**SECTION 00.01.00**

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**SECTION 01.11.00**

**SUMMARY OF WORK**

## I. PART 1 - GENERAL

### 1.01 GENERAL PROVISIONS

A. This section supplements the Conditions of the Contract, Prime Requirements, Drawings, and all other parts of the Contract Documents.

B. This Contractor must be familiar with all other Divisions and Sections of the Specifications which affect the work of this Section.

### 1.02 REQUIREMENTS INCLUDED

A. Work under this Contract.
B. Examination of Site and Documents.
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O. Damage Responsibility.
P. Owner Furnished Products.
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S. List of Drawings.

### 1.03 WORK UNDER THIS CONTRACT

A. The work to be done under this contract consists of executing and completing all work required for the Fire Alarm System Upgrade at Worcester City Hall. The Prime Contractor responsible for the project shall be an electrician with DCAMM certification as a prime contractor in the category of Electrical.

B. The scope of work, without limiting the generality thereof, includes all labor, materials, equipment and services required to perform the work described fully in the Drawings and Specifications and includes, but is not limited to the following major work:

1. Installation of a new addressable fire alarm system throughout the building, including new fire alarm control panel, annunciators, mass notification components and a bi-directional antenna system and all related components for a fully functional system.

2. Creation of a new 2-hour rated fire alarm room.

C. The following major elements will be performed by the Owner, under separate contracts, for which the Prime Contractor has a coordinating responsibility:

1. Relocation of the contents of rooms receiving work, where required to facilitate the installation.

D. The following major elements will be furnished by the Owner, for installation by the Contractor or sub-contractors:

1. None. The Contractor shall furnish all required materials and labor to install them.

E. Reference to Drawings: The work to be done under this Contract is shown on the Drawings listed at the end of this Section.

F. Prevailing Wage: The Massachusetts Standard Labor Wage rates, as outlined in the exhibits, will be used in the construction of this project

1.04 EXAMINATION OF SITE AND DOCUMENTS

A. A pre-bid meeting will be held at the job site on the date and at the time indicated in the Invitation to Bid.

B. Bidders may also visit the site on a non-holiday weekday acceptable to the Owner, between the hours of 9:00 AM and 3:00 PM to visually inspect the location of the work and existing conditions that may affect new work.

C. The bidders are expected to examine and to be thoroughly familiar with all contract documents and with the conditions under which the work is to be carried out. The Owner and Designers will not be responsible for errors, omissions, and/or charges for extra work arising from the Prime Contractor's or Subcontractor's failure to familiarize themselves with the contract documents. The Prime Contractor and Subcontractors acknowledge that they are familiar with the conditions and requirements of the contract documents where they require, in any part of the work a given result to be produced, and that the contract documents are adequate and will produce the required results.

D. Any technical questions subsequent to the submission of the bid shall be directed to: Christopher Gagliastro, City Hall Room 201, Worcester, MA 01608 in writing. Questions may be mailed to this address, faxed to (508)799-1203 or emailed to gagliastroc@worcesterma.gov.

1.05 CONTRACT METHOD

A. Work under this contract shall be lump sum price, for the scopes of work as described in these specifications and shown on the Drawings.

1.06 WORK SEQUENCE

A. The Work will be conducted in the following sequence of demolition/construction:

1. Actual sequence of the work will be left to the discretion of the Contractor, who will prepare a construction schedule showing the sequence and duration of work, for review and approval by the Owner.

2. The existing fire alarm system shall remain operational until such time as the new system can be tested by contractors and determined to be functional and reliable. The building shall not be left without detection and notification.

1.07 SUPERVISION OF WORK

A. The Prime Contractor shall be held directly responsible for the correct installation of all work performed under this Contract. The Prime Contractor must make good repair, without expense to the Owner, of any part of the new work, or existing work to remain, which may become inoperative on account of leaving the work unprotected or unsupervised during construction of the system or which may break or give out in any manner by reason of poor workmanship, defective materials or any lack of space to allow for expansion and contraction of the work during the Prime Contractor's warranty period, from the date of final acceptance of the work by the Owner.

B. The Prime Contractor shall furnish a competent Massachusetts licensed superintendent satisfactory to the Owner and to the Designer. The licensed superintendent shall supervise all work under this contract and who shall remain on duty at the site throughout the Contract period while work is in progress.

1. Submit the name and resume of the superintendent for approval to the Architect. Include experience with projects of equal size and complexity.

1.08 PRIME CONTRACTOR'S USE OF PREMISES

A. Use of the Site: Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy and use by the public (if applicable).

2. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the Owner, the Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Schedule and perform work to afford minimum of interruption to normal and continuous operation of utility systems. Submit for approval, a proposed schedule for performing work; including construction of new utilities, re-routing of existing utilities and final connection of new work to existing work. Schedule shall indicate shutdown time required for each operation.

C. The Prime Contractor shall schedule as per Section 01.50.00 - Temporary Facilities and Controls, the shutting down or interrupting any utilities, services or facilities which may affect the operation of the building outside the area of work or other buildings, services or facilities.

D. The Prime Contractor can gain access to the premises during the hours specified below. In addition the Prime Contractor and his personnel will limit themselves only within the working premises during working hours. If work needs to be scheduled during times other than those listed below, Prime Contractor shall inform the Owner one week prior to work.

1. Deliveries: 7:00 AM to 6:00 PM.
2. Work on site: 8:00 AM to 4:00 PM.
3. Functional testing involving sounding of alarms: Prior to 9AM or after 3PM (on days where no evening meetings are scheduled)
4. Weekends: with Owner's permission, at no additional cost to the project
5. Holidays: with Owner's permission, at no additional cost to the project.

E. The Prime Contractor shall verify that Subcontractors have visited the site and included all costs associated with the location of the project, and any restriction or limitations the location of the project may pose.

F. All contractors shall at all times conduct their operations in a courteous, professional manner while on the project or in the vicinity of the project. Harassment, offensive language or behavior will not be permitted on the site.

G. The Owner can neither accept nor assume responsibility for the security of the Contractor's material or equipment which is lost, stolen or vandalized. The Contractor is advised to exert caution in placement and storage of his equipment and material.

H. Parking: Parking spaces on site are very limited and the Owner may not provide designated parking spaces near the construction site for the Contractor's use. The Contractor shall state his/her parking and staging area requirements during the Pre-construction Meeting. The area(s) for materials storage will then be agreed to between the Contractor and the Owner.

I. Radios, tape players, “boom boxes”, or other audio entertainment equipment, including personal entertainment devices, shall not be allowed on the project site.

J. The Contractor shall not permit smoking within the building. Locate smoking areas away from entries, outdoor intakes, and operable windows, including adjacent buildings.

K. The Contractor shall not allow the use of intoxicating beverages or non-prescription controlled substance drugs upon or about the work site.

L. The Contractor shall provide and maintain in good serviceable condition at all times, warning signs and non-combustible barriers, forms and fire resistive tarps or plastic, each of which shall be approved by the Owner, shall be suitable for the purpose, and shall be installed adjacent to each work area, for complete enclosure and/or isolation of all excavations, wells, pits, manholes, shafts, overhead areas, etc., which are associated with the work under the contract. Barriers shall be a secure fence, guardrail, cover, or similar assembly designed and erected to provide protection for concrete, protection from the weather, and to prevent accidental access. Barrier tape and/or sawhorses shall not be used as a means of such access protection.

1.09 COORDINATION

A. The Prime Contractor shall be responsible for the proper fitting of all the work and for the coordination of the operations of all Subcontractors or material and persons engaged upon the work. The Prime Contractor shall do, or cause his agents to do, all cutting, fitting, adjusting, and repair necessary in order to make the several parts of the work come together properly.

1. Examine Contract Documents in advance of start of construction and identify in writing questions, irregularities or interference to the designer in writing. Failure to identify and address such issues in advance becomes the sole responsibility of the Prime Contractor. A conflict that would cause the reduction of the normal ceiling height of any occupied space is considered to be an interference.

B. Execute the work in an orderly and careful manner with due regard to the occupants of the facility, the public, the employees, and the normal function of the facility.

C. The work sequence shall follow planning and schedule established by the Prime Contractor as approved by the Designer and the Owner. The work upon the site of the project shall commence promptly and be executed with full simultaneous progress. Work operations which require the interruption of utilities, service, and access shall be scheduled so as to involve minimum disruption and inconvenience, and to be expedited so as to insure minimum duration of any periods of disruption or inconvenience.

D. The Prime Contractor shall review the tolerances established in the specifications for each type of work and as established by Subcontractor organizations. The Prime Contractor shall coordinate the various Subcontractors and resolve any conflicts that may exist between Subcontractor tolerances without additional cost to the Owner. The Prime Contractor shall provide any chipping, leveling, shoring or surveys to ensure that the various materials align as detailed by the Designer and as necessary for smooth transitions not noticeable in the finished work.

1.10 PROJECT MEETINGS

A. Project meetings shall be held on a weekly basis and as required subject to the discretion of the Owner.

B. Attendees: In addition to the Project Manager and Designer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

C. In order to expedite construction progress on this project, the Prime Contractor shall order all materials immediately after the approval of shop drawings and shall obtain a fixed date of delivery to the project site

for all materials ordered which shall not impede or otherwise interfere with construction progress. The Prime Contractor shall present a list and written proof of all materials and equipment ordered (through purchase orders). Such list shall be presented at the meetings and shall be continuously updated.

D. Scheduling shall be discussed with all concerned parties, and methods shall be presented by the Prime Contractor, which shall reflect construction completion not being deferred or foreshortened. Identify critical long-lead items and other special scheduling requirements. The project schedule is to include time for submission of shop drawing submittals, time for review, and allowance for resubmittal and review.

1.11 PERMITS, INSPECTION, AND TESTING REQUIRED BY GOVERNING AUTHORITIES

A. If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having any jurisdiction require any portion of the Work to be inspected, tested, or approved, the Prime Contractor shall give the Designer, the Owner or his/her designated representative, and such Authority timely notice (5 business days minimum) of its readiness so the Designer may observe such inspecting, testing, or approval.

B. Prior to the start of construction, the Prime Contractor shall complete application to the applicable Building Code enforcement authority for a Building Permit. Such Permit shall be displayed in a conspicuous location at the project site. The building permit fee shall be paid by the Contractor.

C. Unless otherwise specified under the Sections of the Specifications, the Prime Contractor shall pay such proper and legal fees to public officers and others as may be necessary for the due and faithful performance of the work and which may arise incidental to the fulfilling of this Contract. As such, all fees, charges, and assessments in connection with the above shall be paid by the Prime Contractor.

D. Prime Contractor and specialized Subcontractors as applicable shall identify all permits (other than Prime building permit) required from Authorities having jurisdiction over the Project for the construction and occupancy of the work. The Prime Contractor shall prepare the necessary applications and submit required plans and documents to obtain such permits in a timely manner, and shall furnish the required information to the Building Official and obtain the required permits as early as practicable after award of the Contract.

E. Prior to the start of construction, the Prime Contractor shall complete applicable applications, permits, and notifications to the MADEP, such as the Demolition/Construction form BWP AQ-06, and pay the required fees. These forms must be submitted at least 10 working days in advance of any regulated activity on the site. Demolition permits must be submitted for any work involving demolition, new construction and renovation.

1.12 CUTTING, CORING, AND PATCHING, UNLESS OTHERWISE INDICATED

A. The Prime Contractor shall perform and/or coordinate all cutting, coring, fitting and patching of the work as specified in Section 01.73.29 – Cutting and Patching.

B. The Prime Contractor shall coordinate that the work of the Subcontractor is not endangered by any cutting, coring, excavating, or otherwise altering of the work and shall not allow the cutting or altering the work of any Subcontractor except with the written consent of the Designer.

C. Performance:

1. Execute cutting and patching by methods which will prevent damage to other work, and will provide proper surfaces to receive installation of repairs.

(a) In general, where mechanical cutting is required, cut work with sawing and grinding tools, not with hammering and chopping tools. Core drill openings through concrete work.

(b) Prior to cutting and structural steel or concrete work, contact Designer and Project Structural Engineer in writing. Do not cut any structural steel and concrete work until approval has been granted by the Designer and the Project Structural Engineer.

2. Employ original installer or fabricator to perform cutting and patching for:

   (a) Weather-exposed or moisture-resistant elements.
   (b) Sight-exposed finished surfaces.

3. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.

4. Restore work which has been cut or removed; install new products matching existing to provide completed Work in accordance with requirements of Contract Documents.

5. Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

6. Patch with seams which are durable and as invisible as possible. Flash and seal all penetration of exterior work. Comply with specified tolerances for the work.

7. Restore exposed finishes of patched areas; and, where necessary extend finish restoration onto retained work adjoining, in a manner which will eliminate evidence of patching.

   (a) Where patch occurs in a smooth painted surface, extend final paint coat over the entire unbroken surface containing the patch.

8. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:

   (a) For continuous surfaces, refinish to nearest intersection.
   (b) For an assembly, refinish entire unit.

D. Existing Utilities Services:

1. Interruptions to critical existing utility services will not be allowed except as scheduled per Section 01.50.00 - Temporary Facilities and Controls.

2. The Prime Contractor shall locate and record on Drawings all existing utilities along the course of the work by such means as the Designer and the Owner may approve, and shall preserve such marked locations until the work has progressed to the point where the encountered utility is fully exposed and protected as required. It shall be the Prime Contractor's responsibility to notify the proper authorities and/or utility company before interfering therewith.

3. Existing utilities that are indicated on the Drawings or whose locations are made known to the Prime Contractor prior to excavations, though accuracy and information as to grades and elevations may be lacking, shall be protected from damage during the excavation and backfilling operations and, if damaged by the Prime Contractor, it shall be repaired by the Prime Contractor at his/her own expense.

4. All exposed conduits, wires, and/or cables shall be provided with sufficient protection and support to prevent failure, fraying, or damage due to backfilling or other construction operations.

1.13 DEBRIS REMOVAL

A. The Prime Contractor shall coordinate the removal of all demolition and construction waste including waste by all Subcontractors from the job site on a daily basis.

B. Debris shall be legally disposed of in a D.E.P. approved disposal site.

C. The Prime Contractor shall bear responsibility for maintaining the building and site clean and free of debris, leaving all work in clean and proper condition satisfactory to the Owner and the Designer. The Prime Contractor shall ensure that each of the Subcontractors clean up during and immediately upon completion of

their work. Clean up includes the following tasks:

1. Remove all rubbish, waste, tools, equipment, appurtenances caused by and used in the execution of work.

D. Prevent the accumulation of debris at the construction site, storage areas, parking areas, and along access roads and haul routes.

E. Provide containers for deposit of debris and schedule periodic collection and disposal of debris.

F. Prohibit overloading of trucks to prevent spillage on access and haul routes.

G. The Prime Contractor shall be responsible for proper disposal of all construction debris leaving the site.

1.14 FIELD MEASUREMENTS

A. Although care has been taken to ensure their accuracy, the dimensions shown for existing items and structures are not guaranteed. It is the responsibility of the Prime Contractor to verify these dimensions in the field before fabricating any construction component. No claims for extra payment due to incorrect dimensions will be considered by the Owner.

1.15 SAFETY REGULATIONS

A. This project is subject to compliance with Public Law 91 596 "Occupational Safety and Health Act" latest edition (OSHA 29 CFR 1926), with respect to all rules and regulations pertaining to construction, including Volume 36, numbers 75 and 105, of the Federal Register, as amended, and as published by the U.S. Department of Labor.

B. Hazardous Waste Generation: Any work generating Hazardous or so-called Universal Wastes will comply with all requirements of 310 CMR 30.000. The proper storage, use and disposal of any hazardous chemicals or substances brought on site by the Contractor are the responsibility of Contractor. The Owner will not be responsible for any hazardous materials left on site, the cost to remove these materials will be the Contractor's responsibility. All hazardous wastes generated as a result of demolition and remodeling shall be contained, collected, segregated, labeled per all applicable federal EPA, Massachusetts DEP, and Federal DOT regulations or other applicable local, state or federal hazardous waste regulations, pending the appropriate disposition.

1.16 OSHA SAFETY AND HEALTH COURSE DOCUMENTATION

A. OSHA Safety and Health Course Documentation Records: Chapter 306 of the Massachusetts Acts of 2004 requires that everyone employed at the jobsite must complete a minimum 10-hour long course in construction safety and health approved by the U.S. Occupational Safety and Health Administration (OSHA) prior to working at the jobsite. Compliance is required of Prime Contractors' and Subcontractors' on-site employees at all levels whether stationed in the trailer or working in the field. Unless the Massachusetts Attorney General's office indicates otherwise, this requirement does not apply to home-office employees visiting the site or to suppliers' employees who are making deliveries.

B. OSHA 10 cards for anyone working on site are to be submitted prior to the first requisition.

C. Documentation records shall be initially compiled by the Prime Contractor and Subcontractors, and the Prime Contractor shall create and maintain a copy of the documentation on site at all times.

1.17 DAMAGE RESPONSIBILITY

A. The Prime Contractor shall repair, at no cost to the Owner, any damage to building elements, site appurtenances, landscaping, utilities, etc. caused during demolition operation and work of this Contract.

1.18 OWNER FURNISHED PRODUCTS

A. Products indicated “N.I.C.” (Not in Contract), or “E. O.” (Equipment by Owner), or “O.F.O.I.” (Owner Furnished Owner Installed), or other similar acronyms as defined in the contract documents will be furnished and installed by the Owner. Coordination and provision of service lines for such products shall be included under these Construction Contract Documents, if indicated. Final connections from service lines to equipment will be by the Owner, unless otherwise indicated

1.19 ASBESTOS AND HAZARDOUS MATERIALS DISCOVERY

A. If unanticipated asbestos-containing materials or other Hazardous Materials not included in Contract are discovered at any time during the course of work, the Prime Contractor shall cease work in the affected areas only and continue work in other areas, at the same time notify the Designer of such discovery. Do not proceed with work in such affected areas until written instructions are received. If removal is required, payment will be made in accordance with the contract unit prices bid for each respective material. In the absence of unit prices, costs shall be negotiated or otherwise established prior to commencement of removal, in accordance with provisions of the Contract.

B. The Owner or Designer will work with the Contractor to initiate removal or encapsulation of the asbestos. An extension of the completion date may be granted equal to the time lost. Proper notification must be made to the MADEP through the ANF-001 form, and the Owner.

1.20 LIST OF DRAWINGS

T1 - Cover Sheet
A1 - Fire Alarm Room Plan and Details
ED1.0 - Demo Basement Floor Plan
ED1.1 - Demo First Floor Plan
ED1.2 - Demo Second Floor Plan
ED1.3 - Demo Third Floor Plan
ED1.4 - Demo Fourth Floor Plan
E1.0 - Fire Alarm Basement Floor Plan
E1.1 - Fire Alarm First Floor Plan
E1.2 - Fire Alarm Second Floor Plan
E1.3 - Fire Alarm Third Floor Plan
E1.4 - Fire Alarm Fourth Floor Plan

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION**

**SECTION 01.31.00**

**PROJECT MANAGEMENT AND COORDINATION**

## I. PART 1 - GENERAL

### 1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

### 1.02 SUMMARY

A. Without limitations, coordination will include Critical Path Method Scheduling (CPM), coordination of submittals, coordination of all elements of the Work, and coordination of contract closeout.

B. Description:

1. Coordinate scheduling, submittals, and work of the various trades and elements of the Work to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.

2. Coordinate sequence of the Work to accommodate Partial (Beneficial) Occupancy.

C. Meetings:

1. In addition to progress meetings, hold coordination meetings and pre-installation conferences with personnel and Sub-Contractors to assure coordination of the Work. The coordination meetings are to be separate from the commissioning or commissioning meetings.

D. Coordination of Submittals:

1. Schedule and coordinate submittals.

2. Coordinate work of various trades having interdependent responsibilities for installing, connecting to, and placing in service such equipment.

3. Coordinate requests for substitutions to assure compatibility of space, of operating elements, and effect on work of other trades.

4. Contractor’s mark-up will be excluded from change orders caused by lack of coordination during design.

E. Commissioning:

1. A formal commissioning process is not required for this project, however, the Prime Contractor remains responsible for coordinating the efforts of the sub-trades responsible for installing any MEP systems on the project to assist the design engineers during the time of punchlisting, to be able to verify that the system is functional and complete.

### 1.03 FIELD COORDINATION

A. Project scopes of limited complexity or limited utility installation will not require coordination drawings. The Prime Contractor remains responsible for field coordinating the work of all trades, to see that it comes together without conflict or loss of functionality.

1. Where field coordination is performed, the Prime Contractor shall advise the Designers of any conflict or field condition which results in the system being installed other than as designed.

2. In such instances, contractors are expected to propose alternative routes based on field conditions revealed through the performance of the demolition. Rerouting shall not be performed, however, until first approved by the Designers. No additional compensation will be due for field coordination efforts.

3. Where rerouting of utilities differently than designed creates a conflict with another trade, which was not forseen or properly coordinated between the contractors, the conflicting utility shall be revised at no expense to the Owner, to eliminate the conflict.

1.04 MEP COORDINATION DRAWINGS

A. Not required. Refer to 1.03 above.

**II. PRODUCTS (Not Used)**

**III. EXECUTION (Not Used)**

**END OF SECTION**

**SECTION 01.32.00**

**CONSTRUCTION PROGRESS DOCUMENTATION**

## I. PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 REQUIREMENTS INCLUDED

A. Procedures and requirements for submission and review of progress schedules and reports.

1.03 RELATED SECTIONS

A. Section 01.10.00 – SUMMARY

1. Project meetings.

B. Section 01.31.00 - PROJECT MANAGEMENT AND COORDINATION

1. Progress and coordination meetings.

C. Section 01.33.00 - SUBMITTAL REQUIREMENTS

1. Project reports.
2. Schedule of values.
3. Shop drawings, product data, and samples.

1.04 CONSTRUCTION SCHEDULE

A. Prime Contractor shall prepare and submit for Designer and Owner's information, a Critical Path Method (CPM) Progress Schedule for the work of the project. Said schedule will be coordinated with the Designer's Work Plan to include sequencing of the project work and shall be submitted within 2 weeks of pre-construction meeting.

B. In addition, the Prime Contractor shall prepare and submit at each project meeting, a two- week look-ahead schedule. The schedule shall identify:

C. Major elements of the work which were complete since the last project meeting, organized by room or by trade.

D. Major elements of the work to be performed in the next two weeks, to be able to track short-term conformance to the overall project schedule.

E. A projection of any upcoming required service interruption notices

1.05 CRITICAL PATH METHOD SCHEDULING

A. The Prime Contractor remains responsible for identifying the critical path of all project activities and milestones, and will not be entitled to any additional compensation or any additional days related to Change Order work unless it can be demonstrated that latent conditions impact the critical path.

B. The critical path schedule shall be updated and resubmitted with each Application for Payment, and shall be

considered a prerequisite for payment.

C. Additional Requirements

1. Provide a list in EXCEL format and the associated database file of every submittal of shop drawings, product data, samples and other submittals required by the contract, General Conditions, Supplementary Conditions and/or technical specifications of the construction contract. This required list shall be set upon a template showing the following: Specification Section, Sub-Section Number, Item Number, Description, Shop Drawing Number, Submittal Review and Approval, Actual Order Date, Procurement and Fabrication, Schedule Delivery Date, Date Received, Scheduled Installation Date and Actual Installation Date. The list shall identify the following where applicable:

   (a) Every long lead item required by the contract.

   (b) Every pre-purchase item required by the contract.

   (c) Every Owner-furnished item required by the contract. The list of Owner-furnished items shall correspond with the construction schedule so that the submissions relate to the time when the products and/or systems will actually be required on the site.

      (i) Deliveries of Owner-furnished equipment or materials shall be shown on the schedule with time windows to be provided by the Owner.

      (ii) Neither the Designer nor the College will be responsible for acceptance of a list that calls for out-of-sequence delivery of Owner-furnished items.

**II. PRODUCTS (Not Used)**

**III. EXECUTION (Not Used)**

**END OF SECTION**

**SECTION 01.33.00**

**SUBMITTALS**

## I. PART 1 - GENERAL

### 1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

### 1.02 RELATED DOCUMENTS

A. This Section supplements the General Conditions.

B. Consult the individual sections of the specifications for the specific submittals required under those sections and for further details and descriptions of the requirements

### 1.03 GENERAL PROCEDURES FOR SUBMITTALS

A. Timeliness - The Contractor shall transmit each submittal to the Architect sufficiently in advance of performing related Work or other applicable activities so that the installation is not delayed by processing times, including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery, and similar sequenced activities. No extension of time will be authorized because of the Contractor's failure to transmit submittals to the Architect in advance of the Work.

B. Sequence - The Contractor shall transmit each submittal in a sequence which will not result in the Architect's approval having to be later modified or rescinded by reason of subsequent submittals which should have been processed earlier or concurrently for coordination.

C. Contractor's Review and Approval - Only submittals received from and bearing the stamp of approval of the Contractor will be considered for review by the Architect. Submittals shall be accompanied by a transmittal notice stating name of Project, date of submittal, "To", "From" (Contractor, Subcontractor, Installer, Manufacturer, Supplier), Specification Section, or Drawing No. to which the submittal refers, purpose (first submittal, resubmittal), description, remarks, distribution record, and signature of transmitter.

D. Architect's Action - The Architect will review the Contractor's submittals and return them with one of the following actions recorded thereon by appropriate markings:

1. Final Unrestricted Release: Where marked "No Exceptions Taken" the Work covered by the submittal may proceed provided it complies with the requirements of the Contract Documents.

2. Final-But-Restricted Release: When marked "Note Markings" or “Comments Attached” the Work may proceed provided it complies with the Architect's notations or corrections on the submittal and complies with the requirements of the Contract Documents. Acceptance of the Work will depend on these compliances.

3. Returned for Resubmittal: When marked "Resubmit" or "Rejected" the Work covered by the submittal (such as purchasing, fabrication, delivery, or other activity) should not proceed. The submittal should be revised or a new submittal resubmitted without delay, in accordance with the Architect's notations stating the reasons for returning the submittal.

E. Processing - All costs for printing, preparing, packaging, submitting, resubmitting, and mailing, or delivering submittals required by this contract shall be included in the Contract Sum.

### 1.04 OR EQUALS

A. Definition - Whenever a specification section names one or more brands for a given item, and the Contractor wishes to submit, for consideration, another brand, the submission shall be considered an "or-equal" or a "material substitution". For the purposes of this Contract, the terms "or-equal" and "material substitution" shall be considered synonymous.

B. In no case may an item be furnished on the Work other than the item named or described, unless the Architect, with the Owner's written concurrence, shall consider the item equal to the Item so named or described.

C. The equality of items offered as "equal" to items named or described shall be proved to the satisfaction of the Architect at the expense of the Contractor submitting the substitution.

1.05 SUBMISSION OF PRODUCT DATA

A. The Contractor shall submit an electronic copy of Product Data, in Adobe Acrobat (pdf) format to the Architect. All such data shall be specific and identification of material or equipment submitted shall be clearly marked or highlighted. Data of general nature will not be accepted.

B. Product Data shall be accompanied by a transmittal notice. The Contractor's stamp of approval shall appear on the printed information itself, in a location which will not impair legibility.

C. Product Data returned by the Architect as "Rejected" shall be resubmitted until the Architects approval is obtained.

D. When the Product Data are acceptable, the Architect will stamp them “No Exceptions Taken”, and return 1 copy to the Contractor. The Contractor shall provide and distribute additional copies as may be required to complete the Work.

E. The Contractor shall maintain one full set of approved, original, Product Data at the site.

1.06 SUBMISSION OF SHOP DRAWINGS

A. Shop Drawings shall be complete, giving all information necessary or requested in the individual section of the specifications. They shall also show adjoining Work and details of connection thereto.

B. Shop Drawings shall be for whole systems. Partial submissions will not be accepted.

C. The Architect reserves the right to review and approve shop drawings only after approval of related product data and samples.

D. Shop drawings shall be properly identified and contain the name of the project, name of the firm submitting the shop drawings, shop drawing number, date of shop drawings and revisions, Contractor's stamp of approval, and sufficient spaces near the title block for the Architect's stamp.

E. The Contractor shall submit to the Architect three (3) black line prints of each shop drawing or one electronic copy in Adobe Acrobat (pdf) format, at the Architect’s discretion. Prints may be mailed, delivered in roll form or emailed. Each submittal shall be accompanied by a transmittal notice bearing the Contractor's approval stamp.

F. When the Architect returns a marked submittal with the stamp "Resubmit" or "Confirm", the Contractor shall correct the original drawing or prepare a new drawing and resubmit three prints or an electronic version thereof to the Architect for approval. This procedure shall be repeated until the Architect's approval is obtained.

G. When the Architect returns submittal with the stamp "No Exceptions Taken", the Contractor shall provide and distribute the prints for all Contractor and Subcontractors use.

H. The Contractor shall maintain one full set of approved shop drawings at the site.

1.07 SUBMISSION OF SAMPLES

A. Unless otherwise specified in the individual section, the Contractor shall submit two specimens of each sample.

B. A transmittal notice with the Contractors stamp of approval shall be included with all sample submittals.

C. Samples shall be of adequate size to permit proper evaluation of materials. Where variations in color or in other characteristics are to be expected, samples shall show the maximum range of variation. Materials exceeding the variation of approved samples will not be approved on the Work.

D. Samples that can be conveniently mailed shall be sent directly to the Architect, accompanied by a transmittal notice. All transmittals shall be stamped with the Contractor's approval stamp of the material submitted.

E. All other samples shall be delivered at the field office of the Project Representative with sample identification tag attached and properly filled in.

F. If a sample is rejected by the Architect, a new sample shall be resubmitted in the specified manner. This procedure shall be repeated until the Architect approves the sample.

G. Samples will not be returned unless return is requested at the time of submission. The right is reserved to require submission of samples whether or not particular mention is made in the specifications, at no additional cost to the Owner.

**END OF SECTION**

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**SECTION 01.50.00**

**TEMPORARY FACILITIES AND CONTROLS**

## I. PART I - GENERAL

### 1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

### 1.02 REQUIREMENTS INCLUDED

A. Temporary Facilities and Controls including the following:

1. Temporary Water.
2. Weather Protection.
3. Heating During Construction.
4. Temporary Power.
5. Hoisting Equipment and Machinery.
6. Staging.
7. Maintenance of Access.
8. Dust Control.
9. Noise Control.
10. Indoor Air Quality (IAQ) Management.
11. Enclosures.
12. Cleaning During Construction.
13. Field Offices.
14. Telephone Service.
15. Sanitary Facilities.
16. Construction Barriers.
17. Parking.
18. Debris Control and Removal.
19. Safety Protection.
20. Vehicle and Equipment Protection.
21. Shoring.
22. Construction Fence.
23. Project Identification Sign.
24. Delivery of Materials.
25. Shut Down Notice.
26. Construction Cores.
27. Covered Walkways
28. Excavations and Field Survey Requirements

### 1.03 TEMPORARY WATER

A. Water is available at the basement level within the vicinity of the new Fire Alarm room, and may be used by contractors. The contractor requiring the water shall provide any hoses or buckets required.

