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**END OF SECTION**

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SECTION 1.A

BID FOR LUMP SUM CONTRACT

Date: \_\_\_\_\_

BID OF \_\_\_\_\_  
(hereinafter called "Bidder") a corporation\* organized and existing under laws of the State of \_\_\_\_\_  
\_\_\_\_\_,  
a partnership\* consisting of \_\_\_\_\_,  
an individual\* trading as \_\_\_\_\_,  
a joint venture\* consisting of \_\_\_\_\_

\*Insert Corporation(s), partnership or individual, as applicable.

TO: Curators of the University of Missouri  
c/o Campus Facilities, Planning Design & Construction, Room L100 (Front Reception Desk),  
General Services Building, University of Missouri, Columbia MO 65211

1. Bidder, in compliance with invitation for bids for construction work in accordance with Drawings and Specifications prepared by HELLMUTH, OBATA & KASSABAUM, INC., entitled "New Indoor Practice Facility", project number CP210981, dated July 13, 2021 having examined Contract Documents and site of proposed work, and being familiar with all conditions pertaining to construction of proposed project, including availability of materials and labor, hereby proposes to furnish all labor, materials and supplies to construct project in accordance with Contract Documents, within time set forth herein at prices stated below. Prices shall cover all expenses, including taxes not covered by the University of Missouri's tax exemption status, incurred in performing work required under Contract documents, of which this Bid is a part.

Bidder acknowledges receipt of following addenda:

Addendum No. \_\_\_\_\_ Dated \_\_\_\_\_  
Addendum No. \_\_\_\_\_ Dated \_\_\_\_\_  
Addendum No. \_\_\_\_\_ Dated \_\_\_\_\_  
Addendum No. \_\_\_\_\_ Dated \_\_\_\_\_

2. In following Bid(s), amount(s) shall be written in both words and figures. In case of discrepancy between words and figures, words shall govern.

3. **BID PRICING**

a. Base Bid: New Indoor Practice Facility  
The Bidder agrees to furnish all labor, materials, tools, and equipment required to \_\_; all as indicated on the Drawings and described in these Specifications for sum of:

\_\_\_\_\_ DOLLARS (\$\_\_\_\_\_).

b. Additive Alternate Bids:

Alternate #1: Stone Base  
Alternate #2: Expanded Parking Lot G, Includes Grading for Broadcast Relocation  
Alternate #3: Broadcast Utility Relocation

Above Base Bid may be changed in accordance with following Alternate Bids as Owner may elect. Alternates are as described in Section 1.H of Project Manual. Alternates are written in a priority

order, but Owner is not required to accept or reject in order listed. This is a one (1) contract project, therefore, Alternates shall be studied by each Bidder to determine effect on Bids of Contractor and each Subcontractor and/or Material supplier.

(1) Additive Alternate No. 1: Stone Base

All for sum of:

\_\_\_\_\_ DOLLARS (\$ \_\_\_\_\_).

(2) Additive Alternate No. 2: Expanded Parking Lot G, Includes Grading for Broadcast Relocation

All for sum of:

\_\_\_\_\_ DOLLARS (\$ \_\_\_\_\_).

(3) Additive Alternate No. 3: Broadcast Utility Relocation

All for sum of:

\_\_\_\_\_ DOLLARS (\$ \_\_\_\_\_).

c. Unit Prices:

(1) For changing specified quantities of work from those indicated by Contract Drawings and Specifications, upon written instructions of Owner, the following Unit Prices shall prevail in accordance with General Conditions.

(2) The following Unit Prices include all labor, overhead and profit, materials, equipment, appliances, bailing, shoring, shoring removal, etc., to cover all work.

(3) The following Unit Prices are required where applicable to particular Base Bid and/or Alternate being submitted.

(4) Only a single Unit Price shall be given and it shall apply for either MORE or LESS work than that indicated on Drawings and called for in Specifications as indicated to be included in Base Bid and/or Alternates. In the event that more or less units than so indicated is actually furnished, Change Orders will be issued for increased or decreased amounts as approved by the Owner.

(5) Bidder understands that the Owner will not be liable for any Unit Price or any amount in excess of Base Bid and any Alternate(s) accepted at time of award of Contract, except as expressed in written Change Orders duly executed and delivered by Owner's Representative.

FILL IN ONLY ONE PRICE PER LINE

~~(6) Rock Excavation in addition to soil excavation, as defined in Division 2, per cu. yd.~~

~~(a) General Excavation,  
Base Bid quantity = \_\_\_\_\_ cu. yd. \$ \_\_\_\_\_/cu. yd.~~

~~(b) Trenching,  
Base Bid quantity = \_\_\_\_\_ cu. yd. \$ \_\_\_\_\_/cu. yd.~~

**(6) Removal of unsuitable material below subgrade for building and site, proper**

disposal of unsuitable material, and replacement with satisfactory material when directed by the Geotechnical Engineer. NOTE: All excavation above subgrade is unclassified and shall be included in base bid.

Base Bid quantity = 100 cu. yd. \$\_\_\_\_\_/cu. yd.

- (7) Bulk rock excavation below exposed subgrade for building and site, proper disposal of excavated rock, and replacement with satisfactory material. NOTE: All excavation above subgrade is unclassified and shall be included in base bid.

Base Bid quantity = 100 cu. yd. \$\_\_\_\_\_/cu. yd.

- (8) Removal of unsuitable material below subgrade of footings, utility trenches and utility tunnels, proper disposal of unsuitable material, and replacement with satisfactory materials when directed by the Geotechnical Engineer. NOTE: All excavation above subgrade is unclassified and shall be included in base bid.

Base Bid quantity = 100 cu. yd. \$\_\_\_\_\_/cu. yd.

- (9) Rock excavation below the subgrade of footings, utility trenches, and utility tunnels, proper disposal of excavated rock, and replacement with satisfactory materials. NOTE: All excavation above subgrade is unclassified and shall be included in base bid.

Base Bid quantity = 100 cu. yd. \$\_\_\_\_\_/cu. yd.

#### 4. PROJECT COMPLETION

a. Contract Period - Contract period begins on the day the Contractor receives unsigned Contract, Performance Bond, Payment Bond, and "Instructions for Execution of Contract, Bonds, and Insurance Certificates." Bidder agrees to achieve Substantial Completion by October 31, 2022. Fifteen (15) calendar days have been allocated in construction schedule for receiving aforementioned documents from Bidder.

b. Commencement - Contractor agrees to commence work on this project after the "Notice to Proceed" is issued by the Owner. "Notice to Proceed" will be issued within seven (7) calendar days after Owner receives properly prepared and executed Contract documents listed in paragraph 4.a. above.

c. Not used.

d. Special scheduling requirements: As indicated in 1.E Special Conditions.

#### 5. SUBCONTRACTOR LIST:

Bidder hereby certifies that the following subcontractors will be used in performance of Work:

NOTE: Failure to list subcontractors for each category of work identified on this form or listing more than one subcontractor for any category of work without designating the portion of work performed by each shall be grounds for rejection of bid. List name, city, and state of designated subcontractor, for each category of work listed in Bid For Lump Sum Contract. If work within a category will be performed by more than one

subcontractor, Bidder shall provide name, city, and state of each subcontractor and specify exact portion of work to be performed by each. If acceptance/non-acceptance of Alternates will affect designation of a subcontractor, Bidder shall provide information, for each affected category, with this bid form. If Bidder intends to perform any designated subcontract work by using Bidder's own employees, then Bidder shall list their own name, city, and state. The bidder may petition the Owner to change a listed subcontractor only within 48 hours of the bid opening. See Information For Bidders Section 16 List of Subcontractors for requirements.

