornament or other detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts of the work, unless otherwise indicated.

4. EXAMINATION OF SITE AND CONDITIONS

- A. The Contractor shall inform himself of all of the conditions under which the work is to be performed, the site of the work, the structure of the ground, the obstacles that may be encountered, the availability and location of necessary facilities and all relevant matters concerning the work. All Contractors or suppliers shall carefully examine all Drawings and Specifications and contract documents to determine the kind and type of materials to be used throughout the project and which may, in any way, affect the execution of his work.
- B. The Contractor shall fully acquaint himself with all existing conditions as to ingress and egress, distance of haul from supply points, routes for transportation of materials, facilities and services, availability of temporary or permanent utilities, etc. The Contractor shall include in his work all

expenses or disbursements in connection with such matters and conditions. The Contractor shall verify all work shown on the drawings and conditions at the site, and shall report in writing to the Engineer ten days prior to bid, any apparent omissions or discrepancies in order that clarifications may be issued by written addendum. No allowance is to be made for lack of knowledge concerning such conditions after bids are accepted.

5. EQUIPMENT AND MATERIALS SUBSTITUTIONS OR DEVIATIONS

- A. When any Contractor requests review of substitute materials and/or equipment, and when under an approved formal alternate proposal, it shall be understood and agreed that such substitution, if approved, will be made without additional cost regardless of changes in connections, spacing, service, mounting, etc. In all cases where substitutions affect other trades, the Contractor offering such substitutions shall advise all such Contractors of the change and shall reimburse them for all necessary changes in their work. Any drawings, Specifications, Diagrams, etc., required to describe and coordinate such substitutions or deviations shall be professionally prepared at the responsible Contractor's expense. Special Note: Review of Shop Drawings by the Engineer does not absolve the Contractor of this responsibility
- B. References in the specifications to any article, device, product, material, fixture, form, or type of construction by name, make, or catalog number shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Each Contractor, in such cases, may, at his option, use any article, device, product, material, fixture, form, or type of construction which in the judgment of the Engineer is equivalent to that specified, provided the provisions of paragraph (A) immediately preceding are met. Substitutions shall be submitted to the Engineer a minimum of ten days prior to bid date for approval to bid in written form thru addenda or other method selected by the Engineer. If prevailing laws of cities, towns, states or countries are more stringent than these specifications regarding such substitutions, then those laws shall prevail over these requirements.
- C. Wherever any equipment and material is specified exclusively only such items shall be used unless substitution is accepted in writing by the engineers.
- D. The Contractor shall furnish along with his proposal a list of specified equipment and materials which he proposes to provide. Where several makes are mentioned in the Specifications and the Contractor fails to state which he proposes to furnish, the Engineer shall have the right to choose any of the makes mentioned without change in price.
- E. The Contractor shall review the contract documents and if a material substitution form is required for each proposed substitution, it shall be submitted per requirements.

6. SUPERVISION OF WORK

- A. Each Contractor and Sub-Contractors shall personally supervise the work or have a competent superintendent on the project site at all times during progress of the work, with full authority to act for him in matters related to the project.

7. CODES, RULES, PERMITS, FEES, REGULATIONS, ETC.

- A. The Contractor shall give all necessary notices, obtain and pay for all permits, government sales taxes, fees, and other costs including utility connections or extensions, in connection with his work. As necessary, he shall file all required plans, utility easement requests and drawings, survey information on line locations, load calculations, etc., prepare all documents and obtain all necessary approvals of all utility and governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver same to the Engineer before request for acceptance and final payment for the work.
- B. Ignorance of Codes, Rules, regulations, utility company requirements, laws, etc., shall not diminish or absolve Contractor's responsibilities to provide and complete all work in compliance with such.
- C. The Contractor shall include in the work, without extra cost, any labor, materials, services, apparatus or drawings required in order to comply with all applicable laws, ordinances rules and regulations, whether or not shown on drawings and/or specified.
- D. All materials furnished and all work installed shall comply with the current edition of the National Electrical Codes, National Fire Codes of the National Fire Protection Association, the requirements of local utility companies, and with the requirements of all governmental agencies or departments having jurisdiction.
- E. All material and equipment for the electrical systems shall bear the approval label, or shall be listed by the Underwriters' Laboratories, Incorporated. Listings by other testing agencies may be acceptable with written approval by the Engineer.
- F. The Contractor shall insure that his work is accomplished in accord with OSHA Standards and any other applicable government requirements.
- G. Where conflict arises between any code and the plans and/or specifications, the code shall apply except in the instance where the plans and specifications exceed the requirements of the code. Any changes required as a result of these conflicts shall be brought to the attention of the Engineer at least ten working days prior to bid date, otherwise the Contractor shall make the required changes at his own expense. The provisions of the codes constitute minimum standards for wiring methods, materials, equipment and construction and compliance therewith will be required for all electrical work, except where the drawings and specifications require better materials, equipment, and construction than these minimum standards, in which case the drawings and specifications shall be the minimum standards.

8. COST BREAKDOWNS/SCHEDULE OF VALUES

- A. Within thirty days after acceptance of the Contract, the Contractor is required to furnish to the Engineer one copy of a detailed cost breakdown on each respective area of work. These cost breakdowns shall be made on forms provided or approved by the Engineer or Architect. Payments will not be made until satisfactory cost breakdowns are submitted. Refer to the end of this section for a sample of expected level and breakout being required.

9. CORRECTION PERIOD

- A. All equipment, apparatus, materials, etc., shall be the best of its respective kind. The Contractor shall replace all materials at his own expense, which fail or are deemed defective as described in the General Conditions. The effective date of completion of the work shall be the date each or any portion of the work is accepted by the Architect or Engineer as being substantially complete.
- B. Items of equipment which have longer guarantees shall have warranties and guarantees completed in order, and shall be in effect at the time of final acceptance of the work by the Engineer. The Contractor shall present the Engineer with such warranties and guarantees at the time of final acceptance of the work. The Owner reserves the right to use equipment installed by the Contractor prior to date of final acceptance. Such use of equipment shall in no way invalidate the guarantee except that Owner shall be liable for any damage to equipment during this period due to negligence of his operator or other employee.

10. INSPECTION, APPROVALS AND TESTS

- A. Before requesting a final review of the installation from the Architect and/or Engineer, the Contractor shall thoroughly inspect his installation to assure that the work is complete in every detail and that all requirements of the Contract Documents have been fulfilled. Failure to accomplish this may result in charges from the Architect and/or Engineers for unnecessary and undue work on their part.
- B. The Contractor shall provide as part of this contract electrical inspection by a competent Electrical Inspection Agency (local or state as specific to project), licensed to provide such services in the Commonwealth of Kentucky. The name of this agency shall be included in the list of materials of the Form of Proposal by the Contractor. All costs incidental to the provision of electrical inspections shall be borne by the Electrical Contractor.
- C. The Contractor shall advise each Inspection Agency in writing (with an information copy of the correspondence to the Architect and/or Engineer) when he anticipates commencing work. Failure of the Inspection Agency to inspect the work in the stage following and submit the related reports may result in the Contractor's having to expose concealed work not so inspected. Such exposure will be at the expense of the responsible Contractor.
- D. Inspections shall be scheduled for rough as well as finished work. The rough inspections shall be divided into as many inspections as may be necessary to cover all roughing-in without fail. Report of each such inspection visit shall be submitted to the Architect, Engineer and the Contractor within three days of the inspection.
- E. Approval by an Inspector does not relieve the Contractor from the responsibilities of furnishing equipment having a quality of performance equivalent to the requirements set forth in these plans and specifications. All work under this contract is subject to the review of the Architect and/or Engineer, whose decision is binding.
- F. Before final acceptance, the Contractor shall furnish three copies of the certificates of final approval by the Electrical Inspector (as well as all other inspection certificates) to the Engineer with one copy of each to the appropriate government agencies, as applicable. Final payment for the work shall be contingent upon completion of this requirement.

- G. The Contractor shall test all wiring and connections for cross connects, continuity and grounds before equipment and fixtures are connected, and when indicated or required, demonstrate by continuity/load/voltage test and Megger Test the installation of any circuit or group of circuits. Where such tests indicate the possibility of faulty insulation, locate the point of such fault, replacing same with new and demonstrate by further test the elimination of such defect. The secondary service entrance conductors from the utility (source) transformer to the main service disconnecting means shall be megger tested. The results of this test shall be turned over to the engineer for review and approval. Any conductor failing the test shall be replaced and any costs associated shall be borne by the contractor.

11. CHANGES IN ELECTRICAL WORK

REFER TO GENERAL AND SPECIAL CONDITIONS.

12. CLAIMS FOR EXTRA COST

REFER TO GENERAL AND SPECIAL CONDITIONS.

13. SURVEYS, MEASUREMENTS AND GRADES

- A. The Contractor shall lay out his work and be responsible for all necessary lines, levels, elevations and measurements. He must verify the figures shown on the drawings before laying out the work and will be held responsible for any error resulting from his failure to do so.
- B. The Contractor shall base all measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work.
- C. Should the Contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the drawings and specifications, he shall notify the Engineer thru normal channels of job communication and shall not proceed with his work until he has received instructions from the Engineer.

14. TEMPORARY USE OF EQUIPMENT

- A. The permanent electrical equipment, when installed, may be used for temporary services, subject to an agreement among the Contractors involved, the Owner, and with the consent of the Engineer. Should the permanent systems be used for this purpose, each Contractor shall pay for all temporary connections required and any replacements required due to damage without cost, leaving the equipment and installation in "as new" condition. The Contractor may be required to bear utility costs, user fees, etc.
- B. Permission to use the permanent equipment does not relieve the Contractors who utilize this equipment from the responsibility for any damages to the building construction and/or equipment which might result because of its use.

15. TEMPORARY SERVICES

- A. The Contractor shall arrange for temporary electrical and other services which he may require to accomplish his work. In the absence of other provisions in the contract, the Contractor shall provide for his own temporary services of all types, including the cost of connections, utility company fees, construction, removal, etc., in his bid.

16. RECORD DRAWINGS

- A. The Contractor shall insure that any deviations from the design are being recorded daily or as necessary on record drawings being maintained by the Contractor. Dimensions from fixed, visible permanent lines or landmarks shown in vertical and horizontal ways shall be utilized. Compliance shall be a requirement for final payment. Pay particular attention to the location of underfloor or underground exterior in-contract or utility-owned or leased service lines, main switches and other appurtenances important to the maintenance and safety of the Electrical System. Keep information in a set of drawings set aside at the job site especially for this purpose. Deliver these record drawings electronically to the Engineer in AutoCad 2000 format (or more recent version) along with the hand marked field set. Electronic bid drawings will be furnished to the Contractor for his use at the completion of the work.

17. MATERIALS AND WORKMANSHIP

- A. All electrical equipment, materials and articles incorporated in the work shall be new and of comparable quality to that specified. All workmanship shall be first-class and shall be performed by electricians skilled and regularly employed in their respective trades. The Contractor shall determine that the equipment he proposes to furnish can be brought into the building(s) and installed within the space available. All equipment shall be installed so that all parts are readily accessible for inspection, maintenance, replacement, etc. Extra compensation will not be allowed for relocation of equipment for accessibility or for dismantling equipment to obtain entrance into the building(s).
- B. All conduit and/or conductors shall be concealed in or below walls, floors or above ceilings unless otherwise noted. All fixtures, devices and wiring required shall be installed to make up complete systems as indicated on the drawings and specified herein.
- C. All materials, where applicable, shall bear Underwriters' Laboratories label or that of another Engineer-approved testing agency, where such a standard has been established.
- D. Each length of conduit, wireway, duct, conductor, cable, fitting, fixture and device used in the electrical systems shall be stamped or indelibly marked with the makers mark or name.
- E. All electrical equipment shall bear the manufacturer's name and address and shall indicate its electrical capacity and characteristics.
- F. All electrical materials, equipment and appliances shall conform to the latest standards of the National Electric Manufacturers Association (NEMA) and the National Board of Fire Underwriters (NBFU) and shall be approved by the Owner's insuring agency if so required.

18. QUALIFICATIONS OF WORKMEN

- A. All electrical work shall be accomplished by qualified workmen competent in the area of work for which they are responsible. Untrained and incompetent workmen as evidenced by their workmanship shall be relieved of their responsibilities in those areas. The Engineer shall reserve the right to determine the quality of workmanship of any workman and unqualified or incompetent workmen shall refrain from work in areas not satisfactory to him. Requests for relief of a workman shall be made through the normal channels of responsibility established by the Architect or the contract document provisions.
- B. All electrical work shall be accomplished by Journeymen electricians under the direct supervision of a licensed Electrician. All applicable codes, utility company regulations, laws and permitting authority of the locality shall be fully complied with by the Contractor.
- C. Special electrical systems, such as Telecommunications or Data Systems, etc., shall be installed by workmen normally engaged or employed in these respective trades. As an exception to this, where small amounts of such work are required and are, in the opinion of the Engineer, within the competency of workmen directly employed by the Contractor involved, they may be provided by this Contractor.

19. CONDUCT OF WORKMEN

- A. The Contractor shall be responsible for the conduct of all workmen under his supervision. Misconduct on the part of any workmen to the extent of creating a safety hazard, or endangering the lives and property of others, shall result in the prompt relief of that workman. The consumption or influence of alcoholic beverages, narcotics or illegally used controlled substances on the jobsite is strictly forbidden.

20. COOPERATION AND COORDINATION BETWEEN TRADES

- A. The Contractor is expressly directed to read the General Conditions and all detailed sections of these specifications for all other trades and to study all drawings applicable to his work, including Architectural and other pertinent Drawings, to the end that complete coordination between trades will be affected.
- B. Refer to Coordination Among Trades, Systems Interfacing and Connection of Equipment Furnished by Others section of these Specifications for further coordination requirements.

21. PROTECTION OF EQUIPMENT

- A. The Contractor shall be entirely responsible for all material and equipment furnished by him in connection with his work and special care shall be taken to properly protect all parts thereof from damage during the construction period. Such protection shall be by a means acceptable to the Engineer. All rough-in conduit shall be properly plugged or capped during construction in a manner approved by the Engineer. Equipment damaged while stored on site either before or after installation shall be repaired or replaced (as determined by the Engineer) by the responsible Contractor.

22. MAINTENANCE OF EXISTING UTILITIES AND LINES

- A. The locations of all piping, conduits, cables, utilities and manholes existing, or otherwise, that come within the contract construction site, shall be subject to continuous uninterrupted maintenance with no exception unless the Owner of the utilities grants permission to interrupt same temporarily, if need be. Provide one week's written notice to Engineer, Architect and Owner prior to interrupting any utility service or line. Also see Article 1. - General, this section.
- B. Known utilities and lines as available to the Engineer are shown on the drawings. However, it is additionally required that, prior to any excavation being performed, each Contractor ascertain that no utilities or lines, known or unknown, are endangered by the excavation.
- C. If the above mentioned utilities or lines occur in the earth within the construction site, the Contractor shall first probe and make every effort to locate the lines prior to excavating in the respective area. Electromagnetic utility locators and acoustic pipe locators shall be utilized to determine where metallic and non-metallic piping is buried prior to any excavation.
- D. Cutting into existing utilities and services shall be done in coordination with and as designated by the Owner of the utility. The Contractor shall work continuously to restore service(s) upon deliberate or accidental interruption, providing premium time and materials as needed without extra claim to the Owner.
- E. The Contractor shall repair to the satisfaction of the Engineer any surface or subsurface improvements damaged during the course of the work, unless such improvement is shown to be abandoned or removed.
- F. Machine excavation shall not be permitted within ten feet of existing gas or fuel lines. Hand excavate only in these areas, in accord with utility company, agency or other applicable laws, standards or regulations.
- G. Protect all new or existing lines from damage by traffic, etc. during construction.
- H. Protect existing trees, indicated to remain with fencing or other approved method. Hold all new subsurface lines outside the drip line of trees, offsetting as necessary to protect root structures. Refer to planting or landscaping plans, or in their absence, consult with the Architect.

23. SMOKE AND FIRE PROOFING

- A. The Contractor shall not penetrate rated fire walls, ceilings or floors with conduit, cable, bus duct, wireway or other raceway system unless all penetrations are protected in a code compliant manner which maintains the rating of the assembly. Smoke and fire stop all openings made in walls, chases, ceiling and floors. Patch all openings around conduit, wireway, bus duct, etc., with appropriate type material to smoke stop walls and provide needed fire rating at fire walls, ceilings and floors. Smoke and fire proofing materials and method of application shall be approved by the local authority having jurisdiction.