B. Use of the water may be discontinued by the Owner if, in their opinion, it is wastefully used.

### 1.04 WEATHER PROTECTION

A. Not applicable.

### 1.05 HEATING DURING CONSTRUCTION

A. Not applicable.

1.06 TEMPORARY POWER

A. Contractors may utilize electrical power where available in or around the Work Area, and the Owner shall pay the cost of electricity used.

1. The use of cordless tools is strongly encouraged.

2. Contractors shall provide their own electrical cords, and cords shall not be run through, across or draped within corridors or circulation spaces used by the public. If running electrical cords across circulation spaces is unavoidable, cords shall be secured to the floor with readily visible colored duct tape, and shall be removed as soon as power is no longer needed.

B. Modification of electrical panels is not permitted, except where higher voltages are required for specialty tools. Any panel modifications may only be performed by a licensed electrician, and with the Owner's approval.

C. Generators for temporary power will not be permitted.

1.07 HOISTING EQUIPMENT AND MACHINERY

A. All hoisting equipment and machinery required for the proper and expeditious prosecution and progress of the work shall be furnished, installed, operated and maintained in safe condition by the individual Subcontractors and is so stated in each appropriately related Section of the Specifications. All costs for hoisting operating services shall be borne by the Subcontractors unless specifically excepted in the Contract Documents.

1. A licensed equipment manufacturer's representative shall be present at all times, to witness the erection and dismantling of all hoisting equipment and machinery, whenever such equipment is being erected or dismantled. No such work will be performed without the presence of such representative.

2. Hoisting equipment and machinery erection and dismantling shall be performed only by trained, certified, and experienced riggers qualified to perform such work.

3. Copies of such licenses and/or certifications, clearly indicating qualifications, shall be provided to the designer prior to commencement of such erecting and dismantling work.

B. Review Drawings for hoisting requirements and openness of traffic access routes to installed destinations of specified equipment and furnishings.

1.08 STAGING

A. All staging, planking and scaffolding, exterior and interior, required for the proper execution of the work and over eight feet in height, shall be furnished, installed, and maintained by the General Contractor.

1. Erection and dismantling of staging shall be performed only by trained, certified, and experienced staging personnel qualified to perform such work.

2. Copies of such certifications, clearly indicating qualifications, shall be provided to the Owner prior to commencement of such erecting and dismantling work.

3. All staging up to eight feet in height shall be provided by the individual Subcontractors as applicable to their work.

4. Use of staging extends to the Owner's contractors as may be listed in Section 01.11.00 - Summary of Work, where applicable.

1.09 MAINTENANCE OF ACCESS

A. The General Contractor shall provide and maintain for the duration of his contract, a means of access to, around and within the site, as indicated on the Contract Drawings, for vehicular traffic and authorized personnel. This means of access shall be construed to sustain the weight of equipment customarily engaged for use in construction projects of this type and magnitude. The General Contractor shall, without additional compensation from the Owner, furnish labor and materials as may be required from time to time to maintain this means of access in an acceptable condition as determined by the Designer. Pedestrian access shall provide adequate protection against falling debris, slippage, adequate lighting, warning and directional signs, and protection against construction activities.

B. Where sidewalks are rerouted around the construction site, the Electrical Contractor shall provide temporary lighting to provide a safe level of illumination at all times.

1.10 DUST CONTROL

A. The General Contractor shall have all Subcontractors provide adequate means for the purpose of preventing dust caused by construction operations from creating a hazard, nuisance, and from entering adjacent occupied areas throughout the period of the construction contract.

B. This provision does not supersede any specific requirements for methods of construction or applicable general conditions set forth in the Contract Articles with added regard to performance obligations of the General Contractor.

1.11 NOISE CONTROL

A. Work must be scheduled and performed in such a manner as to not interfere with the operations of the Owner. Construction work that is deemed by the Owner to be excessively noisy may be required to be done during non-normal working hours and at no additional expense.

B. Comply with requirements of authorities having jurisdiction. Develop and maintain a noise-abatement program and enforce strict discipline over all personnel to keep noise to a minimum.

C. Execute construction work by methods and by use of equipment which will reduce excess noise.
   1. Equip air compressors with silencers, and power equipment with mufflers.
   2. Manage vehicular traffic and scheduling to reduce noise.
   3. No heavy equipment may be started or idled before 7A.M.

1.12 INDOOR AIR QUALITY (IAQ) MANAGEMENT

A. Minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke. At a minimum, take the following measures:

   1. Prohibit smoking in the building.
   2. Locate exterior designated smoking areas away from entries, outdoor air intakes, and operable windows.

B. During Construction:

   1. During construction meet or exceed the recommended Control Measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, Chapter 3, November 2007.

   2. Protect stored on-site and installed absorptive materials from moisture damage.

   3. If the Owner authorizes the use of permanent heating, cooling, and ventilating systems during construction, install filter media having a Minimum Efficiency Reporting Value (MERV) of 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction. Replace

air filters immediately prior to occupancy. Replacement air filters shall have a MERV 13 according to ASHRAE 52.2.

C. Before Occupancy:

1. Conduct a baseline indoor air quality testing procedure consistent with the United States Environmental Protection Agency's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air."

1.13 ENCLOSURES

A. Provide temporary, insulated, weather tight closures of openings in exterior surfaces for providing acceptable working conditions and protection for materials, allowing for heating during construction, and preventing entry of unauthorized persons. Provide doors with self-closing hardware and locks.

B. All utilities including electric ducts, conduits, telephone lines, sprinklers, and other utilities shall be protected against damage from construction activity. The General Contractor shall be responsible for all damage to the utilities from construction and shall repair all such damage at no additional cost to Owner.

C. Provide temporary partitions and/or ceiling as required to separate work areas from occupied areas, to prevent penetration of dust and moisture into occupied areas, to prevent damage to existing areas and equipment. Construction shall be framing and sheet materials with closed joints and sealed edges at intersections with existing surfaces; (STC rating 35 in accordance with ASTM E900. Flame Spread Rating of 25 in accordance with ASTM E84.)

1.14 CLEANING DURING CONSTRUCTION

A. Unless otherwise specified under the various Sections of the Specifications, the General Contractor shall perform clean-up operations during construction as herein specified.

B. Control accumulation of waste materials and rubbish; periodically dispose of off-site in a legal manner. The General Contractor shall bear all costs, including fees resulting from such disposal.

C. Clean interior areas prior to start of finish work and maintain areas free of dust and other contaminants during finish operations.

D. Clean all dirt and debris tracked into other buildings by construction personnel, to the satisfaction of the Owner.

E. Maintain project in accordance with all local and Federal Regulatory Requirements.

F. Store volatile wastes in covered metal containers, and remove from premises.

G. Prevent accumulation of wastes which create hazardous conditions.

H. Provide adequate ventilation during use of volatile or noxious substances.

I. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

1. Do not burn or bury rubbish and waste materials on site.
2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
3. Do not dispose of wastes into streams or waterways.
4. Identify potential sources of cleaning water runoff and propose abatement procedures.

J. Use only those materials which will not create hazards to health or property and which will not damage surfaces.

K. Use only those cleaning materials and methods recommended by manufacturer of surface materials to be cleaned.

L. Execute cleaning to ensure that the buildings, the sites, and adjacent properties are maintained free from accumulations of waste materials and rubbish and windblown debris, resulting from construction operations.

M. Provide on-site containers for collection of waste materials, debris, and rubbish.

N. Remove waste materials, debris and rubbish form the site periodically and dispose of at legal disposal dump site (DEP approved). Recycle where possible.

O. Handle material in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.

P. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not damage surrounding surfaces.

1.15 FIELD OFFICES

A. Contractors may utilize space within the project area for a field office. The Owner will not provide usable space, outside of the project area, as field offices for the contractors.

B. If permitted by the Owner, the General Contractor may provide a suitable field office on site for its own use. The office trailer shall be relocated if required by the Owner., and shall be secured to the site as required by the Building Code.

1.16 TELEPHONE SERVICE

A. Wired telephone service to the office trailer or project site is not required, although contractors may elect to have such service at their own expense.

B. All Designers, Superintendents and Project Managers shall maintain cellular telephones and be reachable Monday - Friday between 8AM and 5PM, and after hours for emergency calls. Phone numbers shall be listed on a Project Directory, to be submitted at the pre-construction meeting.

1.17 SANITARY FACILITIES

A. Use of toilet facilities within the building is permitted, provided the General Contractor shall take responsibility for maintenance and cleaning of such areas and shall leave them in first class condition equal to the accepted conditions of toilet facilities not used for construction personnel.

1. Abuse may result in revocation of this privledge, in which case the Prime Contractor shall provide suitable toilet facilities on site, in a location as required by the Owner. Maintain chemical toilets where work is in progress and in quantity required by OSHA Code.

B. Chemical toilets and their maintenance shall meet requirements of state and local health regulations and ordinances and shall be subject to the approval the Resident Engineer and Designer.

1.18 CONSTRUCTION BARRIERS

A. Proper construction barriers shall be provided around the contract work areas as defined by the Contract Drawings or as directed by the Owner.

B. Construction barriers shall consist of traffic cones, ribbons, tapes, secure fencing, trench covers, wood barriers, warning signs, directional signs, and other traffic materials to keep traffic and people from area of construction and maintain ongoing operations.

C. Barriers shall be erected at such approved locations as are necessary, sufficiently cross-braced and supported adequately from floors and ceilings as required.

1.19 PARKING

A. Parking spaces on site are very limited and the Owner may not provide designated parking lot spaces near the construction site for the Contractor's use. Contractors shall anticipate the need to park off-site, and carpool to the project area.

B. Contractor's shall park where directed by the Owner, and move vehicles when requested by the Owner.

1. Access to loading docks, driveways, staff, faculty, visitor or tenant parking shall not be blocked by construction vehicles.

2. Parking in handicapped accessible spaces will not be permitted.

C. Idling of vehicles on site will not be permitted.

D. If the Owner authorizes parking on lawns, the Prime Contractor shall be responsible for repairing any damage to lawns or curbs from parked vehicles.

1.20 DEBRIS CONTROL AND REMOVAL

A. Debris shall not be permitted to accumulate or migrate and the work shall at all times be kept satisfactorily clean. Facility trash receptors shall not be used for the disposal of debris. Dumpster shall be provided by the General Contractor for removal of debris for all Subcontractors.

B. Remove debris from the work site on a daily basis and dispose of same at any (private or public) DEP approved dump that the General Contractor may choose providing that the General Contractor shall make all arrangements and obtain all approvals and permits necessary from the owner or officials in charge of such dumps. During disposal process, copies of daily receipts from dumpsite shall be submitted on a regular basis.

1.21 SAFETY PROTECTION

A. At no time shall the work be left unattended without proper safety protection and shall not be left unprotected to the weather and accessible to the public. It is the responsibility of the General Contractor to maintain proper safety protection for the public while work is in progress or unattended.

1.22 VEHICLE AND EQUIPMENT PROTECTION

A. All construction activities shall be performed in such a manner so as not to dust, stain or damage any building elements, equipment, vehicles, etc. within general vicinity of the construction work area. Any damage to these items shall be cleaned and repaired at the expense of the General Contractor.

1. All construction vehicles and equipment on site shall be effectively disabled and secured when not in use.

1.23 SHORING

A. The Subcontractors shall provide all temporary shoring and bracing as required for the proposed work. Comply with all applicable codes and standards.

1.24 CONSTRUCTION FENCE

A. Not required.

1.25 PROJECT IDENTIFICATION

A. No project sign is required by the Owner.

B. If the Contractor wishes to provide a project sign, at his own expense, the Owner reserves the right to approve the content and appearance of the sign.

C. Any signs will be located on site where directed by the Owner, and shall be relocated or removed if the Owner so directs.

1.26 DELIVERY OF MATERIALS

A. All Materials shall be delivered to the Contractor's or Sub-Contractor's warehouse or may be delivered to the site if the Contractor's representative is present to receive them.

B. No materials will be received by the Owner's personnel.

1.27 SHUT DOWN NOTICE

A. The Contractor shall notify the Owner, at least fourteen (14) calendar days in advance, of the need for any utility shut down to install or modify any utilities or building systems. The shutdown request shall indicate:

1. The utility to be shutdown.
2. The duration of the shutdown.
3. The spaces anticipated to be affected by the shutdown.

B. Investigation of the existing systems to determine the areas served, the location of isolation valves or sub-panels, etc., is to be anticipated and included in the bid scope.

C. Shutdowns involving sprinkler systems or fire alarm systems, for which the Authority Having Jurisdiction (AHJ) requires a fire watch, the contractor performing the shutdown shall provide and pay for the fire watch at no additional cost to the Owner.

D. Utility shutdowns affecting other buildings will be limited to occur after normal working hours. No additional compensation will be paid for overtime.

1.28 EXCAVATIONS AND FIELD SURVEY REQUIREMENTS

A. Not required.

**II. PART II - PRODUCTS (Not Used)**

**III. PART III - EXECUTION (Not Used)**

**END OF SECTION**

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**SECTION 01.73.29**

**CUTTING AND PATCHING**

## I. PART-1 GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this section of the specifications.

1.02 SCOPE OF WORK

A. The General Contractor shall coordinate the work to ensure that all embedded or concealed items are placed prior to the closing of construction. Where opening up construction is required to install any aspect of the work, the General Contractor shall be solely responsible for the cutting and patching of such materials.

1.03 SUMMARY

A. This Section specifies administrative and procedural requirements for cutting and patching.

B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching.

1.04 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.

B. Obtain approval of the cutting and patching proposal from the Designer before cutting and patching structural elements.

C. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

D. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Designer's opinion, reduce the building's esthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in a visually unsatisfactory manner.

1.05 RELATED SECTIONS

A. Section 4.13 - General Conditions of the Contract, Article 3.

## II. PART 2 - PRODUCTS

2.01 MATERIALS

A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

B. Concrete, where used to patch abandoned penetrations in floors or roofs, shall be:

1. Normal weight concrete proportioned in accordance with ACI 211.1 and ACI 30 for 4,000 psi

compressive strength @ 28 days.

2. At openings over 6" wide, provide ASTM A 615/A 615M, Grade 60, deformed reinforcing bars doweled into to the existing slab 48" on center, both sides, staggered.

3. At horizontal openings less than 6" wide, chip out the top of the opening to enlarge it, creating a tapered or conical hole to patch, such that the patch material cannot drop trough the hole.

C. Grout, where used to close annular space around floor or wall penetrations, shall be:

1. non-shrink type, prepackage and preproportioned, requiring only the addition of potable water before use, meeting or exceeding the following standards:

(a) General Properties: ASTM C 1107-02
(b) Compressive strength: ASTM C 109
(c) Bond Strength: ASTM C 882

D. Lumber: where cutting of lumber is required for the installation of utilities or recessed items such at toilet room accessories, or for the incidental replacement of damaged or unsuitable framing materials, new materials used to patch, sister, header or box out openings shall be kiln dried, stud grade S-P-F dimensional lumber with a dressed size of 1½" x the depth of the members receiving the work.

1. Use pressure treated lumber when in contact with ground, masonry, concrete or for roof blocking, with CCA preservative and a minimum retention rate of 0.25 pcf. Treat all cut ends by touching up in field with preservative. Use only galvanized fasteners and separate from materials which will react with preservative by using a separation sheet of peel-and-stick bituminous flashing tape.

E. Roofing: any cutting or patching of the existing roof shall be performed by a qualified roofer authorized by the membrane manufacturer. Patching materials shall be the same or compatible with those materials existing on the roof, unless the roof manufacturer recommends otherwise.

F. Wood Paneling or Acoustic Treatments: cutting and patching is not permitted where wood materials have a transparent finish and a veneer with a grain match to adjacent panels. Such woodwork will be carefully removed, stored and protected, and reinstalled after concealed work is completed.

G. Terrazzo: If cutting and patching of terrazzo is required, the entire portion of terrazzo bounded by zinc transition strips shall be removed and replaced, such that no visible seam or change on color/sheen/appearance is visible.

H. Gypsum Board: patch gypsum board with ASTM C-1396 board materials of a thickness to match existing.

1. Patches in rated assemblies shall be made with Type X materials.
2. Patches in wet areas shall be made with MR (moisture resistant) materials.
3. Joints and fasteners shall receive 3 coats of setting or drying type joint compound (contractor's option), sanded and feathered in successive wider applications to deliver a Level 4 finish to the patched area.

I. Plaster: Where cutting and patching involves plaster, comply with the following:

1. Comply with ASTM C 842
2. Comply with manufacturer's instructions and install thickness and coats as indicated.
3. Unless otherwise indicated, provide 3-coat work.
4. Base Coat: Ready-mixed, sand aggregate gypsum plaster base.
5. Finish Coat: Ready-mixed gypsum finish plaster.
6. Finish gypsum plaster to match existing adjacent surfaces. Sand lightly to remove trowel marks and arises.

## III. PART 3 - EXECUTION

### 3.01 PROTECTION

A. Protect existing trees, plants, roads, walls etc. to remain. Special protection of any lawns and planting around buildings is the responsibility of the Contractor. Contractor will replace any planting killed or damaged by construction operations.

### 3.02 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

1. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

2. Take all precautions necessary to avoid cutting existing pipe, conduit or duct work serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

C. Furnish dropcloths, erect dust partitions and take other measures as required to control dust generated by cutting activities and prevent its spread to adjacent areas

### 3.03 PERFORMANCE

A. The General Contractor shall be responsible for all cutting and patching, including all cutting and patching required by sub contractors.

1. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

2. Before proceeding, meet at the site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

B. General: Employ skilled workmen to perform cutting and patching. Where required to maintain an existing product or system warranty, such as a roof warranty, employ a manufacturer's approved and warranted Contractor to perform the cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

C. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.

1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.

3. Cut through concrete and masonry using a cutting machine such as a Carborundum saw or diamond core drill.

D. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

2. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.

3. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch, after the patched area has received primer and second coat. Touch-up painting may stop at a corner, pilaster or other visual break in the repaired surface.

4. Patch, repair or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.

E. Site Repair:

1. Restore all lawns, plantings, trees which are disturbed by the Work, to their original condition.

2. Repair all walkways and driveways that were damaged due to construction.

3.04 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty and items of similar nature.

B. Clean any portions of the building which were affected by dirt or dust generated by cutting, sanding or other construction activities.

**END OF SECTION**

**SECTION 01.77.00**

**CLOSEOUT PROCEDURES**

## I. PART 1 - GENERAL

1.01 SCOPE

A. This section lists the procedures required for the proper completion of this project including processing the Release of Retainage and making the Final Payment to the Contractor.

B. Consult the Individual sections of the specifications for requirements affecting Project Close Out.

1.02 RELATED DOCUMENTS

A. This section supplements the General Conditions.

B. Consult the individual sections of the specifications for specific items required under those sections.

1.03 SUBSTANTIAL COMPLETION

A. Prior to requesting Substantial Completion the Contractor shall make a thorough inspection of the Work. During this inspection the Contractor shall prepare a comprehensive list of all items remaining to be completed or corrected. This list shall include all remaining Contractor and Subcontractor items to be provided under the Contract Documents.

B. Upon completion of the items noted on the Contractor's list the Contractor shall notify the Architect that the Work is Substantially Complete. The Architect shall then conduct a similar thorough inspection. If the Architect agrees that the Work is Substantially Complete, the Architect will promptly make a thorough inspection and prepare a punch list, setting forth in accurate detail any items on the Contractor's list and additional items that are not acceptable or incomplete. The Contractor shall coordinate all Subcontractors to achieve prompt completion of the punch list.

C. The Contractor shall not be relieved of the responsibility to provide Contract items left off of the Architect's punch list.

D. If the Architect determines that the Work is not Substantially Complete, the Architect shall inform the Contractor of those items that must be completed before the Architect will prepare a punch list. Upon completion of those items, the Contractor shall again request the Architect to prepare a punch list.

E. When the punch list has been prepared, the Architect will arrange a meeting with the Contractor and Subcontractors to identify and explain all punch list items and answer questions on work which must be done before final acceptance.

F. The Architect may revise the punch list, from time to time, to ensure that all items of Work are properly completed.

G. The Architect shall prepare the Certificate of Substantial Completion in accordance with the General Conditions.

H. The Contractors shall correct the items noted on the punchlist(s). The General Contractor shall check the work of his forces, and of all sub-contractors to verify that the work has been corrected, and notify the architect that the project is ready for reinspection. The Architect and Engineers may, at their discretion, check the work to confirm the punchlist has been completed, and advise the Owner.

1. If the Contractor calls for reinspection, and the Project is not actually ready or punchlist items have not been corrected and subsequent reinspections are required, the Architect reserves the right to bill

the Owner for the reinspections, and such monies will be deducted from the balance due to the Contractor.

1.04 RECORD DRAWINGS

A. As-built Drawings shall consist of all the Contract Drawings. As-built Drawings shall be kept up-to-date. Information from on-going Work shall be recorded on As-built Drawings within 48 hours of Work being performed.

B. The General Contractor and each Subcontractor shall be required to maintain one set of As-built Drawings, as the work relates to their Sections of the Specifications, at the site.

C. The As-built Drawings shall be stored and maintained in the General Contractor's field office or a secure location apart from other documents used for construction. The As-built Drawings shall be maintained in a clean, dry, and legible condition and shall not be used for construction purposes.

D. As-built Drawings, as submitted by the General Contractor shall be verified in the field by the Designer or his Consultants. Verification by the Designer shall occur during the construction process and prior to the related work being completed and covered up.

E. The As-built Drawings shall be available at all time for inspection by the Project Manager or Designer. All deficiencies noted shall be promptly corrected.

F. The following information shall be indicated on the As-Built Drawings:

1. Record all changes, including change orders, in the location, size, number and type both horizontally and vertically of all elements of the project which deviate from those indicated on all the Contract Drawings.

2. The tolerance for the actual location of utilities and appurtenances within the building to be marked on the As-built Drawings shall be plus or minus two (2) inches.

3. The location of all underground utilities and appurtenances referenced to permanent surface improvements, both horizontally and vertically at ten (10) ft. intervals and at all changes of direction.

4. The location of all internal utilities and appurtenances, concealed by finish materials, including but not limited to valves, coils, dampers, vents, cleanouts, strainers, pipes, junction boxes, turning vanes, variable and constant volume boxes, ducts, traps and maintenance devices. The location of these internal utilities, appurtenances, and devices shall be shown by offsets to the column grid lines on the Drawings, or marked accurately on the as-built reflected ceiling plans.

5. Each of the utilities and appurtenances shall be referenced by showing a tag number, area served and function on the As-built Drawings.

G. At the end of each month and before payment for materials installed, the General Contractor, each Subcontractor, the Architect and Project Manager shall review the As-built Drawings for purpose of payment.

1. If the changes in location of all installed elements are not shown on the As-Built Drawings and verified in the field, then the material shall not be considered as installed and payment will be withheld.

H. Prior to the installation of all finish materials, a review of the As-built Drawings shall be made to confirm that all changes have been recorded. All costs to investigate such conditions shall be borne by the applicable party as determined by the Designer.

I. At the completion of the contract, each Subcontractor shall submit to the General Contractor a complete set

of his respective As-built Drawings indicating all changes. After checking the above drawings, the General Contractor shall certify in writing on the title sheet of the drawings that they are complete and correct and shall submit the As-built Drawings to the Designer.

J. The original hand-noted as-Built Drawings shall be scanned in color to Adobe Acrobat (*.pdf) format and submitted on CD or DVD to the Designer, to be added to the complete plans as constructed.

1.05 RECORD SURVEYS

A. Provide a record survey at close out for projects involving new construction, additions, sitework or utility work. As-Built surveys are conducted before, during and after construction. As-built surveys ensure the accuracy of the placement of above ground and underground structures and utilities. They are also used to identify and avoid disrupting utilities and historical or environmentally sensitive areas.

B. As-built surveys will be conducted on all structures and utilities that are either above ground or buried below ground. Utilities will be as-built at every horizontal and vertical location where direction and or elevation changes but no greater than twenty feet between as-built shots.

C. Deliverables shall be stamped by a Massachusetts registered professional, qualified for performing survey work. Include hardcopies and electronic copies as specified for other Record Drawings as specified herein.

1.06 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Consult the individual sections of the specifications for the specific requirements for those sections and for further details and descriptions of the requirements.

B. Prior to final payment and completion the Contractor shall provide all Operating Manuals and Maintenance Instructions as required by the Contract Documents.

C. Operating Instructions and Manuals:

1. Subcontractors, installers, and suppliers shall furnish to the Contractor two sets of operating and maintenance instructions of all mechanical, electrical, and manually operated equipment furnished and installed by them. Mechanical and electrical subcontractors shall furnish instructions as specified in their respective sections.

2. The Contractor shall collect all of the above instructions, bind them into two complete sets, and submit them to the Architect who will deliver them to the Owner.

3. The Contractor shall prepare a CD of all O&M items and deliver to the Owner.

4. Submission of operating and maintenance instructions shall be a condition precedent to final payment

D. Instruction of Owner's Personnel

1. Where specified in the individual sections of the specifications, the Contractor and Subcontractor shall instruct the Owner's personnel at the site, in the use and maintenance of equipment installed under the Contract.

2. Submission to the Architect of a certificate of compliance to this requirement, signed by the Contractor and the Owner's Representative, shall be a condition precedent to final payment.

1.07 PARTIAL RELEASE OF RETAINAGE

A. If within 65 days after Substantial Completion, any of the items on the Architect's punch list are not complete or if the Contractor has not provided the appropriate marked up As Built Drawings, Operating Manuals, Warranties, Guarantees, or Spare Parts the Architect shall assign a monetary value for each

incomplete item as well as any other items as provided by M.G.L. c.30 §39K, and the Architect shall prepare a Certificate for Partial Release of Retainage

B. If the Architect is required to prepare a Certificate for Partial Release of Retainage the Contractor shall complete all remaining Work in accordance with the provisions of the General Conditions.

C. The Contractor's signature on this Certificate shall be notarized.

D. The Contractor may make a request for additional releases of retainage when portions of the Work listed on the Architect's punch list have been satisfactorily completed. Each request shall be accompanied by a new application for payment and a new signed and notarized Certificate for Partial Release of Retainage.

E. The Architect's inspections, required to complete the additional payment applications described above, are subject to provisions of the General Conditions.

F. If the Owner has required Performance and Payment Bonds, then prior to the partial release of retainage, the General Contractor shall submit to the Owner Consent of Surety to Partial Release of Retainage using AIA Document G707A or an equivilent document.

1.08 FINAL RELEASE OF RETAINAGE

A. Prior to the final release of retainage, the General Contractor shall submit to the Owner:

1. Consent of Surety, using AIA Document G707 or similar document, if performance and payment bonds were required for the project.

2. Contractor’s Affidavit of Release of Liens, using AIA Document G706A or equivalent. This document shall be accompanied by certified statements from all sub-contractors working on the project, that they have received all monies due, and have paid all suppliers and sub-sub contractors accordingly.

(a) Should any payments be outstanding and contingent upon receipt of the retainage in order to be paid, the General Contractor shall submit AIA Document 706, itemizing those items which have not been paid.

**END OF SECTION**

**SECTION 06.10.00**

**ROUGH CARPENTRY**

## I. PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This Contractor must be familiar with all other Divisions and Sections of the Specifications which affect the work of this Section.

1.02 DESCRIPTION OF WORK

A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Dimensional lumber for framing.
2. Wood blocking.
3. Plywood equipment boards.

B. **Alternates:** Not Applicable.

C. **Items To Be Installed Only:** Not Applicable.

D. **Items To Be Furnished Only:** Furnish the following items for installation by the designated Sections

1. None.

E. **Related Work:** The following items are not included in this Section and will be performed under the designated Sections:

1. None.

1.03 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.

2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.04 QUALITY ASSURANCE

A. Lumber: Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark.

B. Plywood: Mark each sheet with the mark of a recognized association or independent inspection agency that

maintains continuing control over the quality of the plywood. The mark shall identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with APA L870. Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks

C. Preservative Treated Lumber and Plywood: The Contractor shall be responsible for the quality of treated wood products. Each treated piece shall be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The Contractor shall provide inspection report of an approved independent inspection agency that offered products comply with applicable AWPA Standards. The appropriate Quality Mark on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in the manufacturer's original containers, dry, undamaged, and with seals and labels intact.

B. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings. Store products in a weather-protected environment, clear of ground and moisture.

C. Protect all existing and new wood stored on site to prevent moisture absorption. Stacked materials should be covered with tarps (top, sides, and bottom) and stacked to provide sufficient slope to shed water.

## II. PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

3. Provide dressed lumber, S4S, unless otherwise indicated

4. Provide dry lumber with 15 percent by weight on a dry weight basis maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

B. Plywood Panels:

1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.

2. Thickness: As needed to comply with requirements specified but not less than thickness indicated.

3. Factory mark panels according to indicated standard.

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground or concrete, Use Category UC3b for exterior construction not in contact with the ground or concrete, and Use Category UC4a for items in contact with the ground or concrete.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood in direct contact with masonry or concrete.

2. Treated wood in contact with cementitious materials on the interior of the building can be omitted if the untreated wood is separated from physical contact by metal or rubber flashings.

2.03 FRAMING AND MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including the following: Rooftop equipment bases and support curbs, blocking, cants, nailers, furring, grounds.

B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 15 percent maximum moisture content.

C. As noted on the drawings, or a minimum of:
1. Bending Stress: 875 PSI
2. Horizontal Shear Stress: 135 psi
3. Modulus of Elasticity: 1,300,000 PSI
4. Sizes as noted on Drawings.

2.04 PANEL PRODUCTS

A. Equipment Panels and Miscellaneous Concealed Plywood:

1. Type: Fire-Resistant Treated (FRT, KDAT)
2. Grade: CDX or better.
3. Thickness: 3/4"

2.05 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where fire-rated construction is indicated, fasteners shall be of the size and type required by the reference UL Design for that assembly.

2. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

3. The fasteners shall be of sufficient length to penetrate the receiving member a minimum of 1-1/4 inch minimum for wood or plywood into wood, full depth into plywood, and 5/8 inch minimum for wood into steel deck or metal stud framing

B. Nails, Wire, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Wood Screws: ASME B18.6.1.

E. Lag Screws and Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A with ASTM A 563 hex nuts and, where indicated, flat washers.

G. Bolts, Nuts, Studs, and Rivets: ASME B18.2.1, ASME B18.5.2.1M, ASME B18.5.2.2M and ASME B18.2.2.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5; except provide stainless steel complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2, where in contact with pressure-preservative treated wood or when exposed to exterior conditions.