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Work to be performed	Subcontractor Name,	City, State
<b>Mechanical</b>	_____	_____
<b>Electrical</b>	_____	_____
<b>Earthwork</b>	_____	_____

6. SUPPLIER DIVERSITY PARTICIPATION GOALS

a. The Contractor shall have as a goal, subcontracting with Minority Business Enterprise (MBE) of ten percent (10%), with Service Disabled Veteran Owned Business (SDVE) of three percent (3%); and with Women Business Enterprise (WBE), Disadvantage Business Enterprise (DBE), and/or Veteran Owned Business of ten percent (10%) of awarded contract price for work to be performed.

b. Requests for waiver of this goal shall be submitted on the attached Application For Waiver form. A determination by the Director of Facilities Planning & Development, UM, that a good faith effort has not been made by Contractor to achieve above stated goal may result in rejection of bid.

c. The Undersigned proposes to perform work with following Supplier Diversity participation level:

MBE PERCENTAGE PARTICIPATION: \_\_\_\_\_ percent (\_\_\_\_\_%)

SDVE PERCENTAGE PARTICIPATION: \_\_\_\_\_ percent (\_\_\_\_\_%)

WBE, DBE, and/or VETERAN PERCENTAGE PARTICIPATION: \_\_\_\_\_ percent (\_\_\_\_\_%)

d. A Supplier Diversity Compliance Evaluation form shall be submitted with this bid for each diverse subcontractor to be used on this project.

7. BIDDER'S ACKNOWLEDGMENTS

a. Bidder declares that he has had an opportunity to examine the site of the work and he has examined Contract Documents therefore; that he has carefully prepared his bid upon the basis thereof; that he has carefully examined and checked bid, materials, equipment and labor required thereunder, cost thereof, and his figures therefore. Bidder hereby states that amount, or amounts, set forth in bid is, or are, correct and that no mistake or error has occurred in bid or in Bidder's computations upon which this bid is based. Bidder agrees that he will make no claim for reformation, modifications, revisions or correction of bid after scheduled closing time for receipt of bids.

b. Bidder agrees that bid shall not be withdrawn for a period of ninety (90) days after scheduled closing time for receipt of bids.

c. Bidder understands that Owner reserves right to reject any or all bids and to waive any informalities in bidding.

d. Accompanying the bid is a bid bond, or a certified check, or an irrevocable letter of credit, or a cashier's check payable without condition to "The Curators of the University of Missouri" which is an amount at least equal to five percent (5%) of amount of largest possible total bid herein submitted, including consideration of Alternates.

e. Accompanying the bid is a Bidder's Statement of Qualifications. Failure of Bidder to submit the Bidder's Statement of Qualifications with the bid may cause the bid to be rejected. Owner does not maintain Bidder's Statements of Qualifications on file.

f. It is understood and agreed that bid security of two (2) lowest and responsive Bidders will be retained until Contract has been executed and an acceptable Performance Bond and Payment Bond has been furnished. It is understood and agreed that if the bid is accepted and the undersigned fails to execute the Contract and furnish acceptable Performance/Payment Bond as required by Contract Documents, accompanying bid security will be realized upon or retained by Owner. Otherwise, the bid security will be returned to the undersigned.

8. BIDDER'S CERTIFICATE

Bidder hereby certifies:

- a. His bid is genuine and is not made in interest of or on behalf of any undisclosed person, firm or corporation, and is not submitted in conformity with any agreement or rules of any group, association or corporation.
- b. He has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid.
- c. He has not solicited or induced any person, firm or corporation to refrain from bidding.
- d. He has not sought by collusion or otherwise to obtain for himself any advantage over any other Bidder or over Owner.
- e. He will not discriminate against any employee or applicant for employment because of race, color, religion, sex or national origin in connection with performance of work.
- f. By virtue of policy of the Board of Curators, and by virtue of statutory authority, a preference will be given to materials, products, supplies, provisions and all other articles produced, manufactured, mined or grown within the State of Missouri. By virtue of policy of the Board of Curators, preference will also be given to all Missouri firms, corporations, or individuals, all as more fully set forth in "Information For Bidders."

9. BIDDER'S SIGNATURE

Note: All signatures shall be original; not copies, photocopies, stamped, etc.

Authorized Signature	Date
Printed Name	Title
Company Name	
Mailing Address	
City, State, Zip	
Phone No.	Federal Employer ID No.
Fax No.	E-Mail Address
Circle one:    Individual    Partnership    Corporation    Joint Venture	
If a corporation, incorporated under the laws of the State of _____	
Licensed to do business in the State of Missouri?    ___yes    ___no	

(Each Bidder shall complete bid form by manually signing on the proper signature line above and supplying required information called for in connection with the signature. Information is necessary for proper preparation of the Contract, Performance Bond and Payment Bond. Each Bidder shall supply information called for in accompanying "Bidder's Statement of Qualifications.")

**END OF SECTION**

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SECTION 1.E  
SPECIAL CONDITIONS

1. DEFINITIONS

a. "Drawings"

Drawings referred to in and accompanying Project Manual consist of Drawings prepared by and bearing name of below defined Architect, bearing July 13, 2021.

b. Architect  
Hellmuth, Obata, Kassabaum, Inc.  
300 W. 22<sup>nd</sup> Street  
Kansas City, Missouri 64108  
Telephone: (816) 472-3360

c. Mechanical, Electrical, and A/V Engineer  
Henderson Engineers  
1801 Main Street, Suite 300  
Kansas City, Missouri 64108  
Telephone: (816) 663-8700

d. Structural Engineer  
Thornton Tomasetti  
2323 Grand Blvd., Suite 900  
Kansas City, Missouri 64108  
Telephone: 816.221.7771

e. Civil Engineer  
SK Design Group, Inc.  
4600 College Boulevard, Suite 100  
Overland Park, KS 66211  
Telephone: 913.451.1818

f. Other Definitions: See Article 1., General Conditions.

2. SPECIAL SCHEDULING REQUIREMENTS

a. Special scheduling requirements supplemental to the bid form

(1) Contractor shall perform all work in the designated area between 11/22/2021 and 11/30/2022. Substantial Completion shall be as indicated on the bid form.

- (2) On-site mobilization may commence November 21, 2021, after the last 2021 home game scheduled for November 20th, 2021.
- (3) Lot C and Lot G parking lots shall be complete and clear of all construction staging, including equipment and trailers, and turned over to the Owner for intended use by September 16, 2022, in time for the first 2022 home football game scheduled for September 17th, 2022.
- (4) Throughout construction, Contractor shall schedule and coordinate use of existing service drive between lot C and lot G with Owners representative, and shall maintain a safe and clear pathway for both pedestrian foot traffic and emergency vehicular traffic throughout construction of the project.
- (5) Contractor shall schedule and coordinate with Owner Representative approval, all work for the new water line to be constructed in parking lot SG7, (student parking on west side of Memorial Stadium,) during a break in the academic calendar.
- (6) Contractor shall maintain clear and safe access to pedestrian bridge across Providence road at all times. If any work will necessarily disrupt access to either the pedestrian bridge or the service road, scheduling is to be coordinated with the owner representative with at least 72 hours advance notice.
- (7) Mass excavation blasting schedule shall schedule the first blast to occur on a Monday afternoon for a specific time identified between 2:00 and 4:00 PM. This shall be coordinated with MU Research Reactor (MURR) staff, to allow MURR staff to gage the potential impact of a blast on reactor operation.
- (8) Contractor shall coordinate scheduling of video board, building signage, irrigation and plantings, specific telecom scopes, or other work provided and/or installed by Owner or separately contracted Owner Vendors.
- (9) Reference Drawing C071 Site Staging and Laydown Plan.