24. FINAL CONNECTIONS TO EQUIPMENT

- A. The roughing-in and final connections to all electrically operated equipment furnished under this and all other sections of the contract documents or by others, shall be included in the Contract and shall consist of furnishing all labor and materials for connection. The Contractor shall carefully coordinate with equipment suppliers, manufacturers representatives, the vendor or other trades to provide complete electrical and dimensional interface to all such equipment (kitchen, hoods, mechanical equipment, panels, refrigeration equipment, etc.).

25. ACCESSIBILITY

- A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate clearance in partitions and above suspended ceilings for the proper installation of his work. He shall cooperate with the General Contractor (or Construction Manager) and all other Contractors whose work is in the same space, and shall advise each Contractor of his requirements. Such spaces and clearances shall be kept to the minimum size required to ensure adequate clearance and access.
- B. The Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include but not be limited to junction boxes, pull boxes, contactors, panels, disconnects, controllers, switchgear, etc. Minor deviations from drawings may be made to allow for better accessibility, and any change shall be approved where the equipment is concealed.
- C. Each Contractor shall provide (or arrange for the provision by other trades) the access panels for each concealed junction box, pull box, fixtures or electrical device requiring access or service as shown on Engineer's plans or as required. Locations of these panels shall be identified in sufficient time to be installed in the normal course of work. All access panels shall be installed in accord with the Architect's standards for such work.
- D. Access Doors; in Ceilings or Walls:
 - (1) In mechanical, electrical, or service spaces:

14 gauge aluminum brushed satin finish, 1" border.
 - (2) In finished areas:

14 gauge primed steel with 1" border to accept the architectural finishes specified for the space. Confirm these provisions with the Architect prior to obtaining materials or installing any such work.

26. ELECTRICAL CONNECTIONS

- A. The Contractor shall furnish and install all power wiring complete from power source to motor or equipment junction box, including power wiring through starters. The Contractor shall install all starters not factory mounted on equipment. Unless otherwise noted, the supplier of equipment shall furnish starters with the equipment. Also refer to Divisions 11, 14, 20, 21, 22,

23 and 25 of the Specifications, shop drawings and equipment schedules for additional information.

- B. All control wiring required for equipment operation shall be provided by the Contractor. All such installations shall be fully compliant with all requirements of Division 26 and 27 regardless of which trade actually installs such wiring. Motors and equipment shall be provided for current and voltage characteristics as indicated or required. All wiring shall be enclosed in raceways unless otherwise noted.
- C. Each Contractor or sub-contractor, prior to bidding the work, shall coordinate power, control, sensor, interlock and all other wiring requirements for equipment or motors with all other contractors or sub-contractors, to ensure all needed wiring is provided in the Contract. Failure to make such coordination shall not be justification for claims of extra cost or a time extension to the Contract.

27. CUTTING AND PATCHING

- A. Unless otherwise indicated or specified, the Contractor shall provide cutting and patching necessary to install the work specified in this Division. Patching shall match adjacent surfaces to the satisfaction of the Engineer and shall be in accord with the Architect's standards for such work, as applicable.
- B. No structural members shall be cut without the approval of the Structural Engineer and all such cutting shall be done in a manner directed by him.
- C. When installing conduit, pipe, or any other work in insulated concrete form (ICF) walls, the responsible subcontractor for the work shall provide spray foam insulation to patch the rigid insulation to maintain full integrity of the insulating value of the wall after the mechanical and electrical work is complete. Furthermore all new work shall NOT be installed in concrete center of wall. All mechanical and electrical installations shall be on the interior side of the concrete.

28. ANCHORS

- A. Each Contractor shall provide and locate all inserts required for his work before the floors and walls are built, or shall be responsible for the cost of cutting and patching required where inserts were not installed, or where incorrectly located. Each Contractor shall do all drilling required for the installation of his hangers. Drilling of anchor holes may be prohibited in post-tensioned concrete construction, in which case the Contractor shall request approved methods from the Architect and shall carefully coordinate setting of inserts, etc., with the Structural Engineer and/or Architect.

29. OPERATING INSTRUCTIONS

- A. Upon completion of all work and all tests, each Contractor shall furnish the necessary skilled labor and helpers for operating his systems and equipment for a period of three days of eight hours each, or as otherwise specified. During this period, instruct the Owner or his representative fully in the operations, adjustment, and maintenance of all equipment furnished. Give at least one week's written notice to the Owner, Architect and Engineer in advance of this

period. The Engineer may attend any such training sessions or operational demonstrations. The Contractor shall certify in writing to the Engineer that such demonstrations have taken place, noting the date, time and names of the Owner's representative that were present.

- B. Each Contractor shall furnish three complete bound sets for approval to the Engineer of typewritten and/or blueprinted instructions for operating and maintaining all systems and equipment included in this contract. All instructions shall be submitted in draft, for approval, prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instructions.
- C. Each Contractor, in the above-mentioned instructions, shall include the maintenance schedule for the principal items of equipment furnished under this contract and a detailed, easy to read parts list and the name and address of the nearest source of supply.
- D. Formatting & content shall follow the guidelines outlined in the latest version of ASHRAE Applications Handbook, Guideline 4. As a minimum, the following shall be included:

- The operation and maintenance document directory should provide easy access and be well organized and clearly identified.
- Emergency information should be immediately available during emergencies and should include emergency and staff and/or agency notification procedures.
- The operating manual should contain the following information:

- I. General Information

- a. Building function
- b. Building description
- c. Operating standards and logs

- II. Technical Information

- a. System description
- b. Operating routines and procedures
- c. Seasonal start-up and shutdown
- d. Special procedures
- e. Basic troubleshooting

- The maintenance manual should contain the following information:

- I. Equipment data sheets

- a. Operating and nameplate data
- b. Warranty

- II. Maintenance program information

- a. Manufacturer's installation, operation, and maintenance instructions
- b. Spare parts information
- c. Preventive maintenance actions
- d. Schedule of actions
- e. Action description
- f. History

- Test reports document observed performance during start-up and commissioning.

30. SCAFFOLDING, RIGGING AND HOISTING

- A. The Contractor shall furnish all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished. Remove same from premises when no longer required.

31. CLEANING

- A. The Contractor shall, at all times, keep the area of his work presentable to the public and clean of rubbish caused by his operations; and at the completion of the work, shall remove all rubbish, all of his tools, equipment, temporary work and surplus materials, from and about the premises, and shall leave the work clean and ready for use. If the Contractor does not attend to such cleaning immediately upon request, the Engineer may cause cleaning to be done by others and charge the cost of same to the responsible Contractor. Each Contractor shall be responsible for all damage from fire which originates in, or is propagated by, accumulations of his rubbish or debris.
- B. After completion of all work and before final acceptance of the work, each Contractor shall thoroughly clean all equipment and materials and shall remove all foreign matter such as grease, dirt, plaster, labels, stickers, etc., from the exterior of materials, equipment and all associated fabrication. Pay particular attention to finished area surfaces such as lighting fixture lenses, lamps, reflectors, panels, etc.

32. PAINTING

- A. Each fixture device, panel, junction box, etc., that is located in a finished area shall be provided with finish of color and type as selected or approved by the Architect or Engineer. If custom color is required, it shall be provided at no additional cost to the Owner. All other equipment, fixtures or devices located in finished or unfinished areas, that are not required to have or are provided with finish color or coating shall be provided in a prime painted condition, ready to receive finish paint or coating. All galvanized metal in finished areas shall be properly prepared with special processes to receive finish paint as directed and approved by the Architect.

33. INDEMNIFICATION

- A. The Contractor shall hold harmless and indemnify the Engineer, employees, officers, agents and consultants from all claims, loss, damage, actions, causes of actions, expense and/or liability resulting from, brought for, or on account of any personal injury or property damage received or sustained by any person, persons, (including third parties), or any property growing out of, occurring, or attributable to any work performed under or related to this contract, resulting in whole or in part from the negligence of the Contractor, any subcontractor, any employee, agent or representative.

34. HAZARDOUS MATERIALS

- A. The Contractor is hereby advised that it is possible that asbestos and/or other hazardous materials are or were present in this building(s). Any worker, occupant, visitor, inspector, etc., who encounters any material of whose content they are not certain shall promptly report the existence and location of that material to the Contractor and/or Owner. The Contractor shall, as a part of his work, insure that his workers are aware of this potential and what they are to do in the event of suspicion. He shall also keep uninformed persons from the premises during construction. Furthermore, the Contractor shall insure that no one comes near to or in contact with any such material or fumes therefrom until its content can be ascertained to be non-hazardous.
- B. CMTA, Inc., Consulting Engineers, have no expertise in the determination of the presence of hazardous materials. Therefore, no attempt has been made by them to identify the existence or location of any such material. Furthermore, CMTA nor any affiliate thereof will neither offer nor make any recommendations relative to the removal, handling or disposal of such material.
- C. If the work interfaces, connects or relates in any way with or to existing components which contain or bear any hazardous material, asbestos being one, then, it shall be the Contractor's sole responsibility to contact the Owner and so advise him immediately.
- D. The Contractor by execution of the contract for any work and/or by the accomplishment of any work thereby agrees to bring no claim relative to hazardous materials for negligence, breach of contract, indemnity, or any other such item against CMTA, its principals, employees, agents or consultants. Also, the Contractor further agrees to defend, indemnify and hold CMTA, its principals, employees, agents and consultants, harmless from any such related claims which may be brought by any subcontractors, suppliers or any other third parties.

35. ABOVE-CEILING AND FINAL PUNCH LISTS

- A. The Contractor shall review each area and prepare a punch list for each of the subcontractors, as applicable, for at least two stages of the project:
 - (1) For review of above-ceiling work that will be concealed by tile or other materials well before substantial completion.
 - (2) For review of all other work as the project nears substantial completion.
- B. When all work from the Contractor's punch list is complete at each of these stages and prior to completing ceiling installations (or at the final punch list stage), the Contractor shall request that the Engineer develop a punch list. This request is to be made in writing seven days prior to the proposed date. After all corrections have been made from the Engineer's punch list, the Contractor shall review and initial off on each item. This signed-off punch list shall be submitted to the Engineer. The Engineer shall return to the site once to review each punch list and all work prior to the ceilings being installed and at the final punch list review.
- C. If additional visits are required by the Engineer to review work not completed by this review, the Engineer shall be reimbursed directly by the Contractor by check or money order (due net 10 days from date of each additional visit) at a rate of \$140.00 per hour for extra trips required to complete either of the above-ceiling or final punch lists.



Phone: (859) 253-0892 – Fax: (859) 231-8357

The following is CMTA’s guide for required electrical information relative to the Schedule of Values. Please utilize all items that pertain to this project and add any specialized system as required. A thorough and detailed schedule of values will allow for fair and equitable Pay Application approval and minimize any discrepancies as to the status of the job.

Electrical

Description of Work	Scheduled Value	Labor	Material
Shop Drawings			
Mobilization/Permits			
Demolition			
Feeder Conduit			
Branch Conduit			
Feeder Wire			
Branch Wiring			
Cabletray & Accessories			
Wiring Devices			
Surge Suppression			
Voice/Data System Conduit			
Voice/Data System Wiring			
Voice/Data System Devices & Termination			
Electrical Inspection			
Owner Training			
Record Drawings			
O & M Manuals			

Punch List / Closeout			
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END OF SECTION 260501

SECTION 26 0502

ELECTRICAL SCOPE OF WORK

1. GENERAL

Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

2. SCOPE OF THE ELECTRICAL WORK

The Electrical work for this project includes all labor, materials, equipment, fixtures, excavation, backfill and related items required to completely install, test, verify place in service and deliver to the Owner complete electrical systems in accordance with the accompanying plans and all provisions of these specifications. This work shall primarily include, but is not limited to the following:

- A. All conduits, conductors, outlet boxes, fittings, etc.
- B. Fault Current, Arc Flash and Coordination Studies.
- C. All wiring devices and device plates.
- D. Fire Alarm Devices and initiation/notification circuit infrastructure.
- E. Prior to submitting a bid, the Contractor shall contact all serving utility companies to determine exactly what each utility company will provide and exactly what is required of the Contractor and the Contractor shall include all such requirements in his base bid.
- F. Obtaining, coordinating and paying all necessary fees and costs for permits and inspections required by local, state and federal law. The Contractor shall contact the appropriate agencies prior to submitting a bid to determine exactly these charges will be.

END OF SECTION 260502

SECTION 26 0503

SHOP DRAWINGS, LITERATURE, MANUALS, PARTS LISTS, AND SPECIAL TOOLS

1. SHOP DRAWINGS

- A. Each Contractor shall submit to the Architect and/or Engineer, within thirty days after the date of the Contract, seven sets of shop drawings and/or manufacturer's descriptive literature on all equipment required for the fulfillment of his contract. Each shop drawing and/or manufacturer's descriptive literature shall have proper notation indicated on it and shall be clearly referenced so the specifications, schedules, light fixture numbers, panel names and numbers, etc., so that the Architect and/or Engineer may readily determine the particular item the Contractor proposes to furnish. All data and information scheduled, noted or specified by hand shall be noted in color red on the submittals. The Contractor shall make any corrections or changes required and shall resubmit for final review as requested. Review of such drawings, descriptive literature and/or schedules shall not relieve the Contractor from responsibility for deviation from drawings or specifications unless they have, in writing, directed the reviewer's attention to such deviations at the time of submission of drawings, literature and manuals; nor shall it relieve them from responsibility for errors or omissions of any nature in shop drawings, literature and manuals. The term "as specified" will not be accepted.
- B. If the Contractor fails to comply with the requirements set forth above, the Architect and/or Engineer shall have the option of selecting any or all items listed in the specifications or on the drawings, and the Contractor will be required to provide all materials in accordance with this list.
- C. Review of shop drawings by the Engineer applies only to conformance with the design concept of the project and general compliance with the information given in the contract documents. In all cases, the installing Contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, for seeing that all equipment fits the available space in a satisfactory manner and that piping, electrical and all other connections are suitably located.
- D. The Engineer's review of shop drawings, schedules or other required submittal data shall not relieve the Contractor from responsibility for the adaptability of the equipment or materials to the project, compliance with applicable codes, rules, regulations, information that pertains to fabrication and installation, dimensions and quantities, electrical characteristics, and coordination of the work with all other trades involved in this project.
- E. No cutting, fitting, rough-in, connections, etc., shall be accomplished until reviewed equipment shop drawings are in the hands of the Contractors concerned. It shall be each Contractor's responsibility to obtain reviewed shop drawings and to make all connections, etc. in the neatest and most workmanlike manner possible. Each Contractor shall coordinate with all the other Contractors having any connections, roughing-in, etc., to the equipment, to make certain proper fit, space coordination, voltage and phase relationships are accomplished.

F. In accord with the provisions specified hereinbefore, shop drawings, descriptive literature and schedules shall be submitted on each of the following indicated items as well as any equipment or systems deemed necessary by the Engineer:

Raceways

- Cable tray and each type of cable tray fitting.
- Wireways and each type of wireway fitting.
- Surface-mounted metal or plastic raceways, with each type of fitting.
- J-hook or Bridle ring assemblies.

Devices

- Each type of wiring device and their coverplates.
- Floor boxes, each by type, with required accessories.
- Data/voice/video wallplates, each by type.
- Any special items not listed above.

Systems

Note: Each system submittal is to be complete with legible cutsheets for all devices, equipment, special wiring, etc. Include system specific wiring schematics showing each device and its specific interconnect/wiring requirements. For rack mounted equipment, provide a scalable elevation drawing with proposed component locations & specific interconnect wiring requirements for each component/panel. Also provide scale building specific layout drawings that indicate device placement, wiring, etc. Refer to the specific system's specification for additional submittal requirements where required.

- Data network

2. SPECIAL WRENCHES, TOOLS AND KEYS

A. Each Contractor shall provide, along with the equipment provided, any special wrenches or tools necessary to dismantle or service equipment or appliances installed by him. Wrenches shall include necessary keys, handles and operators for valves, switches, breakers, etc. and keys to electrical panels, emergency generators, alarm pull boxes and panels, etc. At least two of any such special wrench, keys, etc. shall be turned over to the Architect prior to completion of the project. Obtain a receipt that this has been accomplished and forward a copy to the Engineer.