2.06 MISCELLANEOUS MATERIALS

A. Adhesive, Including Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

## III. PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement. Stagger joints layer to layer. Prepared surfaces must be clean and dry. Fill, chip, or grind as required to provide a smooth, uniform surface.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

C. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

D. Securely attach carpentry work as indicated and according to applicable codes and the following:

1. UL Design requirements, where rated construction is indicated.

2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

4. ICC-ES evaluation report for fastener.

E. Countersink fastener heads on exposed carpentry work and fill holes with wood filler

F. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.

**END OF SECTION**

**SECTION 07.84.13**

**PENETRATION FIRESTOPPING**

## I. PART 1 - GENERAL

### 1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This Contractor must be familiar with all other Divisions and Sections of the Specifications which affect the work of this Section.

### 1.02 DESCRIPTION OF WORK

A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

B. **Alternates:** Not Applicable.

C. **Items To Be Installed Only:** Not Applicable.

D. **Items To Be Furnished Only:** Not Applicable.

E. **Related Work:** The following items are not included in this Section and will be performed under the designated Sections:

1. Section 07.84.43 - JOINT FIRESTOPPING for fire-resistive joint systems.

2. Section 26.00.01 - ELECTRICAL WORK for cutting penetrations for cable and conduit and providing firestopping complying with requriements in this Section.

### 1.03 COORDINATION

A. Jobsite conditions of each through-penetration firestop system must meet all details of the UL-Classified System selected. If jobsite conditions do not match any UL-classified systems, contact firestop manufacturer for alternative systems or Engineer Judgment Drawings.

B. Coordinate work with other trades to assure that penetration-opening sizes are appropriate for penetrant locations.

C. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

D. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

E. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined building inspector, if required by authorities having jurisdiction.

### 1.04 PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls and fire partitions.

2. F-Rating: 2 hour.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. Horizontal assemblies include floors, floor/ceiling assemblies and ceiling membranes of roof/ceiling assemblies.

2. F-Rating: 2 hour.

3. T-Rating: 2 hour.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping:

1. Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

2. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

(a) For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems demonstrating no evidence of water leakage when tested according to UL 1479.

(b) For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.

F. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

C. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is

applicable to each through-penetration firestop system configuration for construction and penetrating items.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.

2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.

3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

E. Qualification Data: For Installer.

1.06 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:

(a) Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.

(b) Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed in the UL "Fire Resistance Directory."

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.09 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined building inspector, if required by authorities having jurisdiction.

## II. PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hilti, Inc.
2. BioFireshield; RectorSeal Corporation.
3. Specified Technologies, Inc. (STI).
4. 3M; Fire Protection Products Division.
5. Or equal.

### 2.02 FIRESTOPPING MATERIALS

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Materials: Provide through-penetration firestop systems containing primary materials and fill materials which are part of the tested assemblies indicated in the approved Through-Penetration Firestop System Schedule submittal. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

C. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated

### 2.03 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## III. PART 3 - EXECUTION

### 3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.03 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.

2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 FIELD QUALITY CONTROL

A. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.05 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

**END OF SECTION**

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**SECTION 07.84.43**

**JOINT FIRESTOPPING**

## I. PART 1 - GENERAL

### 1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This Contractor must be familiar with all other Divisions and Sections of the Specifications which affect the work of this Section.

### 1.02 DESCRIPTION OF WORK

A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Floor-to-floor joints.
2. Floor-to-wall joints.
3. Head-of-wall joints.
4. Wall-to-wall joints.

B. **Alternates:** Not applicable

C. **Items to Be Installed Only:** Install the following items as furnished by the designated Sections:

1. None. All items to be installed by this trade, shall be furnished by this trade.

D. **Items to Be Furnished Only:** Furnish the following items for installation by the designated Sections:

1. None.

E. **Related Work Specified Elsewhere:** The following items are not included in the Section, and will be performed under the designated Section:

1. Section 07.84.13 - PENETRATION FIRESTOPPING for through-penetration firestopping systems.

### 1.03 PERFORMANCE REQUIREMENTS

A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.

B. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

### 1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.

C. Fire-Resistive Joint Systems Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.

1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

D. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.

E. Qualification Data: For Installer.

F. Field quality-control test reports.

G. Research/Evaluation Reports: For each type of fire-resistive joint system.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.

2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements" Article and comply with the following:

(a) Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.

(b) Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.08 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until each installation has been examined building inspector, if required by authorities having jurisdiction.

## II. PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hilti, Inc.
2. BioFireshield; RectorSeal Corporation.
3. Specified Technologies, Inc. (STI).
4. 3M; Fire Protection Products Division.
5. Or equal.

2.02 FIRE-RESISTIVE JOINT SYSTEMS

A. General: Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079.

C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide fire-resistive joint systems with rating determined by ASTM E 119 based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa) or ASTM E 2307.

1. Fire-Resistance Rating: 2 hours.

D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079.

1. L-Rating: Not exceeding 5.0 cfm/ft (0.00775 cu. m/s x m) of joint at 0.30 inch wg (74.7 Pa) at both ambient and elevated temperatures.

E. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.

F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

## III. PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. PREPARATION

1. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

(a) Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.

2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

4. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

5. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.02 INSTALLATION

A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.

2. Apply fill materials so they contact and adhere to substrates formed by joints.

3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.03 FIELD QUALITY CONTROL

A. Where deficiencies are found, repair or replace fire-resistive joint systems so they comply with requirements.

B. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.04 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

**END OF SECTION**

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**SECTION 08.20.00**

**DOORS, FRAMES AND HARDWARE**

## I. PART 1 - GENERAL

### 1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This Contractor must be familiar with all other Divisions and Sections of the Specifications which affect the work of this Section.

### 1.02 DESCRIPTION OF WORK

A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Hollow Metal Frames.
2. Wood interior.
3. Door Hardware.

B. **Alternates:** None.

C. **Items to Be Installed Only:** Install the following items as furnished by the designated Sections:

1. None. All items to be installed by this trade, shall be furnished by this trade.

D. **Items to Be Furnished Only:** Furnish the following items for installation by the designated Sections:

1. None.

E. **Related Work Specified Elsewhere:** The following items are not included in this Section, and will be performed under the designated Section:

1. Section 09.99.00 - PAINTING, for field finishing of doors and frames.

### 1.03 SUBMITTALS

A. Refer to Division 01.33.00 Submittal Procedures.

B. Product Data: Include installation details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.

3. Content: Include the following information:

(a) Type, style, function, size, label, hand, and finish of each door hardware item.
(b) Manufacturer of each item.
(c) Fastenings and other pertinent information.
(d) Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
(e) Explanation of abbreviations, symbols, and codes contained in schedule.
(f) Mounting locations for door hardware.
(g) Door and frame sizes and materials.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall have successful experience in producing the type of product required for project applications equivalent to the requirements for this project.

B. Installer Qualifications: Installer shall be a properly licensed and insured contractor who is routinely involved in the execution of door replacement in residential housing, and can demonstrate a successful track record of similar installations for a period of not less than 5 years.

C. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing at positive pressure according to NFPA 252.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site undamaged with labels clearly identifying manufacturer, product name, and installation instructions

B. Storage: Store materials in an upright position, off ground, under cover, and protected from weather, direct sunlight, and construction activities.

C. Handling: protect materials and finish during handling and installation to prevent damage.

1.06 WARRANTY

A. Installer shall warranty the installation, and make any repairs or adjustments including costs for labor and materials, for a period of 1 year after substantial completion.

## II. PART 2 PRODUCTS

2.01 INTERIOR WOOD DOORS

A. MANUFACTURERS

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:

(a) Algoma Hardwoods Inc.
(b) Eggers Industries; Architectural Door Division.
(c) Marshfield Door Systems.
(d) Oshkosh Door Company
(e) VT Industries Inc.
(f) Or equal.

B. DOOR CONSTRUCTION

1. Type: Flush Slab.

2. Grade: Premium.

3. Faces for Interior Doors: Medium-density overlay. Apply medium-density overlay to standard thickness, closed-grain, hardwood face veneers or directly to high-density hardboard crossbands.

   (a) Furnish wood doors shop primed, for field painting under 09.90.00 - PAINTING.

4. Fire-resistance rating: 90 minutes.

   (a) Core: Fire Resistant Mineral Core, with no added urea formaldehyde crossbanding

   (b) Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as needed to eliminate through-bolting hardware

   (c) Edge Construction: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.

C. DOOR LOUVERS

1. Fire Door Louvers: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire rating of one and one-half hours and less.

   (a) Metal and Finish: Galvanized steel, 0.0396 inch thick, hot-dip zinc coated and factory primed for paint finish.

2.02 HOLLOW METAL FRAMES

A. MANUFACTURERS

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:

   (a) Amweld International.
   (b) Ceco Door Products; an ASSA ABLOY Group Company.
   (c) CURRIES Company; an ASSA ABLOY Group Company.
   (d) De LaFontaine.
   (e) Mesker Door Inc.
   (f) Pioneer Industries, Inc.
   (g) Republic Builders Products Company.
   (h) Steelcraft, an Ingersoll Rand Company.
   (i) Or equal.

B. MATERIALS

1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

2. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 metallic coating.

4. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.

    (a) For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

5. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

6. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

7. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

C. STANDARD STEEL FRAMES

1. General: Comply with ANSI A250.8 and with details indicated for type and profile.

2. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.

    (a) Fabricate frames with mitered or coped with internal reinforcement for field assembly (knock-down).

    (b) Frames for Level 2 Steel Doors: 0.053-inch-thick steel sheet.

3. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

D. FRAME ANCHORS

1. Jamb Anchors: Adjustable compression anchors.
2. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, clip-type anchors, with two holes to receive fasteners.

E. FABRICATION

1. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment

2. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

3. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

    (a) Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

    (b) Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

    (c) Jamb Anchors: Locate anchors not more than 18 inches from top and bottom of frame. Provide

not less than 2 compression type anchors per jamb.

(d) Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction. Drill stop in strike jamb to receive three door silencers.

(e) Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

(f) Hardware Preparation: Factory prepare hollow metal work to receive hardware specified herein. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.

F. STEEL FINISHES

1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

2. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.03 HARDWARE

A. Lockset: Schlage ND, Sargent 10 Line, Best 8K or approved equal meeting the following:

1. Type: Cylindrical, meeting ANSI/BHMA A156.2 requirements for Grade 1 suitable for use on 90 minute rated doors.
2. Function: Storeroom
3. Trim: lever
4. Cylinder/Core: non-interchangeable, match building standard
5. Finish: 626
6. Keys: provide 4 cut keys; keying determined by City.

B. Hinges: Ives, McKinney, Hagar, Stanley or approved equal meeting the following:

1. Standard weight, ball bearing, steel, 4½" x 4½" with steel non-rising pins.
2. Provide 3 hinges per door leaf.

C. Closer: LCN 4010/4110, Sargent 281 or approved equal meeting the following:

1. Fully hydraulic, full rack and pinion action with a high strength cast iron cylinder. Cylinder body shall be 1-1/2" in diameter, and double heat-treated pinion shall be 11/16" in diameter.

2. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for the physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and back check.

3. All closers shall have solid forged steel main arms (and forged forearms for parallel arm closers).

4. Closers shall not incorporate a pressure relief valve.

5. All closers shall have metal covers.

6. Closer cylinders, arms, and metal covers shall have a powder coating finish which has been certified to exceed 100 hours salt spray testing by an independent testing laboratory used by BHMA for ANSI

certification. For metal components that can't be powder coated, a special rust inhibiting finish (SRI) must be used.

D. Silencers: Ives, Rockwood, Burns or approved equal "push-in" type silencers for each hollow metal frame, three for each single frame

## III. PART 3 EXECUTION

3.01 FRAMES

A. EXAMINATION

1. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. INSTALLATION

1. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

2. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

(a) Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

(i) At fire-protection-rated openings, install frames according to NFPA 80.

(b) Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

(c) Field apply bituminous coating to backs of frames that are filled with grout.

3. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

(a) Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

(a) Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

(b) Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.

(c) Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

(d) Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

3.02 DOORS

A. EXAMINATION

1. Examine doors and installed door frames before hanging doors.

(a) Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.

(b) Reject doors with defects.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. INSTALLATION

1. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.

2. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

3.03 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Protection: Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

C. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

3.04 HARDWARE

A. EXAMINATION

1. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

2. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. PREPARATION

1. Wood Doors: Comply with DHI A115-W series.

2. Where on-site modification of doors and frames is required, prepare hardware locations in accordance with the following:

(a) Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

(b) Where doors are in rated assemblies, comply with NFPA 80 for restrictions for on-site door hardware preparation.

C. INSTALLATION

1. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

   (a) Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

   (b) Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

2. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

   (a) Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

   (b) Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

D. ADJUSTING

1. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

2. Door Closers: Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

3. Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.

**END OF SECTION**

**SECTION 09.20.00**

**GYPSUM ASSEMBLIES**

## I. PART 1 - GENERAL

### 1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This Contractor must be familiar with all other Divisions and Sections of the Specifications which affect the work of this Section.

### 1.02 DESCRIPTION OF WORK

A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Interior wallboard for walls and ceilings.
2. Taped and sanded joint treatment.
3. All required accessories.

B. **Alternates:** None.

C. **Items to Be Installed Only:** Install the following items as furnished by the designated Sections:

1. None.

D. **Items to Be Furnished Only:** Furnish the following items for installation by the designated Sections:

1. None.

E. **Related Work Specified Elsewhere:** The following items are not included in the Section, and will be performed under the designated Section:

1. None.

### 1.03 REFERENCES

A. ANSI/ASTM C1396 - Gypsum Wallboard.

B. ANSI/ASTM C475 - Joint Treatment Materials for Gypsum Wallboard Construction.

C. ANSI/ASTM C754 - Installation of Framing Members to Receive Screw Attached Gypsum Wallboard, Backing Board, or Water Resistant Backing Board.

D. ASTM E84- Surface Burning Characteristics.

E. GA-201 - Gypsum Board for Walls and Ceilings.

F. GA-216 - Recommended Specifications for the Application and Finishing of Gypsum Board.

### 1.04 SUBMITTALS

A. Submit product data under provisions of Section 01.33.00.

B. Provide product data on specified products.

## II. PART 2 - PRODUCTS

2.01 GYPSUM BOARD MATERIALS

A. General: Complying with ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

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:

(a) USG Corporation.
(b) Georgia Pacific Gypsum.
(c) Lafarge North America.
(d) National Gypsum Company.
(e) Or equal.

B. Fire-Resistant Type X, ASTM C 1396:

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

2.02 ACCESSORIES

A. Joint Materials: ANSI/ASTM C475; GA 201 and GA 216; reinforcing tape, joint compound, adhesive, water, and fasteners

B. Joint Compound: setting type, curing time selected by installer.

C. Corner Beads:

1. Outside and inside corners: metal and paper combination
2. Intersection of dissimilar materials: J-stop, L-trim or J-trim as conditions dictate.

D. Fasteners: as required by UL design for fire rated assembly referenced.

E. Metal furring: hat-shaped channels of 25 gauge cold-rolled steel with G-40 coating, 7/8" heigh.

## III. PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that site conditions are ready to receive work and opening dimensions are as indicated on shop drawings and instructed by the manufacturer.

B. Beginning of installation means acceptance of conditions.

3.02 GYPSUM BOARD INSTALLATION

A. Install gypsum board in accordance with GA 201 and GA 216 and manufacturer's instructions, UL Design where rated assemblies are indicated.

B. Extend all new work to floor framing or other existing construction above the new work, and finish joint following specified procedures.

C. Erect single-layer standard gypsum board in most economical direction, with ends and edges occurring over firm bearing. Install gypsum board tight to underside of structure on both face of each partition.

D. Use drywall screws of appropriate size for both layers, no less than 12" o/c in all directions, to metal framing.

E. Treat cut edges and holes in moisture resistant gypsum board with sealant.

F. Place control joints consistent with lines of building spaces as indicated or as directed.

G. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

3.03 JOINT TREATMENT

A. Finish drywall installations in accordance with Gypsum Association's GA-214 as follows:

1. Finished spaces, level 4 minimum.
2. Concealed spaces, such as above ceilings, may be rough taped and sanded.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes in strict accordance with the manufacturer's instructions.

C. Use a 3-coat application at all joints, sanded smooth between applications. Feather coats onto adjoining surfaces. Place corner beads at external corners. Place edge trim where gypsum board abuts dissimilar materials.

**END OF SECTION**

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**SECTION 09.90.00**

**PAINTING**

## I. PART 1 - GENERAL

### 1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This Contractor must be familiar with all other Divisions and Sections of the Specifications which affect the work of this Section.

### 1.02 DESCRIPTION OF WORK

A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Interior painting and coating systems.
2. Surface Preparation.

B. **Alternates:** None.

C. **Items to Be Installed Only:** Install the following items as furnished by the designated Sections:

1. None. All items to be installed by this trade, shall be furnished by this trade.

D. **Items to Be Furnished Only:** Furnish the following items for installation by the designated Sections:

1. None.

E. **Related Work Specified Elsewhere:** The following items are not included in the Section, and will be performed under the designated Section:

1. Section 08.20.00 - DOORS, FRAMES AND HARDWARE for pre-prined doors and hollow metal frames.

### 1.03 SUBMITTALS

A. Product Data: For each paint system indicated, including.

1. Product characteristics.
2. Surface preparation instructions and recommendations.
3. Primer requirements and finish specification.
4. Storage and handling requirements and recommendations.
5. Application methods.
6. Cautions for storage, handling and installation.
7. Selection Samples: Submit a complete set of color chips that represent the full range of manufacturer's products, colors and sheens available.

B. Verification Samples: For each finish product specified, submit samples that represent actual product, color, and sheen.

C. Only submit complying products based on project requirements. One must also comply with the regulations regarding VOCs (CARB, OTC, SCAQMD, LADCO). To ensure compliance with district regulations and

other rules, businesses that perform coating activities should contact the local district in each area where the coating will be used.

D. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams “Custodian Project Color and Product Information” report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Paint exposed surfaces. If a color of finish, or a surface is not specifically mentioned, Architect will select from standard products, colors and sheens available.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels unless indicated.

D. Mock-Up: Not required.

1.05 DELIVERY STORAGE AND HANDLING

A. Deliver manufacturer's unopened containers to the work site. Packaging shall bear the manufacturer's name, label, and the following list of information.

1. Product name, and type (description).
2. Application and use instructions.
3. Surface preparation.
4. VOC content.
5. Environmental handling.
6. Batch date.
7. Color number.

B. Storage: Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

C. Store materials in an area that is within the acceptable temperature range, per manufacturer's instructions. Protect from freezing.

D. Handling: Maintain a clean, dry storage area, to prevent contamination or damage to the coatings.

1.06 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.07 WARRANTY

A. The installing contractor shall warranty the finishes for a period of 1 year from Substantial Completion. Warranty shall not cover damage caused by the Owner.

1.08 EXTRA MATERIALS

A. Not required.

## II. PART II - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design is for Sherwin - Williams (S-W) products. Equal products as determined by Master Paint Institute (MPI) will be acceptable, upon submission of MPI data sheets.

2.02 APPLICATIONS/SCOPE

A. Interior Paints and Coatings: (LEED-09 NC/CI/CS COMPLIANT)

1. Wood: Interior doors.
2. Drywall: Drywall board, Gypsum board.
3. Metals: Door Frames, louvers.

2.03 PAINT MATERIALS - GENERAL

A. Paints and Coatings.

1. Unless otherwise indicated, provide factory-mixed coatings. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

2. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color. Or follow manufactures product instructions for optimal color conformance.

B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

C. Coating Application Accessories: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required, per manufacturer's specifications.

D. Color: Refer to Finish Schedule for paint colors, and as selected.

2.04 INTERIOR PAINT SYSTEMS (LEED-V4 NC/CI/CS COMPLIANT )

A. WOOD

1. DOORS: Latex Systems, Eg-Shel / Satin Finish:
   (a) 1st Coat: S-W ProMar 200 Zero VOC Interior Latex Primer, B28W2600 (4 mils wet, 1.5 mils dry).
   (b) 2nd Coat: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-12600 Series.
   (c) 3rd Coat: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-12600 Series (4 mils wet, 1.7 mils dry per coat).

2. ELECTRICAL PANEL BOARDS: Intumescent paint, Flame Control Coatings, LLC or approved equal:
   (a) 1st Coat: Flame Control No. 3003 Acrylic Primer
   (b) 2nd Coat: Flame Control 20-20A

B. DRYWALL

1. WALLS: Latex Systems, Eg-Shel / Satin Finish:
   (a) 1st Coat: S-W ProMar 200 Zero VOC Interior Latex Primer, B28W2600 (4 mils wet, 1.5 mils dry).
   (b) 2nd Coat: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-12600 Series.
   (c) 3rd Coat: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-12600 Series (4 mils wet, 1.7 mils dry per coat).

2. CEILINGS: Latex Systems, Flat Finish:
   (a) 1st Coat: S-W ProMar 200 Zero VOC Interior Latex Primer, B28W02600 (4 mils wet, 1.5 mils dry).
   (b) 2nd Coat: S-W ProMar Ceiling Paint Interior Latex Flat, B27-W05050 Series.
   (c) 3rd Coat: S-W ProMar Ceiling Paint Interior Latex Flat, B27-W05050 Series (4 mils wet, 1.2 mils dry per coat).

C. METAL

1. DOOR FRAMES, LOUVERS:

   (a) 1st Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series (5.0 mils wet, 2.0 mils dry).
   (b) 2nd Coat: S-W Pro Industrial DTM Semi-Gloss Acrylic Coating, B66-650 Series.
   (c) 3rd Coat: S-W Pro Industrial DTM Semi-Gloss Acrylic Coating, B66-650 Series (6.0 mils wet, 2.5 mils dry per coat).

## III. PART III - EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared; notify Architect of unsatisfactory conditions before proceeding. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

B. Proceed with work only after conditions have been corrected and approved by all parties, otherwise application of coatings will be considered as an acceptance of surface conditions.

C. Previously Painted Surfaces: Verify that existing painted surfaces do not contain lead based paints, notify Architect immediately if lead based paints are encountered.

3.02 SURFACE PREPARATION

A. General: Surfaces shall be dry and in sound condition. Remove oil, dust, dirt, loose rust, peeling paint or other contamination to ensure good adhesion

1. Remove mildew before painting by washing with a solution of 1 part liquid household bleach and 3 parts of warm water. Apply the solution and scrub the mildewed area. Allow the solution to remain on the surface for 10 minutes. Rinse thoroughly with clean water and allow the surface to dry a minimum of 48 hours before painting. Wear protective glasses or goggles, waterproof gloves, and protective clothing. Quickly wash off any of the mixture that comes in contact with your skin. Do not add detergents or ammonia to the bleach/water solution.

2. Remove items including but not limited to thermostats, electrical outlets, switch covers and similar items prior to painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Drywall - Interior: Must be clean and dry. All nail heads must be set and spackled. Joints must be taped and covered with a joint compound. Spackled nail heads and tape joints must be sanded smooth and all dust removed prior to painting.

C. Wood: Must be clean and dry. Prime and paint as soon as possible. Knots and pitch streaks must be scraped, sanded, and spot primed before a full priming coat is applied. Patch all nail holes and imperfections with a wood filler or putty and sand smooth.

3.03 INSTALLATION

A. Apply all coatings and materials with the manufacturer's specifications in mind. Mix and thin coatings according to manufacturer's recommendations.

B. Do not apply to wet or damp surfaces. Wait at least 30 days before applying to new concrete or masonry. Or follow manufacturer's procedures to apply appropriate coatings prior to 30 days. Test new concrete for moisture content. Wait until wood is fully dry after rain or morning fog or dew.

C. Apply coatings using methods recommended by manufacturer.

D. Uniformly apply coatings without runs, drips, or sags, without brush marks, and with consistent sheen.

E. Apply coatings at spreading rate required to achieve the manufacturers recommended dry film thickness.

F. Regardless of number of coats specified, apply as many coats as necessary for complete hide, and uniform appearance.

G. Inspection: The coated surface must be inspected and approved by the Architect just prior to the application of each coat.

3.04 PROTECTION

A. Protect finished coatings from damage until completion of project.

B. Touch-up damaged coatings after substantial completion, following manufacturer's recommendation for touch up or repair of damaged coatings. Repair any defects that will hinder the performance of the coatings.

**END OF SECTION**

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SECTION 260001

ELECTRICAL WORK

## PART 1 - GENERAL

### 1.1 GENERAL PROVISIONS

A. Work of this Section is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

### 1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section "Summary", Paragraph 1.1A, entitled "Related Documents."

### 1.3 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. All Work of the following sections:
    a. 260001 ELECTRICAL WORK
    b. 260500 COMMON WORK RESULTS FOR ELECTRICAL
    c. 260519 ELECTRICAL POWER CONDUCTORS AND CABLES
    d. 260526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
    e. 260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
    f. 260533 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
    g. 260548 VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS
    h. 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS
    i. 262726 WIRING DEVICES
    j. 275319 PUBLIC SAFETY RADIO DAS
    k. 283111 ADDRESSABLE FIRE-ALARM & MASS NOTIFICATION SYSTEM

2. Firestopping for the Work of this Section, including cutting penetrations and firestopping; complying with requirements specified in Section 078413 - PENETRATION FIRESTOPPING.
3. Core drilling for the Work of this Section.
4. Certified seismic restraints to meet the Commonwealth of Massachusetts Building Code applicable at the time the building permit is issued.
5. Coordination drawings and record drawings and similar requirements.

B. Alternates: Refer to Division 01 requirements.

C. Items to Be Installed Only: Install the following items as furnished by the designated Sections:
   1. N/A

D. Items to Be Furnished Only: Furnish the following items for installation by the designated Sections:
   1. N/A

E. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
   1. N/A

F. The Electrical Subcontractor shall be responsible for filing all documents, payment of all fees, and securing of all inspections and approvals necessary for the electrical work.

G. The Electrical Subcontractor shall carry in the bid price all Utility Company and Municipal back charges for all materials furnished and work performed by them in conjunction with this Contract and pay same to the respective agency upon demand. The Electrical Subcontractor shall not be entitled to additional compensation after the submittal of his bid price should he fail, for any reason, to obtain the total back charge costs to be incurred by the local utility companies or municipal agencies.

## 1.4 SUBMITTALS

A. Comply with requirements specified in Section 013300 – SUBMITTAL REQUIREMENTS.
   1. Shop Drawing: Shop drawings shall include, but not be limited to, the following:
      a. Common Work Results for Electrical
      b. Electrical Power Conductors and Cables
      c. Grounding and Bonding for Electrical Systems
      d. Hangers and Supports for Electrical Systems
      e. Raceway and Boxes for Electrical Systems
      f. Vibration and Seismic Controls for Electrical Systems
      g. Identification for Electrical Systems
      h. Wiring Devices
      i. Public Safety Radio Das
      j. Addressable Fire-Alarm & Mass Notification System

## 1.5 REFERENCES

A. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any electrical item in the drawings or specifications for electrical work carries with it the instruction to furnish, install and connect the item as part of the electrical work, regardless of whether or not this instruction is explicitly stated.

B. It shall be understood that the specifications and drawings for electrical work are complimentary and are to be taken together for a complete interpretation of the electrical work except that indications on the drawings, which refer to an individual element of work, take precedence over the specifications where they conflict with same.

## 1.6 REGULATORY REQUIREMENTS

A. Comply with all applicable federal and state laws, and all local codes, by-laws and ordinances.

B. Where provisions of the Contract Documents conflict with any codes, rules or regulations, the latter shall govern. Where the contract requirements are in excess of applicable codes, rules or regulations, the contract provisions shall govern unless the Designer rules otherwise.

C. Request inspections from authorities having jurisdiction, obtain all permits and pay for all fees and inspection certificates as applicable and/or required. All permits and certificates shall be turned over to the Owner's Project Manager s at the completion of the work. Copies of permits shall be given to the resident engineer prior to the start of work.

D. Unless otherwise specified or indicated, materials and workmanship and equipment performance shall conform with the latest edition of the following standards, codes, specifications, requirements and regulations:

1. State Building Code
2. State Electrical Code
3. National Fire Protection Association (NFPA)
4. Local Town Regulations and By-laws
5. Underwriter's Laboratories, Inc. (UL)
6. National Electrical Manufacturer's Association (NEMA)
7. American National Standards Institute (ANSI)

E. All electrical work shall meet or exceed any other state and local codes and/or authorities having jurisdiction including all other standards indicated herein.

## 1.7 SURVEYS AND MEASUREMENTS

A. Base all required measurements, both horizontal and vertical, on reference points established by the Construction Manager and be responsible for the correct laying out of the electrical work. In the event of a discrepancy between actual measurements and those indicated, notify the Construction Manager in writing, and do not proceed with the work required until written instructions have been issued by the Construction Manager.

## 1.8 COORDINATION

A. HVAC, Plumbing, Fire Protection, and Electrical Drawings are diagrammatic. They indicate general arrangements of mechanical and electrical systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet architectural requirements.

1. Grounding: Plans showing dimensioned locations of grounding features specified including test wells, ground rods. ground rings. grounding arrangements and connections for separately derived systems.

2. Cable Trays: Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements.

Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

a. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
    1) Vertical and horizontal offsets and transitions.
    2) Clearances for access above and to sides of cable trays.
    3) Vertical elevation of cable trays above the floor or bottom of ceiling structure.
    4) Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

B. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow speedy and efficient completion of the work.

C. Furnish to other trades advance information on locations and sizes of all frames, boxes, sleeves and openings needed for their work, and also furnish information and shop drawings necessary to permit trades affected by the work to install same properly and without delay.

D. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated, request information from Designer. Where the electrical work shall interfere with the work of other trades, assist in working out the space conditions to make satisfactory adjustments before installation. Without extra cost to Owner, make reasonable modifications to the work as required by normal structural interferences. Pay the Construction Manager for additional openings, or relocating and/or enlarging existing openings through concrete floors, walls, beams and roof required for any work which was not properly coordinated. Maintain maximum headroom at all locations. All piping, duct, conduit, and associated components to be as tight to underside of structure as possible.

E. If any electrical work has been installed before coordination with other trades so as to cause interference with the work of such trades, all necessary adjustments and corrections shall be made by the electrical trades involved without extra cost to Owner.

F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Designer for review and approval.

G. Protect all materials and work of other trades from damage which may be caused by the electrical work, and repair all damages without extra cost to Owner.

## 1.9 INSTALLATION REQUIREMENTS

A. The arrangement of all electrical work shown on the drawings is diagrammatic only and indicates the minimum requirements of the work. Conditions at the building including actual measurements shall determine the details of the installation. All work shall be laid out and installed so as to require the least amount of cutting and patching.

B. Check the architectural plans and specifications before ordering any material and equipment. Any discrepancies shall be brought to the attention of the Designer for his determination prior to proceeding with the work.

1.10 TYPICAL DETAILS

A. Typical details where shown on the drawings shall apply to each and every item of the project where such items are applicable. They are not repeated in full on the drawings, which in many cases are diagrammatic only, but with the intention that such details shall be incorporated in full. Any alternate method proposed for use by the Electrical Subcontractor shall have the prior approval of the Designer.