### 3. SCOPE OF WORK

- a. The Contractor shall furnish all labor, materials, tools, equipment necessary for, and incidental to, construction of this project as indicated on Drawings and specified herein.
- b. Work shall include everything requisite and necessary to finish work properly, notwithstanding that every item of labor or materials or accessories required to make project complete may not be specifically mentioned.

c. General Description of Work:

- (1) Project consists of a new Indoor Practice Facility located south of Memorial Stadium on existing Parking Lot C. The new facility includes a full-size football field within a pre-engineered metal building superstructure. Additional program elements include restrooms, exam spaces, storage and support for this facility within the building. The site allows access to two mezzanines. One mezzanine is located at the Lot C elevation which provides amenities such as a lobby, restrooms, and a large viewing platform. An intermediate mezzanine can be accessed from Level 2 to be used as a recruit viewing area and camera platform. This project site predominately occupies the existing Parking Lot C, with overlap into the lower Parking Lot G.
  - (2) Demolition shall consist of site related demolition as shown in the civil documents.
  - (3) Architectural work shall consist of a new indoor practice facility with a brick, glass, translucent panel, and insulated metal panel façade. The roof over the IPF will be a standing seam metal roof. The roof over the program space will be a PVC roof.
  - (4) Structural work shall consist of a pre-engineered metal building (PEMB) for the practice field area. The additional program space will be a structural steel framed building. The two elevated floor levels will consist of slab on metal deck composite steel beams and girders supported by steel columns.
  - (5) Mechanical work shall consist of packaged HVAC equipment for mechanical heating and cooling. Cooling will be provided by Direct Expansion (DX) systems utilizing condensing units with refrigerant compressors. Heating will be provided by natural gas heat exchangers.
  - (6) Electrical work shall consist of power for convenience and equipment receptacles, HVAC and plumbing equipment, interior and exterior lighting, elevators, and miscellaneous loads.

4. LOCATION

Work shall be performed under this Contract on campus of the University of Missouri – Columbia.

5. NUMBER OF CONSTRUCTION DOCUMENTS

- a. NOT USED
- b. NOT USED

c. NOT USED

d. The Owner will provide electronic data files to the Contractor for their convenience and use in progressing the Work and the preparation of shop drawings or other submittal requirements required for construction of the referenced project. The electronic data files shall reflect Construction Documents and Bid Addenda only. These files will be transmitted subject to the following terms and conditions:

- (1) The Owner makes no representation as to the compatibility of these files with the Contractor's hardware or software.
- (2) Data contained on these electronic files shall not be used by the Contractor or anyone else for any purpose other than as a convenience in progressing the Work or in the preparation of shop drawings or other required submittals for the referenced project. Any other use or reuse by the Contractor or by others will be at their own sole risk and without liability or legal exposure to Owner. The Contractor agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against the Owner and its consultants, contractors, agents, employees, and representatives that may arise out of or in connection with the use of the electronic files transmitted.
- (3) Furthermore, the Contractor shall, to the fullest extent permitted by law, indemnify and hold harmless the Owner and its consultants, contractors, agents, employees, and representatives, against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.
- (4) These electronic files are not contract documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. The Owner makes no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by the Consultant and the electronic files, the signed and sealed hard-copy construction documents shall govern. The Contractor is responsible for determining if any conflict exists. By use of these electronic files, the Contractor is not relieved of their duty to fully comply with the contract documents.
- (5) Because information presented on the electronic files can be modified, unintentionally or otherwise, the Owner reserves the right to remove all indications of ownership and/or involvement from each electronic display.
- (6) Under no circumstances shall delivery of the electronic files be deemed a sale by the Owner and no warranties are made, either expressed or implied, of merchantability and fitness for any particular purpose. In no event shall the Owner be liable for any loss of profit, or any consequential damages as a result of use or reuse of these electronic files.

## 6. SUBMITTALS

a. The Contractor shall submit for approval to the Architect, equipment lists and Shop Drawings, as expediently as possible. Failure of the Contractor to submit Shop Drawings in a timely manner will result in the Owner holding back Contractor payments. (See General Conditions)

- b. The material and equipment lists shall be submitted and approved before any material or equipment is purchased and shall be corrected to as-built conditions before the completion of the project.
- c. The Contractor shall submit electronic versions of all required Shop Drawings, material and equipment lists. The Contractor shall upload all Shop Drawings to a secure information sharing website determined by the Owner notifying the Owner and Consultant that these shop drawings are available for review. Each submittal shall have the General Contractors digital stamp affixed to the first page signifying their review and acceptance. Review comments, approvals, and rejections will be posted on this same site with notification to the contractor. Submittals requiring a professional seal shall be submitted hard copy with a manual seal affixed.
  - (1) The Contractor shall identify each submittal item with the following:
    - (a) Project Title and Location
    - (b) Project Number
    - (c) Supplier's Name
    - (d) Manufacturer's Name
    - (e) Contract Specification Section and Article Number
    - (f) Contract Drawing Number
    - (g) Acrobat file name: Spec Section\_Times Submitted-Spec Title:  
033000\_01-Cast In Place Concrete.pdf
  - (2) Reference the accompanying Shop Drawing and Submittal Log at the end of this section (1.E.3) for required submittal information.
- d. The Contractor shall submit to the Architect two (2) bound copies of all required Operating Instructions and Service Manuals for the Architect's and the Owner's sole use prior to completing 50% of the adjusted contract. Payments beyond 50% of the contract amount may be withheld until all Operating Instructions and Service Manuals are received as referenced in the accompanying Operating Instructions and Service Manual Log at the end of this section (1.E.4).
- e. The Contractor shall submit to the Owner's Representative all items referenced in the accompanying Closeout Log (1.E.5) within 30 days following substantial completion of the work. The Owner's Representative will maintain the closeout log and include as an agenda item at all coordination meetings.

## 7. NOTIFICATION

Before beginning Demolition Work or service outages, the Contractor shall provide, at minimum, seventy-two (72) hours advance notice to Owner's Representative for purpose of verifying utility locations including, but not limited to, gas, telecommunications,

electric, water, steam, sewer, and nitrogen. Contractor shall minimize the number of outages, minimize the length of outages and related work shall be continuous until the utility is restored.

8. USE OF PREMISES

a. Access: Access to construction site shall be as indicated on Civil Drawings and as directed by the Owner's Representative.

b. Parking:

- (1) Contractors' service vehicle parking shall remain within designated staging limits.
- (2) Parking of personal vehicles within project access/lay down/staging areas is prohibited. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.
- (3) Parking or driving on sidewalks, landscaped areas, within fire and service lanes or generally in areas not designated for vehicular traffic is prohibited except as allowed in the contract documents. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.
- (4) Sidewalk(s) and Hardscape – Parking/driving on hardscapes is strictly prohibited unless specifically directed by the Owner's Representative through the MU sidewalk permitting process. Restricted use permits will be limited to activities that are constrained by an absolute need to access from a sidewalk. Such activities shall be considered the exception and not the norm. Adequate signage, fencing and alternate routes must be provided in the immediate and adjacent areas.
- (5) Free parking for contractor employees is available in the Ashland Road Contractor lot on an as available basis. This space is for use by contractor employees for parking their personal vehicles only and is not to be used for staging or storage.
- (6) Vendor Permits may be purchased by contractor management personnel on an as available basis by contacting the Parking and Transportation office in the General Services Building. These permits will allow contractor management personnel to park in various University lots while conducting business on University construction projects.