3. MAINTENANCE AND OPERATION MANUALS

A. Prior to substantial completion of the project, the Contractor shall deliver to the Engineers (in addition to the required Shop Drawings) three complete copies of

operation and maintenance instructions and parts lists for all equipment provided. Formatting and content shall follow the guidelines outlined in the latest version of ASHRAE Application Handbook, Guideline 4. As a minimum, the following shall be included:

- The **operation and maintenance document directory** should provide easy access and be well organized and clearly identified.
- **Emergency information** should be immediately available during emergencies and should include emergency and staff and/or agency notification procedures.
- **The operating manual** should contain the following information:
 - I. General Information
 - a. Building function
 - b. Building description
 - c. Operating standards and logs
 - II. Technical Information
 - a. System description
 - b. Operating routines and procedures
 - c. Seasonal start-up and shutdown
 - d. Special procedures
 - e. Basic troubleshooting
- **The maintenance manual** should contain the following information:
 - I. Equipment data sheets
 - a. Operating and nameplate data
 - b. Warranty
 - II. Maintenance program information
 - a. Manufacturer's installation, operation, and maintenance instructions
 - b. Spare parts information
 - c. Preventive maintenance actions
 - d. Schedule of actions
 - e. Action description
 - f. History
- **Test reports** document observed performance during start-up and commissioning.

END OF SECTION 260503

SECTION 26 0504

SLEEVING, CUTTING, PATCHING AND REPAIRING

1. GENERAL

- A. The Contractor shall be responsible for all openings, sleeves, trenches, etc. that he may require in ceilings, walls, etc. and shall coordinate all such work with the General Contractor and all other trades. He shall determine and coordinate any openings which he is to provide before submitting a bid proposal in order to avoid conflict and disagreement during construction. Improperly located openings shall be reworked at the expense of the responsible Contractor.
- B. The Contractor shall plan his work ahead and shall place sleeves, frames or forms through all walls, floors and ceilings during the initial construction, where it is necessary for conduit, buss duct, conductors, wireways, etc. to go through; however, when this is not done, this Contractor shall do all cutting and patching required for the installation of his work, or he shall pay other trades for doing this work when so directed by the Architect. Any damage caused to the building by the workmen of the responsible Contractor must be corrected or rectified by him at his own expense.
- C. Openings in slabs and walls shall be cut with core drill. Hammer devices will not be permitted. Edges of trenches and large openings shall be scribe cut with a masonry saw.
- D. In all cases, sleeves shall be at least two inches larger than nominal pipe diameter.
- E. All rectangular or special shaped openings in plaster, stucco or similar materials including gypsum board shall be framed by means of plaster frames, casing beads, wood or metal angle members as required. The intent of this requirements is to provide smooth even termination of wall, floor and ceiling finishes as well as to provide a fastening means for lighting fixtures, panels, etc. Lintels shall be provided where indicated over all openings in bearing walls, etc.
- F. No cutting is to be done at points or in a manner that will weaken the structure and unnecessary cutting must be avoided. If in doubt, contact the Architect.
- G. The Contractor shall be responsible for properly shoring, bracing, supporting, etc. any existing and/or new construction to guard against cracking, settling, collapsing, displacing or weakening while openings are being made. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements, shall be promptly and properly made good to the satisfaction of the Architect.
- H. All work improperly done or not done at all as required by the Contractor will be performed by others. The cost of this work shall be paid for by the Contractor who is in non-compliance with the Contract.

2. SLEEVES, PLATES AND ESCUTCHEONS

- A. The Contractor shall provide and locate all sleeves required for his work before the floors and surface being penetrated are built, otherwise the Contractor shall core drill for conduits where sleeves were not installed, or where incorrectly located. Core drilling is the only acceptable alternative to sleeves.

Do not chisel openings. Where sleeves are placed in exterior walls or in slabs on grade, the space between the conduit and the sleeves shall be made completely and permanently water tight.

- B. Conduits that penetrate fire and/or smoke rated assemblies shall have sleeves installed as required by the manufacturer of the rating seal used.
- C. Where thermal expansion does not occur, the wall may be sealed tight to the conduit.
- D. Sleeves shall be constructed of rigid steel conduit. Sleeves in floors shall extend 6" above finished floor level.
- E. Fasten sleeves securely in floors, walls, so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials being forced into the space between pipe and sleeve during construction.
- F. Escutcheon plates shall be provided for all conduit passing thru walls, floors and ceilings. Plates shall be nickel plated, of the split ring type, of size to match the pipe or conduit. Where plates are provided for pipes passing thru sleeves which extend above the floor surface, provide deep recessed plates to conceal the sleeves.
- G. When installing conduit in insulated concrete form (ICF) walls, the responsible subcontractor for the work shall provide spray foam insulation to patch the rigid insulation to maintain full integrity of the insulating value of the wall after the mechanical and electrical work is complete. Furthermore, all new work shall NOT be installed in concrete center of wall. All electrical installations shall be on the interior side of the concrete.

END OF SECTION 260504

SECTION 26 0505

DEMOLITION, RESTORATION AND SALVAGE

1. GENERAL

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and all other divisions of these specifications apply to work specified in this section.

2. DESCRIPTION OF WORK

- A. This section covers all demolition, restoration and salvage required to perform the electrical work indicated on the drawings, specified and/or as required to complete the project. It is the intent of this section of work to remove all existing electrical equipment, materials, etc. which are not required for the completed building and to restore any and all finished surfaces to their original type and conditions. To accomplish these requirements, the Contractor(s) shall, at his own expense, engage the services of others already performing finish work on this project. All work shall be completed to the satisfaction of the Architect/Engineers whose decisions shall be final. This requirement shall apply to all restoration work whether indicated or specified.
- B. The Contractor shall lawfully dispose of any removed P.C.B.-bearing ballasts (containing polychlorinated biphenyl), and all mercury-vapor bearing lamps, in accordance with all state, local, federal and other applicable laws and regulations.

3. ELECTRICAL

- A. Where electrical fixtures, equipment or other materials are removed and/or relocated, all abandoned conduit and conductors shall be removed in exposed areas. In concealed areas, materials shall be abandoned in place or removed as indicated and patch all openings.
- B. The Contractor shall be responsible for the removal and/or relocation of any electrical equipment, fixtures, devices, appurtenances, etc., which may, in the course of construction, interfere with the installation of any new and/or relocated Architectural, Mechanical, Electrical, Structural or Fire Protection Systems whether indicated or not.

4. REPAIR

- A. Unless otherwise indicated, the Contractor shall be responsible for the patching and repairing of all holes, etc. in the ceiling, wall and floors where electrical equipment is removed.

5. SALVAGE

- A. It is the intent of this section to deliver to the Owner all components of any electrical system which may be economically reused by him. The Contractor shall make every effort to remove reusable components without damage and deliver them to a location designated by the Owner.

END OF SECTION 260505

SECTION 26 0508

COORDINATION AMONG TRADES, SYSTEMS INTERFACING AND CONNECTION OF EQUIPMENT FURNISHED BY OTHERS

1. COORDINATION

- A. The Contractor is expressly directed to read the General Conditions and all sections of these specifications for all other trades and to study all drawings applicable to his work, including Architectural drawings, to the end that complete coordination between trades will be affected. Each Contractor shall make known to all other contractors the intended positioning of materials, raceways, supports, equipment and the intended order of his work. Coordinate all work with other trades and proceed with the installation in a manner that will not create delays for other trades or affect the Owner's operations.
- B. Special attention to coordination shall be given to points where raceways, fixtures, etc., must cross other ducts or conduit, where lighting fixtures must be recessed in ceilings, and where fixtures, conduit and devices must recess into walls, soffits, columns, etc. It shall be the responsibility of each Contractor to leave the necessary room for other trades. No extra compensation or time will be allowed to cover the cost of removing fixtures, devices, conduit, ducts, etc. or equipment found encroaching on space required by others.
- C. The Contractor shall be responsible for coordination with all trades to ensure that they have made provision for connections, operational switches, disconnect switches, fused disconnects, etc., for electrically operated equipment provided under this or any other division of the specifications, or as called for on the drawings. Any connection, circuiting, disconnects, fuses, etc., that are required for equipment operation shall be provided as a part of this contract.
- D. If any discrepancies occur between accompanying drawings and these specifications and drawings and specifications covering other trade's work, each trade shall report such discrepancies to the Architect far enough in advance so that a workable solution can be presented. No extra payment will be allowed for relocation of fixtures, devices, conduit, and equipment not installed or connected in accordance with the above instructions.
- E. In all areas where air diffusers, devices, lighting fixtures and other ceiling-mounted devices are to be installed, the Electrical Trade and the General Trades shall coordinate their respective construction and installations so as to provide a combined symmetrical arrangement that is acceptable to the Architect and Engineer. Where applicable, refer to reflected ceiling plans. Request layouts from the Architect or Engineer where in doubt about the potential acceptability of an installation.

2. INTERFACING

Each Electrical Trade and the General Trades shall ensure that coordination is affected relative to interfacing of all systems. Some typical interface points are (but not necessarily all):

- A. Connection of Telecommunications (voice, video, data) lines to Owner's existing or new services.
- B. Connection of Power lines to Owner's existing or new services.

- C. Electrical power connections to electrically operated (or controlled) equipment.
- D. Electrical provisions for all equipment provided by other trades or suppliers within this contract.

3. CONNECTION OF EQUIPMENT FURNISHED BY OTHERS

- A. Each Contractor shall make all connections to equipment furnished by others, whenever such equipment is shown on any part of the drawings or mentioned in any part of the Specifications, unless otherwise specifically specified hereinafter.
- B. All drawings are complementary, one trade of the other. It is the Contractor's responsibility to examine all drawings and specifications to determine the full scope of his work. The project Engineers have arranged the specifications and drawings in their given order solely as a convenience in organizing the project, and in no way shall they imply the assignment of work to specific trades, contractors, subcontractors or suppliers.
- C. Supervision to assure proper installation, functioning and operation shall be provided by the Contractor furnishing the equipment or apparatus to be connected.
- D. For items furnished by others, relocated, or RIO, the Contractor shall obtain from the supplier or shall field determine as appropriate, the exact rough-in locations and connection sizes for the referenced equipment.
- E. The Contractor shall be responsible for coordinating with the General and all other trades, as necessary, to determine any and all final connections that he is to make to equipment furnished by others.

END OF SECTION 260508

SECTION 26 0519

CONDUCTORS, IDENTIFICATION, SPLICING DEVICES & CONNECTORS

1. GENERAL

- A. This section of the Specifications covers all of the electrical power but does not include communications, data or signal system conductors, which are specified separately in these specifications.
- B. All conduits installed without conductors shall have a 200 lb. test nylon string installed for future use, tied off securely at each end.
- C. **No more than 40% conduit fill is permitted for any conduit system, including video, intercom, data, power or other signal circuits unless specifically indicated otherwise on the plans.**
- D. Receptacle circuits: If multiple circuits are pulled in a single homerun, a dedicated neutral shall be provided for each phase conductor. In these cases, a maximum of seven conductors are permitted in a single conduit. Conductors shall be derated per N.E.C.
- E. Intentional or unintentional painting of exposed low voltage or line voltage cabling is prohibited. The contractor shall ensure that exposed cabling is adequately protected from direct painting or overspray whether painting is required within the electrical specifications or required by other disciplines/trades. The contractor shall review the painting requirements for all disciplines and shall provide cabling protection as required. Where exposed cabling is being installed in exposed ceiling or wall spaces that are required to be painted, the contractor shall provide alternate options for cable colors and shall provide submittals for such cabling to engineer for approval.

2. MATERIALS

A. CONDUCTORS

- (1) All conductors shall be 98% conductive annealed copper unless otherwise noted, UL listed and labeled.
- (2) Receptacle branch circuits shall be not less than No. 12 copper wire or of the sizes shown on the drawings with Type THW, THHN or THWN insulation. All feeder circuits shall be Type THW or THWN of the size as shown on the Contract Drawings. THHN wiring shall only be installed in overhead, dry or damp locations. THWN or THW wiring shall be used for all circuits pulled in underground or other wet locations.
- (3) Conductors No. 10 and smaller sizes of wire shall be solid. Conductors No. 8 and larger sizes shall be stranded.

- (4) All wire on the project shall be new, in good condition, and shall be delivered in standard coils or reels.
- (5) The color of the wire shall be selected to conform with Section 210-5 of the latest edition of the National Electrical Code. Refer also to 260519-4, Color Coding.
- (6) All equipment grounding conductors shall have green color insulation or if larger than #8, shall be taped for two inches, green color at every termination and pullbox access point.
- (7) Conductors used for motor connections and connections to vibrating or oscillating equipment shall be extra flexible.
- (8) Conductors for main ground from neutral bus, equipment grounding bus, building steel, grounding grid and main cold water pipe connection shall be bare copper.
- (9) All conductors shall be identified by color code and by means of labels placed on conductors in all junction boxes and at each terminal point with Brady, Ideal, T & B or approved equivalent labels indicating source, circuit No. or terminal No.
- (10) Branch wiring and feeder conductors that are greater than 100' in length shall be increased at least one size to compensate for voltage drop. All circuits shall be installed and sized for a maximum 2% voltage drop. As calculated using 80% of the supply breaker rating as the load. Adjust conductors and conduit size accordingly for actual field installed conditions.

B. SPLICING DEVICES & CONNECTORS

- (1) Splicing devices for use on No. 14 to No. 10 AWG conductors shall be pressure type such as T & B "STA-KON", Burndy, Reliable or approved equivalent.
- (2) Wire nuts shall be spring pressure type, insulation 600V, 105°C insulation, up to #8 size. Greater than #6 Cu shall be a compression type connection, 600V insulation, cold shrink tubing, taped to restore full insulation value of the wire being spliced.
- (3) Pressure crimp-applied ring type (or fork with upturned ends) terminations shall be employed on motor and equipment terminals where such terminals are provided on motor and equipment leads or on all stranded wire terminations using No. 10 AWG or smaller conductors.
- (4) Splices, where necessary, shall be made with hydraulically-set "Hy-press" or equivalent crimped connectors. All splices shall be insulated to the full value of the wiring insulation using a cold-shrink kit or the equivalent in built-up materials.
- (5) Large connectors (lugs) at terminals shall be mechanical type, hex-head socket or crimp-on style, installed per the manufacturer's recommendations.
- (6) Exterior underground connections made between bare ground wires or to ground rods shall be exothermically welded, "Cadweld" or equivalent.

(7) The use of split-bolt clamps will be permitted in wireways at service entrance only. Torque to 55 foot-pounds or as recommended by manufacturer.

(8) No aluminum conductors shall be used.

3. INSTALLATION

- A. The pulling of all wires and cable on this project shall be performed in strict compliance with applicable sections of the National Electrical Code. No conductor entering or leaving a cabinet or box shall be deflected in such a manner as to cause excess pressure on the conductor insulation. Conductors shall only be installed after insulating bushings are in place.
- B. The radius of bending of conductors shall be not less than eighteen times the outside diameter of the conductor insulation or more, if recommended by the manufacturer.
- C. Conductors installed within environmental air plenums shall be per N.E.C. Article 800 and other applicable codes, with FEP-type insulation or an approved equivalent. Also provide plenum-rated tie-wraps where plastic straps or other supports, etc., are installed in plenum areas.
- D. Where indicated, communications conductors that are installed exposed shall not be routed across ceilings or ductwork. They shall be held up against building structure or against permanent support members. They shall be installed in such a manner that they do not interfere with the access to or operation of equipment or removal of ceiling tiles. Tie-wraps shall be installed in such a manner so as to bundle conductors neatly, allowing runouts of single conductors or groups to drop down to equipment served. Install grommeting where dropping out of trays or into panels or service columns. Install sleeves with bushings where penetrating partitions. Firestop sleeves with approved material. Do not penetrate firewalls if so indicated on plans. Refer to the drawings for support requirements and details on routing exposed communications conductors.
- E. Conductors for isolated power systems shall be installed in as short a run of conduit as practicable. No pulling soap shall be used on conductors in isolated power systems.
- F. Maximum permissible pulling tensions, as recommended by the manufacturer for any given type of cable or wire installed shall not be exceeded. Utilize special remote readout equipment as required to ensure compliance. Use particular caution when installing twisted pair data cable or fiber optic cables -- forces permitted for pulling in are typically very low for these cable types.
- G. All cables and wiring, regardless of voltage, installed in manholes or cable vaults shall be routed in such a manner to provide a minimum of 6 feet of slack cable for future splicing. Install cables along walls by utilizing the longer route from entry to exit. If both routes are symmetrical, provide a loop of cable secured to wall. All cables shall be tied to insulated cable supports on wall-mounted racks, spaced a maximum of three feet apart.
- H. Where multiwire branch circuits are allowed, the phases and neutral shall be wire-tied together in the panelboard and in all pull boxes.