1.11 SLEEVES, INSERTS

A. Furnish and install all sleeves, inserts, anchor bolts and similar items to be set into masonry or concrete, as required for mechanical and electrical work. Internal diameter of sleeve shall be 2" larger than the outside diameter of the pipe or insulation covered line passing through it.

1.12 ACCESSIBILITY

A. Install all work such that parts requiring periodic inspection, operation, maintenance and repair are readily accessible.

B. Furnish all access panels appropriate to particular conditions, to be installed by trades having responsibility for the construction of actual walls, floors or ceilings at required locations.

1.13 SUPPLEMENTARY SUPPORTING STEEL

A. Provide all supplementary steelwork required for mounting or supporting equipment and materials.

B. Steelwork shall be firmly connected to building construction as required.

C. Steelwork shall be of sufficient strength to allow only minimum deflection in conformity with manufacturer's published requirements.

D. All supplementary steelwork shall be installed in a neat and workmanlike manner parallel to floor, wall and ceiling construction; all turns shall be made at forty-five and ninety degrees, and/or as dictated by construction and installation conditions.

E. All manufactured steel parts and fittings shall be galvanized.

1.14 TOOLS AND EQUIPMENT

A. Provide all tools and equipment required for the fabrication and installation of the mechanical and electrical equipment at the site.

1.15 PORTABLE AND DETACHABLE PARTS

A. The Electrical Subcontractor shall retain in their possession all portable and/or detachable parts and portions of materials, devices, equipment etc. necessary for the proper operation and

maintenance of the mechanical and electrical systems until final completion of the work, at which time they shall be handed over to Owner's Project Manager.

## 1.16 RECORD DRAWINGS, PROJECT CLOSEOUT

A. Comply with requirements specified in Section 017700 – CONTRACT CLOSEOUT.

B. This trade shall submit the record set for approval by the fire and building departments in a form acceptable to the departments, when required by the jurisdiction.

C. Drawings shall show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer and make and model numbers of final equipment installation.

## 1.17 GUARANTEE/WARRANTY

A. Guarantee Work of this Section in writing for one year from the date of substantial completion. Guarantees or warranties that start at the date of shipment from the factory, or from the completion date of an individual portion of the project, are not acceptable. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Designer's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

B. In addition to guarantee requirements of Division 01 and of Subparagraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in User Agency's name.

1. Upon receipt of notice from Owner's Project Manager of failure of any part of the systems or equipment during the warranty period, the affected part or parts shall be replaced by the Electrical Subcontractor without any reimbursement.
2. At nine months into the one-year guarantee period, the Electrical Subcontractor shall perform a 100% test of all installed equipment. Any device and/or part found to be defective shall be repaired and/or replaced at no cost to Owner. The Electrical Subcontractor shall notify the fire department one month in advance of the 100% test.
3. Replace material and equipment that require excessive service during guarantee period as defined and as directed by Designer.
4. Provide 24-hour service beginning on the date the project is accepted by Owner, whether or not fully occupied, and lasting until the termination of the guarantee period. Service shall be at no cost to Owner. Service can be provided by the Electrical Subcontractor or a separate service organization. Choice of service organization shall be subject to Designer and Owner's Project Manager's approval. Submit name and a phone number that will be answered on a 24-hour basis each day of the week, for the duration of the service.
5. Submit copies of equipment and material warranties to Designer before final payment.
6. At end of guarantee period, transfer manufacturers' equipment and material warranties still in force to User Agency.
7. This Paragraph shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.
8. Part 2 Paragraphs of this Specification may specify warranty requirements that exceed those of this Paragraph. Those paragraphs will govern.

9. Use of systems provided under this Section for temporary services and facilities shall not constitute Final Acceptance of work by Owner's Project Manager, and shall not initiate the guarantee period.
10. Non-durable items, such as electric lamps, shall be replaced up to the date of acceptance, such that they shall have had no more than 100 hours use prior to this date.
11. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's Project Manager's satisfaction, advise Designer in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Designer will direct course of action.

## 1.18 OPERATING, INSTRUCTION AND MAINTENANCE MANUALS

A. Comply with requirements specified in Section 017700 – CONTRACT CLOSEOUT, including CAMIS spreadsheet data collection for Equipment Template and PM Procedure tabs.

B. Each copy of the approved operating and maintenance manual shall contain copies of approved shop drawings, equipment literature, cuts, bulletins, details, equipment and engineering data sheets and typewritten instructions relative to the care and maintenance for the operation of the equipment, all properly indexed. Each manual shall have the following minimum contents:

1. TABLE OF CONTENTS
2. Introduction
    a. Explanation of manual and its purpose and use.
    b. Description of the electrical systems.
    c. Safety precautions necessary for equipment.
    d. Illustrations, schematics and diagrams.
    e. Installation drawing.
3. Maintenance
    a. Maintenance and lubricating instructions.
    b. Replacement charts.
    c. Trouble shooting charts for equipment components.
    d. Testing instructions for each typical component.
    e. Two typed sets of instructions for ordering spare parts. Each set shall include name, price, telephone number and address of where they may be obtained.
4. Manufacturer's Literature
    a. The equipment for which shop drawings have been submitted and approved.
    b. Power Monitoring: Software and Firmware Operational Documentation:
        1) Software operating and upgrade manuals.
        2) Software licenses.
        3) Software service agreement.
        4) PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Provide separately for each PC.
        5) Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on compact disk or portable storage device with a USB interface of the hard-copy submittal.
        6) Program Software Backup: On compact disk or portable storage device with a USB interface, complete with data files.
        7) Device address list.

8) Printout of software application and graphic screens.

1.19 SERVICE CHARACTERISTICS

A. Primary Utility Voltage: 13.8kW

B. Secondary Building Voltage - High Level: 480/277V

C. Secondary Building Voltage - Low Level: 208/120V

D. All equipment and wiring shall be suitable for the applied voltage.

1.20 QUALITY ASSURANCE

A. The requirements of the State Building Code and local regulations establish the minimum acceptable quality of workmanship and materials, and all work shall conform thereto unless more stringent requirements are indicated or specified herein.

B. All work shall comply with the latest editions of the codes as referenced herein.

C. Follow manufacturer's directions for articles furnished, in addition to directions shown on drawings or specified herein.

D. Protect all work, materials, and equipment from damage during process of work. Replace all damaged or defective work, materials and equipment without additional cost to Owner.

E. All equipment and materials for permanent installation shall be the products of recognized manufacturers and shall be new.

F. Equipment and materials shall:

1. Where normally subject to Underwriters Laboratory Inc. listing or labeling services, be so listed or labeled.
2. Be without blemish or defect.
3. Not be used for temporary light and power purposes.
4. Be in accordance with the latest applicable NEMA standards.
5. Be products which will meet with the acceptance of all authorities having jurisdiction over the work. Where such acceptance is contingent upon having the products examined, tested and certified by Underwriters or other recognized testing laboratory, the product shall be so examined, tested and certified.

G. Except for conduit, conduit fittings, outlet boxes, wire and cable, all items of equipment or material of one generic type shall be the product of one manufacturer throughout.

H. For items which are to be installed but not purchased as part of the electrical work, the electrical work shall include:

1. The coordination of their delivery.
2. Their unloading from delivery trucks driven into any point on the property line at grade level.

3. Their safe handling and field storage up to the time of permanent placement in the project.
4. The correction of any damage, defacement or corrosion to which they may have been subjected. Replacement if necessary shall be coordinated with Contractor who originally purchased the item.
5. Their field make up and internal wiring as may be necessary for their proper operation.
6. Their mounting in place including the purchase and installation of all dunnage, supporting members, and fastenings necessary to adapt them to architectural and structural conditions.
7. Their connection to building wiring including the purchase and installation of all termination junction boxes necessary to adapt and connect them to this wiring. Included also shall be the purchase and installation of any substitute lugs or other wiring terminations as may be necessary to adapt their terminals to the building wiring as called for and to the connection methods set forth in these specifications.

I. Items which are to be installed but not purchased as part of the electric work shall be carefully examined upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of the electric work will be considered only if presented in writing within one week of the date of delivery to the project of the items in question. The electric work includes all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

## 1.21 DELIVERY, STORAGE AND HANDLING

A. All materials for the work of this section shall be delivered, stored and handled so as to preclude damage of any nature. Manufactured materials shall be delivered and stored in their original containers, plainly marked with the products' and manufacturer's name. Materials in broken containers or in packages showing watermarks or other evidence of damage, shall not be used and shall be removed from the site.

B. Transformers: On receipt, inspect for and note any shipping damage to packaging and transformer.

1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
2. Store in a warm, dry, and temperature-stable location in original shipping packaging.
3. Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
4. Follow manufacturer's instructions for lifting and transporting transformers.

## 1.22 FIRESTOPPING

A. Firestopping shall be provided by the Electrical Subcontractor for all penetrations of conduit, wireways, bus ducts, cable trays, cables. etc. installed by the Electrical Subcontractor, through fire-rated walls and floors and other fire-rated separations.

1. Excess space in framed openings through structural floors between conduits and concrete shall be grouted in with concrete to a depth of at least the thickness of the slab plus 2" minimum above the slab.
2. Conduit penetration through poured concrete or masonry walls shall be grouted in with concrete and provided with tight fitting escutcheon plates on both sides.
3. Conduit penetrations through fire-rated dry walls shall be with sleeves through the wall fitted with escutcheon plates on both sides with excess openings filled with fire stop material specifically manufactured for the purpose.
4. Excess space within conduit sleeves or stubs through floor slabs or walls where low voltage/telecommunications cables pass through shall be filled with firestopping material specifically manufactured for the purpose.
5. Utilize fire-rated fittings, as specified elsewhere for penetrations through floor slabs for supplying floor outlets.

B. All conduits/sleeves used for vertical cable passage shall be sealed utilizing suitable material after the installation of cables as follows:

1. The material shall be non-corrosive to the cable jacket or insulation that it applies to.
2. The material shall provide for a minimum of three-hour fire rating.
3. The material shall be non-shrinking, waterproof and smoke tight.
4. The material shall remain flexible and non-hardening.
5. The material shall be of the type that when installed will not slip through the openings, will stick to the surfaces of the openings and the cable and will not require any pressure to be applied to the cable in order to keep it in place.
6. The material shall be installed in a neat and workmanlike manner and the final installation shall be smooth finished to the top of the sleeve or conduit.
7. The material shall be easily removable without damaging the cables after being set or cured for at least one week.

C. The Electrical Subcontractor shall restore any existing firestopping that damaged in the process of executing the electrical scope of work.

D. All materials used for firestopping shall be approved for the purpose and the rating of the wall or floor and all methods employed shall meet with the approval of the local authorities.

## 1.23 STAGING AND SCAFFOLDING

A. Refer to requirements specified hereinabove.

## 1.24 EXTRA MATERIALS

A. Furnish extra materials described in following product specification sections that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

1.25 PHASING, DEMOLITION AND MAINTAINING EXISTING SERVICES

A. During the execution of the work, required relocation, etc., of existing equipment and systems in the existing building areas where new work is to be installed or new connections are scheduled to be made, shall be performed by the Electrical Subcontractor, as required by job conditions and as determined by the Designer in the field, to facilitate the installation of the new system, while demolition, relocation work or new tie ins will be performed. Outages required for construction purposes shall be scheduled for the shortest practical periods of time, in coordination with the User Agency's designated representative, for specified, mutually agreeable periods of time, after each of which the interruption shall cease and the service shall be restored. This procedure shall be repeated to suit the User Agency's working schedule, as many times as required until all work is completed. Any outages of service shall be approved by Owner's Project Manager, prior to commencing the work. No outages or shutdowns of service shall occur without the written authorization of the Owner's Project Manager prior to commencing the work. Give notice of any scheduled shutdowns, a minimum of weeks in advance. User Agency shall make their best efforts to meet this request without adversely affecting the electric service to the existing building.

B. Prior to any deactivation and relocation or demolition work, consult the drawings and arrange a conference with the Designer and the Owner's Project Manager in the field to inspect each of the items to be deactivated, removed or relocated. Care shall be taken to protect all equipment designated to be relocated and reused or to remain in operation and be integrated with the new systems.

C. All deactivation, relocation and temporary tie ins of electrical systems and equipment shall be provided by the Electrical Subcontractor. All demolition and removal of electrical systems and equipment designed to be demolished shall be provided by the Electrical Subcontractor. Place all demolished electrical materials except hazardous materials (PCB lighting ballasts, fluorescent lamps, etc.) As determined by the Authority having jurisdiction in Construction Managers provided dumpster. All hazardous electrical materials shall be legally disposed by the Electrical Subcontractor.

D. Owner's Project Manager reserves the right to inspect the material scheduled for removal and salvage any items he deems usable as spare parts.

E. Phasing:

1. The Electrical Subcontractor shall construct the subject project in phases as directed by the Designer to suit the project progress schedule, as well as the completion date of the project.
2. For additional information related to phasing, review the General Conditions and Supplementary Conditions and the architectural drawings.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

SECTION 26.05.00

COMMON WORK RESULTS FOR ELECTRICAL

## PART 1 - GENERAL

### 1.1 GENERAL PROVISIONS

A. Work of this Section requires is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

### 1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

### 1.3 SUMMARY

A. Section Includes:

1. Sleeves for raceways and cables.
2. Sleeve seals.
3. Grout.
4. Common electrical installation requirements.

### 1.4 SUBMITTALS

A. Product Data: For sleeve seals.

## PART 2 - PRODUCTS

### 2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

## 2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Or approved equal.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Carbon steel Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

# PART 3 - EXECUTION

## 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

## 3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".

J. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

## 3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION

SECTION 26.05.19

ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Work of this Section is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section "Summary", Paragraph 1.1A, entitled "Related Documents."

1.3 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 WARRANTY

A. Comply with Section 260001.

B. The Electrical Subcontractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers – Conductors and Cables

1. AFC Cable Systems, Inc.
2. Southwire.
3. Genera Cable.
4. Or approved equal.

B. Acceptable Manufacturers – Connectors and Splices

1. AFC Cable Systems, Inc.
2. 3M; Electrical Products Division.
3. Tyco Electronics Corp.
4. Or approved equal.

2.2 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70.

B. Conductor Insulation: 90 degree rated; Comply with NEMA WC 70 for THHN, THWN-2 and XHHW-2.

C. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

D. Emergency System Feeders: Emergency System Feeders: Mineral-insulated, metal-sheathed cable, Type MI.

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.4 METAL CLAD (MC) CABLE ASSEMBLY

A. Description

1. Metal clad cable assemblies shall consist of 2 or more insulated, current carrying copper conductors. The Metal-Clad Cable shall be UL Classified as a Through-Penetrating Product (XHLY) for use in One, Two or Three-Hour Through-Penetration Firestop Systems {XHEZ). Assembly shall be suitable for use in cable trays in accordance with the NEC.
2. Current-Carrying Conductors: Soft annealed copper in compliance with the latest edition of ASTM B3 and/or B8.

3. Each separate circuit conductor shall have its own dedicated neutral conductor. The dedicated neutral conductor shall be white/grey with a continuous color stripe matching the color of its dedicated circuit conductor. Multi-wire branch circuits are not allowed.
4. Grounding/Bonding Conductor: Full sized bare aluminum bonding/grounding conductor, sized in accordance with Table 6,1 of UL1569, working in combination with the armor to create a low resistance ground path. Aluminum bonding/grounding conductor shall be cabled with the current-carrying conductors and shall be in intimate contact with the metal armor.
5. Insulated Equipment Grounding Conductor: The equipment ground shall be full-sized in accordance with Table 6.1 of UL 1569 and shall be soft-annealed copper in compliance with the latest edition of ASTM B3 and/or B8.
6. Insulated Conductor: The insulated conductor shall be Type THHN 90°C DRY with an extruded polypropylene protective covering. The Type THHN Insulated Conductor with protective covering shall be manufactured and tested in accordance with UL 83 and UL 1569.
7. Armor: A zinc coated galvanized steel armor shall be applied over the cabled wire assembly with an interlock in compliance with Section 13 of UL 1569.

B. Fittings

1. Fittings shall be UL listed and identified for use with metal clad interlocking armor ground.
2. Connectors shall be of steel or malleable iron and shall have saddle clamp to insure a tight termination of MC Cable to box.

## 2.5 MINERAL INSULATE (MI) CABLE 2-HOUR RATED

A. Description

1. The wiring cable shall be 2-hour fire-rated.
2. The wiring cable shall be listed in the UL Fire Resistance Directory.
3. Mineral Insulated wiring Type MI cable shall have:
   a. Description: ANSI/NFPA 70, Type MI
   b. Conductor: solid high conductivity copper
   c. Insulation Voltage Rating: 600 volts
   d. Cable Temperature Rating: 90 degrees C
   e. Termination Temperature Rating: 90 degrees C
   f. Insulation Material: magnesium oxide
   g. Sheath Material: seamless soft-drawn copper
   h. Fire Rating: complete cable system shall have a 2-hour fire rating as listed and classified by Underwriters Laboratories, Inc.

4. The Electrical Subcontractor shall have a minimum of 10 years of experience in the installation of such systems.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Feeders:

1. Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN-2, single conductors in conduit.
2. Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN-2, single conductors in conduit.
3. Exposed Feeders, Including Crawl Spaces: Type THHN-THWN-2, single conductors in conduit.
4. Exposed Feeders on Building Exterior, Including Roofs: Type XHHW-2, single conductors in conduit.

C. Branch Circuits:

1. Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN-2, single conductors in conduit; Metal-clad cable, Type MC.
2. Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN-2, single conductors in conduit.
3. Exposed, including in Crawlspaces: Type THHN-THWN-2, single conductors in conduit. Coordinate all exposed runs of conduits with the Architect prior to installation.
4. Exposed on Building Exterior, Including Roofs: Type XHHW-2, single conductors in conduit. Coordinate all exposed runs of conduits with the Architect prior to installation.

D. Fire Alarm Cabling:

1. Concealed in Ceilings, Walls, and Partitions: Type FPLP, single conductors in conduit; Listed Fire Alarm Metal-clad cable, Type MC.
2. Exposed Risers: Type FPLP, single conductors in conduit.
   a. Coordinate all exposed runs of conduits with the Architect prior to installation.

3. Exposed: Type FPLP, single conductors in surface raceway.
   a. Coordinate all exposed runs of conduits with the Architect prior to installation.
   b. Exposed surface raceway shall not be permissible in the main public hallways unless permitted by the Architect in writing.

E. Emergency System Feeders in non-corrosive copper or brass environments: Mineral-insulated, metal-sheathed cable, Type MI.

F. Emergency System Feeders direct-buried: Mineral-insulated, metal-sheathed cable, Type MI with an extruded outer polyolefin jacket to provide additional protection.

G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

H. Class 1 Control Circuits: Type THHN-THWN-2, in raceway.

I. Class 2 Control Circuits: Type THHN-THWN-2, in raceway.

## 3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

I. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

## 3.4 INSTALLATION OF METAL CLAD (MC) CABLES

A. General

1. Pathways and Raceways are the support system for the infrastructure. All pathways shall be run perpendicular or parallel to the building structure. MC Cable bend radius shall not

be less than 7 times the external diameter of the cable. All horizontal cable shall be properly supported every 72". Infrastructure Support Systems include, but may not be limited to the following:

a. Properly supported Cable Trays.
b. Independent Cable Hangers spaced no more than 60" apart.
c. 'Trapeze" style supports.

2. In existing buildings, the preferred method of support is independently supported cable hangers. These hangers are to be suitable for installation of MC Cable.
3. In new buildings the preferred method is a combination of Cable Tray and/or J Cable Hangers. All backbone cable shall also follow these cable tray pathways. The primary cable routes will be located over corridors for future maintenance and access.
4. Wiring shall be installed in compliance with the latest version of the National Electrical Code and other applicable codes and standards as indicated elsewhere in these specifications.
5. Use of metal clad cable shall be permitted for lighting, equipment and receptacle branch circuits indicated on the Construction Drawings.
6. Bends in metal clad cable shall be made so that the cable will not be damaged. The radius of the curve of the inner edge of a bend shall not be less than 7 times the diameter of the metallic sheath.
7. Each branch circuit shall have its own neutral conductor from the branch circuit load back to the circuit breaker panelboard. Shared neutral conductors shall not be installed.
8. All wiring shall be identified with permanent wire labels, using alphanumeric designations. Terminations and splices shall be identically labeled for the same wire {i.e., common conductors terminated in multiple locations). Wire labels shall agree with the circuit designations on the Construction Drawings.
9. Identify conductors in outlets, pull boxes and similar locations where conductors are accessible with printed plastic adhesive tapes to show circuit numbers. Wrap tapes at least two turns around conductor. Mark panel identification number with felt tip pen on cloth or plastic tag and attach to entering conductors with nylon string.
10. Conductors in Enclosures: Provide neat and workmanlike installation with conductors tied with nylon wire ties in terminal cabinets, gutters, and similar locations.

B. Splices and Terminations

1. Splices at junction boxes shall be made with an approved, insulated, live spring type connectors.

C. Fittings

1. Fittings used for connecting metal clad cable to boxes, light fixtures or other equipment shall be UL listed and identified for such use.
2. Cable preparation for installation of fittings shall follow manufacturer's instructions.
3. The cable end shall be cleanly cut with metal clad cable rotary cutting tool to ensure flush seating of the cable into the fitting. Fitting securement screws shall be properly torqued.

D. Arrangement and Support

1. Where metal clad cables are exposed, run parallel with walls or structural elements. Vertical runs shall be plumb, horizontal runs level and parallel with structure, as

appropriate. Groups shall be racked together neatly with both straight runs and bends parallel and uniformly spaced.

2. Metal clad cables shall be securely fastened in place at intervals of not more than six feet, with suitable clamps or fasteners of approved type, and vertical runs shall be properly supported to present a secure installation.
3. Metal clad cable installed parallel to framing members, such as studs, joist, or rafters, shall be supported so that the nearest outside surface of the cable is not less than 1-1/4 inches {31 mm) from the nearest edge of the framing member. Where this distance cannot be maintained, the cable shall be protected by a steel plate, sleeve, or equivalent that is at least 1/16-inch thick.
4. Maintain at least 6-inch clearance between metal clad cables and other piping systems. Maintain 12-inch (300 mm) clearance between metal clad cables and heat sources such as flues, steam pipes, and heating appliances.
5. No metal clad cable shall be fastened to other conduits or pipes or installed so as to prevent the ready removal of other pipes or ducts for repairs.
6. Individual metal clad cables hung from roof structure or structural ceiling shall be supported by split-ring hangers and wrought-iron hanger rods. Where 3 or more metal clad cables are suspended from the ceiling in parallel runs, use steel channels, Unistrut or equal, hung from 1/2-inch (13 mm) rods to support the cables. The cables on these channels shall be held in place with metal clad cable clamps designed for the particular channel that is used.
7. Secure metal clad cable support racks to concrete walls and ceilings by means of cast-in-place anchors; die-cast, rustproof alloy expansion shields; or cast flush anchors. Wooden plugs, plastic inserts, or gunpowder driven inserts shall not be used as a base to secure conduit supports.
8. Metal clad cable shall be supported immediately on each side of a bend and not more than 1 foot (300 mm) from an enclosure where a run of metal clad cable ends.
9. Use of cable tray:
    a. Basket, ladder rack, or ventilated cable tray may be utilized for support of metal clad cabling.
    b. The sum of the cross-sectional areas of cables shall not exceed the maximum allowable cable fill area allowed by NEC.
    c. Ampacity of cables installed in cable tray shall meet the requirements of NEC.

10. Terminating metal clad cables into panelboards:
    a. Provide a junction box within plenum space with sweep elbows down to panelboard, or
    b. Use a ladder tray mounted vertically above the panelboard. Strap cables to rungs and install cover on cable tray.

E. Uses not permitted:

1. MC cables shall not be permitted within BSL-3 biocontainment areas.
2. MC cables shall not be permitted where installed exposed. In exposed areas MC cables may be installed in cable trays at the discretion of the Architect. Coordinate all runs in the exposed areas with the Architect prior to installation.

F. Inspections and Tests

1. General: The electrical installation shall be inspected and tested to ensure safety to building occupants and operating personnel and conformity to Code, authorities and contract documents.
2. Field tests shall be performed in conformance with the National Electrical Testing Association {NETA) Standards.
3. All fittings and locknuts shall be re-examined for tightness. A continuity test is to be performed at each connection as a final means of inspection for tightness of joints.

## 3.5 INSTALLATION OF MINERAL INSULATED (MI) CABLES

A. Examination

1. Verify that the factory installed temporary end seals are intact.
2. Verify that no moisture has entered cable insulation.

B. Storage

1. Cables shall be shipped from the manufacturer with ends sealed against moisture.
2. Protect the exposed cable ends with shrinkable, molded polyolefin end caps or other suitable means such as standard conduit sealing compound and PVC tape.
3. Cable shall be stored in a clean dry location.

C. Handling

1. Cable shall be uncoiled by rolling or rotating supply reel.
2. Take precautions necessary to prevent damage to cable from contact with sharp objects, such as when pulled over foreign material on sheaves.

D. Installation

1. The wiring cable shall be installed according to the manufacturer’s recommendations, the instructions in the Installation Specification or Manual and the requirements of the UL Fire resistance Directory listing.

E. Field Quality Control

F. Inspect cable for physical damage and proper connection.

G. Measure tightness of any bolted connections and compare torque measurements with manufacturer’s recommended values.

H. Verify continuity of each conductor.

I. Prior to energizing cables, measure insulation resistance of each cable. Tabulate and submit for approval.

J. Provide certification from cable manufacturer that installation is in accordance with their requirements.

## 3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

## 3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07.

END OF SECTION

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SECTION 26.05.26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Work of this Section is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section "Summary", Paragraph 1.1A, entitled "Related Documents."

1.3 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

1.6 WARRANTY

A. Comply with Section 260001.

B. The Electrical Trade Contractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

### 2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

### 2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad; 3/4-inch by10 feet (19 mm by 3 m) in diameter.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

## 3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

E. Manholes and Handholes: Metal covers and other exposed conductive surfaces shall be bonded in accordance with NEC Article 250.92 if the conductors are service conductors, or in accordance with NEC Article 250.96(A) if the conductors are feeder or branch-circuit conductors.

## 3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

F. Grounding for Lightning Protection System: Install 3/0 AWG copper grounding conductor, in conduit, to the building's main service ground busbar.

## 3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
    a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

B. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

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SECTION 26.05.29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 GENERAL PROVISIONS

A. Work of this Section is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

### 1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section "Summary", Paragraph 1.1A, entitled "Related Documents."

### 1.3 SUMMARY

A. Section includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

### 1.4 PERFORMANCE REQUIREMENTS

A. Provide supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Provide equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. 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 five times the applied force.

### 1.5 SUBMITTALS

A. Product Data: For steel 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. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

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. Manufacturers
   a. Cooper B-Line, Inc.; a division of Cooper Industries.
   b. Thomas & Betts Corporation.
   c. Unistrut; Tyco International, Ltd.
   d. Or approved equal.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. 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.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. 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. Manufacturers
        1) Hilti Inc.
        2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Or approved equal.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    a. Manufacturers
        1) Cooper B-Line, Inc.; a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) Or approved equal.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. 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.

## 2.3 WARRANTY

A. Comply with Section 260001.

B. The Electrical Subcontractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

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 required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other 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 1-1/2-inch (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 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 lb. (90 kg).

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 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (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.

F. The Electrical Subcontractor shall install all hangers and supports for electrical systems prior to fireproofing.

## 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.

## 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 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 09 painting Sections 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

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SECTION 26.05.33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Work of this Section is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section "Summary", Paragraph 1.1A, entitled "Related Documents."

1.3 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Boxes, enclosures, and cabinets

B. See Division 26 for exterior duct banks and manholes, and underground handholes, boxes, and utility construction.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 WARRANTY

A. Comply with Section 260001.

B. The Electrical Subcontractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Acceptable Manufacturers

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. O-Z Gedney; a unit of General Signal.
4. Or approved equal.

B. Rigid Metal Conduit (RMC): ANSI C80.1.

C. Electric Metallic Tubing (EMT): ANSI C80.3.

D. Flexible Metal Conduit (FMC): Zinc-coated steel.

E. Liquidtight Flexible Metal Conduit (LFMC): Flexible steel conduit with PVC jacket.

F. Fittings for Conduit (Including all Types and Flexible and Liquid tight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel, set screw or compression type.

2.2 METAL WIREWAYS

A. Acceptable Manufacturers

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric
4. Or approved equal.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 and Type 3R (exterior) unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type.

E. Finish: Manufacturer's standard enamel finish.

## 2.3 SURFACE RACEWAYS

A. Acceptable Manufacturers

1. Thomas & Betts Corporation.
2. Walker Systems, Inc.; Wiremold Company (The).
3. Wiremold Company (The); Electrical Sales Division.
4. Or approved equal.

B. Basis-of-Design Product: Wiremold/Legrand.

C. One Piece Surface Metal Raceways:

1. Wiremold #700 Series
   a. Factory finished color shall be ivory.

D. Two Piece Surface Metal Raceways:

1. Wiremold #2100, #3000, #4000, #6000 Series
   a. Factory finished color shall be ivory.

2. Where two-piece raceway covers pass through walls, floors, and/or ceilings, the cover shall be cut on both sides of the wall, floor or ceiling (maximum of 6” from edge of penetration) to permit removal of the cover on each side of the obstruction.
3. To maintain electrical continuity where two-piece surface raceway is fed from a flush mounted/recessed device box, use the appropriate manufactures connector fitting. If manufactures fitting is not available the back of raceway is to be cut out to the size of the device box opening and raceway attached to device box using appropriate size machine screws. The use of chase nipple is not acceptable.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

A. Acceptable Manufacturers

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
3. RACO; a Hubbell Company.
4. Or approved equal.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.