- (7) Temporary University parking permits may be purchased by contractor employees for use with their personal vehicles on an as available basis by contacting the Parking and Transportation office in the General Services Building.
- (8) Conley Avenue between Missouri Avenue and University Avenue and Hitt Street between University Avenue and the Memorial Union are designated for pedestrian use only during the work week between the hours of 8:15 AM and 3:45 PM. Unless otherwise indicated in the contract documents, this area is strictly off limits to vehicular traffic without authorization from the Owner's Representative.
- c. Storage of materials: The Contractor shall store all materials within project limits. The Contractor shall confine apparatus, materials, and operation of workers to location established by the Owner's Representative. The Contractor shall not unreasonably encumber premises with materials. In addition, storage trailer locations may be available within 1-1/2 miles of project site as directed by the Owner's Representative. Storage trailer locations shall be subject to approval by the Owner's Representative and are available to the Contractor without cost.
- d. Utilities: Drinking water, water required to carry on work, and 120 volt electrical power required for small tool operation may be obtained without cost to the Contractor from existing utilities at locations designated by the Owner's Representative. Provisions for obtaining power, including temporary extensions, shall be furnished and maintained by the Contractor. Upon completion of work such extensions shall be removed and any damage caused by use of such extensions shall be repaired to satisfaction of the Owner's Representative, at no cost to the Owner.
- e. Restroom: The Contractor shall provide and maintain, in a sanitary condition, chemical type portable toilet facilities at work site for use by his personnel. Toilets and toilet location shall be subject to approval by the Owner's Representative.
- f. Smoking is prohibited at the University of Missouri and all properties owned, operated, leased or controlled by the University of Missouri. Violation of the policy is defined as smoking any tobacco products, including e-cigarettes.
- g. Landfill: The Contractor shall not use the Owner's landfill. Dumping or disposal of excavated or demolition materials on Owner's property shall not be permitted. The Contractor shall remove and legally dispose of excavated or demolished materials off the Owner's property.
- h. Care of Project Work Site: The contractor shall be responsible for maintaining the construction site in a reasonably neat and orderly condition by regular cleaning and mowing of the premises as determined by the Owner's Representative.

- i. Discharge to Sewer Request: The University of Missouri’s MS4 permit and NPDES Storm Water Discharge Permits along with the City of Columbia’s POTW Operating Permit as well as local ordinances, and state and federal environmental regulations prohibit hazardous materials from being disposed into either the storm water or sanitary sewer systems. Unless specifically approved, all chemical products such as paints, dyes, lawn care products, maintenance products, and oil is are prohibited from drain disposal. Any product, including contaminated water, being discarded into the storm water or sanitary sewer systems requires written approval from the Owner through a formal “Discharge to Sewer Request” form obtained at [Discharge to Sewer Request Form](#). The contractor should submit the form to the Owner’s Representative, not to the Department of Environmental Health and Safety as the form indicates.
- j. All concrete waste material including washout water shall be totally contained and removed from the Owner’s property.
- k. Artifacts Found During Construction: Contractor shall immediately notify the Owner’s Representative when artifacts are uncovered or found during the demolition or construction process. Artifacts include, but are not limited to, tools, drawings (construction or other), photographs, books and other objects/devices which may hold historical importance/significance. Do not remove or disturb the object(s) in question. Artifacts are not considered part of demolished materials and shall remain the property of the University of Missouri.
- l. **“Permit Required Confined Space” Entry Communication and Coordination**  
(See OSHA 1926 subpart aa – Construction Confined Space for the definition of “permit required confined spaces” - Note: OSHA does not apply to the University. However, the University will provide a list of all known “permit required confined spaces”)

The following are the known locations of “permit required confined spaces” currently identified within the project limits:

- (1) Storm sewer manholes and structures
- (2) Sanitary sewer manholes and structures
- (3) Electrical manholes and structures
- (4) Telecom manholes and structures
- (5) Utility trenches
- (6) Excavations
- (7) Any other confined space meeting the requirements of OSHA 1926

The hazards or potential hazards in each “permit required confined space” or the reason it is a “permit required confined space”:



- (1) Contains or has a potential to contain a hazardous atmosphere;
- (2) Contains a material that has the potential for engulfing an entrant;
- (3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller crosssection; or
- (4) Contains any other recognized serious safety or health hazard.

Any precautions that the owner or previous contractors have implemented for the protection of employees in the “permit required controlled space”:

- (1) Contractor shall comply with the requirements of OSHA 1926.1204.

The above list of known confined spaces within the project limits may not be a complete listing. Each contractor shall survey the project to identify all confined spaces. It is incumbent upon each contractor to list all “permit required spaces”.

The Contractor shall notify the Owner’s Representative if 1) conditions change resulting in a non-permit required confined space being reclassified to a “permit required confined space” after evaluation of the space by a competent person; 2) a space previously thought to be non-permit required space is classified as a “permit required confined space” after evaluation by a competent person; or 3) during the course of construction a “permit required confined space” is created after evaluation by a competent person.

The Contractor shall submit to the Owner’s Representative a copy of the cancelled confined space entry permit and a written report summarizing the permit space program followed and all hazards confronted or created during entry operations. This information shall be submitted within one week of cancelling the permit.

## 9. PROTECTION OF OWNER'S PROPERTY

- a. The Contractor shall be responsible for repair of damage to building exterior and interior, drives, curbs, streets, walks, grass, shrubbery and trees, which was caused by workmen or equipment employed during progress of work. All such repairs shall be made to satisfaction of the Owner's Representative, at no cost to the Owner, or reimburse the Owner if the Owner elects to make repairs. For landscape damage, the Owner shall make such repairs. Compensation for these repairs shall be determined by the Owner's Representative using the "Valuation of Landscape Trees, Shrubs, and other Plants" as published by the International Society of Arboriculture, as last revised.
- b. Construction Project Fencing:
  - (1) Fencing requirements, as indicated on Drawings, shall be constructed of 9

or 11-gauge chain link not less than six (6) feet in height and not more than 2-inch mesh with posts spaced not more than ten (10) feet apart and all corner and gate posts imbedded in concrete. All other posts shall be sufficiently secured in ground to maintain proper and adequate support of fence. Fenced in area shall have at least two (2) access gates and all gates shall be lockable.

- (2) Fence screening fabric shall be used on all perimeter fencing. Fabric shall be black in color, full height of the project fence, securely attached and properly maintained throughout the duration of the project.
- (2) Using existing landmarks, lamp posts, trees or other Owner property for support of fencing is strictly prohibited unless a written waiver is obtained from Owner's Representative.
- (3) Use of ribbon, snow fence, chicken wire, rope, and wooden barricades as fencing is prohibited.
- (4) Fencing shall be maintained in an "as-installed" condition throughout the life of the project.
- (5) The Contractor may use used fencing provided it is in good condition and is satisfactory to the Owner's Representative.

c. Preserving and Protecting Existing Vegetation:

- (1) Protection and compensation for damages:
  - (a) Contractor shall take sequential steps in the following order, to protect trees shown to remain/be protected or be saved.
    1. Mark designated drip line of treed area or trees to remain/be protected.
    2. Trim branches as described herein and as required to minimize potential damage.
    3. Mulch as described herein.
    4. Install protective fencing and construction fencing where indicated on the drawings.
  - (b) Trees and shrubs within work area designated to remain, or trees beyond construction limits designated to be saved, shall be protected from damage during construction by fixed chain link fencing or armoring as indicated on Drawings or specified herein. Plant

protection devices shall be installed before work has begun and shall be maintained for duration of work unless otherwise directed by Owner's Representative. Trees located in areas beyond the construction limits and that branch beyond the designated drip line shall be trimmed to minimize potential damage.

- (c) In the event that damage(s) to the Owner's trees, shrubs or vegetation occurs as a result of the Contractor's unauthorized operations, the Contractor shall pay or allow to the Owner compensation for said damage(s). Compensation shall be determined by the Owner's Representative using the "Valuation of Landscape Trees, Shrubs, and other Plants" as published by the International Society of Arboriculture, as last revised.

- (2) To prevent compaction of soil over tree roots, vehicles or equipment shall not at any time park or travel over, nor shall any materials be stored within drip line of trees designated to remain.
- (3) Owner's Representative will stop work immediately when proper measures are not being employed to protect trees and shrubs. Contractor will be notified to resume work after required protection measures are implemented.
- (4) Trimming of limbs necessary to minimize potential damage or provide clearance for work shall be done by approved, trained tree maintenance subcontractor and coordinated with the Owner's representative prior to trimming. Limbs shall be cut off cleanly and cut surfaces treated according to established horticultural standards.
- (5) A minimum 30 foot wide swath of coarse (minimum 6" deep) coarse mulch shall be installed on the ground in the wooded areas along the length and immediately beyond the designated tree drip line and/or construction limits, which ever is closest to the work. Install mulch immediately before installation of construction fencing.