4. COLOR CODING DISTRIBUTION VOLTAGE CONDUCTORS, 600 VOLT OR LESS

A. Conductors to be color coded as follows:

(1) 120/208 Volt Conductors

Phase A - Black

Phase B - Red

Phase C - Blue

Neutral - Solid White or White with tracer stripe to match phase conductor

Note: Further identify isolated power conductors with 2" wide purple tape at all terminations and junctions.

(2) Control Wiring - Red, or as indicated.

(3) Conductors within enclosures that may be energized when enclosure disconnect is off - yellow, or taped with 1/2" yellow tape every 6" of length, inside enclosure. Provide lamacoid plate warning sign on front of enclosure where this condition occurs.

5. COMMUNICATIONS CONDUCTORS

A. Communications conductors shall be of type suitable for the service, installed in accordance with the manufacturer's recommendations for pulling tensions, support, terminations, proximity to high power fields, etc. Types not indicated on this schedule but indicated on plans shall be as noted or required for the service. If in doubt, contact the Engineer for clarification.

B. Plenum-rated conductors (per N.E.C.) shall be installed where required by codes. If installation is thru an approved raceway system that excludes the wiring from the plenum, non-plenum type may be used.

C. All communications cables shall be furnished and installed in compliance with U.L. 444, U.L. 13, N.E.C. 800, 725, 760 and all applicable codes and standards, for premises or riser installations.

D. Riser cables shall be provided in accord with current edition of the N.E. Code.

E. Schedule of Wiring Types - Plenum-Rated

Data Circuits	24 AWG, 4 Pair Certified Category Six augmented U.T.P. Plenum-Rated	Anixter #CMP-00424 FAS-5B Superior Essex TE Connectivity Belden Equivalent Berk-Tek Equivalent
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- OR -

F. Schedule of Wiring Types - Non-Plenum Rated

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Data Circuits	24 AWG, 4 Pair Certified Category Six augmented U.T.P.	Anixter #CM-00423PND-6A-06 Superior Essex TE Connectivity Belden Equivalent Berk-Tek Equivalent
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6. TESTING OF PRIMARY CABLE

A. All new primary cable shall be tested prior to energization in accord with the following criteria, or other approved method.

(1) Use equipment made by one of the following (or approved equivalent) and abide by their operation rules for their respective equipment:

- a. Associated Research, Inc.
- b. J.G. Biddle Company
- c. Hipotronics, Inc.
- d. Von Corporation

(2) Clear cable of all equipment, switchgear, etc. for elbows, install insulation plugs. On cable end, insulate by high voltage taping, insulating jar or plastic. All terminations and splices shall be completely and properly grounded. All adjacent equipment shall be grounded, where danger of flashover exists.

(3) A sphere gap in parallel with the 100,000 volt D.C. "Hipot" tester shall be calibrated for sparkover at 70 KV D.C.

(4) The direct current test voltage shall be applied in increments of 5 KV and shall be left at the step for 1 minute. Saturate cable for 15 minutes at test voltage as in (5) below.

(5) Test: (as appropriate)

- a. 15 KV cables with open terminations at 55 KV D.C.
- b. 15 KV cables with elbow termination at 45 KV D.C., or to the limit of the elbow or splice. Verify with manufacturer.

SPECIAL NOTE: It is suggested that tests be performed when relative humidity is 50 to 60% or less in clear, dry weather for greater safety.

(6) Record the leakage current at each step and at end of saturation time.

(7) Acceptance: The above procedure with less than 100 microamperes of current registered.

(8) Proof test on existing cable at 35 KV for 5a and 35 KV for 5b above.

(9) After test (in order listed):

- a. Turn tester power off.

- b. Discharge tester and cable thru a resistive discharge device (8 MEGOHM discharge stick).
 - c. Ground cable thru a grounding means (#12 AWG THW wire to ground).
 - d. Disconnect tester.
- (10) For Safety:
- a. Wear high voltage gloves at all times.
 - b. Treat cable and tester as high voltage at all times.
 - c. Remember, D.C. static charges can be very harmful.
- (11) All tests must be made in the presence of the Engineer and shall be recorded on a form sheet signed by the person performing the test and dated. Three (3) copies shall be submitted to the Engineer. Provide 48 hour advance written notice to Engineer.

END OF SECTION 260519

SECTION 26 0526

GROUNDING

1. GENERAL

- A. All metallic conduit, raceways, cable trays, wireways, supports, cabinets and equipment shall be grounded in accordance with the latest issue of the National Electrical Code, as shown on the Contract Drawings and in accord with the requirements of the local authority having jurisdiction, as applicable.
- B. The size of the equipment grounding conductors, grounding electrode conductors and service grounding conductors shall be not less than that given in Article No. 250 of the National Electrical Code, and/or as shown on the Contract Drawings. Where ungrounded conductor sizes are increased to minimize voltage drop, grounded conductor sizes shall be increased in the proper proportion.
- C. Grounding bus and non-current carrying metallic parts of all equipment and raceway systems shall be securely grounded by connection to common ground.

2. MATERIALS

- A. Ground wires and cables shall be of the AWG sizes shown on the Contract Drawings or shall be sized in accord with the prevailing codes. All ground wires and cables shall be copper.
- B. All grounding fittings shall be heavy cast bronze or copper of the mechanical type except for underground installations or interconnection of grounding grid to cable, columns and ground electrodes, which shall be thermally welded type as manufactured by Cadweld, Burndy Co., Therm-O-Weld, or approved equivalent. Other bonding clamps or fittings in above ground locations shall be as manufactured by O.A. Co., T & B, Burndy, or approved equivalent.

3. INSTALLATION

- A. All grounding conductors shall be protected from mechanical injury and shall be rigidly supported. Where ground conductors are run through flexible conduit and through panelboard switchboard or motor control center feeders, they shall be securely bonded to such conduit thru the use of grounding bushings at the entrance and exit. All connection of equipment shall be made with an approved type of solderless connection and same shall be bolted or clamped to equipment or conduit.
- B. All equipment grounding conductors to lighting fixtures, devices, receptacles, electric heaters, furnace and other equipment not exceeding No. 8 AWG in size shall be green colored Type "THWN".
- C. Equipment ground connections to GFI circuit breakers shall be carried and bonded to each outlet on the circuit. Provide a separate equipment grounding conductor with green color insulation.
- D. Resistance to the grounding at the service entrance equipment shall be in accordance with the N.E.C. for style of construction and shall not exceed ten ohms as measured by the described testing method.

- E. All circuits shall have a separate grounding conductor, except as otherwise noted.
- F. When grounding systems are completely installed and all grading in the area of the service grounding electrode has been completed up to finish elevations, perform a fall-of potential or other approved test to determine actual system resistance to earth. Report results to the Engineer in writing. Refer to testing provisions in this section of specifications.

4. GROUND TESTING PROCEDURE

- A. The actual resistance to earth of the service grounding electrode shall be measured by the Contractor via the fall-of-potential method. This testing shall be accomplished after the grounding electrode has been completely installed and the finished grade is achieved.
- B. The results of the testing shall be summarized in a written report by the Contractor, which shall be forwarded to the Engineer for review. The report shall also be included with the operation and maintenance manuals for the Owner's information and future reference. This report is to also contain a detailed description and illustrations of the testing procedure, along with the name and model number of the testing instrument(s).
- C. For the actual testing, the Contractor shall follow the procedures outlined below. A self-contained instrument such as a "Megger" or "Ground OHMMETER" shall be used that is designed to eliminate the influence of stray current effects on the accuracy of the measurements.
 - (1) Connect one side of the instrument to the grounding electrode conductor where it connects to the facility main ground bus (point C1). Disconnect and isolate the grounding electrode conductor for the test.
 - (2) Drive a copperweld reference electrode probe (point C2) into earth between 300 and 500 feet away from C1 and connect to measurement instrument.
 - (3) Drive the movable grounding probe (C3) into earth at ten equally spaced intervals, in a straight line between C1 and C2 points and note the $E/I=R$ resistance readings on a graph at each point.
 - (4) The resistance measurements in OHMS taken from the flat part of the curve shall be averaged to determine the true grounding electrode resistance to earth.
 - (5) At completion of testing, remove reference electrode C2 and all temporary wiring and connections.
 - (6) If actual measurements of grounding electrode indicate a resistance greater than five OHMS, contact the Engineer for instructions. If deemed necessary by the Engineer, additional electrodes shall be placed and the measurement process repeated until the desired ground potential achieved.

END OF SECTION 260526

SECTION 26 0529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS\

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of (5) Five times the applied force.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.

2. Nonmetallic slotted support systems.
- B. Shop Drawings: [Signed and sealed by a qualified professional engineer.] Show fabrication and installation details and include calculations for the following:
1. Trapeze hangers. Include Product Data for components.
 2. Steel slotted channel systems. Include Product Data for components.
 3. Nonmetallic slotted channel systems. Include Product Data for components.
 4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.

- f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 6. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 14 mm diameter holes at a maximum of 200 mm o.c., in at least 1 surface.
- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 - 3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 - 4. Fitting and Accessory Materials: Same as channels and angles
 - 5. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
- 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

- a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

- c. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- d. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.

- 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
- 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
- 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
- 5. Toggle Bolts: All-steel springhead type.
- 6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 6 mm in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least (25) percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 38 mm and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lbs.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 100 mm thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 100 mm thick.
 - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.
- D. Anchor equipment to concrete base.
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 0.05 mm.
- B. Touchup: Comply with requirements in Division 09 [painting Sections] [Section "High-Performance Coatings"] for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 26 0531

CABINETS, OUTLET BOXES AND PULL BOXES

1. GENERAL

- A. This section of the specifications covers all electrical cabinets, outlet boxes and pull boxes.
- B. Continuous runs of conduit shall have properly sized pull boxes at least each eighty-five feet of run, or as near as possible to that limit.

2. MATERIALS & INSTALLATION

- A. Cabinets for power specified or shown on the Contract Drawings, shall be constructed of code gauge, galvanized steel with sides formed and corner seams riveted or welded before galvanizing. Boxes assembled with sheet metal screws will not be accepted. Pull boxes shall include all boxes used to reduce the run of conduit to the required number of feet or bends, supports, taps, troughs, and similar applications and shall also be constructed as specified above.
- B. All cabinets and boxes for NEMA 1 and 1A application shall be provided with knockouts, as necessary, or shall be cut in the field by approved cutting tools which will provide a clean, symmetrically cut opening. All boxes, except panelboards, shall be provided with code gauge fronts with hex head or pan head screw fasteners. Outdoor cabinets shall be hinged cover with pad locking provisions. Fronts for panelboards shall be as specified for panelboards.
- C. Unless otherwise noted on the drawings or in the specifications, outlet boxes shall be installed at the following heights to centerline of box:

Wall Switches, Control Stations	3'-10"
Convenience Outlets	1'-6"
Convenience Outlets - Above Counters.....	Bottom at 2" above top of backsplash

- D. The location of outlets, as shown on the drawings, shall be considered as approximate only. It shall be incumbent upon this Contractor to study the general building drawings, with relation to spaces surrounding each outlet, in order to make his work fit the work of others and in order that when the devices or fixtures are installed, they will be symmetrically located and will not interfere with any other work or equipment. Any change in fixture or layout shall be coordinated with and approved by the Engineer before this change is made. Regardless of the orientation shown on the drawings, all devices shall be easily accessible when installed.
- E. Boxes installed in fire rated assemblies shall not compromise the rating of the assembly. The Contractor is responsible for identifying assembly ratings and construction requirements prior to rough-in.
 - a. Listed single and double gang metallic outlet and switch boxes with metallic or nonmetallic cover plates may be used in bearing and nonbearing wood stud and steel stud walls with rating not exceeding 2 h. The boxes shall be fastened to the studs with the openings in the wallboard facing cut so that the clearance between the boxes and the wallboard do not

exceed 1/8 in. The boxes shall be installed so that the surface area of individual boxes do not exceed 16 sq in, and the aggregate surface area of the boxes do not exceed 100 sq in per 100 sq ft of wall surface unless approved alternate protection materials are used.

- b. Boxes located on opposite sides of walls or partitions shall be separated by a minimum horizontal distance of 24 in. This minimum separation distance between the boxes may be reduced when listed Wall Opening Protective Materials are installed according to the requirements of their Classification.
 - c. Boxes installed on opposite sides of walls or partitions of staggered stud construction shall have listed Wall Opening Protective Materials installed with the boxes in accordance with Classification requirements for the protective materials.
 - d. All installation shall be done in accordance with AHJ requirements.
- F. All outlets, pull boxes, junction boxes, cabinets, etc., shall be sized per the current edition of the National Electrical Code.
- G. Cabinets, outlet boxes and junction or pull boxes shall be threaded for rigid-threaded conduit, dust-tight, vapor-tight or weatherproof as required for areas other than for NEMA 1 or 1A application. These shall be as manufactured by Crouse-Hinds, Appleton, Killark, or approved equivalent.
- H. NEMA 1 or 1A cabinets, outlet boxes or pull or junction boxes shall be as manufactured by Appleton, Steel City, T & B, or approved equivalent.
- I. Outlet boxes for switches, receptacles, telephone, etc., concealed in walls shall be galvanized steel, 2" X 4" X 2" with plaster cover for the number of devices as required. Where outlet boxes are installed in walls of glazed tile, brick, concrete block, or other masonry which will not be covered with plaster or in walls covered by wood wainscot or paneling, deep sectional masonry boxes shall be used and they shall be completely covered with the plates or lighting fixtures. This Contractor shall cooperate with the brick layers, block layers and carpenters to ensure that the outlet boxes are installed straight and snugly in the walls. Receptacles shall be set vertically in walls, unless noted otherwise.
- J. Outlet boxes mounted in glazed tile, brick, concrete block or other types of masonry walls shall be mounted above or below the mortar joint. Do Not Split the Mortar Joint.
- K. Boxes for more than two devices shall be for the number of devices required and shall be one piece. No ganging of single switch boxes will be allowed.
- L. Outlets provided shall have only the holes necessary to accommodate the conduit at the point of installation and shall be rigidly secure in position. Boxes with knockouts removed and openings not used shall be replaced or be provided with a listed knockout closure.
- M. Openings for conduit entrance in cabinets and boxes shall be prefabricated, punched, drilled and/or reamed. The use of a cutting torch for this purpose is prohibited.

END OF SECTION 260531

SECTION 26 0533

RACEWAYS & FITTINGSS

1. GENERAL

- A. This section is intended to specify the raceways, conduit, conduit fittings, hangers, junction boxes, splice boxes, specialties and related items necessary to complete the work as shown on the drawings and specified herein.
- B. This section specifies basic materials and methods and is a part of each Division 26, 27 and 28 that implies or refers to electrical raceways specified therein.
- C. The types of raceways specified in this section include the following:
 - (1) Steel electrical metallic tubing. (E.M.T.)
 - (2) Rigid galvanized steel conduit. (G.R.S.)
 - (3) Intermediate metal conduit (I.M.C.).
 - (4) Rigid aluminum conduit.
 - (5) Rigid nonmetallic conduit.
 - (6) Surface metal raceways.
 - (7) Wireways, wall ducts and trench ducts.
 - (8) Cable tray or cable trough.
- D. All raceways, as listed in 1C. above and otherwise specified herein shall be provided in compliance with latest editions of all applicable U.L., NEMA, N.E.C. and A.N.S.I. standards. All conduit, raceways and fittings shall be Underwriters Laboratories listed and labeled, or bear the listing of an agency acceptable to the local authority having jurisdiction.
- E. Conduit and raceways, as well as supporting inserts in contact with or enclosed in concrete shall comply with the latest edition of all A.C.I. standards and the equipment manufacturer's recommendations for such work.
- F. P.V.C. or other non-metallic conduit shall be rated for the maximum operating temperature that could be developed by the conductors it encloses, while in normal operation.
- G. The decision of the Engineer shall be final and binding in any case where a question or inquiry arises regarding the suitability of a particular installation or application of raceways, supports or materials, if other than outlined herein.
- H. Minimum size of conduit shall be 3/4" trade size. All conduit and raceways shall be sized for the number of conductors contained, in accord with the latest edition of the National Electrical Code or any other applicable standards.
- I. The installer of raceway systems shall avoid the use of dissimilar metals within raceway installations that would result in galvanic-action corrosion.