F. Nonmetallic Floor Boxes: Nonadjustable, round.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

J. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: RMC.
2. Concealed Conduit, Above ground: RMC, EMT.
3. Underground Conduit outside the foundation wall: Schedule 80 PVC, direct buried. Convert nonmetallic conduit to rigid steel conduit before rising through earth.
4. Underground Conduit within building confines: RMC, Schedule 80 PVC, direct buried. Convert nonmetallic conduit to rigid steel conduit before rising through earth.
5. Exposed or underground conduit to sewage ejector pump chamber: PVC coated RMC.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
7. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
8. Underground Raceways Warning Tapes: 6 inches wide by 0.004-inch-thick polyethylene film with aluminum coil detectable tape with appropriate label:
   a. Tape color red with label “Caution – Electrical Line Below”
   b. Tape color yellow with label “Caution – Communications Line Below”

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed: EMT.
2. Exposed and Subject to Severe Physical Damage: RMC. Includes raceways in the following locations:
   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.
   d. Lift station, chiller plants, tower yards, and boilers areas.
   e. Fire pump room.
3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: Rigid steel conduit; EMT (All supports, bolts, straps, strews, and so forth shall be of corrosion-resistant materials or protected against corrosion by corrosion-resistant materials).
6. Raceways for Optical Fiber or Communications Cable: EMT or plenum rated inner duct.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations; as well as in fire pump rooms, kitchen, lift stations areas, chiller plants, tower yards, boiler plants, and wells.
8. Exposed or underground conduit to sewage ejector pump chamber: PVC coated rigid steel conduit.
9. Exposed or underground conduit to acid neutralization chamber: PVC coated rigid steel conduit.
10. Exposed or concealed conduit in BSL-3 biocontainment areas: RMC.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

## 3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. Run conduits under floor slab as if exposed.

I. Restrictions Applicable to EMT

1. Do not use where subject to severe physical damage.
2. Do not use in fire pump rooms.

J. Restrictions Applicable to Flexible Conduit

1. Use only as specified in paragraph FLEXIBLE CONNECTIONS. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

K. Conduit Support

1. Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work.
2. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load.
3. Fasteners attached to concrete ceiling shall be vibration resistant and shock resistant.
4. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes.
5. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system.
6. Conduit and box systems shall be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts.
7. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems.
8. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Support exposed risers in wire shafts of multistory buildings by U-clamp hangers at each floor level and at 10-foot maximum intervals.
9. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means.

10. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

L. Directional Changes in Conduit Runs

1. Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

M. Locknuts and Bushings

1. Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

N. Flexible Connections

1. Provide flexible steel conduit between 3 and 6 feet in length for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 1/2-inch diameter. Provide liquid-tight flexible conduit in wet and damp locations and in fire pump rooms for equipment subject to vibration, noise transmission, movement, or motors. Provide separate ground conductor across flexible connections.

O. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

Q. Raceways for Optical Fiber and Communications Cable: Install as follows:

1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

R. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a

blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

S. Expansion-Joint Fittings for Rigid Nonmetallic Conduit: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   d. Attics: 135 deg F (75 deg C) temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

T. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi recessed lighting fixtures, ]equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

END OF SECTION

SECTION 26.05.48

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Work of this Section is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section "Summary", Paragraph 1.1A, entitled "Related Documents."

1.3 SUMMARY

A. Section includes:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the State Building Code.
2. Assigned Seismic Use Group or Building Category as Defined in the State Building Code.

1.5 SUBMITTALS

A. Product Data: For the following.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.

2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:
a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Welding certificates.

D. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on

calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

D. Comply with NFPA 70.

1.7 WARRANTY

A. Comply with Section 260001.

B. The Electrical Subcontractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Mountings Co., Inc.

2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.

4. Or approved equal.

B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.

3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.2 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Or approved equal.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: [Steel tube or steel slotted-support-system sleeve with internally bolted connections] [Reinforcing steel angle clamped] to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### 3.2 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

## 3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

## 3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
2. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
3. Test to 90 percent of rated proof load of device.
4. Measure isolator restraint clearance.
5. Measure isolator deflection.
6. Verify snubber minimum clearances.
7. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

## 3.5 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

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SECTION 26.05.53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 GENERAL PROVISIONS

A. Work of this Section is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

### 1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section "Summary", Paragraph 1.1A, entitled "Related Documents."

### 1.3 SUMMARY

A. This Section includes the following:

1. Identification for conductors and communication and control cable.
2. Warning labels and signs.
3. Equipment identification labels.

### 1.4 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

### 1.5 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

### 1.6 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

1.7 WARRANTY

1. Comply with Section 260001.

2. The Electrical Subcontractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.

C. Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical systems, provide tags of plasticized card stock, preprinted.

D. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

E. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).

F. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).

G. Fasteners for Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

H. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 mm)."

2.2 ELECTRICAL SYSTEM IDENTIFICATION

A. Manufacturers:

1. T&B.
2. 3M
3. EMED Co.
4. Or approved equal.

B. Identification of Equipment:

1. All pieces of major electrical equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Care shall be taken not to obliterate this nameplate in any way.
2. The Electrical Subcontractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, junction boxes, etc., by marking them. All items of equipment, pull boxes, junction boxes, etc., shall be clearly marked using engraved nameplates as hereinafter specified. The item of equipment shall indicate the same number as shown on the Drawings, where applicable.
3. White background and black letters equipment nameplates shall be three ply laminated plastic, a minimum of 3/32" thick, black background, white letters for normal power, red background, white letters for emergency power, and blue-white-blue for UPS power. Letters shall be similar to Roman Gothic of a size that is legible (1/2" minimum for main nameplates and 3/8" minimum for branch device nameplates) and appropriate to the application. Attachment of nameplates shall be by stainless steel screws. Rivets or adhesives are not acceptable.
   a. Electrical equipment to be identified includes: All switchgear, switchboards, unit substations, distribution panels, transformers, motor control centers, panelboards, automatic transfer switches, busway plugs, disconnect switches, motor controller/starters, lighting control panels, pull boxes, junction boxes, and similar equipment.
   b. Nameplates on switchgear, switchboards, unit substations, automatic transfer switches, transformers, distribution panels, motor control centers, disconnect switches, motor controller/starters, variable frequency drives and panelboards shall give voltage and current characteristics and the source feeding the panel. Current characteristics shall indicate the size of the overcurrent devices serving the equipment and not the equipment current rating.
      1) Provide panel and circuit designation on disconnect switches, motor controllers/starters, variable frequency drives, etc.

      Example:

      PANEL PP2
      120/208V, 3PH, 4 W, 225 A
      Fed from DPA-3
      Room 1.102

   c. Individual overcurrent devices and pilot lights in switchgear, switchboards, unit substations, distribution panels, motor control centers, and similar equipment shall have nameplates showing the load served and its location, where remote. Nameplates on motor starters shall indicate variable speed, time delay operation, etc., where applicable.
   d. Blank nameplates shall be mounted on each spare or bussed space in motor control centers, and on each spare or space in distribution panels.

e. Branch circuit panelboards shall have neatly typed circuit directories behind clear plastic. Identify circuits by room numbers. Room numbers shall be those finally selected by the Owner; not necessarily those given on contract Drawings. Spares and spaces shall be indicated with erasable pencil; not typed. Circuit numbers shall be provided in the directory and at each circuit breaker.

C. Conduit Systems: Provide adequate marking of major conduit, which is exposed or concealed in accessible spaces, to distinguish each run as either a normal power, emergency power, fire alarm, control wiring or voice/data conduit. Except as otherwise indicated, use white banding with black lettering except that emergency power orange and white, fire alarm conduit markers shall use red banding. Provide self-adhesive or Snap-On type plastic markers. Indicate voltage ratings of conductors exceeding 250 volts. Locate markers at ends of conduit runs, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors, or enters non-accessible construction and at spacings of not more than 30' along each run of exposed conduit.

D. Cable Tray Systems: Provide engraved nameplates identifying cable tray systems as to use, on maximum 50' centers on all tray systems and whenever a tray enters a room or concealed accessible location. Nameplate text shall be submitted to the Engineer for review.

E. Underground Cable Identification: Bury a continuous, preprinted, red and silver metallic ribbon cable marker, Brady No. 91600 Series or an approved equal with each underground cable (or group of cables), regardless of whether conductors are in conduit or direct buried. Locate each directly over cables, 12" above cable below finished grade. Ribbons shall be detectable from above grade using a pipe or cable locator.

F. Cable/Conductor Identification: Coordinate a uniform and consistent scheme of color identification of power wiring throughout the building system. Identification shall be by the permanent color of the selected covering. On large conductors, secure identification by means of painted color banding or plastic tape.

1. Color scheme shall be as follows, [or as required to match the existing color coding in the building for 120/240 V systems with high leg provide Orange for phase B]

| | 208/120 Volt | 480/277 Volt | 5kV/15kV |
|---|---|---|---|
| Phase A | Black | Brown | Black |
| Phase B | Red | Purple | Red |
| Phase C | Blue | Yellow | Blue |
| Neutral | White | Gray | White |
| Ground | Green | Green | |

2. Wiring for switches shall be same color as phase wire.
3. Colored insulation in sizes up through #4. Conductors #3 and larger may have black insulation, but color coded with 1/2" wide band of colored tape, at accessible locations. Rap conductor minimum 6" width.
4. Feeder cables shall be tagged in pull boxes, wireways, wiring gutters of panels, and at other accessible locations. Tags shall be fireproof, nonconductive material, approved by Architect.
5. Maintain same conductor color from service entrance to last device.

G. Phase Rotation: Phase rotation shall be maintained throughout the project.

1. Phase rotation shall be clockwise or counterclockwise, per serving power company standards, A-B-C, and identified as such left-to-night, top-to-bottom, and front-to-back with color coding as specified above at switchboards, panelboards, substations, transformers, motor control centers, motor starters, and similar locations.
2. Motor phase reversal, if necessary, shall be made at motor controller.

H. Branch Circuit and Control Wiring Tags: All branch circuit and control wiring conductors shall be tagged using self-sticking vinyl cloth or mylar cloth wire markers. Embossed pressure sensitive plastic or metal ribbon markers will not be accepted. Tags shall be installed at all wiring splice, tap and termination points and shall correspond to the designations shown on the control wiring diagrams or panel schedules.

I. Branch Circuit Pull Boxes and Junction Boxes: Branch circuit pull boxes shall be neatly stenciled with a black permanent marker indicating the panel name and branch circuit number. Boxes on emergency power systems shall be painted orange prior to marking. Boxes on fire alarm power systems shall be painted red prior to marking.

J. Miscellaneous Switch Plates or Device Plates: Adhesive Film Label with Clear Protective Overlay for interior use: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

1. Nomenclature shall include the panel and circuit of the outlet or switch, or the indication of the pilot, or the area of control, or equipment served.
2. Switched and non-switched device plates shall be engraved. Engraving shall be 3/16" condensed Gothic and shall be filled with black enamel.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

### 3.2 CLEANING AND PAINTING OF ELECTRICAL WORK

A. Prime, protective and touch-up painting is included in the Work of this Division. Finish painting in equipment spaces, concealed locations, and other locations not exposed to the view of building occupants is included in the work of this Division. Finished painting in areas exposed to the view of building occupants is specified under Division 9.

B. All equipment and materials furnished by the Electrical Subcontractor shall be delivered to the job with suitable factory protective finish.

C. Electrical switchgear, disconnect switches, contactors, etc., with suitable factory-applied finishes shall not be repainted; except for aesthetic reasons where located in finished areas as directed by the Architect and in a color selected by the Architect. Where factory-applied finishes are damaged in transit, storage or installation, or before final acceptance, they shall be restored to factory-fresh condition by competent refinishers using the spray process.

D. All equipment not finished at the factory shall be given a prime coat and then finish painted with two coats of enamel in a color as directed by the Architect/Engineer. No nameplates on equipment shall be painted, and suitable protection shall be afforded such plates to prevent their being rendered illegible during the painting operations.

E. The surfaces to be finish-painted shall first be prepared as follows:

1. Galvanized and black steel surfaces shall first be painted with one coat of galvanized metal primer.
2. Aluminum surfaces shall first be painted with one coat of zinc chromate primer.

F. All ferrous metal surfaces without a protective finish and not galvanized in exposed and concealed areas including chases, under floor and above ceilings shall be painted with two coats of zinc chromate primer as the construction progresses to protect against deterioration.

G. All junction and pull boxes and covers which are part of raceway systems distributing emergency power shall be painted orange. Where a multiple branch emergency power system is installed, the branch designation (LS, CB or EQ) shall be stenciled on the box cover in minimum one inch (1") high white letters.

H. All junction and pull boxes and covers and terminal cabinets which are part of the raceway/wiring system for emergency alarm wiring shall be painted orange and fire alarm wiring shall be painted red. A system designation (FA) shall be stenciled on the box or cabinet cover in minimum one inch (1") high white letters.

I. All conduit exposed to view shall be finish painted as directed by the Architect.

J. Before painting, all surfaces to be painted shall be suitably prepared. This shall include removing all oil, rust, scale, dirt, and other foreign material. Surfaces shall be made smooth by grinding, filing, brushing, or other approved method. In the painting operations, the primer for metal surfaces shall be of the zinc dust type unless specified otherwise, and where finish painting is specified, it shall be painted using materials and colors selected and approved by the Architect. Refer to Division 9 for additional requirements.

END OF SECTION

SECTION 26.27.26

WIRING DEVICES

## PART 1 - GENERAL

### 1.1 GENERAL PROVISIONS

A. Work of this Section is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

### 1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section "Summary", Paragraph 1.1A, entitled "Related Documents."

### 1.3 SUMMARY

A. This Section includes the following:

1. Receptacles.
2. Snap switches.
3. Time switches.
4. Occupancy and daylighting sensor control.
5. Emergency lighting control relay.
6. Lighting contactors.
7. Emergency shunt relay.

### 1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 WARRANTY

A. Comply with Section 260001.

B. The Electrical Subcontractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WIRING DEVICES

A. Manufacturers

1. Legrand; Wiring Devices & Accessories (Legrand).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Or approved equal.

2.2 BASIS OF DESIGN

A. Basis of design based upon products by Legrand.

2.3 RECEPTACLE OUTLETS

A. General: All receptacle outlets shall be tamper-resistant.

B. Tamper-Resistant Convenience Receptacles, 125V, 20A: Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL498 and Federal Specification W-C-596. Prewired pigtail connectors that accommodate Fed Spec receptacles are approved. Must be crimped and welded terminal right-angle application connector.

1. Pass & Seymour: TR5351 (single), TR5362 (duplex), PTTR5362 (use with PTRA6STRNA prewired pigtail connector).

C. Weather-Resistant Convenience Receptacles, 125V, 20A: Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL498 and Federal Specification W-C-596. Prewired pigtail connectors that accommodate Fed Spec receptacles are approved. Must be crimped and welded terminal right-angle application connector.

1. Pass & Seymour: WR5362.

2. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant thermoplastic with lockable while-in-use cover.
   a. Hubbell: MX3200 single gang
   b. Hubbell: MX6200 dual gang

D. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL 498, Federal Specification W-C-596 and UL943, Class A, and include indicator light that is lighted when device is tripped.

1. Pass & Seymour: 2097TR.

## 2.4 SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Pass & Seymour; CSB20AC1 (single pole), PT20AC1 (single pole – use with PTS6STR3 prewired pigtail connector), CSB20AC2 (two pole), CSB20AC3 (three way), PT20AC3 (three way – use with PTS6STR4 prewired pigtail connector), CSB20AC4 (four way).

C. Finishes

1. Color by Architect.

## 2.5 WALL PLATES

A. Single and combination types:

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover and listed and labeled for use in "wet locations."
5. Coordinate colors with the Architect.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at the proper heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

## 3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign material from outlet boxes.

## 3.3 INSTALLATION

A. Perform work in a neat and workmanship manner in accordance with NECA 1 and where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

   A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

   1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
   2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
   3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
   4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

   1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
   4. Existing Conductors:
      a. Cut back and pigtail or replace all damaged conductors.
      b. Straighten conductors that remain and remove corrosion and foreign matter.

c. Pig-tailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

I. Install lighting control devices in accordance with manufacturer’s instructions.

J. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

K. Install lighting control devices plumb and level and held securely in place.

L. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on

wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough opening. Do not use oversized wall plates in lieu of meeting this requirement.

M. Occupancy Sensor Locations:

1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturers recommendations, in order to minimum false triggers.

N. Outdoor Photo Control Locations:

1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install photo sensor facing east, west or down.
2. Locate outdoor photo controls so that photo sensor do not face artificial light sources, including light sources controlled by the photo control itself.

O. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.

P. Lamp Burn-in: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer’s recommendation prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

Q. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel inaccessible ceiling near the sensor location.

R. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

S. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

T. Where indicated or required, provide cabinet or enclosure for mounting of lighting control device system components.

## 3.4 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

## 3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

C. Lighting Control:

1. Inspect each lighting control device for damage and defects.
2. Test occupancy sensors to verify operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
3. Test outdoor photo controls to verify proper operation, including time delays where applicable.
4. Correct wiring deficiencies and replace damaged or defective lighting control devices.

## 3.6 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensors settings to minimize undesired activations while optimizing energy savings, and to achieve optimal coverage as required.

C. Where indicated or as directed by Architect/Engineer, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

D. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect/Engineer.

## 3.7 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

## 3.8 COMMISSIONING

A. Comply with requirements specified in Division 1.

B. Engage a factory-authorized service representative to supervise and assist with startup service. Complete installation and startup checks according to the approved manufacturer's written instructions.

## 3.9 TRAINING AND SERVICE

A. Comply with Section 26 00 01.

B. Conduct two 4-hour training sessions. Train the Owner’s maintenance personnel on procedures and schedules related to start up and shutdown, troubleshooting, servicing, and preventive maintenance.

END OF SECTION

SECTION 27.53.19

PUBLIC SAFETY RADIO DISTRIBUTED ANTENNA SYSTEM (DAS)

## PART 1 - GENERAL

### 1.1 GENERAL PROVISIONS

A. Work of this Section is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

### 1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.1A, entitled “Related Documents.”

### 1.3 SUMMARY

A. It is the intent of these specifications that the Electrical Subcontractor, Manufacturer and/or its Authorized System Integrator expeditiously furnishes and installs a system complete in every respect and ready to operate. All miscellaneous items and accessories required for such installation, whether or not each such item or accessory as shown on the plans or mentioned in these specifications, shall be furnished and installed.

B. This specification describes the criteria for deploying a Public Safety Radio Distributed Antenna System (DAS). The DAS components specified in this document include: Bi-Directional Amplifiers (BDA), Donor Antennas, Coverage Antennas, Coax Cable, Coax Connectors, Splitters, Combiners and Couplers. These devices shall be used as part of a system, by the DAS integrator, experienced with designing projects for in-building, public safety, 2-way radio systems.

C. It shall be the integrator’s responsibility to base the design on the frequency ranges used by both Police and Fire departments and any proposal/submittal shall be reflective of advance investigation of this requirement. The system shall include a true, integrated battery backup unit which is serially connected to the main BDA system. Small UPS units not serially connected shall not be acceptable.

### 1.4 ABBREVIATIONS AND ACRONYMS

A. ACG: Automatic Gain Control

B. AHJ: Authority Having Jurisdiction

C. ATP: Acceptance Test Plan

D. BDA: Bi-Direction Amplifier

E. BOM: Bill-of-Material

F. DAS: Distributed Antenna System

G. EBS: Educational Broadband Service

H. ESMR: Enhanced Specialized Mobile Radio

I. FCC: Federal Communications Commission

J. GUI: Graphical User Interface

K. LMR: Land Mobile Radio

L. MTBF: Mean Time Between Failure

M. NFPA: National Fire Protection Association

N. NMS: Network Management System

O. PSN: Public Safety Network

P. RoF: Radio-over-Fiber

Q. RSL: Received Signal Level

R. SMR: Specialized Mobile Radio

S. SMS: Short Message Service

T. SNIR: Signal-to-Noise Interference Ratio

U. SOW: Statement of Work

V. VSWR: Voltage Standing Wave Ratio

## 1.5 DEFINITIONS

A. Acceptance: Expressed approval by the AHJ and owner's representative.

B. Specialty Trade Contractor: The Contractor experienced in installation and commissioning of 2-way Public Safety Radio In-Building Systems.

## 1.6 FIRE DEPARTMENT SUBMISSIONS

A. The vendor will complete a Fire Alarm Permit Application acquired from the Fire Prevention Division stating a Bi-Directional Antenna "BDA" installation.

B. Plan Review: Provide one line, schematic and detail drawings of the proposed system architecture. Indicate proposed locations for system components. Provide specifications for procurement and installation of a complete system for review by the Fire Department and all other agencies and authorities having jurisdiction (included will be operational frequencies).

C. Testing and Commissioning: Coordinate the completion date of the Fire Department radio signal repeater system so as to permit a Certificate of Occupancy to be obtained in a timely manner, in accordance with a schedule established by the owner's project manager.

D. The entire system shall meet with the approval of the Fire Department and all other agencies and authorities having jurisdiction before a Certificate of Occupancy will be issued.

## 1.7 QUALITY ASSURANCE

A. Qualifications: The Integrator shall be an authorized reseller of the proposed system and shall employ NICET certified technicians.

## 1.8 CODES, STANDARDS AND CERTIFICATIONS

A. All work, including but not limited to: cabling, pathways, support structures, wiring, equipment, installation, workmanship, maintenance and testing shall comply with the latest editions of the National Fire Protection Association (NFPA), National Electrical Code, National Electrical Safety Code, all applicable local rules and regulations, equipment manufacturer's instructions, and the National Electrical Contractors Association (NECA) Standard of Installation. In case of discrepancy or disagreement between the documents noted above, the Electrical Subcontractor shall satisfy the most stringent requirements.

B. Requirements set forth by first-responder code, ordinance, or the AHJ shall supersede the requirements described herein and shall be met in their entirety. It is the Electrical Subcontractor's responsibility to ensure that the installation complies with local code, ordinances or requirements established by the AHJ.

## 1.9 SUBMITTALS

A. The Electrical Subcontractor, prior to beginning the on-site installation, is required to submit, for approval by the owner, a complete list of the proposed equipment with a system diagram showing how the various components are interconnected and their function. Included in the submittal shall be:

1. Prior to assembling or installing the system, the Electrical Subcontractor shall provide complete shop drawings which include the following:
    a. List the name of the manufacturer's local representative and his/her phone number.
    b. Table of contents.
    c. Manufacturer's parts lists
    d. Product serial numbers
    e. Catalog cut sheets
    f. Installation instructions
    g. Typical wiring diagrams
    h. Drawings showing equipment locations

i. Manufacturer’s warranty documents

2. All drawings shall be fully dimensioned.
3. Operating License: Submit evidence of application for FCC Radio Station Authorization prior to installing equipment when required for operation of the equipment.
4. Product Data: Submit manufacturer datasheets for the following components:
   a. Bi-Directional Amplifiers (BDA)
   b. Donor and Coverage Antennas
   c. Coaxial Cable and Connectors
   d. Splitters, Combiners and Couplers
   e. Fiber-Optic Master Unit (if needed)
   f. Fiber-Optic Remote Units (if needed)

5. Shop Drawings: Submit the following items:
   a. RF site survey results
   b. System overview and riser diagram.
   c. Overlay of system components on floor plans.
   d. Donor Antenna lightning suppression and grounding details

6. Statement of Work (SOW): Submit a brief description of the DAS integrator role and responsibilities on this project. At a minimum, the services included shall be to perform the RF survey, systems design, test, optimization and commissioning of the DAS system
7. Acceptance Test Plan (ATP): Submit a proposed ATP including cable testing reports.

B. Submittal Requirements at Close Out

1. Drawings: Submit as-built drawings indicating:
   a. A final, signed copy of all previously submitted documents reflecting the final, as-built
   b. representation, equipment used and details
   c. Cable routing, splitters, couplers and coverage antenna final locations
   d. Active component locations, layout, configuration and programmed parameters

2. Test Reports
   a. Submit Accepted ATP reports.

3. Field Reports: Submit sweep-testing results for all cable runs.
4. Field Reports: Submit OTDR test results for all fiber runs.
5. Operation and Maintenance Data: Submit hardware and software manuals for all Active Components.
6. Warranty Documents:
   a. Submit for all manufactured components specified in this Section.
   b. Submit System Warranty.

## 1.10 WARRANTY

A. Comply with Section 260001.

B. The Electrical Subcontractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Approved Manufacturers

1. RSI.
2. Honeywell.
3. CommScope/Andrew.
4. Or approved equal.

### 2.2 BASIS OF DESIGN

A. The system specified is based upon RSI Signal Booster and represents the performance standard upon which any equivalent solution shall be based.

### 2.3 SYSTEM DESCRIPTION

A. General

1. The system must utilize only Class A Signal Boosters’
2. The distributed antenna system may be a radiating cable, fixed antennas or a combination of both.
3. The system must comply with all applicable sections of FCC Rules.
4. Permanent external filters or attachments shall not be permitted.
5. Assembly/installation of all components shall comply with the National Electrical Code.
6. Survivability from attack by fire shall meet NFPA 72.
7. All system components shall be installed, tested, inspected, and maintained in accordance with the manufacturers' published instructions.
8. The system design, and installation, shall not exceed the FCC's OET 65 standards.
9. The system shall be normally powered on and continuously provide passing of required frequencies.
10. Shall be compatible with both analog and digital communications, simultaneously at the time of installation.
11. BDA systems shall have lightning protection that complies with NFPA 780.
12. Maximum propagation delay is 15us (microseconds).

### 2.4 SIGNAL STRENGTH

A. A minimum inbound (downlink) signal strength of -95 dBm shall be provided throughout the coverage area. The inbound signal level shall be sufficient to provide a minimum of DAQ 3.0 for either analog or digital signals.

B. A minimum outbound (uplink) strength of -95 dBm shall be provided at the Fire Department receivers. The outbound signal level shall be sufficient to provide a minimum of DAQ 3.0 for either analog or digital signals.

## 2.5 ISOLATION

A. Antenna isolation shall be maintained between the donor antenna and all inside antennas to a minimum of 20dB under all operating conditions.

## 2.6 PATHWAY SURVIVABILITY

A. Levels shall be as described in Section 5.10. (IFC, 2015)

B. Radiating cable shall not be required to be installed in metal raceway.

C. Feeder and riser coaxial cables shall be rated as plenum cables.

1. Feeder coaxial cables shall be connected to the riser coaxial cable using hybrid coupler devices of a value determined by the overall design.
2. Riser coaxial cables shall be rated as riser cables and routed through a 2-hour-rated enclosure.

D. The connection between the riser and feeder coaxial cables shall be made within the 2-hour-rated enclosure, and passage of the feeder cable in and out of the 2-hour-rated enclosure shall be fire-stopped to 2-hour ratings.

## 2.7 NON-INTERFERENCE AND NON-PUBLIC SAFETY SYSTEM DEGRADATION

A. No amplification system capable of operating on frequencies or causing interference on frequencies assigned to the Fire Department by the FCC shall be installed without prior coordination and approval of the Fire Department.

B. The property owner shall suspend and correct equipment installations that degrade the performance of the Fire radio system or the BDA.

C. BDA Systems that share infrastructure with non-public safety services shall ensure that the coverage and performance of the public safety communications channels are not degraded below the required level of performance, regardless of the amount of traffic carried by the nonpublic safety services.

D. Secondary users must furnish a complete list of transmit and receive frequencies along with an intermodulation (IM) study that will accompany the permit application. The IM Study will consist of the following calculations: IM=Q*F, IM=F1+F2+F3, IM=F1+F2-F3, IM=Q1*F1+Q2*F2, and IM=Q1*F1-Q2*F2 for all frequencies up-link and down-link. These calculations will be done to the 5th order.

## 2.8 SYSTEM RADIO FREQUENCIES

A. The BDA shall be capable of transmitting all radio frequencies, assigned to the Fire Department, and be capable of using any modulation technology in current use by the Fire Department.

## 2.9 FREQUENCY CHANGES

A. The BDA system shall be upgradeable to allow for changes or additions to system frequencies to maintain radio system coverage as it was originally designed.

## 2.10 RADIO SURVEY

A. The system vendor shall test the in-building radio system ensure that two-way radio coverage on each floor of the building meets or exceeds the required signal strength.

B. Each floor of the building shall be divided into a grid of approximately twenty (20) equal areas. A maximum of two (2) areas will be allowed to fail the test per floor. A spot located approximately in the center of a grid area will be selected for the test. Once the spot has been selected, prospecting for a better spot within the grid area will not be permitted. Field strength testing instruments are to be calibrated annually and of the frequency selective type incorporating a flexible antenna similar to the ones used on Fire Department handheld transceivers.

C. RF plots indicating the initial assessment of radio coverage and the enhanced coverage shall be submitted at the time of acceptance testing.

D. All compliance testing to be done with 50 ohm loads in place of the donor antenna to avoid interference to the Fire Department radio system.

E. Unattended operation of the BDA is not permitted until the completion of acceptance testing.

## 2.11 REQUIREMENTS

A. On a per channel basis, the downlink RSL for each frequency band shall meet or exceed Design Audio Quality (DAQ) testing criteria.

B. The DAS shall deliver coverage throughout 95% of the building, and 99% of areas designated as critical. Critical areas include fire command centers, fire pump rooms, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical.

C. The system shall be housed in a NEMA 4 cabinet and shall include 24-hour battery backup.

D. The system shall maintain maximum required output power while preventing excessive emissions per FCC requirements.

E. Antenna locations as shown on the drawings are approximations. The Integrator is responsible for locating the in-building antennas and the donor antenna as required by the equipment selected, proposed design and the design criteria.

## 2.12 POWER SUPPLY

A. The central equipment shall be supplied with an emergency power unit including batteries and battery charging equipment that maintains this cabinet and all outlying equipment that requires power operation

without any change in status for a minimum period of twenty-four (24) hours. The emergency power units(s) shall be sized to meet the following minimum requirements: operating in normal (supervisory) mode, twenty-four (24) hours, followed by twelve (12) hours of emergency operation. Batteries shall be of the sealed maintenance free type.

B. System design shall be such that neither the failure of the normal power source, the transfer to an emergency source, nor the retransfer to the normal source shall cause a change in system status.

C. At least two independent and reliable power supplies shall be provided for all RF emitting devices and any other components of the system.

D. The Primary Power Source Shall be supplied from a dedicated branch circuit and comply with NFPA 72.

## 2.13 EQUIPMENT LOCATION AND PROTECTION

A. Secured Space: The bi-directional radio amplifiers shall be installed in 2-hour rated closet. They shall be located in a suitable non-finished space as approved by the engineer and/or where specifically shown on the drawings. The entrance to the secured space shall clearly identify the space as having the “Fire Department” radio signal repeater equipment, by the use of an attached engraved nameplate.

B. All BDA components, RF filters, and battery system components shall be contained in a NEMA4- or NEMA4X-type enclosure(s).

C. The cabinet shall be large enough to dissipate internal heat without venting the inside of the cabinet to the outside atmosphere. External or exposed RF filters are unacceptable.

1. Dedicated battery cabinets may be vented.

D. The cabinet shall be painted red and equipped with a locking mechanism.

E. The cabinet shall be labeled (in bright yellow):

FIRE DEPT. RADIO
BDA Permit #
Serviced by: (Vendor Name)
(Vendor Phone)

## 2.14 SYSTEM MONITORING

A. A sign will be located at the dedicated monitoring panel with the name and telephone number of the radio service provider indicating that they shall be notified of any alarm.