## 10. SUBSTITUTIONS and EQUALS

- a. Substitutions are defined in General Conditions article 3.11.8 for and Equals are defined General Conditions Article 3.12 .
- b. Use of materials, products or equipment other than those named and described in the Contract Documents are substitutions and/or equal. Substitutions and/or equals

of any item described in the Contract Documents will be allowed only prior to the receipt of bids provided that a request for approval has been received by both the Architect and the Owner at least ten calendar days prior to the date for receipt of Bids. To be considered, bidder's proposal shall include a complete description of the proposed substitution and/or equal and a comparison of significant qualities of the proposed substitution and/or equal with those specified including drawings, performance and test data, and other information necessary for an evaluation. The Architect's decision on the approval or disapproval of a proposed substitution and/or equal shall be final.

- c. If the Architect and Owner approve a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approval made in any other manner.
- d. No substitutions and/or equal will be allowed for the following items:

<u>Item</u>	<u>Specification Section</u>
Lock Cylinders	08 71 00
Water Meters	22 11 16
Fire Hydrants	33 11 00

## 11. CODES AND STANDARDS

The Contractor shall comply with applicable codes and standards as listed in General Conditions. The following codes and standards shall also apply:

- a. City of Columbia - Sewer Line Installation Standards - Department of Public Works

“All sanitary sewer construction shall be in accordance with the City of Columbia Specifications and Standards and in conformance with the rules and regulations of the Missouri Clean Water Commission.”

## 12. PERMITS

Before commencement of Boilers, Water Heaters or Pressure Vessels the Contractor must obtain an installation permit from the State of Missouri, Division of Fire Safety, Boiler and Pressure Unit as required by 11 CSR 40-2.010 through 11 CSR 40-2.065. The permit applications are available at <http://www.dfs.dps.mo.gov/programs/bpv/>.

## 13. SPECIALTIES

- a. Owner furnished products: Owner will furnish products indicated. The Work

includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.

- (1) Toilet Accessories.
- (2) Turf.
- (3) Monitors.
- (4) LED Video Boards.
- (5) **Fire Alarm.**

14. PRE-BID INSPECTION

All pre-bid inspections of work areas shall be scheduled with pre-bid inspection guide, telephone: (573) 882-2228.

15. ROOF WARRANTY REQUIREMENT

- a. The Contractor shall submit, before the first progress payment, a copy of University of Missouri Roof System Manufacturer's No Dollar Limit Guarantee which shall be manually signed by an authorized representative of Manufacturer of each proposed roofing system. Certifications shall have original signature.
- b. Following final inspection and acceptance of the roofing system(s) by the Owner and the roofing system manufacturer(s), the Contractor shall submit a manually signed standard warranty agreement provided and executed by the roofing system manufacturer for each roofing system provided. Standard warranty agreement(s) shall be of the duration specified in Division 7.
- c. University of Missouri three (3) year Contractor's Roofing/Flashing/ Sheetmetal Guarantee shall be signed by the roofing contractor after final inspection and acceptance of each roofing system by Manufacturer and by Owner.

16. MODIFICATIONS TO INFORMATION TO BIDDERS

- a. Information to Bidders:
  - (1) Referenced Information to Bidders, Page IFB/5.  
Add new Article 15.8.5 as follows:

**15.8.5** Within 48 hours of the receipt of bids, the apparent low bidder shall submit to the Director of Facilities Planning and Development an "Affidavit of Supplier Diversity Participation" for every diverse subcontractor or

supplier the bidder intends to award work to on the contract. The affidavit will be signed by both the bidder and the diverse firm.

17. MODIFICATION TO INFORMATION FOR BIDDERS: BIDDERS STATEMENT OF QUALIFICATIONS

a. Information For Bidders

(1) Reference: Information for Bidders, Article 8.4

Insert new Article 8.4 to read as follows:

In addition to the Bidder's Statement of Qualifications, the Bidder must also submit evidence and meet the following qualifications:

(a) MINIMUM QUALIFICATIONS

- (i) The schedule for the project is aggressive and requires a contractor with a successful track record of managing projects with average monthly expenditures of more than \$25-million
- (ii) Successful completion of one project of similar type and scope.
- (iii) Successful completion of at least three projects of \$25-million or greater value. Submit references for the three most recent projects over \$25-million in value.
- (iv) Electrical Contractor must have extensive experience installing 13.8-kV equipment and cable. Applicable for High Voltage work.
- (v) Successful and sustained track record of effectively utilizing project/schedule management software for at least the last two years.

(b) QUALIFICATION SUBMITTALS

- (i) Submitted qualification packages should include the following information:
  - Project and Schedule
    - Management Experience managing projects with equal or greater schedule demands.
    - Demonstrated and consistent on-time completion success
  - Project Organization / Personnel

- Key project team members and their resume
- Project team roles and responsibilities of team members
- Reporting/accountability procedures
- Quality control program and procedures
- Organizational Support
  - Home office support
  - Labor and subcontractor relations
  - Submittal processing procedures
  - Material ordering/tracking/delivery Procedures
  - Cost accounting support
  - Financial stability/capacity
  - Record of mentoring and supporting Supplier Diversity Subcontractor Participation

(ii) Packages must include the following items:

- Corporate Organizational Charts
- Project Organizational Charts
- Summary of Similar Projects
- Client References
- Resumes – resumes for each key individual proposed for the project, include: position in the firm, project responsibility, education, license or registration and relevant experience over the last five years.
- Financial Statements and/or Evidence of Bonding Capacity
- Sample progress reports and schedules
- Brief Narratives indicating how the Contractor intends to manage this project, including subcontractors.

(c) QUALIFICATION PROCEDURE

(i) All qualification information and supporting materials must be submitted with your bid. Following the bid date, the Owner reserves the right to request additional information material to evaluate qualifications. Failure of the Contractor to demonstrate their ability to comply with these qualifications may be grounds for the Owner not recommending aware of the Contract.

18. MODIFICATIONS TO GENERAL CONDITIONS

- a. The Commercial General Liability policy or policies specified in Article 11 shall provide coverage for special hazards, where they exist, such as, but not limited to, the operation of material hoist, blasting or other use of explosives, and damage to underground property.

- (1) Reference: General Conditions Article 11.2.1 Commercial General Liability.

Delete in the first sentence of 11.2.1: "\$2,000,000 per occurrence, \$5,000,000 in general aggregate, \$5,000,000 products and completed operations aggregate and \$1,000,000 personal injury and advertising injury"

and insert: "\$2,000,000 per occurrence, \$25,000,000 in general aggregate, \$25,000,000 products and completed operations aggregate and \$1,000,000 personal injury and advertising injury"

19. PROJECT SCHEDULING

The project scheduling specification for the project are included immediately after the Special Conditions. For this project the Contractor shall meet the following scheduling requirements.

Option 1: Contractor Schedule – Contractor is responsible for the schedule and must comply with the Owner's requirements. See Contractor Schedule Specification included in these documents.

20. PROJECT COORDINATION

- a. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.

- (1) Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
- (2) Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
- (3) Make provisions to accommodate items scheduled for later installation.



- b. Coordination Drawings: Within sixty (60) days of Notice to Proceed provide coordination drawings for the integration of the Work, including work first shown in detail on shop drawings or product data. Show sequencing and relationship of separate units of work which must interface in a restricted manner to fit in the space provided, or function as indicated.
  - (1) Show the interrelationship of components shown on separate shop drawings.
  - (2) Indicate required installation sequences.
  - (3) Call attention in advance to Architect of any dimensional or detail information needed to complete the coordination drawings.
  