2. MATERIALS

A. STEEL ELECTRICAL METALLIC TUBING

- (1) Electrical metallic tubing, (E.M.T.) of corrosion-resistant steel construction shall be permitted for concealed installation in dry interior locations. Electrical metallic tubing shall not be installed in concrete slabs or where exposed to physical damage. Electrical metallic tubing shall be permitted for exposed work in mechanical and electrical rooms and other exposed structure areas where not subjected to physical damage, as determined by the Engineer.

B. RIGID GALVANIZED STEEL CONDUIT

- (1) Rigid galvanized steel conduit shall be used where subject to physical damage for exposed work in mechanical spaces, within factory or other industrial work areas, for exposed fit-up work on machinery, for exposed exterior damp or wet location work, in hazardous atmospheres, in exterior underground locations where installed beneath roadways, where ells occur in underground P.V.C. conduits, or where turning out of concrete encased duct banks, and at other locations as specifically called out on the drawings.
- (2) Rigid galvanized steel conduit shall be used for all building interior power wiring or cables of over 600 Volts.

C. INTERMEDIATE METAL CONDUIT

- (1) Unless otherwise indicated on the drawings, intermediate metal conduit (I.M.C.) may be used in any location in place of rigid galvanized steel conduit, as permitted by codes, and as approved by the Engineer.

D. RIGID ALUMINUM CONDUIT

- (1) Rigid aluminum conduit, shall be permitted for installation indoors in dry locations only. Under no conditions shall it be cast into concrete slabs or pass thru construction where prolonged contact will degrade the aluminum. All ells used in rigid aluminum conduit systems shall be rigid galvanized steel. Rigid aluminum conduit shall always be used for power wiring greater than 5 KVA and higher than 60 Hz frequency.

E. RIGID NON-METALLIC CONDUIT

- (1) Rigid non metallic conduit shall be constructed of P.V.C, nominally schedule 40 weight, except where encased in concrete, where it may be "EB" type. If installation will enclose utility company provided conductors, verify exact type required and install in accord with their standards, if more stringent than this specification.
- (2) Rigid non-metallic conduit may be used in exterior wet or damp locations where installed underslab or underground. It shall not be run in interior locations, except with special permission from the Engineer for use in corrosive environments, and then only if protected from physical damage. No rigid nonmetallic conduit may be installed in environmental air plenums or cast into above-grade concrete slabs. No rigid nonmetallic conduit may be installed in locations where the ambient temperature might exceed the rating of the raceway.

- (3) Where rigid non metallic conduit is placed underground, as for feeder circuits, secondaries or branch circuit runs and where ell is made upward thru a slab on grade, transition the turning ell and the riser to rigid steel conduit to a height of 6" above the concrete slab. Transition may then be made to E.M.T or other approved conduit for remainder of run.
- (4) Flexible nonmetallic conduit shall not be used, except by special permission, obtained in writing from the Engineer.
- (5) Provide equipment grounding conductors of copper, sized as required by codes, in all circuits installed in rigid nonmetallic raceways.

F. SURFACE METAL RACEWAYS

- (1) Surface metal raceways shall be constructed of code gauge corrosion-resistant galvanized steel or aluminum extrusions, and finished in an ivory, buff or grey color as selected by the Architect. Finishes shall be suitable for field painting, prepared by the installing contractor as necessary.
- (2) Surface metal raceways, where used as raceways only, shall be sized for the conductors indicated. Nominal minimum size of such raceways shall be equivalent to Wiremold Co. Series #700, or equivalent by Isotrol or other approved manufacturer.
- (3) Surface metal raceways to be furnished with integral receptacles shall have Simplex Nema 5-20R outlets spaced on centers as indicated on plans. These shall be Wiremold Co. #2200 Series or equivalent Isotrol or other approved manufacturer.
- (4) Surface metal raceways and all components and fittings shall be furnished by a single manufacturer, wherever practical. All trim and cover fittings, flush feed boxes, splices, outlet fittings, etc, necessary for a complete installation shall be provided by the installing contractor. These raceways shall be rigidly mounted with approved fasteners on not to exceed 24" centers in a run, or 6" from ends and on either side of a corner. Refer to plans for notations on exact types of these raceways and outlet configurations.

G. CABLE TRAY OR CABLE TROUGH

- (1) Cable tray shall be furnished in all-aluminum construction or galvanized steel construction, as noted and sized on the drawings.
- (2) Galvanized finishes on tray shall be hot-dipped after fabrication for all trays in exterior locations. Mill finished galvanizing may be used where tray is installed indoors in dry locations.
- (3) The installing contractor shall carefully follow the manufacturer's recommendations for hanger sizing and hanger support spacing. The weight per linear foot of tray, fully loaded with a 200% safety factor shall be accounted for in sizing hangers. Refer to manufacturer's instructions and/or the drawings, as applicable for hangers and supports. In no case shall supports be spaced further than 8'-0" apart.

- (4) Cable tray shall be of the ladder type with rungs spaced 12" apart. Side rails shall be of I-Beam or C-Channel construction with welded rungs, depth and width as indicated on the drawings.
- (5) Cable trough shall be similar to cable tray, except bottom shall be a ribbed solid piece, depth and width as indicated on the drawings.
- (6) Cable tray or trough shall be provided with all required fittings for a complete installation. Fittings shall include, but not be limited to: Horizontal and vertical elbows and tees, smooth dropout fittings, end closure plates, fixed (or adjustable) splices as needed for field offsets, reducers, barriers or box connector flanges.
- (7) Cable tray and trough shall be equivalent to Square "D" Company Series CLA/CLG (ladder tray) or CTA/CTG (trough) as a standard of quality and construction.

H. OPEN WIRE MESH CABLETRAY

- (1) Section includes continuous, rigid, welded steel wire mesh cable management system.
- (2) References
 - a. ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. ASTM A 510 - General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
 - c. ASTM B 633 - Electrodeposited Coatings of Zinc on Iron and Steel.
- (3) Design Requirements
 - a. Maximum Deflection Between Supports: $L/240$.
- (4) Submittals
 - a. Product Data: Submit manufacturer's product data, including UL classification.
 - b. Shop Drawings: Submit shop drawings indicating materials, finish, dimensions, and accessories. Show layout, support, and installation details.
 - c. Manufacturer Qualifications: Submit manufacturer's certification indicating ISO 9002 quality certified.
- (5) Delivery, Storage and Handling
 - a. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
 - b. Storage: Store materials in a dry area indoors, protected from damage, and in accordance with manufacturer's instructions.

- c. Handling: Protect materials and finishes during handling and installation to prevent damage.

(6) Manufacturer

- a. Cablofil, Inc., 8319 State Route 4, Mascoutah, IL, 62258. Phone (618) 566-3230. Toll Free (800) 658-4641. Fax (618) 566-3250. www.cablofil.com, or approved equivalent. Part numbers included in this section are not meant to restrict truly equivalent manufacturers.

(7) Open Wire Mesh Cabletray System

- a. Description: Continuous, rigid, welded steel wire mesh cable management system.
 - 1) Mesh System: Permitting continuous ventilation of cables and maximum dissipation of heat.
 - 2) Safety Edge: Continuous safety edge T-welded wire lip.
 - 3) Wire Mesh: Welded at all intersections.
- b. UL Classification: Straight sections 4" x 8", 12", and 18 inches.
- c. Material: Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture.
- d. Finish for Carbon Steel Wire: Finish applied after welding and bending of mesh.
 - 1) Hot-Dip Galvanizing: ASTM A 123. (Only in exterior, wet or corrosive locations)
 - 2) Flat Black: Powder painted surface treatment using ASA 61 black polyester coating. (In indoor dry locations)
- e. Nominal Dimensions:
 - 1) Nominal Mesh: 2 x 4 inches.
 - 2) Nominal Straight Section Lengths: 80 inches and 118 inches.
 - 3) Width: [6 inches] [8 inches] [12 inches] [18 inches] [24 inches].
 - 4) Depth: Four inches in depth for all but 6" wide, which shall be 2" depth.
 - 5) Wire Diameter: Nominal .177 inch, minimum.
- f. Fittings: Field fabricated in accordance with manufacturer's instructions from straight sections.
- g. Support System: Standard.

- 1) Wall Installation: CS Bracket. Maximum tray width of 12 inches (300 mm).
 - 2) Trapeze Mounting to Ceilings: CS Profile. Maximum tray width of 18 inches (450 mm).
 - 3) Ceiling Installation: CSC Bracket. Maximum tray width of 12 inches (300 mm).
 - 4) Fasteners: As required by tray widths. To be furnished by manufacturer.
- h. Hardware: Hardware, including splice connectors, grounding fittings and support components to be furnished by the manufacturer.
- i. Grounding: GTA-2-2 grounding lugs for attachment on tray of continuous ground conductor fixing system.

(8) Examination

- a. Examine areas to receive cable management system. Notify the Engineer of conditions that would adversely affect the installation or subsequent utilization of the system. Do not proceed with installation until unsatisfactory conditions are corrected.

(9) Installation

- a. Install open wire mesh cabletray system at locations indicated on the drawings and in accordance with manufacturer's instructions.
- b. Load Span Criteria: Install open wire mesh cabletray system in accordance with span load criteria of $L/240$.
- c. Cutting:
 - 1) Cut wires in accordance with manufacturer's instructions.
 - 2) Cut wires with side action bolt cutters to ensure integrity of galvanic protective layer.
 - 3) Cut each wire with 1 clean cut to eliminate grinding or touch-up.
- d. Install open wire mesh cabletray system using hardware, splice connectors, support components, and accessories furnished by manufacturer.
- e. Coordinate with other trades to provide as straight and accessible runs as possible. Not all offsets are shown on drawings, but Contractor shall make accessible offsets as required around ductwork, structure, piping or other interferences as required.

I. RACEWAY FITTINGS

- (1) Raceway fittings (or condulets) shall be of gray iron, malleable iron or heavy copper-free cast aluminum. They shall be furnished in proper configurations, avoiding excessive plugged

openings. Any openings that are left shall be properly plugged. All coverplates shall be gasketed with neoprene or similar approved materials, rated for the environment.

- (2) Where required, raceway fittings shall be provided in explosion-proof configurations rated for the atmosphere. Place conduit seal off fittings at each device in accord with applicable codes. Seal off fittings shall be packed with wadding, and poured with an approved non-shrink sealing compound.
- (3) Where conduit transitions in a run from a cold to a warm environment, (such as at a freezer, refrigerator or exterior wall) sealoff fittings shall be placed on the warm side immediately at the boundary to prevent migration of condensation within raceway systems.
- (4) Expansion fittings shall be provided at all locations where conduits or other raceways cross over expansion joints. Provide copper ground bonding jumpers across expansion fittings.
- (5) Conduit bodies, junction boxes and fittings shall be dust tight and threaded for dusty areas, weatherproof for exterior locations and vapor tight for damp areas. Conduit fittings shall be as manufactured by Crouse Hinds, Appleton, Killark or approved equivalent. All surface mounted conduit fittings as with "FS", "FD", "GUB" Types etc., shall be provided with mounting hubs.
- (6) Where lighting fixtures, appliances or wiring devices are to be suspended from ceiling outlet boxes, they shall be provided with 3/4" rigid conduit pendants. Outlet boxes shall be malleable iron, provided with self-aligning covers with swivel ball joint and No. 14 gauge steel locking ring. Provide safety chain between building structure and ballast housing of light fixtures for all fixtures, appliances or devices greater than 10 lbs weight. Fixtures shall be installed plumb and level.
- (7) Fittings for threaded raceways shall be tapered thread with all burrs removed, reamed ends and cutting oil wiped clean.
- (8) Fittings for E.M.T. conduit shall be of the compression type. Conduit stops shall be formed in center of couplings. All EMT connectors and couplings shall be of formed steel construction.
- (9) Indentation or die-cast fittings shall not be permitted in any raceway system.
- (10) All conduit fittings shall be securely tightened. All threaded fittings shall be engaged seven full threads. Fasteners shall be properly torqued to manufacturer's recommendations.

J. SUPPORTS AND HANGERS

- (1) Supports and hangers shall be installed in accord with all applicable codes and standards. They shall be corrosion - resistant, galvanized or furnished with an equivalent protective coating. All electrical raceways shall be hung independently from the building structure with U.L. listed and approved materials. Hangers and supports depending on the support systems of other trades' work shall not be permitted, except with specific approval in writing from the Engineer. The use of tie wire for support or fastening of any raceway system is prohibited. Perforated metal tape shall not be used for raceway support.

- (2) No raceway shall be installed on acoustic tile ceiling tees, or in any location that will impair the functioning, access or code-required clearances for any equipment or system.
- (3) Supports for raceways shall be of materials compatible with the raceway, of malleable iron, spring steel, stamped steel or other approved material. Die-cast fittings are not permitted for supports.
- (4) The installing contractor shall provide all necessary supports and braces for raceways, in a rigid and safe installation, complying with all applicable codes.
- (5) Individual conduits run on building walls or equipment shall be secured by one hole galvanized malleable iron or stamped steel pipe strap or "minerallac" 2-piece straps. The straps are to be anchored by an approved means such as expansion anchors, toggle bolts, through bolts, etc. Where required by codes or other standards, provide spacers behind mounting clamps to space conduits off walls.
- (6) Individual conduits run on building steel shall be secured by means of clamp supports similar and equal to those manufactured by the C.C. Korn Company, Elcen Co., B-Line or approved equivalent. Provide korn clamps, bulb tee clamps, flange clamps, beam clamps, "minerallacs", etc.
- (7) Where feasible, vertical and/or horizontal runs of conduit shall be grouped in common hangers on "trapezes" of channel stock as manufactured by "Unistrut" or equivalent, 1-5/8" minimum depth, 12 gauge. Utilize conduit clamps appropriate to the channel.
- (8) Channel strut systems for supporting electrical equipment or raceways in outdoor wet or corrosive locations shall be constructed of 12 gauge minimum hot dip galvanized steel with 9/16" diameter holes on 8" centers, with finish coat of paint as manufactured by Unistrut, B-Line, Kindorf, or approved equivalent. In indoor dry locations, factory finish paint will be acceptable.
- (9) The minimum diameter of round all-thread steel rods used for hangers and supports shall be 1/4", 20 threads per inch. All-thread rod shall be furnished with a corrosion-resistant finish.
- (10) Welding directly on conduit or fittings is not permitted.
- (11) Provide riser support clamps for vertical conduit runs. Riser support clamps shall be of heavy gauge steel construction. Install riser support clamps at each floor level penetration, or as otherwise required.
- (12) Provide conduit cable support clamps for vertical conductor runs as required or indicated on plans. Clamps to be insulating wedging plug, with malleable iron support ring. Install within properly sized and anchored junction box.
- (13) Spring steel clips and fittings such as those manufactured by HITT-Thomas, Caddy-Erico, or approved equivalent, with black oxide finish are permitted in any indoor dry location for concealed work, where acceptable to the local authority having jurisdiction.