B. Trouble signals must be immediately reported to the radio service provider.

C. The Fire Department must be notified of any failures that extend past the two (2) hour time limit.

D. The building's Fire Alarm system shall include automatic supervisory signals for malfunctions of the BDA system that are annunciated by the fire alarm system in accordance with NFPA 72, and shall comply with the following:

1. Monitoring for integrity of the system shall comply with NFPA 72, Chapter 10.
2. System supervisory signals shall include the following:
    a. Donor antenna malfunction
    b. Active RF emitting device failure
    c. Low-battery when 70% of the 12-hour operating capacity has been depleted
    d. System component failure

3. Power supply supervisory signals shall include the following for each RF emitting device and system component:
    a. Loss of normal ac power
    b. Failure of battery charger

4. The communications link between the fire alarm system and the BDA must be monitored for integrity.

E. A dedicated monitoring panel shall be provided within the fire command center to annunciate the status of all RF emitting devices and system component locations. The monitoring panel shall provide visual and labeled indications of the following for each system component and RF emitting device:

1. Normal ac power
2. Loss of normal ac power
3. Battery charger failure
4. Low battery capacity (to 70 percent depletion)
5. Donor antenna malfunction
6. Active RF emitting device malfunction
7. System component malfunction

F. The communications link between the dedicated monitoring panel and the two-way radio communications enhancement system must be monitored for integrity.

## 2.15 COMPONENTS

A. Low Profile Qmni-Directional DAS Antenna

1. Model Number: BDA-FA-7800-1 (DAS Antenna)
2. Model Number: BDA-FA-7800-2 (DAS Antenna, Indoor/Outdoor)
3. Model Number: BDA-LP-7800-1 (DAS Antenna, Indoor)

B. Ultra-Wideband DAS Antenna

1. Model Number: BDA-LPA-4502700-1 (DAS Antenna, Indoor)

C. Directional Panel Antenna

1. Model Number: BDA-DP-7800-2 (DAS Antenna, Indoor/Outdoor)

D. Donor Antenna - Outdoor

1. Model Number: DA-7800-1
2. Model Number: BDA-DA-LP582700-1

E. Bi-Directional Amplifier (BDA):

1. Electrical Specifications
   a. Frequency Range: 806-815MHz UL / 851-860MHz DL
   b. Maximum Gain (adjustable): 92dB max. (90dB typ.)
   c. Gain Adjustment. 1 dB steps: 50dB to 92 dB = 42 dB total adjustment range
   d. Maximum Composite Output Power (i.e., single carrier max. power): 32dBm max. 31dBm typ.
   e. Power Limiter Adjustment (1 dB increments): 30dBm to 16 dBm
   f. Impedance: 50 Ohm
   g. Maximum RF Signal Input Level for FCC spurious limits compliance: -20dBm
   h. Absolute Maximum Input RF Signal Level: 0dBm continuous, +10dBm peak
   i. Noise Figure: < 6.5dB typ. 8dB max.
   j. Alarms: Two Form C relays for each of the alarms: AC Power Status, Charger Status, Low Battery Capacity, Low Battery Voltage, BDA Trouble, Antenna Trouble and Aux Alarm. Second relay contact set provided for a LED annunciator panel.
   k. Alarm Logging: Standard SD Card up to 16GB. Mini SD with adaptor. Realtime clock time stamp included.
   l. AC Power Supply: Two independent power supplies with 110-240VAC/2.1A or 277VAC/0.8A 50/60Hz each.
   m. Power Supply Efficiency 93% (Typ.)
   n. DC Power Supply: UL-60950 Listed, supports either 2x75Ah 12V AGM Sealed L.A. Batteries in series for DC UPS Backup or an external 28VDC Supply. Max. Current Draw: 2.15A & > 24-28VDC
   o. Run Time with standard 2x75Ah Battery Backup: > 25-30 Hours under full load.
   p. Battery Charging with the Built-in Charger: UL-609SO Listed, Charging Current Limited to 4A max. Float voltage: 27.4V
   q. Operating Temperature Range: -30°C to +6S°C
   r. Recommended Ambient Temperature: -20°C to +35°C (-4°F to +95°F)

2. Mechanical Specifications
   a. Dimensions: NFMA4 enclosure:
      1) 20"W x 24"H x 7"D
      2) Total Width Including Heatsinks: 24"
      3) Total Height Including Mounting Tabs: 26"
   b. Signal Booster Enclosure Type: NEMA-4, Sealed Enclosure, Aluminum with Powder-Coat or Enamel Finish. Red for NFPA-Compliant Mission-Critical BDA Version and Beige for others. UL-Listed enclosure version available.
   c. Weight - Standard Enclosure, Single Band Configuration, NFPA Compliant Version with two power supplies: <55 lbs.
   d. RF Connectors: N-Female
   e. Booster Shipping Box Size: 30" x 30" x 15" – UPS, FedEx Shippable
   f. Backup Battery Enclosure (Applies to NFPA-Compliant Version of the Booster): 22"W X 13"H X 8"D
      1) Contains two 12V/75Ah Sealed Lead-Acid Batteries.

2) Enclosure Color: Beige
3) Includes Louvered Vents on Both Sides

g. Connections: Four 1/2" trade size cutouts provided for conduit or strain relief fittings for power, battery backup and alarm lines.

F. BDA Status Annunciator

1. Model Number: ANP-11A

G. Cable:

1. 2-Hour Fire Rated Cable: AFW-2HFR-3, American Fire Wire® Low Loss 2-Hour Rated Coaxial Cable, braided copper, 1/2 in, red LSZH polyolefin jacket.
   a. Install 2-hour rated cable from the antennas on the roof to the BDA, and from the BDA to the first antenna on each floor.

2. Plenum Rated Cable: AL4RPV-50, Commscope HELIAX® Plenum Rated Air Dielectric Coaxial Cable, corrugated aluminum, 1/2 in, Red PVDF jacket.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Donor Antenna Considerations & Mounting

1. Antenna shall be mounted free and in the clear.
2. Antenna shall be mounted away from all power lines.
3. Antenna shall be Yagi type with approximately 10dbi gain.
4. The antenna is typically mounted on the wall or roof of the side of the building with the strongest signal.
5. It is recommended to install antenna on opposite side of building from closest DAS antenna to eliminate the possibility of isolation related oscillation issues.
6. The exterior antenna must not be co-located or operating in conjunction with any other antenna.
7. Support mast shall not be EMT. Mast shall be rigid pipe, galvanized water pipe or antenna mast.
8. Mounts shall be manufactured to hold antenna mast, and galvanized.
9. Antenna shall be a minimum of 3’ and a maximum of 6’ from roof so as not to encumber additional snow and ice load.
10. Support mast shall have a minimum of two clamps to affix to mount.
11. Mounts shall be sufficiently spaced so as to minimize torque and bending moment.
12. Support mast shall be mounted to a rigid surface so as not to require guy wires.
13. Support mast shall be plumbed vertical.
14. Antenna shall be pointed only at the prime site even if higher RSSI is found at another azimuth.
15. Antenna shall be mounted for vertical polarization.
16. Any drip/weep holes shall be installed to face down.
17. When at all possible, antenna design shall be a fully enclosed radome over driven element(s) & feedpoint.
18. Antenna support mast shall be grounded to building steel directly. Refer to proper NEC regulations.

19. Exterior antenna connections shall be courtesy wrapped with tape, wrapped with butyl mastic, and sealed with High Quality UV stable wrap. The courtesy wrap shall allow connection to be sliced open without leaving mastic on connectors so as to enable future service if needed.
20. Antenna cable bend radius shall not exceed manufacturers recommended radius for cable.
21. Antenna surge arrestor & cable ground kit shall be mounted as close to building penetration as possible and grounded to building steel. Refer to proper NEC regulations.

B. DAS antenna/splitter(s)

1. Sufficient antennas & BDA gain shall be provided so as to prevent issues with "near/far" effect.
2. There shall be a minimum of 20db isolation between outdoor donor antenna and indoor das antennas at all times.
3. Omnidirectional antennas shall be mounted free and in the clear, preferably in the center of the room or area they are to cover.
4. Flat panel antennas shall be wall-mounted as close as possible to the center of the wall, or at one end of long narrow space.
5. Dome antennas are mounted on the ceiling as close to the center of the desired coverage area as possible, domed (convex) side pointing down.
6. If suspended ceilings are used in the building, all DAS antennas shall be mounted inverted in the center of a room or hall ceiling.
7. It is important to keep the cable runs equal or use taps to ensure a harmonious install.
8. Verify that all interior antennas meet the separation requirements needed for proper system function, and that no antenna is aimed towards the exterior donor antenna.
9. Manufacturer mounting instructions shall be followed. If antenna/splitter mount has 4 holes to mount then 4 holes shall be utilized at all times.
10. In no cases are unapproved cable hangers to be used. Manufacturers spec cable hanger listed for the type cable shall be utilized. Tyraps are not permitted to hang cables.
11. Interior DAS antennas, and cables shall be mounted with their own mounts and shall not be tyrapped or held in place with anything other than manufacturers approved clamping devices. There is to be no clamping of antennas or cables etc. to existing interior piping such as sprinkler, air, gas etc. pipes.
12. All cables & antennas shall have their own independent means of support.

C. Antenna Cable installation

1. Antenna cable shall be affixed at a minimum of every 48" using cable manufacturer approved clamps designed for the cable directly.
2. Manufacturers published instructions shall be used in providing independent support and protection from physical damage.
3. Manufacturers minimum bend radius shall be followed for all cables.
4. Use appropriately rated sealant/caulking to waterproof/fireproof interior or exterior cable entry points.
5. All perforations through walls shall be sleeved with conduit to avoid cable damage.
6. Antenna cable is preferred to be marked "Fire Dept BDA" in clearly readable letters. Markings shall be at approximately every 10 feet and especially at any point where cable could be damaged by contractors on site work.
7. Antenna cable shall not be deformed in clamps.
8. Antenna cable shall be properly supported within 12" of BDA connections.
9. Antenna cables shall have proper service loops installed so as to eliminate possibility of damage when performing service on unit.

10. Splitters shall have 50-ohm resistive loads installed on any output tap which is un-used.
11. Antenna connector ferrules shall be finger-tight and not improperly torqued with pliers/wrenches etc.
12. Antenna cabling shall not be bundled or ran with other cables under any circumstances.

D. BDA Installation

1. BDA location shall be walk-up access and shall not require a ladder to service.
2. BDA shall be located in a 2-hour fire rated location.
3. BDA location shall not be encumbered by other building infrastructure so as to limit service or installation.
4. BDA location shall not be in a tightly enclosed or overly hot space.
5. BDA Power and warning lights shall be easily visible.
6. Annunciators shall be manufacturer rated for use with BDA.
7. BDA shall be mounted on wall with piece of plywood and unistrut to support BDA enclosure.
8. BDA Battery backup shall be manufacturer approved and UL listed for operation with BDA.
9. Backup battery shall be mounted in a minimum of a NEMA 3R metal enclosure, plastic enclosures are not allowed.
10. BDA alarm wiring shall have proper pull-up resistors so as not to cause errant fire alarm activation in the event of loss of AC power.

E. Post Installation

1. Installer shall be fully equipped to demonstrate isolation level between interior DAS antennas and outdoor Donor antennas to Fire Department personnel. Isolation should be tested both ways, donor-DAS and DAS-donor antennas. Measurements of incoming signal from Prime Site and outgoing to DAS will be checked and noted. A complete site walk will be conducted and measurements for RSSI will be conducted at each DAS antenna and grid square testing will be spot checked in the worst areas for signal quality. Uplink levels at all DAS antennas will be measured via remote spectrum analyzer. Alarms will need to be demonstrated with proper NFPA alarm name reporting to the Fire Alarm Panel under Fire Department direction.
2. BDA shall be run on battery during inspectional testing and grid square testing for verification of -95 dBm levels.
3. In NO event is an installed system to be powered on even for testing without authorization/notification to the Fire Department.

## 3.2 INSTALLER QUALIFICATIONS

A. Approved Radio Service Provider

1. An approved Radio Service Provider is a company whose normal course of business involves the installation, repair and servicing of portable radios, mobile radios, signal boosters, base stations, and associated infrastructure.

B. Senior Technician

1. The Design, Installation and Commissioning shall be conducted, documented, and certified by a radio technician who is in possession of all of the following:
   a. FCC General Radiotelephone Operator License.

b. ETA Senior Certified Electronics Technician (CETsr) or equivalent Certification from an industry organization acceptable to the Fire Department.
c. Manufacturer's Certification.

C. Radio Technician

1. The inspection, repair and preventative maintenance shall be conducted, documented, and certified by a radio technician who is in possession of all of the following:
   a. FCC General Radiotelephone Operator License.
   b. ETA Certified Electronics Technician (CET) or equivalent Certification from an industry organization acceptable to the Fire Department.
   c. Manufacturer's Certification.

D. Radio service providers will be issued call signs for use when transmitting on the Fire Radio System.

E. Annual inspection reports and 5-year RF Surveys must be submitted to the Fire Department in a timely manner.

F. The Fire Department shall be notified in writing at least thirty (30) days prior to cancellation of a maintenance contract. Such notice shall contain the date and time such cancellation is to take effect, BDA location, and BDA Permit #.

G. The Fire Department Radio Supervisor shall be notified in writing upon the procurement of contractual agreements relating to in-building radios covered by this specification.

## 3.3 GROUNDING PROCEDURE

A. In order to minimize problems resulting from improper grounding, and to achieve maximum signal-to-noise ratios, the following grounding procedures shall be adhered to.

B. System Ground: A signal primary “system ground” shall be established for the system. All grounding conductors in that area shall connect to this primary system ground. The system ground shall consist of a copper bar of sufficient size to accommodate all secondary ground conductors. An extension of the ground shall connect to the buildings lightning protection system.

C. A copper conductor, having a maximum of 0.1 Ohms total resistance, shall connect the primary system ground bar to the primary system ground ring.

D. Secondary system grounding conductors shall be provided from all racks, radio consoles, and undergrounded radio equipment in each area, to the primary system grounding point for the area. Each of these grounding conductors shall have a maximum of 0.1 Ohms total resistance.

E. Under no conditions shall the AC neutral conductor, either in the power panel or in receptacle outlets, be used for a BDA system ground.

F. Radio cable Shields: All radio cable shields shall be grounded at both ends.

G. General: Because of the great number of possible variations in grounding systems, it shall be the responsibility of the installer to follow good engineering practice, as outlined above, and to deviate from

these practices only when necessary to minimize crosstalk and to maximize signal to-noise ratios and reduce interference in the radio systems.

## 3.4 CABLE AND CONDUIT

A. Note the following circuitry requirements:

1. Conduit intended for use with the firefighter's communication bi-directional radio amplifier system shall be steel electric metallic tubing (EMT), except as follows:
   a. It shall be galvanized steel intermediate conduit where mounted within 8'-0" of the floor in mechanical spaces or otherwise exposed to mechanical damage, or where intended for embedment in concrete.
   b. It shall be galvanized steel intermediate conduit if local authorities prohibit use of EMT.
   c. It shall be rigid galvanized steel conduit for the power supply to the central equipment and to all outlying equipment cabinets requiring a 120-volt or 120/208-volt supply.

2. All cables shall be installed in conduit.

## 3.5 ACCEPTANCE TESTING

A. Delivered audio quality (DAQ) testing will be conducted by Fire Department radio personnel to ensure that two-way radio coverage, on each floor of the building, meets the minimum coverage requirements. Tests will be scheduled with at least 5 days advance notice.

B. It is the building owner's responsibility to ensure that acceptance testing occurs prior to Fire Alarm System testing for the building.

C. At the time of this test, the following are also required:

1. The approved radio technician shall certify that the in-building radio system was installed and tested in accordance with the requirements of the current Fire Department In-Building Radio Specification.
2. An approved radio service company shall certify that a maintenance contract is in effect that provides 24 hour by 7 day response within 2 hours of notification of a problem. This contract must be for a period of at least 1 year.
3. RF Survey results, gain values of all amplifiers including screen shots.
4. Small scale drawings (11" x 17" maximum) of the structure shall be provided by the owner/contractor. The plans shall show each floor divided into the grids. Each grid shall be labeled to indicate the DAQ result from the RF Survey.
5. As built drawings (if needed)
6. BDA Manufacturer, Model #, Serial #, FCC Certification #
7. Link budget

## 3.6 TESTING PROCEDURES

A. For testing system signal strength and quality, the testing shall be based on the DAQ system. A DAQ level below 3.0 shall be considered a failed test for a given grid cell.

B. Delivered Audio Quality Definitions:

1. DAQ 1: Unusable, speech present but unreadable.
2. DAQ 2: Understandable with considerable effort. Frequent repetition due to noise / distortion.
3. DAQ 3: Understandable with slight effort. Occasional repetition required due to noise/distortion.

C. A number of cells per floor shall be selected at random. Signal strength measurements shall be taken at the center of each cell.

D. A maximum of two grid cells per floor will be allowed to fail the test. In the event that three of the areas fail the test, in order to be more statistically accurate, the testing grid resolution maybe doubled. If the number of grid cells is adjusted, the number of failed cells permitted shall be adjusted accordingly to meet the 90% coverage requirement.

E. Failures shall not be allowed in critical areas, including but not limited to the Fire Command Center, Fire Pump Room, Emergency Generator Room, Stairwells with a standpipe, Elevator Lobbies serving the Emergency Elevator, and other areas as identified by the Fire Department.

F. Both inbound and outbound signals shall be measured on each and every floor above and below ground including stairwells, basements, penthouse facilities and parking areas of the structure.

G. Measurements shall be made with the antenna held in a vertical position at three (3) to four (4) feet above the floor, (portable radio worn on the belt or turnout coat pocket).

## 3.7 ANNUAL TEST

A. All active components of the in-building radio system, including but not limited to amplifier, power supplies, and back-up batteries, shall be inspected a minimum of once every twelve (12) months.

B. Annual tests will be conducted by an authorized company.

C. Amplifiers shall be tested to ensure that the gain is the same as it was upon initial installation and acceptance. The original gain shall be noted and any change in gain shall be documented.

D. Back-up batteries and power supplies shall be tested under load for a period of one (1) hour to verify that they will operate during an actual power outage.

E. Active components shall be tested to verify they are operating as designed by the manufacturer.

F. If communications appear to have degraded or if the tests fail to demonstrate adequate system performance, the owner of the building or structure is required to remedy the problem and restore the system in a manner consistent with the original approval criteria.

G. The re-testing will be done at no expense to the City as required in the original testing procedures.

## 3.8 FIVE YEAR RF SURVEY

A. An RF Survey be conducted a minimum of once every five (5) years to insure that the radio system continues to provide the required level of radio coverage.

B. The procedure set forth in Section L shall apply to such tests.

## 3.9 MAINTENANCE & SERVICING

A. At final acceptance the building owner shall supply a letter to the Fire Department accepting the property owner's responsibilities. These responsibilities are as follows:

1. Upgrades to system as directed by the Fire Department.
2. Maintenance contract in place with name of authorized company, who will provide a 24 hour by 7-day emergency response within two (2) hours after notification. The system shall be maintained in accordance with FCC requirements.
3. Maintain a list of contact personnel with phone numbers at the BDA cabinet. The contact personnel shall have knowledge of the building and the BDA system and be available to respond to the building in the case of an emergency.
4. Annual Inspections.
5. 5-year RF surveys.
6. This letter is to be on company letterhead signed by the property owner or a legal representative.

## 3.10 MODIFICATIONS

A. Modification of an existing BDA System requires prior approval from the Fire Department.

B. A permit application shall be submitted which includes a description of the work to be performed and drawings showing intended modification.

C. Modification work must not degrade radio coverage at any time.

D. An RF Survey must be completed and submitted after any modification to an existing antenna system.

## 3.11 FIRE DEPARTMENT INSPECTIONS

A. Fire Department Radio personnel, after providing reasonable notice to the owner or their representative, shall have the right to enter onto the property to conduct field testing to be certain that the required level of radio coverage is present.

## 3.12 COMMISSIONING

A. Comply with requirements specified in Division 1.

B. Engage a factory-authorized service representative to supervise and assist with startup service. Complete installation and startup checks according to the approved manufacturer's written instructions.

3.13 TRAINING AND SERVICE

A. Comply with Section 26 00 01.

B. Conduct two 4-hour training session. Train the Owner's maintenance personnel on procedures and schedules related to start up and shutdown, troubleshooting, servicing, and preventive maintenance.

C. Training shall include fire department personnel.

END OF SECTION

SECTION 28.31.11

ADDRESSABLE FIRE-ALARM & MASS NOTIFICATION SYSTEM

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Work of this Section is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section "Summary", Paragraph 1.1A, entitled "Related Documents."

1.3 SUMMARY

A. This work includes furnishing and installing a new, complete, fire alarm and mass notification (MNS) system as described herein and on the contract drawings. Include system wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, initiating devices, notification appliances, supervising station fire alarm transmitters/mass notification transceiver, and other accessories and miscellaneous items required for a complete operational system even though each item is not specifically mentioned or described. Provide system[s] complete and ready for operation.

B. Provide equipment, materials, installation, workmanship, inspection, and testing in strict accordance with NFPA 72, except as modified herein. [The system layout on the drawings show the intent of coverage and suggested locations.

C. The fire alarm and mass notification system must be independent of the building security, building management, and energy/utility monitoring systems other than for control functions.

D. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm & mass notification system as indicated on the drawings and specifications.

E. The work covered by this Section of the Specification shall include all labor, equipment, materials and services to furnish and install a complete fire alarm and mass notification system of the addressable, non-coded type. It shall be complete with all necessary hardware, software and memory specifically tailored for this installation. It shall be possible to permanently modify the software on site by using a plug-in programmer. The system shall consist of, but not be limited to, the following:

1. Fire Alarm Control Panel and related remote data gathering panels.

2. Remote Annunciators with semi flush backbox.
3. Addressable manual fire alarm stations.
4. Addressable analog area smoke detectors.
5. Addressable analog duct smoke detectors.
6. Addressable analog heat detectors.
7. Magnetic door\card access release override control.
8. Audible notification appliances - Speakers.
9. Visual notification appliances – strobes (white: fire alarm, amber: mass notification).
10. Radio masterbox.
11. Air handling systems shutdown control.
12. Magnetic door holder release.
13. Dry pipe sprinkler release valve/deluge valve control.
14. Pre-Action Sprinkler System.
15. Sprinkler supervisory switches and tamper switch supervision.
16. Battery standby.

## 1.4 RELATED WORK

A. The Electrical Subcontractor shall coordinate work in this Section with all related trades. Work and/or equipment provided in other Sections and related to the fire alarm system shall include, but not be limited to:

1. Duct smoke detectors furnished, installed, wired, and connected to the fire alarm system by the Electrical Subcontractor.
2. Elevator recall control circuits.
3. BDA DAS systems monitoring. Provide for each police and fire department BDA DAS.
    a. Signal booster trouble
    b. Normal AC power
    c. Failure of battery charger
    d. Low battery capacity
    e. Antenna malfunction

B. Installing dedicated outgoing RJ-31X telephone lines (2) shall be the responsibility of the Electrical Subcontractor. Establishment of central station monitoring account shall be the responsibility of the fire alarm equipment vendor.

C. Secure permits and approvals prior to installation.

D. Prior to commencement and after completion of work notify Authorities Having Jurisdiction.

E. Submit letter of approval for installation before requesting acceptance of system.

## 1.5 APPLICABLE CODES AND STANDARDS

A. All equipment shall be UL listed for its intended use and conform to the latest UL Standards.

B. Underwriters Laboratories Inc.: The system and all components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:

1. UL 864/UOJZ, APOU Control Units for Fire Protective Signaling Systems.
2. UL 268 Smoke Detectors for Fire Protective Signaling Systems.
3. UL 268A Smoke Detectors for Duct Applications.
4. UL 217 Smoke Detectors Single Station.
5. UL 521 Heat Detectors for Fire Protective Signaling Systems.
6. UL 228 Door Holders for Fire Protective Signaling Systems.
7. UL 464 Audible Signaling Appliances.
8. UL 1638 Visual Signaling Appliances.
9. UL 38 Manually Activated Signaling Boxes.
10. UL 346 Waterflow Indicators for Fire Protective Signaling Systems.
11. UL 1971 Standard for Signaling Devices for the Hearing Impaired
12. UL 1481 Power Supplies for Fire Protective Signaling Systems.
13. UL 1711 Amplifiers for Fire Protective Signaling Systems.

C. This installation shall comply with:

1. Americans with Disabilities Act (ADA)
2. National Electric Code, Article 760.
3. National Fire Protection Association Standards: NFPA72
4. Local and State Building Codes and the Local Authorities Having Jurisdiction.
5. International Standards Organization (ISO): ISO-9001.

## 1.6 DEFINITIONS

A. Wherever mentioned in this specification or on the drawings, the equipment, devices, and functions must be defined as follows:

1. Interface Device
   a. An addressable device that interconnects hard wired systems or devices to an analog/addressable system.

2. Fire Alarm and Mass Notification Control Unit (FMCU)
   a. A master control unit having the features of a fire alarm control unit (FACU) and an autonomous control unit (ACU) where these units are interconnected to function as a combined fire alarm/mass notification system. The FACU and ACU functions may be contained in a single cabinet or in independent, interconnected, and co-located cabinets.

3. Remote Fire Alarm and Mass Notification Control Unit
   a. A control unit, physically remote from the fire alarm and mass notification control unit, that receives inputs from automatic and manual fire alarm devices; may supply power to detection devices and interface devices; may provide transfer of power to the notification appliances; may provide transfer of condition to relays or devices connected to the control unit; and reports to and receives signals from the fire alarm and mass notification control unit.

4. Local Operating Console (LOC)
   a. A unit designed to allow emergency responders and/or building occupants to operate the MNS including delivery of recorded messages and/or live voice

announcements, initiate visual, textual visual, and audible appliance operation and other relayed functions.

5. Terminal Cabinet
   a. A steel cabinet with locking, hinge-mounted door where terminal strips are securely mounted inside the cabinet.

6. Control Module and Relay Module
   a. Terms utilized to describe emergency control function interface devices as defined by NFPA 72.

## 1.7 SUBMITTALS

A. Provide list of all types of equipment and components provided. This shall be incorporated as part of a Table of Contents, which will also indicate the manufacturer's part number, the description of the part, and the part number of the manufacturer's product datasheet on which the information can be found.

B. Provide description of operation of the system (Sequence of Operation), similar to that provided in Part 2 of this Section of the Specifications, to include any and all exceptions, variances or substitutions listed at the time of bid. Any such exceptions, variances or substitutions which were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment. The sequence of operation shall be project specific, and shall provide individual sequences for every type of alarm, supervisory, or trouble condition, which may occur as part of normal or off-normal system use.

C. Provide manufacturer's ORIGINAL printed product data, catalog cuts and description of any special installation procedures. Photocopied and/or illegible product data sheets shall not be acceptable. All product datasheets shall be highlighted or stamped with arrows to indicate the specific components being submitted for approval.

D. Provide manufacturer's installation instruction manual for specified system.

E. Provide samples of various items when requested.

F. Provide copy of State License to perform such work.

G. Provide copies of NICET Level IV Fire Alarm certifications for a minimum of two (2) technicians assigned to this project.

H. Provide shop drawings as follows:

1. Coversheet with project name, address and drawing index.
2. General notes drawing with peripheral device backbox size information, part numbers, device mounting height information, and the names, addresses, point of contact, and telephone numbers of all contract project team members.
3. Device riser diagram that individually depicts all control panels, annunciators, addressable devices, and notification appliances. Shall include a specific, proposed point descriptor above each addressable device. Shall include a specific, discrete point address that shall correspond to addresses depicted on the device layout floor plans. Drawing

shall provide wire specifications, and wire tags shown on all conductors depicted on the riser diagram. All circuits shall have designations that shall correspond with those require on the control panel and floor plan drawings. End-of-line resistors (and values) shall be depicted.

4. Control panel termination drawing(s). Shall depict internal component placement and all internal and field termination points. Drawing shall provide a detail indicating where conduit penetrations shall be made, so as to avoid conflicts with internally mounted batteries. For each additional data gathering panel, a separate control panel drawing shall be provided, which clearly indicated the designation, service and location of the control enclosure. End-of-line resistors (and values) shall be depicted.
5. Device typical wiring diagram drawing(s) shall be provided which depict all system components, and their respective field wiring termination points. Wire type, gauge, and jacket shall also be indicated. When an addressable module is used in multiple configurations for monitoring or controlling various types of equipment, different device typical diagrams shall be provided. End-of-line resistors (and values) shall be depicted.
6. Device layout floor plans shall be created for every area served by the fire alarm system. CAD Files (AutoCAD latest version) shall be provided by the consulting engineer for the use of the fire alarm system equipment vendor in the preparation of the floor plans. Floor plans shall indicate accurate locations for all control and peripheral devices. Drawings shall be NO LESS THAN 1/8 INCH SCALE. All addressable devices shall be depicted with a discrete address which corresponds with that indicated on the Riser Diagram. All notification appliances shall also be provided with a circuit address which corresponds to that depicted on the Riser Diagram. If individual floors need to be segmented to accommodate the 1/8" scale requirements, KEY PLANS and BREAK-LINES shall be provided on the plans in an orderly and professional manner. End-of-line resistors (and values) shall be depicted.
7. Contained in the title block of each drawing shall be symbol legends with device counts, wire tag legends, circuit schedules for all addressable and notification appliance circuits, the project name/address, and a drawing description which corresponds to that indicated in the drawing index on the coversheet drawing. A section of each drawing title block shall be reserved for revision numbers and notes. The initial submission shall be Revision 0, with Revision A, B, or C as project modifications require.

I. Battery calculations shall be provided on a per power supply/charger basis. These calculations shall clearly indicate the quantity of devices, the device part numbers, the supervisory current draw, the alarm current draw, totals for all categories, and the calculated battery requirements (which reflect a 20% DEGRADE, for 24 Hour supervisory, 15 minute alarm operation). Battery calculations shall also reflect all control panel component, remote annunciator, and auxiliary relay current draws. Failure to provide these calculations shall be grounds for the complete rejection of the submittal package.

J. Table of contents, product data sheets, sequences of operation, battery calculations, installation instructions, licenses, NICET certifications and B-Size (blackline) reduced shop drawings shall be provided by the fire alarm vendor as part of a single, spiral bound submittal book. The submittal book shall have laminated covers indicating the project address, project number, system type, and Electrical Subcontractor. The book shall consist of labeled dividers, and shall not exceed 9 ½" in width, and 11 ½" in height. No less than three (3) sets of submittal booklets shall be provided to the consulting engineer for review and comment. Additional copies may be required at no additional cost to the project.

K. Scale drawing sets shall be submitted along with the submittal booklets. These drawings may be either D-Size or E-Size Blueline drawings and of a sufficient resolution to be completely read. Sets shall be bound and folded so that is does not take up more than 100 square inches of space. No less than three (3) sets of scale drawing sets shall be provided to the consulting engineer for review and comment. Additional copies may be required at no additional cost to the project.

L. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

M. Field quality-control reports.

N. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
    a. Frequency of testing of installed components.
    b. Frequency of inspection of installed components.
    c. Requirements and recommendations related to results of maintenance.
    d. Manufacturer's user training manuals.
5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 25.

O. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

## 1.8 AS-BUILT DRAWINGS

A. At the conclusion of the project, the Electrical Subcontractor shall provide “as built” drawings. The “as built” drawings shall be a continuation of the Electrical Subcontractor’s shop drawings as modified, augmented, and reviewed during the installation, check out and acceptance phases of the project. All drawings shall be fully dimensioned and prepared in DWG format using the latest version of AutoCAD.

B. The as-built drawings shall incorporate all updated system riser diagrams prepared in DWG format using the latest version of AutoCAD.

C. The as-built drawings shall show point-to-point wiring of all devices as installed in the field.

## 1.9 OPERATION AND MAINTANANCE MANUALS

A. Manuals

1. At the conclusion of the project, the Electrical Subcontractor shall provide copies of the manuals as described herein. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each system integrator installing equipment and systems and the nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and labeled sections. The manuals shall include all modifications made during installation, checkout, and acceptance. The manuals shall contain the following:
2. Operators Manual
    a. The operator's manual shall fully explain all procedures and instructions for the operation of the system including:
        1) Computers and peripherals
        2) System start up and shut down procedures
        3) Use of system, command, and applications software
        4) Recovery and restart procedures
        5) Graphic alarm presentation
        6) Use of report generator and generation of reports
        7) Data entry
        8) Operator commands
        9) Alarm messages and reprinting formats
        10) System access requirements

3. Maintenance Manual
    a. The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

## 1.10 QUALITY ASSURANCE

A. Manufacturer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Manufacturer Qualifications: Personnel certified by NICET as fire-alarm Level III technician. Provide certification with the submittal package.

C. System and Shop Drawings Qualifications: System engineering and shop drawings shall be by performed by a NICET fire-alarm Level IV technician. Provide certification with the submittal package.

D. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.11 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.12 WARRANTY

A. Comply with Section 260001.

B. The Electrical Subcontractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

C. Manufacturer’s Warranty

1. The manufacturer shall guarantee that the fire alarm panel technology and firmware is the latest available and shall be supported for at least 10 years.
2. The manufacturer shall guarantee that the system components shall be available for at least 10 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers

1. Notifier, NFS2-3030
2. Johnson Controls Inc., 4100ES
3. Edwards, EST-4
4. Or approved equal.

2.2 CIRCUITING GUIDELINES

A. Fire alarm system/mass notification system including textual display sign control panel(s), components requiring power, except for the FMCU(s) power supply, must operate on 24 volts DC unless noted otherwise in this section.

B. The interior fire alarm and mass notification system must be a complete, supervised, noncoded, analog/addressable fire alarm and mass notification system conforming to NFPA 72, UL 864,

and UL 2572. Systems meeting UL 2017 only are not acceptable. The system must be activated into the alarm mode by actuation of an alarm initiating device. The system must remain in the alarm mode until the initiating device is reset and the control unit is reset and restored to normal. The system may be placed in the alarm mode by local microphones, LOC, FMCU, or remotely from authorized locations/users.

C. Provide the system with an interconnected riser loop or network having Class X supervision. Ensure that the return portion of the loop is remote from the supply portion of the loop. Ensure that a single impairment cannot adversely affect more than one-half of any floor.

D. Alarm Initiating Devices and Notification Appliances

1. Connect alarm initiating devices to initiating device circuits (IDC) Class "A" or to signaling line circuits (SLC) Class "A" and installed in accordance with NFPA 72.
2. Connect notification appliances to notification appliance circuits (NAC) Class "A".

E. Each addressable analog loop shall be circuited so device loading is not to exceed 80% of loop capacity in order to leave for space for future devices. The loop shall have Class A operation.

1. Class A circuits must meet the performance requirements that "allow all connected devices to operate during a single open or a non-simultaneous single ground fault on any circuit conductor."
2. Class A circuits must be installed so that the outgoing and return conductors, exiting from and returning to the control unit, respectively, are routed separately. The outgoing and return (redundant) circuit conductors must also not be run in the same cable assembly (i.e., multi-conductor cable), enclosure or raceway.

F. Where it is necessary to interface conventional initiating devices provide intelligent input modules to supervise Class A zone wiring.

G. Each of the following types of devices or equipment shall be provided with supervised circuits as shown on the drawings but shall be typically as follows:

1. Sprinkler Valve Supervisory Switches: Provide one (1) supervisory module circuit for each sprinkler valve supervisory switch.
2. When waterflow and tamper switches exist at the same location, provide one (1) dual input addressable module. When odd numbers of devices exist provided multi-input addressable module.

H. Each of the following types of alarm notification appliances shall be circuited as shown on the drawings but shall be typically as follows:

1. Audible Signals: Provide sufficient spare capacity to assure that the addition of five (5) audible devices can be supported without the need for addition control components (power supplies, signal circuit modules, amplifiers, batteries, etc.)
2. Visual Signals Provide sufficient spare capacity to assure that the addition of three (3) visual devices can be supported without the need for addition control components (power supplies, signal circuit modules, batteries, etc.)

I. Each of the following types of remote equipment associated with the fire alarm system shall be provided with a form 'C' control relay contact as shown on the drawings, but shall be typically as follows:

1. HVAC Fan Systems: Provide one (1) shutdown control relay contact for each HVAC fan system.
2. HVAC Supply Fans: Provide one (1) shutdown control relay contact for each HVAC supply fan.
3. HVAC Return Fans: Provide one (1) shutdown control relay contact for each HVAC return fan.

J. Provide a dedicated 24VDC circuit to feed all auxiliary relays required for inductive loads. Circuits shall be supervised via an end-of-line relay and addressable input module. Auxiliary relays shall not derive their power from the starter or load being controlled.

K. Each control or data gathering panel shall have a dedicated 20Amp-120VAC feed. This feed shall come from an emergency or lighting circuit breaker panel and shall have a locked circuit breaker. Earth grounds shall also terminate to the same circuit breaker panel from each respective control panel.

## 2.3 FIRE ALARM SYSTEM SEQUENCE OF OPERATION

A. The system shall identify any off normal condition and log each condition into the system database as an event.

1. The system shall automatically display on the control panel Liquid Crystal Display the first event of the highest priority by type. The priorities and types shall be alarm, supervisory, trouble, and monitor.
2. The system shall have a Queue operation and shall not require event acknowledgment by the system operator. The system shall have a labeled color-coded indicator for each type of event; alarm - red, supervisory - yellow, trouble - yellow, monitor - yellow. When an unseen event exists for a given type, the indicator shall be lit.
3. For each event, the display shall include the current time, the total number of events, the type of event, the time the event occurred and up to a 42-character custom user description.
4. The user shall be able to review each event by simply selecting scrolling keys (up-down) for each event type.
5. New alarm, supervisory, or trouble events shall sound a silencing audible signal at the control panel.

B. Operation of any alarm initiating device shall automatically:

1. Update the control/display as described above (A.1.)
2. Sound all audible speaker appliances with a prerecorded message. Audible devices shall have the ability to be silenced.
3. Activate all strobe appliances throughout the facility. All strobe appliances shall be synchronized with each other in any location with two or more devices in a common field of view. Visual devices shall be non-silenced unless the system is successfully reset.
4. Operate control relay contacts to shut down all HVAC units serving the floor of alarm initiation.

5. Operate control relay contacts to return all elevators that serve the floor of alarm initiation to the ground floor. If the alarm originates from the ground floor, operate control circuits contacts to return all elevators to the floor above or to a level as directed by the local fire department.
6. Operate control relay contacts to release all magnetically held smoke doors throughout the building.
7. Visually annunciate the individual point of alarm on all remote annunciator panels. The visual indication shall remain on until the alarm condition is reset to normal.
8. Transmit an alarm condition to Local Fire Department (as required by the AHJ).

C. Elevator smoke and heat detector sequences shall comply with the ANSI A17.1 requirement for main/alternate floor recalls.

D. Activation of a sprinkler supervisory initiating device shall:

1. Update the control/display as described above.
2. Transmit a supervisory condition to Local Fire Department (as required by the AHJ).
3. Visually annunciate the individual point of alarm on all remote annunciator panels. The visual indication shall remain on until the alarm condition is reset to normal.

E. The entire fire alarm system wiring shall be electrically supervised to automatically detect and report trouble conditions to the fire alarm control panel. Any opens, grounds or disarrangement of system wiring and shorts across alarm signaling wiring shall automatically:

1. Update the control/display as described above.
2. Transmit a trouble condition to Local Fire Department (as required by the AHJ).
3. Visually and audibly annunciate a general trouble condition, on the remote annunciator panels. The visual indication shall remain on until the trouble condition is repaired.

F. Provide dry contacts or relay contact closures to the BMS for purge system.

G. Provide switch in the fire alarm control panel to release all stair doors. Provide wiring and signal to access control system to accomplish door release.

## 2.4 SUPPORT FOR INSTALLER AND OWNER MAINTENANCE

A. Provide a coded one-man walk test feature. Allow audible or silent testing. Signal alarms and troubles during test. Allow receipt of alarms and programmed operations for alarms from areas not under test.

B. Provide internal system diagnostics and maintenance user interface controls to display/report the power, communication, and general status of specific panel components, detectors, and modules.

C. Provide loop controller diagnostics to identify common alarm, trouble, ground fault, Class A fault, and map faults. Map faults include wire changes, device type changes by location, device additions/deletions and conventional open, short, and ground conditions. Ground faults on the circuit wiring of remote module shall be identified by device address.

D. Allow the user to display/report the condition of addressable analog detectors. Include device address, device type, percent obscuration, and maintenance indicator. The maintenance indicator shall provide the user with a measure of contamination of a device upon which cleaning decisions can confidently be made.

E. Allow the user to report history for alarm, supervisory, monitor, trouble, smoke verification, watchdog, and restore activity. Include Facility Name, Licensee, Project Program Compilation date, Compiler Version, Project Revision Number, and the time and date of the History Report.

F. Allow the user to disable/enable devices, zones, actions, timers and sequences. Protect the disable function with a password.

G. Allow the user to activate/restore outputs, actions, sequences, and simulate detector smoke levels.

## 2.5 FIRE ALARM AND MASS NOTIFICATION CONTROL UNIT

A. Provide a complete fire alarm and mass notification control unit (FMCU) fully enclosed in a lockable steel cabinet as specified herein. Operations required for testing or for normal care, maintenance, and use of the system must be performed from the front of the enclosure. If more than a single unit is required at a location to form a complete control unit, the unit cabinets must match exactly. If more than a single unit is required, and is located in the lobby/entrance, notify the Architect, prior to installing the equipment. The system must be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling such as waterflow switches, valve supervisory switches, fire pump monitoring, independent smoke detection systems, relays for output function actuation, etc.

1. The FMCU and all system devices (Speaker-strobes, strobes, pull stations, smoke, and heat detectors, etc. shall be all under one label “UL listed and approved” for the use of fire alarm systems in this area of the United States of America. The operating controls shall be located behind locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified.
2. System Controllers: The main controller 3-CPU shall be supervised, site programmable, and of modular design supporting up to 125 detectors and 125 remote modules per addressable Signaling line Circuit (SLC). The CPU shall support up to 10 SLC's per panel for a total system capacity of 2500 Intelligent Addressable points.
3. Network Configurations: The system shall be designed for enhanced survivability and support multiple media connections including twisted pair copper, fiber, and Category 6A interfaces. Configurations for panel-to-panel communications shall support Class A, Class B, Class X and Class N topologies. The cabinets shall be steel.
4. The Main Controller Module shall control and monitor all local or remote peripherals. The panel LCD touch screen display shall be a minimum of 5.7 inches in size and support a minimum of 256K colors. Each display shall support a minimum of 8 events simultaneously without the need to scroll or make manual selections at the display. If configured as a network, each system shall display each point in the system and shall also support touch screen display annunciators. Remote annunciators shall also display each point in the system and be sized with the same number of characters as in the main FMCU display.

5. The panel shall have an interface module for remote site monitoring. The module shall have a dialer (alarm communicator transmitter (DACT)) module to transmit alarm, supervisory and trouble signals to a Central Monitoring Station (CMS). The DACT shall support dual telephones lines, Contact I.D. communications, and configured for dual tone multi-frequency (DTMF) or pulse modes. It shall be possible to delay AC power failure reports, auto test call, and be site programmable. The dialer shall be capable of transmitting every individual alarm condition to the central station.
6. The system shall have built-in automatic system programming to automatically address and map all system devices attached to the main controller. A minimum default single stage alarm system operation shall be supported with alarm silence, event silence, drill, lamp test, and reset common controls.
7. Advanced Windows-based System Definition Utility with Program Version Reporting to document any and all changes made during system start-up or system commissioning shall be used to maintain site specific programming. Time and Date Stamps of all modifications made to the program must be included to allow full retention of all previous program version data. It shall support programming of any input point to any output point. It shall allow authorized customization of fundamental system operations using initiating events to start actions, timers, sequences and logical algorithms. The system program shall meet the requirements of this project, current codes and standards, and satisfy the local Authority Having Jurisdiction.
8. The system shall support distributed processor intelligent detectors with the following operational attributes; integral multiple differential sensors, automatic device mapping, electronic addressing, environmental compensation, pre-alarm, dirty detector identification, automatic day/night sensitivity adjustment, normal/alarm LEDs, relay bases, sounder bases and isolator bases.
9. The system shall use full digital communications to supervise all addressable loop devices for placement, correct location, and operation. It shall allow swapping of “same type” devices without the need of addressing and impose the “location” parameters on replacement device. It shall initiate and maintain a trouble if a device is added to a loop and clear the trouble when the new device is mapped and defined into the system.
10. Each controller shall contain a RS232 printer/programming port for programming locally via an IBM PC. When operational, each controller shall support a printer through the RS232 port and be capable of message routing.
11. Single stage operation shall be provided.
12. The system shall have a UL Listed Detector Sensitivity test feature, which will be a function of the smoke detectors and performed automatically every 4 hours.
13. The system shall support 100% of all remote devices in alarm and provide support for a 100% compliment of detector isolator bases.
14. All panel modules shall be supervised for placement and return trouble if damaged or removed.

B. Cabinet

1. Install control unit components in cabinets large enough to accommodate all components and also to allow ample gutter space for interconnection of control units as well as field wiring. The cabinet must be a sturdy steel housing, complete with back box, hinged steel door with cylinder lock, and surface and/or semi-recessed mounting provisions. The enclosure must be identified by an engraved phenolic resin nameplate. Lettering on the nameplate must say "Fire Alarm and Mass Notification control unit" and must not be less than 25 mm 1-inch high. Provide prominent rigid plastic or metal identification plates for lamps, circuits, meters, fuses, and switches.

C. Silencing Switches

1. Alarm Silencing Switch
   a. Provide an alarm silencing switch at the FMCU that must silence the audible and visual notification appliances. Subsequent activation of initiating devices must cause the notification appliances to re-activate.

2. Supervisory/Trouble Silencing Switch
   a. Provide supervisory and trouble silencing switch(es) that must silence the audible trouble and supervisory signal(s), but not extinguish the visual indicator. This switch must be overridden upon activation of a subsequent supervisory or trouble condition. Audible trouble indication must resound automatically every 24 hours after the silencing feature has been operated if the supervisory or trouble condition still exists.

D. Non-Interfering

1. Power and supervise each circuit such that a signal from one device does not prevent the receipt of signals from any other device. Initiating devices must be manually reset by switch from the FMCU after the initiating device or devices have been restored to normal.

E. Audible Notification System

1. The Audible Notification System must comply with the requirements of NFPA 72 for Emergency Voice/Alarm Communications System requirements, except as specified herein. The system must be a one-way, multi-channel voice notification system incorporating user selectability of a minimum eight distinct sounds for tone signaling, and the incorporation of a voice module for delivery of recorded messages. Audible appliances must produce a three-pulse temporal pattern for three cycles followed by a voice message that is repeated until the control unit is reset or silenced. For carbon monoxide detector activation, audible appliances must produce a four-pulse temporal pattern for three cycles followed by a voice message that is repeated until the control unit is reset or silenced. Automatic messages must be broadcast through speakers throughout the building/facility but not in stairs or elevator cabs. A live voice message must override the automatic audible output through use of a microphone input at the control unit or the LOC/Annunciator.
2. The Audible Notification System shall contain a paging microphone, pre-recorded messages and zoned amplifiers capable of delivering multi-channel audio messages. Transmission of audio shall be over the same data network cabling as the fire panel data. These messages shall be automatically played in various areas of a facility under program control. Systems that cause signaling devices to go silent while performing any signaling functions will not be accepted. The system shall support repeat counts of audio messages and stacking of audio messages in a FIFO configuration. Each FMCU containing an audio amplifier or audio source connection shall contain its locally required pre-recorded messaging onboard. Should a fire AND a control network system failure occur, the programmed pre-recorded messages shall be played from the locally stored data. Sending pre-recorded messages across a network or external panel interconnection shall not be considered equal. Should local pre-recorded audio be unavailable, the local amplifiers shall provide an integral backup 1 KHz temporal tone generator which shall operate in the event primary audio signals are lost and the amplifier is instructed to

broadcast alarm information. The amplifier shall support an alert pattern distinct from the evacuation temporal tone pattern.

3. Audio Amplifiers: Every floor/level shall have a dedicated amplifier(s) assigned to do audio on that floor/level. Amplifier configurations that distribute audio signals to multiple floors/levels from one amplifier will not be acceptable. Each audio power amplifier shall have integral audio signal de-multiplexers, allowing the amplifier to select any one of eight digitized audio channels. The channel selection shall be directed by the system software. Each amplifier output shall include a dedicated, supervised 25/70 Vrms speaker circuit which is suitable for connection of emergency speaker appliances. Each amplifier shall also include a notification appliance circuit rated at 24Vdc @ 3.5A for connection of visible (strobe) appliances. This circuit shall be fully programmable, and it shall be possible to define the circuit for the support of audible, visible, or ancillary devices. Standby Audio amplifiers shall be provided that automatically sense the failure of a primary amplifier, and automatically program themselves to select and de-multiplex the same audio information channel of the failed primary amplifier, and fully replace the function of the failed amplifier. In the event of a total loss of audio data communications, all amplifiers will default to the local “EVAC” tone generator channel. If the local panel has an alarm condition, then all amplifiers will sound the EVAC signal on their connected speaker circuits. In the event of a loss of the fully digitized, multiplexed audio riser, the audio amplifiers shall automatically default to an internally generated alarm tone which shall be operated at a 3-3-3 temporal pattern. Audio amplifiers shall automatically detect a short circuit condition on the connected speaker circuit wiring and shall inhibit itself from driving into that short circuit condition.
4. When using the microphone, live messages must be broadcast throughout a selected floor or floors, selectable by zone, or all call. The system must be capable of operating all speakers at the same time.
5. The microprocessor must actively interrogate circuitry, field wiring, and digital coding necessary for the immediate and accurate rebroadcasting of the stored voice data into the appropriate amplifier input. Loss of operating power, supervisory power, or any other malfunction that could render the digitalized voice module inoperative must automatically cause the three-pulse temporal pattern to take over all functions assigned to the failed unit in the event an alarm is activated.
6. Outputs and Operational Modules
    a. All outputs and operational modules must be fully supervised with on-board diagnostics and trouble reporting circuits. Provide form "C" contacts for system alarm and trouble conditions. Provide circuits for operation of auxiliary appliance during trouble conditions. During a Mass Notification event, the control unit must not generate nor cause any trouble alarms to be generated with the Fire Alarm system.

7. Mass Notification
    a. The system must have the capability of utilizing an LOC/annunciator with redundant controls of the FMCU. Notification Appliance Circuits (NAC) must be provided for the activation of strobe appliances. Audio output must be selectable for line level. A hand-held microphone must be provided and, upon activation, must take priority over any tone signal, recorded message or PA microphone operation in progress, while maintaining the strobe NAC circuit activation.
    b. The Mass Notification functions must override the manual or automatic fire alarm notification, and public address (PA) functions. Other fire alarm functions including transmission of a signal(s) to the fire department must remain operational. When a mass notification announcement is disengaged and a fire alarm condition

still exists, the audible and visual notification appliances must resume activation for alarm conditions. The fire alarm message must be of lower priority that all other messages (except any "test" messages) and must not override any other messages.

c. Messages must be recorded professionally utilizing standard industry methods, in a professional female voice. Message and tone volumes must both be at the same decibel level. Messages recorded from the system microphone must not be accepted. A 1000 Hz tone (as required by NFPA 72) must precede messages and be similar to the following unless Installation or Facility specific messages are required:
   1) "May I have your attention please. May I have your attention please. [Insert installation specific message here.]" (Provide a 2 second pause.) "May I have your attention please, (repeat the tones and message on a continuous loop).
      a) Coordinate custom messages with the Owner.
   2) Carbon Monoxide: "May I have your attention please. May I have your attention please. Carbon monoxide has been detected in the building. Please walk to the nearest exit and leave the building." (Provide a 2 second pause.) "May I have your attention please, (repeat the tones and message on a continuous loop).
   3) Fire: "May I have your attention please. May I have your attention please. A fire emergency has been reported in the building. Please leave the building by the nearest exit or exit stairway. Do not use the elevators." (Provide a 2 second pause.) "May I have your attention please, (repeat the tones and message on a continuous loop)."
   4) Test: "May I have your attention please. May I have your attention please. This is a test of the building mass notification system. Please continue your normal duties. This is only a test." (Provide a 2 second pause.)
   5) All Clear: "May I have your attention please. May I have your attention please. An all clear has been issued, resume normal activities." (Provide a 2 second pause.)

d. Auxiliary Input Module must be designed to be an outboard expansion module to either expand the number of optional LOC's, or allow a telephone interface.

F. User Interface:

1. Each fire alarm control panel and annunciator shall be provided with a backlit color LCD touchscreen display. The display on each system panel shall be configurable to display the status of any and/or all combinations of alarm, supervisory, trouble, monitor, or service group event messages on the network. Each LCD display on the system shall be capable of being programmed to allow control functions of any combination of panels on the entire network. All panel touch screen LCD displays shall use resistive technology, be a minimum of 5.7 inches in size and support a minimum of 256K colors.
2. Each display shall support the display of a minimum of 8 events simultaneously without the need to scroll or make manual selections at the display. The LCD display shall provide a minimum of 10 separate color-coded event queues to minimize operator confusion by automatically categorizing event types, the queues shall include but not be limited to Alarm, Emergency, Supervisory, Disables/Bypasses/Test, Ground Fault, Monitor, and Fire Phone call in. To further enhance the usability only queues with events shall display, queues without active events shall not be displayed. It shall be possible to scroll through and view specific alarm, trouble, supervisory and monitor events

separately. Having to scroll through a mixed list of event types shall not be considered as equal. The total number of active and disabled events by type shall be displayed.

3. Visual indication shall be provided of any event type that has not been acknowledged or viewed. It shall be possible to customize the designation of all user interface LEDs and Switches for local language requirements. The display shall support Instructional text messages by event of up to 2,000 characters each.

G. Power Supplies:

1. The power supply shall be a high efficiency switch mode type with line monitoring to automatically switch to batteries for power failure or brown out conditions. The automatic battery charger shall have low battery discharge protection. The power supply shall provide internal power and 24 Vdc at 7.0A continuous for notification appliance circuits. The power supply shall be capable of providing 7A to output circuits for a maximum period of 100 ms. All outputs shall be power limited. The battery shall be sized to support the system for 24 hours of supervisory and trouble signal current plus general alarm for 15 minutes.
2. Auxiliary power supplies shall be a high efficiency switch mode type with line monitoring to automatically switch to batteries for power failure or brown out conditions. The automatic battery charger shall have low battery discharge protection. The power supply shall provide internal power and 24 Vdc at 7.0A continuous for notification appliance circuits. The power supply shall be capable of providing 7A to output circuits for a maximum period of 100 ms. All outputs shall be power limited. The battery shall be sized to support the system for 24 hours of supervisory and trouble signal current plus general alarm for 15 minutes.

H. Network Local Operator Console (LOC) alpha-numeric annunciators shall be located throughout the facility as indicated on the plans. The LOC shall utilize standard fire alarm user interface components to provide the ability to operate the Autonomous Control Unit/Fire Alarm Control Panel functions from alternate locations within the building. The LOC shall be capable of receiving the same event information and issuing the same system commands as the FMCU to which it is connected, as specified in the functional matrix elsewhere in this specification. Functions shall include initiating all pre-recorded messages and live page messages. The following common indicators and controls shall be provided on the LOC. The LOC shall include an integral color LCD touch screen text annunciator. LOC Power, System Trouble, and Signal Silenced LEDs; System Reset, Silence, Panel Silence, Drill push buttons and support local Lamp Test. The annunciator shall include the ability to integrate a Fire Fighters telephone. The LOC shall be equipped with a key locked see-through door. The LOC shall be powered by a battery backed up nominal 24 VDC power source. All communication between the LOC annunciator and the fire alarm control panel shall be via an IPv6 network. Each annunciator must be capable of supporting custom messages as well as system event annunciation. It must be possible to filter unwanted annunciation of trouble, alarm or supervisory functions on a by point or by geographic area.

## 2.6 REMOTE ANNUNCIATOR WITH VOICE EVAC FUNCTIONS (LOBBY)

A. Provide remote annunciator with the same "look and feel" as the FMCU operator interface where shown on the drawings. The Remote Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys, Status LEDs and Display as the FMCU as well as voice paging functions.

B. The panel touch screen LCD display shall be a minimum of 5.7 inches in size and support a minimum of 256K colors. Each display shall support a minimum of 8 events simultaneously without the need to scroll or make manual selections at the display. The intuitive control key interface to allow for the following:

1. "Activity in System" primary display choices include: First and Most Recent, First 5 and Most Recent, First 8, Site Plan with activity status icons, General Alarm, or Direct to List; selectable individually by event type.
2. System reports are easily viewed; logs can be read with minimal scrolling required.
3. Up to six "softkeys" per screen provide functions that vary with the particular screen information aiding operators to determine how to proceed.
4. Menu-driven format conveniently prompts operators for the next action required.
5. Key controls are provided to select the highlighted entry, load next screen of information, or jump to top or bottom of activity lists.
6. Direct point callup displays individual points alphabetically and then homes in on the logical choice as more point information is entered.
7. A Site Plan bitmap can be displayed for reference; icons can be added to indicate system status.
8. Up to 50 custom point detail messages can be generated.
9. Date formats are either MM/DD/YY or DD/MM/YY.
10. Time formats are either 24 hour or 12 hour with AM/PM.
11. System Normal screen supports a gray scale bitmap (watermark) for location name, company logo, or site plan.

C. Microphone and audio control switches shall be contained in the same housing as the touch screen annunciator and controls – no exceptions.

## 2.7 COMPONENTS

A. Intelligent Devices — General: Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Each device shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and supervision by location. Setting a device's address by physical means shall not be necessary.

B. Intelligent Detectors — General: The System Intelligent Detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and

analog loop controller. Detectors not capable of making independent alarm decisions shall not be acceptable. Maximum total analog loop response time for detectors changing state shall be 0.5 seconds. Each detector shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm communication with the analog loop controller. A red LED shall flash to display alarm status. The detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient "Environmental Thresholds" approximately six times an hour. The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminates as well as detector aging. The process shall employ digital compensation to adapt the detector to both 24-hour long term and 4-hour short-term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the "learned" base line sensitivity. The base line sensitivity information shall be updated and permanently stored at the detector approximately once every hour. The intelligent analog detectors shall be suitable for mounting on any Signature Series detector mounting base.

## 2.8 FIXED TEMPERATURE / RATE OF RISE HEAT DETECTOR

A. Provide intelligent combination fixed temperature/rate-of-rise heat detectors at the locations shown on the drawings. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135 deg. F (57 deg. C) and a rate-of-rise alarm point of 15 deg. F (9 deg. C) per minute. The heat detector shall be rated for ceiling installation at a minimum of 70 ft. (21.3m) centers and be suitable for wall mount applications. Where shown on the project plans, include combination Heat and Carbon Monoxide (CO) detector. The combination Heat and CO device shall report separately to the control panel where a heat condition is considered a fire alarm and a CO condition is a supervisory alarm with separate and unique evacuation sequence.

## 2.9 COMBINATION HEAT AND CO DETECTOR

A. At the locations shown on the project plans, include combination Heat and Carbon Monoxide (CO) detector. The combination Heat and CO device shall report separately to the control panel where a heat condition is considered a fire alarm and a CO condition is a supervisory alarm with separate and unique evacuation sequence.

## 2.10 PHOTOELECTRIC SMOKE DETECTOR

A. Provide intelligent multi-criteria UL268 7th edition photoelectric smoke detectors model at the locations shown on the drawings. The optical detector shall be listed as a multi criteria detector without the use of other sensing elements, and the use of fixed end of life sensing components is not acceptable. Each optical smoke detector shall be capable of rejecting nuisance sources and detect smoke in the full life safety window of 0.5% to 4.36% obscuration/foot. Must be listed to UL268 7th edition. Detectors that must operate in a special application mode that cannot achieve the full 0.5% to 4.36% life safety window shall not be considered equal. The analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC or the Program/Service Tool. The photo detector shall be rated for ceiling installation at a minimum of 30 ft. (9.1m) centers and be suitable for wall mount applications. The photoelectric smoke detector shall be suitable for direct insertion into air ducts up to 3 ft. (0.91m) high and 3 ft. (0.91m) wide with air velocities up to 5,000 ft./min. (0-25.39 m/sec) without requiring specific duct detector housings or supply tubes. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photo detector shall be suitable for operation in the following environment: Temperature: 32 deg. F to 120 deg. F (0 deg. C to 49 deg. C), Humidity: 0-93% RH, non-condensing, Elevation: no limit.