- 21. NOT USED
  
- 22. NOT USED
  
- 23. BUILDING SYSTEM COMMISSIONING AND QUALITY ASSURANCE
  - a. Contractor shall provide all personnel and equipment required to complete the commissioning/quality assurance activities referenced in the Commissioning Plan/Quality Assurance Log. The requirements of the Quality Assurance Log shall be completed in their entirety before substantial completion and submitted as referenced in the Closeout Log.
  
  - b. The contractor shall designate a competent person, separate from the superintendent or Project Manager, to act as the contractor's commissioning/quality assurance coordinator. The commissioning/quality assurance coordinator is responsible for planning, scheduling, coordinating, conducting and verifying all commissioning/quality assurance activities required by the Quality Assurance Log and ensuring all building systems are complete, operable and ready for use by the Owner. At a minimum, building ventilation systems, hot water generation systems, hydronic distribution systems, power distributions systems and fire detection and alarm and building envelope systems, as applicable.
  
  - c. **The owner has hired a third-party Commissioning Agent, Braun Intertec for building envelope and Doyle Field Services for MEP, for this project. The Contractor shall participate in this Commissioning process as outlines in the Building System Commissioning requirements included in section 1.E.7 Commissioning Plan, 019191, 019191.2, and 230800 of this project manual.**
  
  - d. **The Contractor shall provide all personnel and equipment required to complete the quality assurance/commissioning activities and reporting, and**

coordinate with Owner as noted in the Quality Assurance Log and Commissioning Plan. The requirements of the Quality Assurance Log and Commissioning Plan shall be completed in their entirety before substantial completion and submitted as referenced in the Closeout Log.

24. MECHANICAL, ELECTRICAL, PLUMBING (MEP) PRE-INSTALLATION MEETING(S)
- a. Before the start of MEP installation, the Owner's Representative will convene an MEP pre-installation meeting. Meeting participants to include contractor (including MEP subcontractors), Owner's Representative and additional contractor and University operational staff invited by the Owner's Representative. Topics will include underground rough-ins, steam piping, chilled water piping, sprinkler piping, hot water piping, electrical system, duct, telephone/data wiring, control wiring. Additional meetings will be conducted as required for the review of coordination drawings and scope specific installations. Cross section drawings of corridor ceilings and other congested areas will be of highest priority and will be reviewed prior to the start of installations in the affected areas. Meeting minutes and sign-up sheet will be transcribed by contractor and distributed to attendees.
25. NOT USED
26. PROJECT MANAGEMENT/COMMUNICATION REQUIREMENTS
- a. The Contractor shall be represented at the site by both a competent full-time Project Manager and a full-time, competent superintendent with no other assigned duties or responsibilities from the beginning of the work until its final acceptance, unless otherwise permitted by the Owner's Representative. The superintendent for the Contractor for the general building work shall exercise general supervision over all subcontractors of any tier engaged on the work with decision-making authority of the Contractor.
- b. The Contractor shall use a current industry standard (Primavera, Microsoft Project, etc.) project scheduling software which provides as a minimum: Critical paths, milestones, estimated and actual start and completion dates, scheduled vs. actual progress, and detailed task and subtask breakdown. The following schedules shall be provided as a minimum and kept current: Overall project schedule, four- (4-) week look-ahead, and two- (2-) week look-ahead.
- c. The Contractor shall furnish on-site Internet access for use by his Project Manager and superintendent. . The contractor shall utilize the Owner's secure information sharing system for submittals, construction payment process, change orders,

RFI's/ASI's, O&M manuals and all other project manual requirements as directed by the Owner's Representative. Field staff are also required to utilize this software as directed by the Owner's Representative.

- d. The Contractor shall provide at least two (2) job site FM handheld communication radios (walkie-talkies) for use by the on-site superintendent and the Owner's Representative or the Contractor shall provide his on-site superintendent with a handheld cellular telephone.

27. SAFETY PRECAUTIONS AND PROGRAMS

- a. The Bidder's Statement of Qualifications includes a requirement that the Bidder provide its Worker's Compensation Experience Modification Rates (EMR) and Incidence Rates for the three recent years. The Bidder shall also include the EMR and Incidence Rates of listed major subcontractors on the Bid for Lump Sum Contract. If the EMR exceeds 1 or the Incidence Rate exceeds 13, the Contractor or major subcontractor shall take additional safety measures including, but not limited to, developing a site specific safety plan and assigning a Safety Manager to the Project to perform inspections on a schedule as determined acceptable by the Owner with written reports to be submitted to the Owner. The Owner reserves the right to reject a Bidder or major subcontractor whose rates exceed these stated rates.
- b. The contractor shall provide Emergency Contact Information for the Contractor's on-site staff and home office management as well as contact information for all major subcontractor personnel. This information shall contain business and personal phone numbers for each individual for contact during or after hours in case of an emergency. This information shall be submitted within 15 days of the Notice to Proceed.

28. HOT WORK PERMITTING AND GENERAL REQUIREMENTS

Hot work Requirements: The contractor shall comply with the following hot work requirements and the requirements of the International Fire Code and 2014 NFPA 51B.

- a. Hot work shall be defined as any work involving burning, welding, grinding, cutting, or similar operations that are capable of initiating fires or explosions.
- a. The Contractor shall utilize the hot work permit decision tree and permit provided in the 2014 NFPA 51B for all Hot Work operations.
- b. A hot work permit shall be used on all hot work performed outside a designated hot work area. The hot work permit shall be posted and clearly visible within proximity of the hot work area. The hot work permit authorizing individual (PAI) shall be as designated by the Contractor.
- c. Notify the Owner's Representative 24 hours prior to starting hot work in buildings with operational fire alarm or fire suppression systems. The Owner's Representative will coordinate the appropriate system outage with Campus Maintenance personnel.
- d. Unless otherwise instructed by the Owner's Representative, the Contractor shall post a copy of each completed hot work permit to the Owner's project management file system the following business day.

29. GENERAL REQUIREMENTS FOR CRANE AND HOISTING OPERATIONS

All crane and hoisting operations shall be performed in compliance with OSHA 29 CFR 1926. All Operators, riggers, and signal persons must have the proper qualifications and training necessary to perform the intended hoisting activities for this project.

- a. Only fully certified and evaluated Operators shall perform equipment operations. Operators in an “Operator in Training” status shall not be used.
- b. Submittal requirements:
  1. Submit copies of Operator certifications, licenses, and evaluations to the Owners Representative.
  2. Submit Rigger and Signal Person qualifications to the Owners Representative.
  3. Unless otherwise directed by the Owners Representative, submit a lift plan and conduct a lift coordination meeting for hoisting or crane operations for any lift greater than 2,000 pounds, or for any multi pick lift. Include protective measures for existing underground utilities, occupied buildings, pedestrian and vehicle pathways, adjacent buildings and overhead power lines. If the lift is to occur over an occupied building, provide a registered structural engineer’s review and verification that the building can resist the impact of a dropped load for the intended lift. If evacuation of an occupied building is necessary to conduct the lift, the decision for building evacuation or scheduling the lift for off-hours will be determined by the Owner.

30. CONSTRUCTION WASTE MANAGEMENT (for projects without a Division 02 specification)

The goal of Construction Waste Management is to divert waste from the sanitary landfill. This shall be accomplished through reuse, recycling and/or salvage of non-hazardous construction and demolition debris to the greatest extent practical. Track and report all efforts related to reuse, recycling and/or salvage materials from the project (including clean fill material). Report all material types and weights, where material was diverted, type of diversion, documentation of diversion (eg: waste or recycling tickets), and applicable dates. In order to calculate the diversion percentage, total weights of all non-hazardous landfill material must be reported. This information shall be updated monthly utilizing the [Construction Waste Management Worksheet](#) provided here: [for MU] [http://www.cf.missouri.edu/cf/pdc/contractor\\_information](http://www.cf.missouri.edu/cf/pdc/contractor_information). Copies of all applicable receipts, tickets and tracking logs shall be uploaded to the Owner’s information sharing website or reported as required by the Construction Project Manager.