3. INSTALLATION

- A. This Contractor shall lay out and install all conduit systems so as to avoid any other service or systems, the proximity of which may prove injurious to the conduit, or conductors which it confines. All conduit systems, except those otherwise specifically shown to the contrary, shall be concealed in the building construction or run above ceilings. Size of all conduit shall as a minimum conform to the National Electrical Code, unless larger size is indicated on the Contract Drawings.
- B. No conduit larger than ¾" shall be installed in poured concrete slabs except with permission of the structural engineer. All other shall be held below slab. Conduit shall be held at least 6" from flues or hot water pipes.
- C. All exposed conduit shall be installed with runs parallel or perpendicular to walls, structural members or intersections of vertical planes and ceilings, with right angle turns consisting of cast metal fittings or symmetrical bends unless otherwise shown. All conduit shall have supports spaced not more than eight feet apart.
- D. Conduit shall be installed in such a manner so as to insure against collection of trapped condensation. All runs of conduit shall be arranged so as to be devoid of traps. Trapped conduit runs shall be provided with explosion proof drains at low points. Runs of conduit between junctions shall not have more than the equivalent of three 90° bends.
- E. Junction boxes shall be installed so that conduit runs will not exceed 85', or as shown on the Contract Drawings.
- F. Junction boxes, troughs, pull boxes or similar shall contain no more than three circuits. If boxes containing more circuits are deemed necessary for special circumstances such as fit or coordination, the Contractor shall contact the Engineer for written direction.
- G. Underground electric, cable TV, telephone service or other rigid steel conduit and underfloor rigid steel conduit below the concrete floor slab shall be painted with two coats of bitumastic paint, such as "Asphaltum".
- H. All underground or underfloor conduits shall be swabbed free of all moisture and debris before conductors are pulled.
- I. At least two 1 inch and four ¾ inch conduits shall be stubbed from flush-mounted panelboards into the nearest accessible area for future use. Provide suitable closures for these stubs. Identify each stub with a suitable hang tag.
- J. Install electrical raceways in accordance with manufacturer's written instructions, applicable requirements of latest edition of the N.E.C., and NECA "Standard of Installation", complying with recognized industry practices.
- K. Coordinate with other trades, including metal and concrete deck trades, as necessary to interface installation of electrical raceways and components.
- L. Level and square raceway runs, and install at proper elevations and required heights. Hold tight to structure or route through joists webbing wherever possible, to maximize available space and not restrict other trades.

- M. Complete installation of electrical raceways before starting installation of cables or wires within raceways.
- N. All underground conduits shall be buried to minimum depth of 24" from the top of the concrete encasement or raceway to finished grade, unless otherwise noted on plans. Observe minimum burial requirements of local utility company where their standards or regulations apply. Conduits containing primary power conductors, (higher than 600 volts to ground) shall be 42" to top below finished grade, unless otherwise noted on plans.
- O. All raceways shall be installed to maintain a minimum of 4" clearance below roof decking.

4. SPECIALTIES

- A. All EMT terminations at junction boxes, panels, etc. shall be made with case hardened locknuts and appropriate fittings, with insulated throat liners. Insulating terminations shall be manufactured as a single unit. The use of split sleeve insulators is not permitted.
- B. All rigid conduit, except main and branch feeders, shall have heavy fiber insulating bushings reinforced with double locknuts. All branch and main feeders shall have insulated bushings with grounding lugs and shall be bonded to enclosures with appropriately sized copper jumpers, except at pad mounted transformers. Bonding jumpers shall be installed as required by the N.E.C. and other applicable codes.
- C. All conduit stubbed through floor during construction shall have openings protected with plastic caps approved for this purpose. Connections on both ends of all flexible conduit shall be equivalent to Thomas and Betts, Ideal, Appleton, Efcor, or approved equivalent, rated for the environment.
- D. All pulling lines left in open conduit systems shall be non-metallic, left securely tied off at each end.
- E. Where spare raceways terminate in switchboards or motor control centers a fishtape barrier shall be provided.

END OF SECTION 260533

SECTION 26 0553

IDENTIFICATIONS

1. GENERAL

- A. Equipment shall be clearly marked as to its function and use. Markings shall be applied neatly and conspicuously to the front of each item of equipment with 1/2" white lamacoid plate (or equivalent) with black (or red for emergency power) letters 1/4" high.

- B. The Contractor shall provide clearly legible typewritten directories in each electrical panel/fire alarm panel indicating the area, item of equipment, etc., controlled by each switch, breaker, fuse, etc. These directories are to be inserted into plastic card holders in each panel. The Contractor shall be required to demonstrate the accuracy of the panel directory for a random sampling of circuits in each panelboard/control panel as directed in the field by the Engineer with corrections made immediately so it is imperative that care be taken during installation to insure 100% accurate directories.
 - (1) Room numbers shall match the final numbering as indicated by building signage and owner-approved numbering scheme.
 - (2) The contractor shall provide electronic copies of all final schedules in Excel or Word format at project closeout.

END OF SECTION 260553

SECTION 28 4600

ADDRESSABLE FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions, Division 01 Specification Sections, and Section 260010 “General Requirements for Electrical Systems” apply to this Section.

1.2 SUMMARY

- A. Description: This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire detection equipment required to form a complete, operative, coordinated system.
- B. Section Includes:
 - 1. Analog-Addressable fire-alarm system.
 - 2. Fire-alarm control unit (FACU).
 - 3. Manual fire-alarm boxes.
 - 4. System Detectors.
 - 5. Fire-alarm notification appliances.
 - 6. Fire-alarm annunciators.
 - 7. Fire-alarm addressable interface devices.
 - 8. Fire-alarm system communications.
 - 9. Fire-alarm system accessories.
 - 10. Fire-alarm conductors and cabling.

1.3 REFERENCES

- A. Abbreviations and Acronyms
 - 1. DACT: Digital alarm communicator transmitter.
 - 2. FACU (FACP): Fire-alarm control unit (panel).
 - 3. NAC: Notification Appliance Circuit
 - 4. NICET: National Institute for Certification in Engineering Technologies.
 - 5. NRTL: Nationally Recognized Testing Laboratory.
 - 6. SLC: Signaling Line Circuit
- B. Definitions
 - 1. Circuit: Wire path from a group of devices or appliances to a control panel or transponder.
 - 2. Zone: Combination of one or more circuits or devices in a defined building area

- C. Reference Standards: The following publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
 - 1. National Electrical Contractors Association (NECA):
 - a. NECA 305, "Standard for Fire Alarm System Job Practices".

1.4 COORDINATION

- A. Testing existing system: Provide a complete functional test of the existing fire alarm systems prior to commencement of work. Report any non-functioning equipment or components to Architect and Engineer. After commencing work, Contractor shall be responsible for ensuring all existing portions of the fire alarm system are properly functioning at all times with no trouble conditions.
- B. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. When new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from building.
- C. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment indicated for removal along with all associated wiring.
- D. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
 - 1. Notify Engineer and Owner no fewer than 10 days in advance of proposed interruption of fire-alarm service.
 - 2. Identify specific locations affected by interruption, circuits which may be inoperable during the outage, and the length of time the system will be impaired.
 - 3. Do not proceed with interruption of fire-alarm service without the Owner's written permission.
- E. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.5 SUBMITTALS

- A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.
- B. Product Data: For each type of product, including furnished options and accessories.
- C. Shop Drawings: Provide for the fire alarm system.
 - 1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - 2. Include floor plans drawn to scale which clearly show locations of devices, equipment. Indicate electrical power connections, approximate location and size of conduit/wiring runs, and other information required to clearly describe the proposed system. Plans should

- include identification numbers and wiring connections for all equipment and devices in entire fire alarm system.
3. Include enlarged plans, drawn to a scale not less than 1/4 -inch equals 1 foot, for all equipment rooms and any fire command centers with dimensioned equipment layouts.
 4. Include detailed riser diagrams based on the project floor plans, with all devices indicated along with proposed circuit routing. The conductor composition for each conduit section shall be provided. Show consecutive connections for all devices with addresses, candela ratings, and speaker wattages.
 5. Provide scaled elevations, sections, and details, including critical dimensions and details of attachments to other Work.
 6. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 7. Detail assembly and support requirements.
 8. Annunciator panel details as required by authorities having jurisdiction.
 9. Include current draw for each device submitted and the listed minimum voltage required to operate.
 10. Include voltage drop calculations for notification-appliance circuits. Provide maximum allowable voltage drop for panel and for individual NAC circuits.
 - a. Identify Notification Appliance Circuits (NAC) current draws and voltage drops for each circuit. Vendor must utilize the "end of line" method for voltage drop calculations. The "mid-point" method is not acceptable. In no case shall the calculated voltage at any notification appliance fall below the minimum listed operating voltage for the devices used.
 - b. The voltage drop at EOL must not exceed 14% of the expected battery voltage, after the required standby time plus alarm time. Determine "worst case" voltage at far end of each NAC, by subtracting its calculated V-drop from the expected battery voltage. The result must be no less than the minimum listed operating voltage for the alarm notification appliances used. All these calculations must be placed on a dedicated sheet, for future reference by fire alarm service technicians.
 11. Include battery-size calculations showing battery capacity and supervisory and alarm standby power requirements.
 - a. Use manufacturer's battery discharge curve to determine expected battery voltage after specified time period of providing standby power. Then use calculated Notification Appliance Circuit current draw in the alarm mode to determine expected voltage drop at End of the Line Resistor (EOL), based on conductor resistance per conductor manufacturer's data sheet or NEC.
 12. Include system response matrix showing the fire alarm system's actions (outputs) required for each type of alarm, supervisory, and trouble signal. Any non-compliant features must be fully described.
 13. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
 14. Include performance parameters and installation details for each type of detector.
 15. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 16. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.

- b. Provide control wiring diagrams and show equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
 - c. Locate detectors in accordance with manufacturer's written instructions.
 - 17. Include equipment rack or console layout, grounding schematic, power calculations, and single-line connection diagram.
 - 18. Include manufacturer's detailed installation instruction for the Fire Alarm Control Panel and all duct mounted smoke detectors, flow switches, tamper switches, supervisory switches, and similar items which require mechanical installation.
- D. Delegated Design: For notification appliances and detectors, in addition to submittals listed herein, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional responsible for their preparation.
 - 1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
 - 2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
 - 3. Indicate audible appliances required to produce square wave signal per NFPA 72.
- E. Qualification Data: For Certified System Designer, Lead Technician, and Installers including names, license numbers, and certifications as described under Quality Assurance.
- F. Sample Warranty.
- G. Field quality-control reports.
- H. Closeout Submittals
 - 1. Operation and Maintenance Data: For fire-alarm systems and components to include in operation and maintenance manuals.
 - 2. In addition to items specified in Division 01 and Section 260010 "General Requirements for Electrical Systems", include the following:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - d. Software and Firmware Operational Documentation: Provide operating manuals and backups of software database on USB media. The database provided shall be useable by any authorized and certified distributor of the product line, and shall include all applicable passwords necessary for total and unrestricted use and modification of the database.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. Manufacturer must be regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristics required, and whose products are Listed and Labeled.
2. Manufacturer shall maintain an authorized distributor within 100 miles of the project location which stocks a full complement of parts for all equipment to be furnished.

B. Installer Qualifications

1. Obtain certification by NRTL in accordance with NFPA 72.
2. Licensed or certified by authorities having jurisdiction to perform fire alarm installations in the specified jurisdiction.
3. Be in business a minimum of 5 continuous years with documented experience installing fire alarm systems similar in size and scope.
4. Installer must be responsible for all program changes and must be present for all testing and inspections.
5. All connections to the FACP and the system's programming shall only be done by the manufacturer, or by an authorized distributor.

C. Project Personnel Requirements: Installer must have the following certified full-time employees on staff and assigned to the project.

1. All personnel must be trained and certified by manufacturer for installation of units required for this Project.
2. System Designer: Preparation of shop drawings, cabling administration drawings, and field-testing program development by a NICET certified Level IV technician who shall be trained and certified in fire alarm system design by the approved manufacturer within the last 36 months and be licensed by the authorities having jurisdiction.
3. Lead Technician: Minimum NICET certified Level III technician who shall provide all devices, connections, and programming for the fire alarm system. Technician shall be certified by the approved manufacturer within the last 36 months and licensed by the authorities having jurisdiction. The lead technician shall be present at all times when work of this Section is performed at the project site.
4. Installer Qualifications: Any work related to this section shall be installed by personnel trained and certified by the approved manufacturer within the last 24 months.

1.7 WARRANTIES

- ### A. Manufacturer Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship for a period of 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to the authority having jurisdiction, and marked for intended location and application.
- B. All components provided shall be listed for use with the selected system.

2.2 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Edwards EST
 - 2. Notifier
 - 3. Siemens
 - 4. Simplex
- B. Being listed as an acceptable Manufacturer in no way relieves obligation of the Contractor to provide all equipment and features in accordance with these specifications.

2.3 ADDRESSABLE FIRE ALARM SYSTEM REQUIREMENTS

- A. Noncoded, UL-certified, FM Global-approved, Networked analog/addressable system, with multiplexed signal transmission and voice/strobe evacuation.
- B. The system shall be designed, inspected, tested and approved to provide occupant notification audibility levels of 15 dBA over ambient conditions. Design intelligibility to ensure Common Intelligibility Standard (CIS) rating of 0.7 or Sound Transmission Index of 0.5 in all areas designated on the drawings to have intelligible audio.
- C. Fire Alarm System shall supervise and monitor the integrity of all sub-systems, circuits, and devices connected to the system and annunciate all system faults. All intelligent initiating, signaling, and control devices shall be individually addressed.
- D. The system shall be fully programmable so that any type of input event can be correlated to any combination of output functions.
- E. The fire alarm system operational priority shall ensure that life safety functions takes precedence over other activities coordinated by the system.

2.4 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.

4. Automatic sprinkler system water flow.

B. Fire-alarm signal must initiate the following actions:

1. Continuously operate alarm notification appliances, including voice evacuation.
2. Identify alarm and specific initiating device at fire-alarm control unit and any remote annunciators or network connected control panels. The system alarm LED shall flash and a local distinct audible signal in the control panel shall sound.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Switch HVAC equipment controls to fire-alarm mode.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Activate emergency lighting control.
9. Record events in system memory.
10. Record events by system printer.
11. Indicate device in alarm on graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Duct smoke detectors.
3. Device tamper.
4. Zones or individual devices have been disabled.
5. Elevator shunt-trip supervision for Shut-Down.
6. Elevator hoistway detectors for Recall.
7. Carbon Monoxide detectors.

D. System Supervisory Signal Actions:

1. Identify specific device initiating the event at fire-alarm control unit and remote annunciators. The corresponding system LED shall flash and a local distinct audible signal in the control panel shall sound.
2. Record the event on system printer.
3. Transmit a supervisory signal to the remote alarm receiving station with no time delay.

E. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable device or networked panel.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal AC voltage at fire-alarm control units.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Voice signal amplifier failure.
11. Smoke Detector Contamination.
12. Carbon Monoxide Detector End of Life.

F. System Trouble Signal Actions:

1. Identify specific device initiating the event at fire-alarm control unit and remote annunciators. The system trouble LED shall flash and a local distinct audible signal in the control panel shall sound.
2. Record the event on system printer.
3. Transmit a trouble to the remote alarm receiving station after a programmable time delay of 200 seconds or as required by AHJ.
4. A trouble signal from loss of primary power shall not be transmitted unless maintained after a programmable time delay of 1 to 3 hours or as required by AHJ.
5. Fire alarm signal shall override trouble signals, but any pre-alarm trouble signal shall reappear when the panel is reset.

2.5 FIRE ALARM CONTROL PANEL (FACP)

A. General Requirements for Fire Alarm Control Panel:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with NFPA 72 and UL 864, and protected from voltage surges and line transients.
 - a. System software and all control-by-event programs shall be held in nonvolatile memory, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer. Time-of-Day and date shall be retained through failure of primary and secondary power supplies.
 - c. The Central Processing Unit (CPU) shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the CPU.
 - d. Provide communication between the FACP and intelligent detectors, addressable modules, local and remote operator terminals, remote circuit interface panels, annunciators, and other system-controlled devices.
 - e. The FACP shall be listed for connection to a central-station signaling system service.
 - f. The system is to have multiple access levels, so owner's authorized personnel can disable individual alarm inputs or normal system responses (outputs) for alarms, without changing the system's executive programming or affecting operation of the rest of the system. A minimum of two different password levels shall be accessible through the display interface assembly to prevent unauthorized system control or programming.
2. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
3. The system shall perform time-based control functions including automatic changes of specified smoke detector sensitivity settings.
4. Digitized electronic signals shall employ check digits or multiple polling. In general, a single ground or open on any system signaling line circuit shall not cause system malfunction, loss of operating power, or the ability to report an alarm.
5. Loss of Power: Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.

- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, three lines of 80 characters, minimum.
 2. Alphanumeric Touch Keypad: Arranged to permit entry and execution of programming, display, and control commands.
 3. Color coded system status LEDs. At minimum, Indicate the status of the following system parameters:
 - a. System AC Power
 - b. System Common Alarm
 - c. System Common Trouble
 - d. System Supervisory
 - e. Signal Silence
 4. Provide operator's interface which allows the following minimum functions. In addition, the operator's interface shall support any other functions required for system control and/or operation:
 - a. Signal Silence Switch: Silenced audible signal shall resound in a time period acceptable to AHJ if the condition has not been resolved.
 - b. System Reset Switch
 - c. System Test Switch
 - d. Panel Silence Switch
 - e. Panel Lamp Test Switch
 - f. System Bypass Switches: Programmable, supervised switches for fire safety function bypasses. i.e. NAC Bypass, Elevator Capture Bypass, HVAC Shutdown Defeat, Smoke Control Bypass, etc. Switch operation shall be password protected.
 - g. Interface shall allow programming of the system without any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
- C. Notification-Appliance and Signaling-Line Circuits:
1. Signaling Line Circuits (SLC): NFPA, Class B.
 - a. Provide a minimum of one signaling line circuit per floor.
 - b. Locate end of line resistors at devices that are accessible without the use of a ladder.
 2. Notification Appliance Circuits (NAC): NFPA 72, Class B.
 3. SLC Between Networked Panels: NFPA 72, Class X.
 4. Door Hold Open control circuits: NFPA 72, Class D for fail safe operation.
 5. Size each signaling line circuit and notification appliance circuit to allow a minimum additional capacity of 20%.
- D. Signaling Line Circuit (SLC) Modules:
1. Power limited, capable of accommodating up to 198 addressable devices on each SLC and a minimum of 1980 initiating points per system.
 2. On-board microprocessor capable of operating in a local mode in the event of a failure in the main CPU of the control panel.
 3. Capable of receiving analog information from all intelligent detectors and processing the information to determine whether normal, alarm, or trouble conditions exist for specific detectors.

4. Automatically maintain detector desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. Analog information may also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

E. Notification-Appliance Circuit (NAC) Modules:

1. Power limited, minimum circuit output rating: 2 Amps at 24VDC.
2. Polarized to provide for both synchronized strobes and independent horn/strobe operation over two wires.
3. Selectable as auxiliary power outputs and rated for continuous duty.

F. Digital, Multiplexed Voice/Alarm Signaling: Emergency communication system, integral to FACP, with master and remote microphones, zoned amplifiers, and tone generators that provide both live and pre-recorded messages.

1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the microphones. Amplifiers shall comply with UL 1711. Group speakers into zones as required by building code.
 - a. Allow the application of, and evacuation signal to, multiple zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Provide standard digitally recorded messages for the following:
 - 1) Evacuation
 - 2) All Clear
 - 3) Weather warning
 - 4) Test
 - 5) Stand-by
 - d. Generator tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits.
2. Status Annunciator: Indicate the status of various voice/alarm speaker zones.
3. Amplifiers and tone generators shall automatically transfer to backup units, on primary equipment failure.

G. Serial Interfaces:

1. One USB port for system printer.
2. One USB or Ethernet port for on-site programming or system modification with a PC.

H. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

I. Elevator Recall and Shutdown:

1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room/space or control room/space.
 - c. Smoke detectors in elevator hoist way.
2. Program elevator controller to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
3. Heat Detectors or Water-flow alarm associated with sprinklers in an elevator shaft and elevator machine room shall remove power to elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- J. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to and powered by fire-alarm system.
- K. Remote Smoke-Detector Sensitivity Adjustment and Testing: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out final adjusted values on system printer. The system shall also annunciate a trouble condition when any smoke detector approaches 80% of its alarm threshold due to gradual contamination, with an annunciation of the location of the smoke detector requiring service. If any specialized equipment must be used to program any function of the smoke detector devices, then one must be furnished as part of the system.
- L. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station in accordance with parameters specified herein.
- M. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- N. Primary Power: Obtained from dedicated 120-V ac branch circuit and a high efficiency power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
 1. Power supply modules shall have a continuous rating adequate to power all equipment and functions in full alarm continuously. All modules and drivers must be able to withstand prolonged short circuits in the field wiring, either line-to-line or line-to-ground, without damage. The power supply shall be expandable for additional notification appliance power in 3.0 Ampere increments.
 2. Each system power supply shall be individually supervised.
 3. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating to allow for future system expansion.
 4. Install lock clips on circuit breakers in the "ON" position.

- O. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power shall be automatic and shall not cause transmission of a false alarm.
 - 1. Batteries: Maintenance-free, rechargeable, sealed, lead acid with rated lifespan of 10 years.
 - 2. Provide sufficient capacity to operate the complete alarm system in normal, supervisory, or trouble conditions, including audible trouble signal devices, mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm notification devices in alarm mode for a period of 15 minutes. Battery capacity must include a 25% safety factor.
 - 3. Locate batteries either within the control panel or in a separate substantial steel cabinet, finished on inside and outside with enamel paint. Provide a cylinder lock keyed to match FACP. Separate cells to prevent contact between terminals of adjacent cells and between terminals and other metal parts.
 - 4. Battery Charger: Provide solid state automatic float type, capable of dual rate charging techniques that will recharge a fully discharged battery to a minimum 70% capacity in 12 hours or less. Locate charger within the control panel or within the battery cabinet. Provide voltmeter and ammeter to indicate battery voltage and charging current.
 - 5. All standby batteries shall be continuously monitored by the power supply. The power supply shall be able to perform an automatic test of batteries and indicate a trouble condition if the batteries fall outside a predetermined range.
- P. Enclosure: The FACP shall be housed in a listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be hinged on either the right or left side (field selectable).
- Q. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.6 REMOTE POWER SUPPLIES

- A. Stand-alone panel capable of powering a minimum of four synchronized NACs. Power limited, 24 VDC, filtered-regulated, and supervised. Configurable as a continuous 24VDC auxiliary power output.
- B. Alarms from the host fire alarm control panel shall signal the NAC remote power supply panel to activate. The panel shall monitor itself and each of its NACs for trouble conditions and shall report trouble conditions to the host panel.
- C. Internal Primary and Secondary power supplies: comply with performance requirements for FACP.

2.7 MANUAL FIRE ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type with visual indicator of operation; with screw terminals and integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control panel. When the station is operated, the handle shall lock in a manner showing visual indication of operation.
 2. Station Test/Reset: Key-operated test/reset switch. Stations shall be keyed alike with the fire alarm control panel.
 3. Manual pull stations that initiate an alarm condition when opening the unit are not acceptable.
 4. Indoor Protective Shield: Where indicated, provide factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
 5. Weatherproof Protective Shield: At wet locations, provide factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.
 6. Material: High impact Lexan Polycarbonate or Cast Metal.
 7. Suitable for ambient temperatures up to 120 deg F.
 8. Where required, provide weatherproof backbox and device listed for outdoor applications.

2.8 SYSTEM DETECTORS

- A. General Requirements:
1. Operating Voltage: 24VDC, nominal. Two-wire type.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACP through a SLC.
 3. Device Identification: Detectors shall permanently store an internal identifying type code that the control panel shall use to identify the type of device.
 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base.
 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 6. Integral Visual-Indicating Light: dual LED type. LEDs shall flash under normal conditions, indicating that the device is operational and in regular communication with the control panel. The flashing mode operation of the detector LEDs shall be optional through the system field program.
 7. Automatic Device Mapping: Detector address must be accessible from FACP and must be able to identify detector's location within system and its sensitivity setting.
 8. Detectors shall be rated for operation in the following environment unless noted otherwise:
 - a. Temperature: 32 deg F to 120 deg F
 - b. Humidity: 0-93% relative humidity, non-condensing
 9. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

- a. Multiple levels of detection sensitivity for each sensor.
 - b. Sensitivity levels based on time of day.
 - c. Automatically compensate for detector sensitivity changes due to ambient conditions and dust build-up within detectors.
10. Test Means: Provide a test means whereby detectors will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself or initiated remotely on command from the control panel when in the "test" condition.

B. Photoelectric Smoke Detector: Comply with UL 268.

1. Intelligent photoelectric smoke detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
2. Each detector shall utilize an environmental compensation algorithm that shall automatically adjust for background environmental conditions such as dust, temperature, and pressure.
 - a. Provide a maintenance alert signal when 80% of the available compensation range has been used.
 - b. Provide a dirty fault signal when 100% or greater compensation has been used.
3. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor compensation range (normal, dirty, etc.).

C. Duct Smoke Detector: Comply with UL 268A.

1. Listed for air velocity, temperature, and humidity present in specific duct application with standard Intelligent Photoelectric Detector and detector mounting base.
2. Duct Housing Enclosure: NRTL listed for use with supplied detector for smoke detection in HVAC system ducts. Provide gasketed NEMA 4X housing for harsh environments.
3. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
4. Relay Fan Shutdown: Fully programmable supervised relay rated to interrupt fan motor-control circuit.

D. Heat Detector: Comply with UL 521.

1. Heat detectors shall use an electronic sensor to measure thermal conditions caused by a fire and shall, on command from the control panel, send data to the panel representing the analog level of such thermal measurements.
2. Fixed Temperature Type: Actuated by fixed temperature of 135 deg F unless otherwise required.
3. Combination Type: Actuated by fixed temperature of 135 deg F or rate of rise that exceeds 15 deg F per minute unless otherwise required.
4. Rated for ceiling installation at a minimum of 50 ft centers and suitable for wall mount applications.

E. Multicriteria Detector

1. Multi-criteria optical smoke sensor with integrated rate of rise sensing and optional carbon monoxide detection.
 2. Integrated nuisance rejection to reduce unwanted alarms.
 3. Provide independent signals to the control panel for detectors with CO sensors.
- F. Electro-chemical Carbon Monoxide (CO) Detector: Comply with UL 2075.
1. Initiates a Temporal 4 tone when paired with a sounder base for local audible notification.
 2. Transmit a maintenance condition to the control panel when the sensor approaches the end of its useful life.
 3. Capable of a functional gas test using a canned test agent to test the functionality of the CO sensing cell.
- G. Detector Bases: Suitable for mounting to standard 4-inch octagon or square outlet boxes.
1. Standard Base: Twist lock, suitable for all intelligent detectors. Provided with integral terminal strips for circuit connections, rather than wire pigtails. Capable of supporting a remote alarm indicator light.
 2. Relay base: Includes programmable, supervised relay, configurable for control with attached detector or from the FACP. Minimum contact rating of 1 amp at 30VDC and listed for pilot duty.
 3. Sounder Base: Includes piezoelectric sounder with configurable low or high output, programmable operation, listed to UL 268. Produces Temporal Code 4 tone for CO detectors and Temporal Code 3 tone for all other detectors. or low frequency 520Hz signal tone patterns.
 4. Low Frequency Sounder Base: Emits 520Hz tone as defined by NFPA 72 for sleeping areas, listed to UL 268 and UL 464.
 5. Isolator Base: Includes integral isolation module.

2.9 NOTIFICATION APPLIANCES

A. General Requirements

1. Connected to system notification-appliance signal circuits, zoned as noted, equipped for mounting as indicated, and within and out screw terminals for system connections.
2. All visual appliances shall be synchronized. Light and audible output levels shall be designed to meet ADA and NFPA requirements.
3. Audible/Visual Combination Devices shall comply with all applicable requirements for both Audible Notification and Visible Notification Appliances.
4. Devices located in a damp or wet location shall be listed for environment. Exterior mounted devices shall be provided with a weatherproof backbox.
5. Devices located in sleeping areas shall produce a low frequency alarm signal that has a fundamental frequency of 520Hz +/- 10% and shall be a square wave.
6. All notification appliances shall be factory finished red unless noted otherwise on the drawings

B. Fire Alarm Voice-Tone Notification Appliances:

1. Description: Notification appliances capable of outputting voice evacuation messages.
2. Performance Criteria: Comply with UL 1480.

3. Voice-tone appliances shall sound in a three-pulse temporal pattern with a minimum of two cycles preceding and following the voice message, as defined in NFPA 72.
 4. Speakers for Voice Notification: Locate speakers for voice notification to provide intelligibility requirements of "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
 5. Speaker Operating Voltage: 25V or 70V.
 6. Mounting: Flush mount on a standard electrical box.
 7. Minimum rated sound pressure level of 84dBA at 10 feet for 1-watt tap.
 8. Matching Transformers: Tap range at 1/4-watt, 1/2-watt, 1-watt, and 2-watt, selected to match acoustic environment of speaker location. Speakers shall be tapped at 1/2 watt for design purposes.
- C. Fire Alarm Visible Notification Appliances: LED strobe lights with clear high impact polycarbonate lens mounted on an aluminum faceplate, complying with UL 1971. The word "FIRE" is engraved in minimum 1-inch- high letters on the housing.
1. Rated Light Output:15/30/75/110cd or 135/177/185cd, switch selectable at the device. Selected strobe rating shall be visible when the horn-strobe is in its installed position.
 2. Voltage: 24VDC nominal
 3. Mounting: Wall or ceiling mounted to standard electrical box unless otherwise indicated.
 4. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 5. Flashing shall be in a temporal pattern, synchronized with other units. Maximum pulse duration: 2/10ths of one second.
 6. Strobe Leads: Factory connected to screw terminals.
- D. Bell: Vibrating under dome type with 10-inch gong, utilize a heavy-duty mechanism, polarized for supervised operation.
1. Voltage: 24VDC nominal.
 2. Mounting: Semi-Flush mount on a standard electrical box.

2.10 ANNUNCIATORS

A. Fire Alarm Remote Annunciator

1. Description: Annunciator functions must match those of FACP for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACP, including acknowledging, silencing, resetting, and testing.
2. Mounting: Flush cabinet, NEMA 250, Type 1.
3. Annunciator shall communicate with the fire alarm control panel via a supervised RS-485 communications loop that supports multiple annunciators and shall individually annunciate all zones in the system.
4. Display Type and Functional Performance: Large format LCD Alphanumeric display and LED indicating lights must match those of FACP. Provide manual control switches to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.
5. Power shall be supplied directly from the FACP or listed auxiliary power supply, ensuring a reliable and monitored power source.
6. Provide remote microphone to facilitate live page announcements over the FACP system from the remote annunciator. The remote microphone shall feature a Push-to-Talk switch; local and remote page active LEDs, and a trouble LED.

- B. Fire Alarm Graphic Annunciator Panel: Mounted in aluminum frame with nonglare, minimum 3/16-inch thick, clear acrylic cover over graphic representation of facility. Detector locations must be represented by red LED lamps. Normal system operation must be indicated by lighted, green LED. Trouble and supervisory alarms must be represented by amber LED.
1. Comply with UL 864.
 2. Operating voltage must be 24 VDC provided by local battery backed up 24 V power supply provided with annunciator.
 3. Include built-in voltage regulation, reverse polarity protection, RS 232/422 serial communications, and lamp test switch.
 4. Semi flush mounted in NEMA 250, Type 1 cabinet, with key lock and no exposed screws or hinges.
 5. Graphic representation of facility must be CAD drawing and each initiating device must be represented by LED in its actual location. CAD drawing must be at 1:100 scale or larger.
 6. LED representing detector must flash two times per second while detector is in alarm.

2.11 ADDRESSABLE INTERFACE DEVICES

A. General Requirements:

1. Arrange to monitor or control one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and control of building systems.
2. All Circuit Interface Devices shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions.
3. Each module shall be equipped with two (2) diagnostic indicators; a green LED to confirm communications and a red LED to display active status. LEDs shall be visible through the finished cover plate. The module shall be capable of storing a unique serial number and up to 24 diagnostic codes, hours of operation, number of alarms and troubles, and time of last alarm in its memory which can be retrieved for troubleshooting.
4. Include electronic address-setting means on the module.

B. Monitor Module: Microelectronic module providing system address for alarm-initiating devices in wired applications with normally open contacts.

1. Supervision: Unless specifically noted otherwise on the drawings provide one monitor module for each sprinkler flow, tamper, and pressure switch.