## 2.11 ADDRESSABLE MULTI-CRITERIA SMOKE WITH CARBON MONOVIDE (CO) DETECTOR

A. Provide intelligent multi-criteria UL268 7th edition photoelectric smoke detectors with carbon monoxide (CO) detectors at the locations shown on the drawings. The combination smoke and CO detector shall provide two independent signals (smoke & CO) to the control panel for programming system responses. When mounted in a sounder base, the detector shall be capable of initiating a temporal 3-3-3 when smoke is detected or temporal 4-4-4-4 when CO is detected. Units installed in sleeping or potential sleeping units shall be capable of generating a low frequency 520hz signal. Detectors that transmit a common signal to the control panel for both smoke and CO alarms shall not be considered as equals. The detector shall be listed under standards UL-268 and UL-2075. Each smoke detector shall be individually programmable to operate at any one of five (5) sensitivity settings. The detector shall also store pre-alarm and alternate pre-alarm sensitivity settings. Pre alarm sensitivity values shall be configurable in 5% increments of the alarm and alternate alarm sensitivity settings respectively. The detector shall be able to differentiate between a long-term drift above the pre alarm threshold and fast rise above the threshold. The detector shall monitor the sensitivity of the smoke sensor. If the sensitivity shifts outside the UL limits, a trouble signal shall be sent to the panel. It shall be possible to automatically change the sensitivity of individual intelligent addressable smoke detectors for day and night (alternate) periods. Each detector shall utilize an environmental compensation algorithm that shall automatically adjust for background environmental conditions such as dust, temperature, and pressure. The detector shall provide a maintenance alert signal when 80% (dirty) of the available compensation range has been used. The detector shall provide a dirty fault signal when 100% or greater compensation has been used. The electro-chemical CO sensor shall generate a CO alarm in compliance with UL-2034

requirements. When the sensor approaches the end of its useful life, it shall transmit a maintenance condition to the control panel, indicating the CO sensor board replacement is required. Only when the sensor is no longer operational shall a trouble condition be sent to the control panel. Sensors that transmit a common trouble indication for both sensor end-of-life and other causes of detector trouble shall not be considered as equal. Performing a "sensitivity" check from the panel shall report the approximate number months of CO sensor life remaining. Placing the CO detector in test mode shall facilitate the use of direct injection of small quantities of CO to check detector functionality.

## 2.12 ADDRESSABLE CARBON MONOXIDE (CO) DETECTOR

A. Provide addressable carbon monoxide (CO) detectors at the locations shown on the drawings. The CO detector shall provide a signal to the control panel for programming system responses. When mounted in a sounder base, the detector shall be capable of initiating a temporal 4-4-4-4 signal when CO is detected. The detector shall be listed under standard UL-2075. The electro-chemical CO sensor shall generate a CO alarm in compliance with UL-2034 requirements. The sensor shall have a nominal six-year life. Performing a "sensitivity" check from the panel shall report the approximate number months of sensor life remaining. When the sensor approaches the end of its useful life, it shall transmit a maintenance condition to the control panel, indicating the CO sensor board replacement is required. Only when the sensor is no longer operational shall a trouble condition be sent to the control panel. Detectors that transmit a common trouble indication for both sensor end-of-life and other causes of detector trouble shall not be considered as equal.

## 2.13 STANDARD DETECTOR MOUNTING BASES

A. Provide standard detector mounting bases suitable for mounting on North American 1-gang, 3½" or 4" octagon box and 4" square box. The base shall, contain no electronics, support all Signature Series detector types and have the following minimum requirements: Removal of the respective detector shall not affect communications with other detectors, Terminal connections shall be made on the room side of the base, bases that must be removed to gain access to the terminals shall not be acceptable. The base shall be capable of supporting one (1) Remote Alarm LED Indicator.

## 2.14 AUDIBLE DETECTOR MOUNTING BASE

A. Provide audible/sounder bases suitable for mounting on North American 1-gang, 3½" or 4" octagon box and 4" square box. The sounder base shall be capable of two tones, Temporal 3 for a fire condition and Temporal 4 for a Carbon monoxide condition. The tones shall be fully programmable and synchronize the sound with other sounder bases. The system shall be UL2017 listed for dual signaling for this purpose. The base shall be capable of supporting one (1) Remote Alarm LED Indicator.

## 2.15 REMOTE ALARM INDICATORS

A. Provide remote alarm indicators and permanently attached placard for all detectors that are installed behind locked doors and/or as indicated on the drawings.

B. The location of the detector and the area protected by the detector shall be prominently indicated at the remote alarm indicator by a permanently attached placard.

C. Remote alarm or supervisory indicators shall be installed in an accessible location and shall be clearly labeled to indicate both their function and any device or equipment associated with each detector.

## 2.16 DUCT DETECTOR

A. Provide low profile intelligent addressable duct smoke detector as indicated on the project plans. Provide for variations in duct air velocity between 100 and 4,000 feet per minute and include a wide sensitivity range of .79 to 2.46%/ft. obscuration. Include one Form-C shut down relay rated 2.0 amps @ 30 Vdc and also include slave high contact relays if required. Provide an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten feet. The addressable DUCT housing shall be suitable for extreme environments, including a temperature range of –20 to 158 degrees F and offer a harsh environment gasket option. Provide Remote Alarm LED Indicators and remote test station as indicated on the project plans.

B. Exterior Enclosure: A NEMA 4X weatherproof duct housing enclosure shall be provided for the circulation of conditioned air around the addressable duct sensor housing to maintain the sensor housing at its rated temperature range when the duct detector is mounted on the exterior of the building. The housing shall be UL Listed to Standard 268A.

C. Sequence of operation:

1. Upon sensing smoke, the duct smoke detector shall stop the fan(s) and de-energize controls through a direct circuit normally closed (NC) interlock contacts.
2. A set of normally open (NO) contacts will close, to signal the fire alarm system to initiate a supervisory alarm. The fire alarm system will report the alarm to the fire department.
3. A second set of NO contacts shall close and signal the building management system (BMS).

D. Smoke Damper Actuation

1. The smoke damper shall close upon actuation of a listed smoke detector or detectors installed in accordance with one of the following methods, as applicable:
    a. Where a smoke damper is installed within a duct, provide a smoke detector installed in the duct within 5 feet (1524 mm) of the damper with no air outlets or inlets between the detector and the damper. The detector shall be listed for the air velocity, temperature and humidity anticipated at the point where it is installed. Dampers shall be closed upon fan shutdown where local smoke detectors require a minimum velocity to operate.
    b. Where a smoke damper is installed above smoke barrier doors in a smoke barrier, provide a spot-type detector listed for releasing service installed on either side of the smoke barrier door opening.
    c. Where a smoke damper is installed within an air transfer opening in a wall, provide a spot-type detector listed for releasing service installed within 5 feet (1524 mm) horizontally of the damper.
    d. Where a smoke damper is installed in a corridor wall or ceiling, the damper shall be controlled by the smoke detection system installed in the corridor.

e. Where a total-coverage smoke detector system is provided within areas served by a heating, ventilation, and air-conditioning (HVAC) system, smoke dampers shall be controlled by the smoke detection system.

## 2.17 BEAM DETECTORS

A. Projected Beam Detector – Single End: The projected beam type smoke detector shall be a 4-wire 12/24 Vdc device monitored by the Fire Alarm control panel through a two circuit monitor module (one zone for alarm and one for trouble). The unit shall be listed to UL 268 and shall consist of an integrated transmitter and receiver. The beam detector shall operate between a range of 15 and 160 feet or 160 and 330 feet (Electrical Subcontractor shall determine distance to select appropriate model). It shall feature automatic gain control, which will compensate for gradual signal deterioration due to dirt accumulation on the lenses. The unit shall include a wall mounting bracket. Testing shall be carried out using a calibrated test filter. Furnish and install a remotely installed key-operated test station to test the detector without direct access to it.

## 2.18 INTELLIGENT MODULES

A. General: The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller. Modules requiring EPROM, PROM, ROM changes and/or jumper changes shall not be acceptable. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A red LED shall flash to display communications and latch on alarm status. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment: Temperature: 32 deg. F to 120 deg. F, Humidity: 0-93% RH, non-condensing.

B. Single Input Module, (Waterflow Detectors, Tamper Switches etc.): Provide intelligent single input modules at the locations of devices shown on the drawings. The Single Input Module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The single input module shall support the following circuit types: Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.), Normally-Open Alarm Delayed Latching (Waterflow Switches), Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.), Normally-Open Active Latching (Supervisory, Tamper Switches).

C. Isolation Module: Provide isolation modules to subdivide each signaling line circuit into groups of not more than 25 addressable devices between adjacent isolation modules.

D. Dual Input Module:: Provide intelligent dual input modules at the locations of devices shown on the drawings. The Dual Input Module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The dual input module shall support the following circuit types: Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.), Normally-Open Alarm Delayed Latching (Waterflow Switches), Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.), Normally-Open Active Latching (Supervisory, Tamper Switches).

E. Single Input Signal Module: Provide intelligent single input signal modules at locations of devices shown on the drawings. The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation. When selected as a telephone power selector, the module shall be capable of generating its own "ring tone". The module shall be suitable for mounting on North American 2 ½" (64mm) deep 2-gang boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes. The single input signal module shall support the following operations: Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A).

F. Control Relay Module (2A or less): Provide intelligent control relay modules at locations of devices shown on the drawings. The Control Relay Module shall provide one form "R" dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware. The control relay module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" deep 4" square boxes with 1-gang covers.

G. Control Relay Module (high current): Provide high current intelligent control relay modules for applications where external loads exceed 2.0A. Any external load exceeding 2.0A shall require an addressable high current relay for switching. No pilot relays shall be acceptable for connection to the addressable relay. All addressable relay functions shall be incorporated into the addressable device and shall not require the connection and wiring of separate relays. Addressable relay shall have 2 separate form C contacts, accepting 12 to 18AWG wiring from two sources. The control module shall be suitable for mounting on North American double gang or standard 4' square boxes.

## 2.19 INTELLIGENT MANUAL PULL STATIONS

A. General: The manual stations shall have a minimum of 2 diagnostic LEDs mounted on their integral, factory assembled single or two stage input module. A red LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. Input circuit wiring shall be supervised for open and ground faults. The fire alarm pull station shall be suitable for operation in the following environment: Temperature: 32F to 120F, Humidity: 0-93% RH, non-condensing.

B. Manual Pull Station: Provide intelligent dual action, single stage fire alarm stations at locations shown on the drawings. The fire alarm station shall be of metal construction with an internal toggle switch. Provide a locked test feature. Finish the station in red with silver "PULL IN CASE OF FIRE" English lettering. The manual station shall be suitable for mounting on North American 2 ½" deep 1-gang boxes and 1 ½" deep 4" square boxes with 1-gang covers.

C. Parking or outdoor area Pull Stations shall be NEMA 4X rated for outdoor use and key operated. Matching weatherproof back box to be included. Addressable monitor module for monitoring of pull station to be installed in environmentally controlled area.

## 2.20 NOTIFICATION APPLIANCES

A. General: All appliances shall be UL Listed for Fire Protective Service. All strobe appliances or combination appliances with strobes shall be capable of providing the "Equivalent Facilitation"

which is allowed under the Americans with Disabilities Act accessibility guidelines (ADA(AG)), and shall be UL 1971, and ULC S526 Listed. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to ensure absolute compatibility between the appliances and the control panels, and to ensure that the application of the appliances are done in accordance with the single manufacturers' instructions. Any appliances that do not meet the above requirements and are submitted for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from the control panel manufacturer clearly stating that the control equipment (as submitted) is 100% compatible with the submitted Notification Appliances.

B. Strobes: Provide ceiling/wall mounted strobes at the locations shown on the drawings. All visual devices are to be calculated at the highest candela setting of 110cd. In the event that strobe candela coverage for a given area needs to be increased, any additional current draw will already be calculated and available on the circuit. Strobes shall provide synchronized flash outputs. Strobe output shall be field selectable as indicated on the drawings in one of the following intensity levels; 15cd, 30cd, 75cd or 110cd. Candela setting switch shall be accessible while device is mounted on wall. Strobes shall mount in a standard North American 1-gang, 2-gang, 4-inch octagon, and 4-inch square electrical boxes, and protrude less than 1.5" from the finished wall. To ensure a clean installation a room side wiring plate shall connect to the backbox for easy snap in of the device. The wiring plate shall have a circuit integrity bar that can be removed to ensure all wiring can be field inspected before device installation. For surface mount applications, provide a matching back box provided by the manufacturer, as directed in the field.

C. Speakers: Provide ceiling/wall mounted speakers with a 4" cone at locations shown on the drawings. Speaker must provide a frequency response between 400 – 4,000 HZ, a STI index of at least .81, and must be UL tested and approved. The rear of the speaker shall be completely sealed protecting the cone during and after installation. Screw terminals shall be provided for wiring and the speaker housings shall be red and include "FIRE" labeling. Speakers shall be provided for use with 70 or 25V systems and shall provide power taps at 1/4w, 1/2w, 1w, and 2w. Speakers shall provide UL confirmed 87 dBA sound output at 2w with an STI rating of .81. All speakers mounted in sleeping, or potential sleeping rooms, shall be UL approved and capable of delivering a 520 HZ square wave signal. Speakers shall mount in a North American 4" electrical box with extension ring using the 2 screws provided with ring. For easier installation a room side wiring plate shall connect to the backbox for easy snap in. The wiring plate shall have a circuit integrity bar that can be removed to ensure all wiring can be field inspected before device installation. It must not be necessary to completely remove the screws to facilitate mounting.

D. Speaker/Strobes: Provide ceiling/ wall mounted speaker/strobes at the locations shown on the drawings. All visual devices are to be calculated at the highest candela setting of 110cd. If strobe candela coverage for a given area needs to be increased, any additional current draw will already be calculated and available on the circuit. Speaker must provide a frequency response between 400 – 4,000 HZ, a STI index of at least .81, and must be UL tested and approved. The rear of the speaker shall be completely sealed protecting the cone during and after installation. Screw terminals shall be provided for wiring and the speaker housings shall be red and include "FIRE" labeling. Speakers shall have a switch to select either 70 or 25V options. Speakers not capable of use at either voltage will not be accepted. Devices shall provide power taps at 1/4w, 1/2w, 1w, and 2w. Speakers shall provide UL confirmed 87 dBA sound output at 2w with an STI rating of no less than .81. All units shall install to a room side wiring plate, for convenient installation and troubleshooting. All speakers mounted in sleeping, or potential sleeping rooms,

shall be UL approved and capable of delivering a 520 HZ square wave signal. Speakers shall mount in a North American 4" electrical box. Strobes shall provide synchronized flash outputs. Strobe output shall be field selectable as indicated on the drawings in one of the following intensity levels; 15cd, 30cd, 75cd or 110cd. Candela setting switch shall be accessible while device is mounted on wall.

E. Outdoor area notification devices shall all be weatherproof and listed for the application along with weatherproof back box. Speakers shall be provided for use with 70V systems and shall provide power taps at 1/4w, 1/2w, 1w, and 2w. Speaker/strobes shall provide UL confirmed 90 dBA sound output at 2w. Strobes shall provide 15, 29, 70 & 87 candela synchronized flash outputs. The strobe shall have lens markings oriented for wall mounting.

## 2.21 MULTI-VOLTAGE CONTROL RELAYS

A. Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be DPDT and rated for 10 amperes at 115 Vac. A single relay may be energized from a voltage source of 24 Vdc, 24 Vac, 115 Vac, or 230 Vac. A red LED shall indicate the relay is energized. A metal enclosure shall be provided.

## 2.22 ELECTROMAGNETIC DOOR HOLDERS

A. General: Electromagnetic door holders submitted for use must have written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purposes intended.

B. Provide flush, semi-flush or surface wall mounted electromagnetic door holder/releases rated at 24 Vac/dc at the locations shown on the drawings. Finish shall be brushed zinc.

## 2.23 KNOX BOX

A. Furnish and install where shown on the drawings.

B. The Knox box shall be flush mounted Knox Box model 4400 Series (verify with Fire Department) with tamper switch.

C. Features: Box and lock are UL® Listed. Weather resistant door gasket. Hinged door allows single-handed operation. Colors: Black, Dark Bronze or Aluminum. Verify with the Architect. Coordinate mounting (surface or recessed) and color with the Architect. Provide monitor module to supervise the Knox box against tampering.

## 2.24 TERMINAL CABINETS

A. Furnish and install as required.

B. Coordinate color with the Architect.

C. Provide Space Age or equal.

2.25 CENTRAL STATION ALARM REPORTING

A. Furnish and install two phone lines to the fire alarm control panel in 3/4" EMT. The phone lines shall be cross connected ahead of the phone system.

B. Include the costs at a UL listed central station for the duration of the warranty period.

2.26 TEST TOOL

A. In order to expedite the installation process and ensure proper install of devices, include a manufacturer's certified technician test tool to be supplied to the Electrical Subcontractor that will identify opens and shorts in the addressable loop. The test tool shall also indicate errors in addressing of specific devices as well as condition of devices in the loop.

2.27 MASTERBOX

A. The installation shall comply with the requirements of the Fire Department. Refer to the rules and regulations provided by the fire department.

B. All master boxes shall be an AES 7788F radio transmitter type.

C. Master boxes shall be installed in accordance with NFPA 1221.

D. The radio master fire alarm box connected to the fire protection system must be compatible with the receiving equipment of the fire department. The Electrical Subcontractor shall coordinate the requirements with the fire department.

E. The master box shall be mounted on the inside of the building at the main entrance, next to the fire alarm panel or annunciator. Coordinate exact location with fire department prior to installation.

F. The Electrical Subcontractor shall provide all necessary connections, materials, contacts, relay cards, etc. in the existing fire alarm panel to facilitate interconnection to the masterbox.

2.28 EXTERIOR BEACON

A. Basis of design shall be Edwards Signaling 3000SD-EK Series 150,000 candle power strobe.

1. Red for fire alarm.
2. White or blue for sprinkler flow alarm (if required).

2.29 SURGE PROTECTIVE DEVICES

A. Surge protective devices must be provided to suppress all voltage transients which might damage fire alarm control unit components. Systems having circuits located outdoors, communications equipment must be protected against surges induced on any signaling line circuit. Cables and conductors, that serve as communications links, must have surge protection circuits installed at each end. The surge protective device must wire in series to the power

supply of the protected equipment with screw terminations. Line voltage surge arrestor must be installed directly adjacent to the power panel where the FMCU breaker is located.

1. Surge protective devices for nominal 120 VAC must be UL 1449 listed with a maximum 500 volt suppression level and have a maximum response time of 5 nanoseconds. The surge protective device must also meet IEEE C62.41.1 and IEEE C62.41.2 category B tests for surge capacity. The surge protective device must feature multi-stage construction and be provided with a long-life indicator lamp (either light emitting diode or neon) which extinguishes upon failure of protected components. Any unit fusing must be externally accessible.
2. Surge protective devices for nominal 24 VAC, fire alarm telephone dialer, or ethernet connection must be UL 497B listed, meet IEEE C62.41.1 and have a maximum response time of 1-nanosecond. The surge protective device must feature multi-stage construction and be self-resetting. The surge protective device must be a base and plug style. The base assembly must have screw terminals for fire alarm wiring. The base assembly must accept "plug-in" surge protective module.
3. All surge protective devices (SPD) must be the standard product of a single manufacturer and be equal or better than the following:
    a. For 120 VAC nominal line voltage: UL 1449 and UL 1283 listed, series connected 120 VAC, 20A rated, surge protective device in a NEMA 4x enclosure. Minimum 50,000 amp surge current rating with EMI/RFI filtering and a dry contact circuit for remote monitoring of surge protection status.
    b. For 24-volt nominal line voltage: UL 497B listed, series connected low voltage, 24-volt, 5A rated, loop circuit protector, base and replaceable module.
    c. For alarm telephone dialers: UL 497A listed, series connected, 130-volt, 150 mA rated with self-resetting fuse, dialer circuit protector with modular plug and play.
    d. For IP-DACTS: UL 497B listed, series connected, 6.4-volt, 1.5A rated with 20 kA/pair surge current, data network protector with modular plug and play.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. The installation shall comply with 780 CMR and requirements of the fire department.

B. The entire system shall be installed in a workmanlike manner, in accordance with approved manufacturer’s wiring diagram. The Electrical Subcontractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the manufacturer, approved by the local Fire Department and specified with in.

C. All penetration of floor slabs and firewalls shall be sleeved (1” conduit minimum) fire stopped in accordance with all local fire codes.

D. End of Line Resistors shall be furnished as required for mounting as directed by the manufacturer. Devices containing end-of-line resistors shall be appropriately labeled. Devices should be labeled so removal of the device is not required to identify the EOL device.

E. All manual pull stations shall be mounted 48 inches above the finished floor, as measured to the handle.

F. All audio/visual devices shall be mounted 80 inches above the finished floor, as measured to the lens. Devices shall be mounted no less than 6 inches from the ceiling. All audiovisual devices shall have Lexan covers in all areas subject to mechanical damage.

G. No area smoke detectors shall be mounted within 36 inches of any HVAC supply, return air register or lighting fixture.

H. No area smoke or heat detector shall be mounted within 12 inches of any wall. All detectors shall be installed in strict accordance with NFPA 72 guidelines for such devices.

I. All mechanical rooms, boiler rooms, wiring closets, custodian rooms, attic spaces, etc. or areas with no hung ceilings shall be piped with minimum 3\4" conduit. All device plenum rated wiring shall be mechanically protected with conduit.

J. In areas with concealed ceiling spaces all device plenum rated wiring shall be mechanically protected with conduit.

K. All addressable modules shall be mounted within 36 inches of the monitored or controlled point of termination. This shall include, but is not necessarily limited to, fan shutdown, elevator recall, shunt trip, sprinkler status points, Ansul/Hood subsystems, or door release. Label all addressable modules as to their function.

L. New door holders shall derive their 24VAC/VDC power from a separate power supply housed in a dedicated, metal enclosure. The power supply shall have a 120VAC feed and is to be centrally located to serve door holders on a per floor or area basis. All existing door holders shall be connected to new FMCU. E.C. shall extend all existing wiring in order to make this work. Locations and quantities of door holder power supplies shall be referenced and submitted in the submission package for approval by the Consulting Engineer.

M. All low voltage wiring shall be PLENUM RATED with no exceptions and no less than No. 18 AWG in size, and solid copper.

N. All line voltage (120VAC) wiring shall be no less than No. 12 AWG in size, and solid copper. This shall include all system grounding. FMCU must have a DEDICATED 20 Amp circuit marked back at the power panel NO EXCEPTIONS.

O. All wiring shall be color-coded throughout, to National Electrical Code standards.

P. Power-limited/Non-power-limited NEC wiring standards SHALL BE OBSERVED.

Q. All junction box covers shall be painted federal safety red and labeled FIRE ALARM SYSTEM ONLY in black letters.

R. Fire alarm system wiring shall not co-mingle with any other system wiring in the facility. Conduits shall not be shared under any circumstance. Only when fire alarm wiring enters the enclosure of a monitored or controlled system will co-habitation be permitted (i.e. at fan starters or elevator controllers).

S. Fire alarm control panel enclosures shall have engraved labels indicating, “FIRE ALARM SYSTEM”, and the areas of the building served by that panel.

T. Auxiliary relays shall be appropriately labeled to indicate “FIRE ALARM SYSTEM” and their specific function (i.e. FAN S-1 SHUTDOWN).

U. All fire alarm wiring shall be continuous and un-spliced. Terminations shall only occur at fire alarm devices or control panel enclosures under terminal screws. All other splicing methods are specifically disallowed (i.e. plastic wire nuts).

V. All fire alarm wiring shall be installed using a dedicated system of supports (i.e. bridle rings). Fire alarm wiring shall not be bundled or strapped to existing conduit, pipe or wire in the facility.

W. All fire alarm wiring shall be sleeved when passing through any wall, using conduit sleeves (1” min.) with bushings, and fire stopped in accordance with Code.

X. The system shall be arranged to receive power from one three wire 120 Vac, 20 A supply. All low voltage operation shall be provided from the fire alarm control panel.

Y. All fire alarm devices shall be accessible for periodic maintenance. Should a device location indicated on the Contract Drawings not meet this requirement, it shall be the responsibility of the Electrical Subcontractor to bring it, in writing, to the attention of the Project Engineer. Failure to bring such issues to the attention of the Project Engineer shall be the exclusive liability of the installing Electrical Subcontractor.

Z. The existing fire alarm system shall remain in operation until such time that approval has been granted for its removal. The installing Electrical Subcontractor shall be responsible for the upkeep of the existing system until such time that it can be removed.

## 3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 16 Section "Electrical Identification."

B. Install instructions frame in a location visible from the FMCU.

## 3.3 GROUNDING

A. Ground the FMCU and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FMCU.

## 3.4 FIELD QUALITY CONTROL

A. The system shall be installed and fully tested under the supervision of a trained manufacturer’s representative. The system shall be demonstrated to perform all of the function as specified.

B. The installing Electrical Subcontractor or fire alarm equipment vendor shall have no less than two (2) NICET Level IV fire alarm technicians dedicated to this project.

C. The Installing Contract and the Fire Alarm System Vendor shall, upon the request of the Consulting Engineer or End-User, attend any and all project meetings for the purpose of accurately determining progress.

D. It shall be the responsibility of the Electrical Subcontractor to assure that construction debris does not adversely affect any sensing devices installed as part of this project. Should it be deemed necessary by the Consulting Engineer, End-User or AHJ, the Electrical Subcontractor shall be responsible for the cleaning of all smoke detectors prior to final acceptance.

## 3.5 IMPAIREMENTS TO EXISTING FIRE ALARM SYSTEM

A. Impairments to existing fire alarm systems for purpose of repair, alteration or installation shall comply as a minimum with the requirements of 780 CMR, NFPA 241 and NFPA 72. Proposed mitigation measures shall be in writing and submitted by the fire alarm vendor at the time of permit application submittal and shall be for all phases of the proposed work and as required per MGL CH 148 S 27A is subject to any additional conditions required by the fire department.

B. In renovation work, which includes existing smoke detectors, the smoke detectors shall be replaced during renovations by appropriate heat detectors only if the smoke detectors do not perform a fire safety function, i.e., smoke control, elevator recall, etc. unless otherwise approved by the fire marshal. In fully sprinklered areas sprinkler heads may serve as heat detectors if approved by the fire marshal. When smoke detectors are removed circuit integrity shall be maintained. When renovation work is completed, smoke detectors must be reinstalled.

## 3.6 TESTING AND ACCEPTANCE

A. Additions and modifications to existing systems will require a new application and Submittal. A written "cutover" procedure with an installation schedule is required at time of permit application whenever a new fire alarm system or portion of the system is to be installed in a building in order to replace an existing fire alarm system. A proposed testing schedule subject to the scheduling demands and approval of the internal systems inspectors, shall also be submitted. The existing fire alarm system shall remain operational until the new fire alarm system or portion of it has been successfully acceptance tested and witnessed by the internal systems inspectors. New fire alarm systems proposed to be installed in phases shall describe in writing the fire protection and life safety features that will be maintained or implemented during any fire alarm system impairment and will be subject to review and approval by the fire marshal. Fire alarm system installations for buildings proposing to apply for temporary certificates of occupancy shall be in accordance with fire department guidelines including construction floor fire alarm systems in partially occupied buildings and shall be subject to testing and inspection and also shall be subject to review and approval of the fire marshal. Proposed multiple phase fire alarm system installations shall be submitted as a single project at the time of permit application and shall include with the application, but not be limited to, the following documentation; a schedule of installation phasing and testing, all proposed occupancies, all impairment mitigations and will be subject to review and approval by the fire marshal. A written explanation from the owner or owner's agent for any temporary or partial certificate of occupancy request shall also be submitted for review and subject to approval by the fire marshal.

B. The Electrical Subcontractor is responsible for giving all notices, filing all plans, obtaining all permits, fire alarm system testing and obtaining necessary approvals from authorities having jurisdiction.

C. The authority having jurisdiction, the Fire Department., requests periodic inspection of the fire alarm system during the installation period. The Electrical Subcontractor shall contact the Fire Dept. to schedule these inspections.

D. The Electrical Subcontractor shall schedule all fire alarm tests a minimum of 2 weeks in advance. Coordinate testing times with the Owner, Designers, and authorities having jurisdiction. Fire Alarm Testing will be performed before or after normal business hours or on weekends and holidays. Additional compensation will not be provided to the Electrical Subcontractor for non-business hours testing.

E. Initial Acceptance Testing

1. All new systems shall be inspected and tested in accordance with the requirements of NFPA 72, Chapter 14.
2. The authority having jurisdiction shall be notified prior to the initial acceptance test.

F. Reacceptance Testing

1. When an initiating device, notification appliance, or control relay is added, it shall be functionally tested.
2. When an initiating device, notification appliance, or control relay is deleted, another device, appliance, or control relay on the circuit shall be operated.
3. When modifications or repairs to control equipment hardware are made, the control equipment shall be tested in accordance with NFPA 72, Table 14.4.3.2, items 1 (a) and 1 (d).
4. When changes are made to site-specific software, the following shall apply:
    a. All functions known to be affected by the change, or identified by a means that indicates changes, shall be 100 percent tested.
    b. In addition, 10 percent of initiating devices that are not directly affected by the change, up to a maximum of 50 devices, also shall be tested and correct system operation shall be verified.
    c. A revised record of completion in accordance with NFPA 72, 7.5.6 shall be prepared to reflect these changes.

G. Changes to the system executive software shall require a 10 percent, functional test of the system, including a test of at least one device on each input and output circuit to verify critical system functions such as notification appliances, control functions, and off-premises reporting.

## 3.7 FINAL ACCEPTANCE TEST

A. This test is required for issuance of the Certificate of Occupancy by the Fire Department. The Electrical Subcontractor shall submit to the Fire Department the following documentation prior to requesting the final fire alarm system acceptance test:

1. Affidavit from the fire alarm system designer letter certifying the system has been installed according to plans and specifications and the system is 100% operational and ready for the final testing.
2. Affidavit from the Electrical Subcontractor letter certifying the fire alarm system has been installed according to the plans and specifications and is ready for final testing.
3. Fire alarm manufacturer completed and signed NFPA Record of Completion form.
4. Copy of the approved Fire Alarm Narrative, Matrix and English language device list.
5. Copy of the fire alarm manufacturer's program notes and approved shop drawings.
6. Copy of the stamped fire alarm drawings (as-built drawings if available).

B. The Electrical Subcontractor shall schedule the final fire alarm test with the Fire Department, the Owner and other required participants.

C. Required participants at the final acceptance test to include:

1. Fire Department
2. General Contractor's site Superintendent
3. Electrical Subcontractor
4. Owner's Representative
5. If the final acceptance fire alarm test is successful, the Fire Department will issue a letter of acceptance. If the fire alarm test is not successful the Electrical Subcontractor shall immediately provide the required changes and reschedule the fire alarm test.

## 3.8 COMMISSIONING

A. Comply with requirements specified in Division 1.

B. Engage a factory-authorized service representative to supervise and assist with startup service. Complete installation and startup checks according to the approved manufacturer's written instructions.

## 3.9 TRAINING AND SERVICE

A. Comply with Section 26 00 01.

B. Conduct two 4-hour training sessions. Train the Owner's maintenance personnel on procedures and schedules related to start up and shutdown, troubleshooting, servicing, and preventive maintenance.

C. Training shall include fire department personnel.

## 3.10 EXTRA MATERIALS

A. Furnish the following component at the end of the project to the Owner:

1. Pull stations: 5
2. Smoke detectors: 10
3. Duct smoke detectors: 2
4. Notification appliances

a. Multi-candela ceiling mounted audiovisual devices: 5 of each kind
b. Multi-candela ceiling mounted visual devices: 5 of each kind
c. Multi-candela wall mounted audiovisual devices: 5 of each kind
d. Multi-candela wall mounted visual devices: 5 of each kind

END OF SECTION