C. Control Relay Module: For control of auxiliary devices or equipment.

1. Provide form C dry relay contacts rated 24VDC at 2 amps.

D. Isolation Module: For short circuit protection on signaling line circuits.

1. When a short circuit is detected, the module isolates the affected segment on the circuit, allowing the remaining devices to continue functioning.
2. Self-restoring and automatically reconnects to the circuit segment when the fault is removed.
3. SLC isolation shall be provided for each floor or protection zone of building.

2.12 DIGITAL ALARM COMMUNICATIONS

- A. UL 864 listed as conforming to the requirements of NFPA 72 for Central Station connections.
- B. Digital alarm communications transmitter (DACT): capable of sending system events to remote central station receivers over conventional telephone lines.
 - 1. Dual telephone line, rotary or touch-tone-dial DACT interface to public switched telephone network
- C. IP/Cellular digital alarm communications transmitter (IP DACT): capable of sending system events to compatible remote central station receivers over a cellular or IP path.
 - 1. UL 864 listed as conforming to the requirements of NFPA 72 for Central Station connections.
 - 2. TCP/IP Ethernet Communicator supporting encrypted communications.
 - 3. Cellular Communicator: LTE fall back cellular connection through the cellular module. Provide antenna extension kits where required to ensure a high-quality connection.
- D. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture a transmission line and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If primary service is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of primary line to the remote alarm receiving station over the remaining transmission line. Transmitter shall automatically report transmission channel restoration to the central station. If service is lost on both transmission channels, transmitter shall initiate the local trouble signal.
- E. Digital Data Transmission must include the following at a minimum:
 - 1. Address of alarm-initiating device.
 - 2. Address of supervisory signal.
 - 3. Address of trouble-initiating device.
 - 4. Loss of ac supply, where exceeding programmable time delay.
 - 5. Loss of power.
 - 6. Low battery.
 - 7. Abnormal test signal.
 - 8. Communication bus failure.
- F. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Supervised communications.
 - 2. Programmable
 - 3. Auxiliary relay to indicate alarm or trouble.
 - 4. LED display with audible trouble alarm.
 - 5. Manual test report function and manual transmission clear indication.
 - 6. Communications failure with the central station or fire-alarm control unit.
- G. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.13 SYSTEM ACCESSORIES

- A. Magnetic Door Holders: wall or floor mounting and complete with matching doorplate. The door portion shall have a plated steel pivot mounted armature with shock absorbing nylon bearing. Material and finish to match door hardware.
1. Operation: Under normal conditions, the magnets shall attract and hold the door open. Upon activation of the building fire alarm system, the devices shall be de-energized, thus releasing the doors on the circuit.
 2. Electromagnets: Require no more than 1 W to develop 35-lbf holding force.
 3. Wall-Mounted Units: Flush mounted in a single gang electrical box unless otherwise indicated.
 4. Rating: 24-V dc operating on power from the fire alarm control panel.
 5. Power source shall be supervised.
 6. Door hold open magnets shall be furnished with keepers, door chains, and other accessories as required to properly hold open doors as indicated on the Drawings.
 7. Operation: Under normal conditions, the magnets shall attract and hold the door open. Upon activation of the building fire alarm system, the devices shall be de-energized, thus releasing the doors on the circuit.
- B. Surge Suppression Devices:
1. AC circuits: UL 1449 listed, 120VAC, 20A branch circuit surge suppressor with EMI filtering. Ditek DTK-120SRD or equal. Shunt type devices are not permitted.
 2. DC circuits: UL 497B listed, 24VDC, 5A multi stage hybrid design surge suppressor. Ditek DTK-2MHLP24BWB or equal. Devices using only MOV active elements are not permitted.
- C. Wire Guards: Welded steel wire mesh of size and shape for manual stations, detectors, strobes, or other devices requiring protection.
1. Guard design shall not affect performance of device.
 2. Factory fabricated and furnished by manufacturer of device.
 3. Finish: Paint of color to match the protected device.
- D. Remote Alarm Indicator Lights: Key type switch for testing of the annunciated device.
- E. Terminal Cabinets: Steel cabinet with red finish, hinged cover, identification labels, and listed terminal blocks for up to 120 high barrier termination points. Terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.

2.14 FIRE ALARM CONDUCTORS AND CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Allied Wiring and Cable
 2. Belden
 3. Comtran Corporation
 4. General Cable
 5. Honeywell Genesis
 6. Radix Wire & Cable

7. Southwire
8. Superior Essex
9. West Penn Wire

B. General Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

1. Type FPLR or FPLP, red jacket, suitable for indoor locations.
2. Type PLTC, suitable for underground or wet locations.
3. Twisted, shielded pair, low capacitance, not less than No. 18 AWG unless recommended otherwise by system manufacturer.
4. Circuit Integrity Cable: Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
5. Multiconductor Metal Clad Cable: NFPA 70, Type MC/FPLP, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, steel armor with red identifier stripe, NRTL listed for fire-alarm and cable tray installation, plenum rated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

- A. All equipment supplied must be specifically listed for its intended use and shall be installed in accordance with the manufacture's recommendations. The contractor shall consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- B. Comply with NECA 305, NFPA 70, NFPA 72, and requirements of AHJ for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

- C. Securely fasten all system components to wall and ceiling assemblies using fasteners and supports rated to support the required load in accordance with Section 260500, "Common Work Results for Electrical Systems".
 - 1. Ceiling mounted devices shall not be supported solely by suspended ceilings.
- D. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above finished floor. Locate annunciators at a height that enables easy viewing.
- E. Provide additional remote NAC power supplies as required to comply with voltage drop requirements.
- F. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm boxes in the normal path of egress within 60 inches of the exit doorway.
 - 2. Mount manual fire-alarm box on a background of a contrasting color.
 - 3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- G. Notification Devices:
 - 1. Comply with NFPA 72 and ADA criteria for strobe visual intensity, audible appliance intelligibility, and final device placement.
 - 2. Install wall devices with entire lens between 80-inches and 96-inches above the floor but not less than 6 inches below the ceiling. Install devices on flush-mounted back boxes with the audible device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- H. End of Line (EOL) Resistors: Label devices containing end-of-line resistors with NAC panel and circuit number in such a manner that removal of the device is not required to identify the EOL device. Locate EOL devices in a readily accessible location no more than 12-feet above finished floor.
- I. Smoke and Heat Detectors:
 - 1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 - 2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 - 3. Smooth ceiling spacing for smoke detectors shall not exceed 30 feet except in corridors where increased spacing are allowed in accordance with NFPA 72.
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
 - 5. HVAC: Locate detectors not closer than 36 inches from diffusers or return-air openings.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
 - 7. When installed in a room, detectors shall be oriented, so their alarm light is visible from the nearest door to the corridor.
 - 8. Unless suitably protected against dust, paint, etc., spot type smoke detectors shall not be installed until the final construction clean-up has been completed. In the event of contamination during construction, the detectors must be replaced by the contractor at no additional cost to the Owner. Covers supplied with smoke detector heads do not provide

protection against heavy construction dust, spray painting, etc., and must not be used for that purpose. They are suitable only during final, minor cleanup or touchup operations.

- J. Duct Smoke Detectors: Comply with NFPA 72, IMC, and NFPA 90A for HVAC system shutdown and closing of smoke dampers. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends. Extend the intake tube through the far side of the duct, seal around the tube where it penetrates the duct wall and plug the end with a rubber stopper to facilitate visual inspection and intake tube cleaning.
 - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to final acceptance.
 - 2. Locate duct detectors in a manner that provides suitable, convenient access for required periodic cleaning and calibration.
 - 3. Comply with manufacturer's requirements for clearances from HVAC equipment and duct accessories such as humidifiers.
 - 4. The numbers of detectors per duct shall be per NFPA 72 requirements based on the size of the air duct, air duct configuration, air speed, and duct manufacturer's installation requirements.
 - 5. Indicate airflow direction on the duct, adjacent to the detector, using stencil or permanent decal.
 - 6. Provide each duct smoke detector with a remote keyed test switch and alarm indicator.
- K. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position and where indicated. Locate in the nearest corridor or public area and identify with engraved label.
- L. Carbon Monoxide Detectors:
 - 1. Ceiling mounted CO detectors should be kept 12-inches from sidewalls.
 - 2. Wall mounted CO detectors should be at least 48-inches above the finished floor, but less than 6-inches from the ceiling.
 - 3. Locate at least 60-inches from fuel burning appliances.
 - 4. Install CO detectors no closer than 36 inches from air supply diffusers or return-air openings.
- M. Elevator Hoistway and Machine/Control Rooms and Spaces: Provide initiating devices and elevator controls interface to comply with NFPA 72 and ANSI A17.1 elevator code requirements for elevator recall and shutdown.
 - 1. Coordinate initiating device temperature ratings, sensitivity settings, and location with sprinkler rating and location. Select temperature rating nominal 10 degrees F less than the adjacent fire sprinkler.
 - 2. Ensure device operating ranges for temperature and humidity are suitable for installed environment. Do not install smoke detectors in un-sprinklered elevator hoistway unless required otherwise by AHJ.
- N. Addressable Interface Modules:
 - 1. Addressable interface and control modules (used to monitor all contact type initiating devices) must be in a conditioned space, unless they are tested, listed, and marked for

continuous duty across the range of temperatures and humidity expected at their installed location.

2. Sprinkler system supervisory circuits for monitoring valve position, air pressure, water temperature, pump status, etc., must cause distinct audible and visible indications at the FACP.
 3. Install interface devices no more than 36 inches from the device controlled.
- O. Isolation Modules: Provide in the following locations to minimize the impact of wiring faults:
1. After each 50 initiating devices and control points on the addressable loop, or a lesser number where recommended by the manufacturer.
 2. Near the point any addressable circuit extends outside the building, except for those attached to the building exterior walls and well sheltered by walkways.
 3. For loops covering more than one floor, install isolator at terminal cabinet on each floor with additional isolator[s] on any floor with over 50 addresses.
 4. Each isolation module must be clearly labeled, readily accessible for convenient inspection (not above a lay-in ceiling).
- P. HVAC Unit Shutdown
1. All shutdown relays must be directly controlled and monitored by the fire alarm system. The Building Automation System (BAS) shall not be used for life safety functions unless the BAS is supervised by the Fire Alarm System for off normal conditions. Relays should be wired fail safe.
 2. A supervised "AHU Shutdown Defeat" switch must be provided in/adjacent to the FACP with an informative engraved label at the FACP about this function. The switch must cause a system "trouble" indication when it's placed in the off-normal ("Shutdown Defeated") position. This is to provide the owner with a convenient means to temporarily resume HVAC operation in the event an unwanted alarm will not clear, prior to arrival of the fire alarm service technician, or for testing purposes.
- Q. Independent fire-suppression/extinguishing systems
1. Provide interface modules and all control unit connections required to supervise fire-suppression and extinguishing system indicated on drawings.

3.3 PATHWAYS AND CONDUCTORS

- A. Wiring Methods: Install all fire alarm wiring in metal conduit, minimum 1/2-inch, in accordance with Section 260533, "Raceways and Boxes for Electrical Systems" and manufacturer's recommendations. Conceal raceway, except in unfinished spaces.
1. MC Fire Alarm cable is permitted for fire alarm wiring in concealed locations not subject to physical damage.
- B. Provide red finish for fire alarm raceways in assessable areas above ceilings, and exposed unfinished spaces. Match adjacent architectural finish for exposed fire alarm raceways in finished areas with red junction box covers.
- C. All junction box covers shall be painted red on both sides to designate use for Fire Alarm conductors. The interior of junction boxes shall not be painted.

- D. Where allowed, surface boxes shall be as manufactured by the device manufacturer for the installed device and shall match devices in size.
- E. There shall be no splices in the system other than at device terminal blocks, or on terminal blocks in cabinets. "Wire nuts" and crimp splices will not be permitted. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.
- F. For underground raceways, provide moisture resistant PLTC cable.
- G. All fire alarm and communications circuits that extend beyond the building footprint and are run outdoors shall be provided with a surge protective device.
- H. All circuits leaving the riser on each floor or building zone shall feed through a labeled terminal block in a terminal cabinet accessible from the floor.
- I. T-Taps are not permitted for Class B circuits. Locate end of branch devices in a readily accessible location.

3.4 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Coordinate connections to electronic access-controlled doors with door hardware specifications and actual door hardware. Provide all connections for release of locking mechanisms in egress paths as required.
- C. Verify exact connection requirements to all equipment and devices of other trades with those trades prior to ordering equipment.
- D. Make addressable connections with a supervised interface device to controlled or monitored devices and systems. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

3.5 IDENTIFICATION

- A. Comply with Section 270553, "Identification for Communications Systems"
 - 1. Identify system components, wiring, cabling, and terminals. Identify all fire alarm circuits at terminal and junction locations.
 - 2. Install a nameplate on each fire alarm panel and power supply to indicate the equipment designation, panelboard and circuit number supplying the fire alarm equipment.
 - 3. Branch circuit overcurrent protective devices powering fire alarm equipment shall be identified as FIRE ALARM CIRCUIT with a red and white engraved label permanently affixed to the equipment.
 - 4. Provide engraved label for each remote alarm indicator.

5. Label all addressable control modules to identify their function.

- B. Basic operating instructions shall be framed and permanently mounted at the FACP. (If the owner concurs, they may instead be affixed to the inside of the FACP's door.) In addition, the NFPA 72 "Record of Completion" must either be kept at the FACP, or its location shall be permanently indicated there by an engraved label. All System documentation shall be provided and housed in a Documentation Cabinet at the control panel or other approved location in accordance with NFPA 72.

3.6 GROUNDING

- A. Ground FACP and surge protective devices for associated circuits in accordance with Section 260526, "Grounding and Bonding for Electrical Systems".
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

- A. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
- B. Coordinate all testing in occupied buildings with the owner's representative to minimize the disturbance to the building occupants.
- C. Visual Inspections: Conduct prior to testing.
1. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 2. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
- D. Preliminary Testing
1. Check all wiring for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any two conductors shall be 10 megohms, as verified with an insulation tester.
 2. Ensure all devices and circuits are functioning properly in accordance with manufacturer's requirements.
- E. System Acceptance Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
1. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
 2. Verify candela settings and test visible appliances for public operating mode in accordance with manufacturer's written instructions.

3. Test all site-specific software functions and provide a detailed report showing the system's operational matrix. Each initiating device shall activate the proper response and system notification.
 4. Verify all other system functions, including (where applicable) elevator capture and the control of HVAC systems, door locks, pressurization fans, fire or smoke doors/dampers/shutters, etc.
 5. Verify digital communicators are on-line and tested for proper communication to the receiving station.
 6. All supervised circuits must also be tested to verify proper supervision.
 7. Verify the voltage drop of each NAC circuit by testing and recording the voltage at the origin and at the EOL for each NAC circuit, under battery power only.
- F. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances, software modification, or wiring modifications. Such re-testing shall be included as part of the base bid and provided at no additional cost to the Owner.
- G. Final Acceptance Test: Complete record drawings and system operation matrix are required prior to scheduling final acceptance test.
1. The owner's representative, monitoring service, and fire department shall be notified before final tests in accordance with local requirements.
 2. Operate every device to verify proper operation and correct annunciation.
 3. Open signaling line circuits and notification appliance circuits in at least two locations to verify proper supervision.
- H. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- I. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72. Submit certified results to the AHJ, Owner, Architect, and Engineer.
- J. Prepare test and inspection reports.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.
- B. The manufacturer's authorized representative must instruct the owner's designated employees in operation of the system, and in all required periodic maintenance. A minimum of 6 hours on-site time will be allocated for this purpose. Two copies of a written, bound summary will be provided, for future reference.
- C. Training shall cover as minimum the following topics:
1. Preventive maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
 2. Overall system concepts, capabilities, and functions. Training shall be in depth, so that the owner shall be able to take any device out of service and return any device to service without need of Manufacturer's approval or assistance.

3. Explanation of all control functions, including training to program and operate the system software.
 4. Methods and means of troubleshooting and replacement of all field wiring devices.
 5. Methods and procedures for troubleshooting the main fire alarm control panel, including field peripheral devices as to programming, bussing systems, internal panel and unit wiring, circuitry and interconnections.
 6. Manuals, drawings, and technical documentation. Actual system software used for training shall be provided in digital form and shall be left with the Owner at the completion of training for the Owner's use in the future.
- D. A receipt shall be obtained from the Owner that this has been accomplished, and a copy included in the close-out documents.

END OF SECTION