(A summary worksheet is required prior to substantial completion).

31. WARRANTY WALKTHROUGH

Contractor shall attend a walk-thru with the Owner at 11 months after acceptance to review and document any warranty items to be addressed as part of the 12 month warranty stated in article 3.1 of the General Conditions.

32. DELEGATED DESIGN SUBMITTALS

DELEGATED DESIGN SUBMITTALS	
a.	FIRE SPRINKLER
b.	FIRE ALARM
c.	STRUCTURAL STEEL CONNECTIONS
d.	PRE-ENGINEERED METAL BUILDING
e.	METAL STAIRS
f.	GUARD RAILINGS
g.	FALL ARREST SYSTEMS <i>Reviewed For Loads Imposed to Structure Only</i>
h.	COLD FORMED METAL FRAMING
i.	MEP ANCHORAGE
j.	OVERHAD COILING DOORS AND FRAMES
k.	EXTERIOR CLADDING
l.	<i>NOTE: ANY ADDITIONAL DELEGATED DESIGN ITEMS NOTED IN THE DOCUMENTS SHOULD BE ADDED TO THE ABOVE LIST</i>

**END OF SECTION**



# SUBSTITUTION REQUEST

(During the Bidding/Negotiating Phase)

PROJECT: \_\_\_\_\_ SUBSTITUTION REQUEST NUMBER: \_\_\_\_\_

FROM: \_\_\_\_\_

TO: \_\_\_\_\_ DATE: \_\_\_\_\_

A/E PROJECT NUMBER: \_\_\_\_\_

RE: \_\_\_\_\_ CONTRACT FOR: \_\_\_\_\_

SPECIFICATION TITLE: \_\_\_\_\_ DESCRIPTION: \_\_\_\_\_

SECTION: \_\_\_\_\_ PAGE: \_\_\_\_\_ ARTICLE/PARAGRAPH: \_\_\_\_\_

PROPOSED SUBSTITUTION: \_\_\_\_\_

MANUFACTURER: \_\_\_\_\_ ADDRESS: \_\_\_\_\_ PHONE: \_\_\_\_\_

TRADE NAME: \_\_\_\_\_ MODEL NO.: \_\_\_\_\_

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.  
Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

SUBMITTED BY: \_\_\_\_\_

SIGNED BY: \_\_\_\_\_

FIRM: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

TELEPHONE: \_\_\_\_\_

**A/E's REVIEW AND RECOMMENDATION:**

- Approve Substitution—Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
- Approve Substitution as noted—Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
- Reject Substitution—Use specified materials.
- Substitution Request received too late—Use specified materials.

SIGNED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

SUPPORTING DATA ATTACHED:  Drawings  Product Data  Samples  Tests  Reports  \_\_\_\_\_

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SHOP DRAWING AND SUBMITTAL LOG

Project: New Indoor Practice Facility  
 Project Number: CP210981  
 Contractor:

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
<b>031000</b>	<b>CONCRETE FORMWORK</b>										
	Submittal Schedule										
	Shop Drawings										
	Shoring/Reshoring Calculations										
	Product Data										
	Samples										
	Compatibility Certification										
	Hazardous Materials Notification										
	LEED Submittals										
<b>032000</b>	<b>CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES</b>										
	Submittal Schedule										
	Shop Drawings										
	Product Data										
	Mill Reports										
	Reinforcement Strain Test										
	Hazardous Materials Notification										
	LEED Submittals										
<b>033000</b>	<b>CAST-IN-PLACE CONCRETE</b>										
	Submittal Schedule										
	Mix Designs										
	Concrete Travel Times to the Project Site										
	Hot and Cold Weather Procedures										
	Product Data										
	Concrete Joint Locations										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Comprehensive Layout Drawings										
	Preconstruction Survey										
	Survey of Flat Plate of Flat Slab Concrete Floors during construction										
	FF/FL Testing										
	Structural Repairs										
	Patching Defective Concrete Finishes										
	Conduit and Pipes Embedded in Concrete										
	Hazardous Materials Notification										
	LEED Submittals										
<b>033713</b>	<b>SHOTCRETE</b>										
	Mix Designs										
	Materials Certifications										
	Samples										
<b>042000</b>	<b>UNIT MASONRY</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Initial Selection										
	Samples for Verification										
	Product										
	Qualification Statements										
<b>047200</b>	<b>CAST STONE MASONRY</b>										
	Product Data										
	Shop Drawings										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Product										
	Qualification Statements										
	Material Test Reports										
<b>051200</b>	<b>STRUCTURAL STEEL</b>										
	Submittal Schedule										
	Calculations, Shop Drawings and Erection Drawings										
	Submittal Letters										
	Pre-construction Survey										
	Quality Control Program										
	Product Data										
	Samples										
	Welding Procedures Specification (WPS)										
	Welder Certifications										
	Mill Reports										
	As-built surveys										
	LEED Submittals										
<b>053000</b>	<b>STEEL DECK</b>										
	Submittal Schedule										
	Shop Drawings and Erection Drawings										
	Manufacturer's Certification										
	Manufacturer's Installation Instructions										
	Welder Certifications										
	Research Reports or Evaluation Reports										
	LEED Submittals										
<b>054000</b>	<b>COLD-FORMED METAL FRAMING</b>										
	Product Data										
	Shop Drawings										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Product										
	Delegated-Design Submittal										
	Qualification Statements										
	Welding Certificates										
	Product Test Reports										
<b>055000</b>	<b>METAL FABRICATIONS</b>										
	Product Data										
	Shop Drawings										
	Product										
	Delegated-Design Submittal										
	Qualification Statements										
	Welding Certificates										
	Research/Evaluation Reports										
<b>055113</b>	<b>METAL PAN STAIRS</b>										
	Product Data										
	Shop Drawings										
	Product										
	Delegated-Design Submittal										
	Welding Certificates										
<b>057100</b>	<b>DECORATIVE METAL STAIRS</b>										
	Product Data										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Shop Drawings										
	Product										
	Delegated-Design Submittal										
	Qualification Statements										
	Welding Certificates										
<b>057300</b>	<b>DECORATIVE METAL RAILINGS</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Verification										
	Product										
	Delegated-Design Submittal										
	Qualification Statements										
	Welding Certificates										
	Product Test Reports										
	Preconstruction Test Reports										
<b>061053</b>	<b>MISCELLANEOUS ROUGH CARPENTRY</b>										
	Product Data										
	Product										
	Warranty										
<b>061600</b>	<b>SHEATHING</b>										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Product Data										
	Product										
<b>064116</b>	<b>PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Initial Selection										
	Samples for Verification										
	Product										
	Qualification Statements										
<b>066400</b>	<b>PLASTIC PANELING</b>										
	Product Data										
	Samples										
	Product										
<b>071326</b>	<b>SELF-ADHERING SHEET WATERPROOFING</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Product										
	Qualification Statements										
	Field Quality-Control Reports										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Warranty										
<b>071900</b>	<b>WATER REPELLENTS</b>										
	Product Data										
	Samples										
	Product										
	Qualification Statements										
	Preconstruction Test Reports										
	Field Quality-Control Reports										
	Warranty										
<b>072100</b>	<b>THERMAL INSULATION</b>										
	Product Data										
	Product										
	Product Test Reports										
<b>072726</b>	<b>FLUID-APPLIED MEMBRANE AIR BARRIERS</b>										
	Product Data										
	Shop Drawings										
	Product										
	Qualification Statements										
	Product Test Reports										
	Field Quality-Control Reports										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
<b>074113.16</b>	<b>STANDING-SEAM METAL ROOF PANELS</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Initial Selection										
	Samples for Verification										
	Product										
	Qualification Statements										
	Product Test Reports										
	Field Quality-Control Reports										
	Warranty										
<b>074213.19</b>	<b>INSULATED METAL WALL PANELS</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Verification										
	Product										
	Qualification Statements										
	Product Test Reports										
	Field Quality-Control Reports										
	Warranty										



Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
<b>074293</b>	<b>SOFFIT PANELS</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Verification										
	Product										
	Qualification Statements										
	Product Test Reports										
	Warranty										
<b>075419</b>	<b>POLYVINYL-CHLORIDE (PVC) ROOFING</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Verification										
	Product										
	Qualification Statements										
	Product Test Reports										
	Field Quality-Control Reports										
	Warranty										
	Manufacturer Certificates										
<b>076200</b>	<b>SHEET METAL FLASHING AND TRIM</b>										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Initial Selection										
	Samples for Verification										
	Product										
	Qualification Statements										
	Product Test Reports										
	Warranty										
<b>077200</b>	<b>ROOF ACCESSORIES</b>										
	Product Data										
	Shop Drawings										
	Product										
	Coordination Drawings										
	Warranty										
<b>078413</b>	<b>PENETRATION FIRESTOPPING</b>										
	Product Data										
	Product										
	Qualification Statements										
	Product Test Reports										
	Installer Certificates										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
<b>078443</b>	<b>JOINT FIRESTOPPING</b>										
	Product Data										
	Product										
	Qualification Statements										
	Product Test Reports										
	Installer Certificates										
<b>079200</b>	<b>JOINT SEALANTS</b>										
	Product Data										
	Samples										
	Samples for Initial Selection										
	Samples for Verification										
	Product										
	Qualification Statements										
	Product Test Reports										
	Warranty										
	Compatibility And Adhesion Test Report										
<b>079500</b>	<b>EXPANSION CONTROL</b>										
	Shop Drawings										
	Samples										
	Samples for Initial Selection										
	Samples for Verification										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Product										
	Product Test Reports										
<b>081113</b>	<b>HOLLOW METAL DOORS AND FRAMES</b>										
	Product Data										
	Shop Drawings										
	Product										
	Door Hardware Schedule										
	Product Test Reports										
<b>083113</b>	<b>ACCESS DOORS AND FRAMES</b>										
	Product Data										
	Shop Drawings										
	Product										
<b>083323</b>	<b>OVERHEAD COILING DOORS</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Initial Selection										
	Samples for Verification										
	Product										
	Qualification Statements										
	Warranty										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
<b>083416</b>	<b>hangar doors</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Initial Selection										
	Samples for Verification										
	Product										
	Delegated-Design Submittal										
	Qualification Statements										
<b>083613</b>	<b>SECTIONAL DOORS</b>										
	Product Data										
	Shop Drawings										
	Product										
	Qualification Statements										
	Warranty										
<b>084113</b>	<b>ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Verification										
	Product										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Door Hardware Schedule										
	Delegated-Design Submittal										
	Qualification Statements										
	Product Test Reports										
	Source Quality-Control Reports										
	Field Quality-Control Reports										
	Warranty										
<b>084513</b>	<b>STRUCTURED-POLYCARBONATE-PANEL ASSEMBLIES</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Product										
	Delegated-Design Submittal										
	Qualification Statements										
	Product Test Reports										
	Field Quality-Control Reports										
	Warranty										
<b>088000</b>	<b>GLAZING</b>										
	Product Data										
	Samples										
	Product										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Delegated-Design Submittal										
	Qualification Statements										
	Product Test Reports										
	Warranty										
<b>088113</b>	<b>DECORATIVE GLASS GLAZING</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Product										
	Delegated-Design Submittal										
	Qualification Statements										
	Warranty										
	Compatibility Test Reports										
<b>092116.23</b>	<b>GYP SUM BOARD SHAFT WALL ASSEMBLIES</b>										
	Product Data										
	Product										
<b>092216</b>	<b>NON-STRUCTURAL METAL FRAMING</b>										
	Product Data										
	Product										
<b>092900</b>	<b>GYP SUM BOARD</b>										
	Product Data										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Samples										
	Product										
<b>093013</b>	<b>CERAMIC TILING</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Verification										
	Product										
	Qualification Statements										
	Product Test Reports										
<b>095113</b>	<b>ACOUSTICAL PANEL CEILINGS</b>										
	Product Data										
	Samples										
	Product										
	Coordination Drawings										
	Qualification Statements										
	Product Test Reports										
<b>095423</b>	<b>LINEAR METAL CEILINGS</b>										
	Product Data										
	Samples										
	Samples for Initial Selection										



Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Samples for Verification										
	Product										
	Coordination Drawings										
<b>096113</b>	<b>floor sealers</b>										
	Product Data										
	Product										
	Qualification Statements										
<b>096513</b>	<b>RESILIENT BASE AND ACCESSORIES</b>										
	Product Data										
	Samples										
	Samples for Initial Selection										
	Samples for Verification										
	Product										
<b>096516</b>	<b>RESILIENT SHEET FLOORING</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Product										
	Qualification Statements										
<b>096519</b>	<b>RESILIENT TILE FLOORING</b>										
	Product Data										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Shop Drawings										
	Samples										
	Product										
	Qualification Statements										
<b>096536</b>	<b>STATIC-CONTROL RESILIENT FLOORING</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Verification										
	Product										
	Qualification Statements										
	Product Test Reports										
<b>096566</b>	<b>RESILIENT ATHLETIC FLOORING</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Product										
	Qualification Statements										
<b>096813</b>	<b>TILE CARPETING</b>										
	Product Data										
	Shop Drawings										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Product										
	Qualification Statements										
	Product Test Reports										
	Warranty										
<b>097200</b>	<b>WALL COVERINGS</b>										
	Product Data										
	Shop Drawings										
	Product										
	Qualification Statements										
	Product Test Reports										
<b>097723</b>	<b>FABRIC-WRAPPED PANELS</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Verification										
	Product										
	Coordination Drawings										
	Warranty										
<b>097800</b>	<b>INTERIOR WALL PANEL SYSTEMS</b>										
	Product Data										
	Shop Drawings										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Samples										
	Samples for Verification										
	Product										
	Coordination Drawings										
	Warranty										
<b>099113</b>	<b>EXTERIOR PAINTING</b>										
	Product Data										
	Samples										
	Samples for Verification										
	Product										
	Product List										
<b>099123</b>	<b>INTERIOR PAINTING</b>										
	Product Data										
	Samples										
	Samples for Initial Selection										
	Samples for Verification										
	Product										
	Product List										
<b>101423</b>	<b>PANEL SIGNAGE</b>										
	Product Data										
	Shop Drawings										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Samples										
	Samples for Verification										
	Product										
<b>102113.17</b>	<b>PHENOLIC-CORE TOILET COMPARTMENTS</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Initial Selection										
	Samples for Verification										
	Product										
<b>102113.19</b>	<b>PLASTIC TOILET COMPARTMENTS</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Initial Selection										
	Samples for Verification										
	Product										
	Product Test Reports										
<b>102123</b>	<b>CUBICLE CURTAINS AND TRACK</b>										
	Product Data										
	Shop Drawings										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Samples										
	Samples for Initial Selection										
	Samples for Verification										
	Product										
<b>102600</b>	<b>WALL AND DOOR PROTECTION</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Initial Selection										
	Product										
<b>102800</b>	<b>TOILET, BATH, AND LAUNDRY ACCESSORIES</b>										
	Product Data										
	Samples										
	Product										
<b>104413</b>	<b>FIRE PROTECTION CABINETS</b>										
	Product Data										
	Shop Drawings										
	Product										
<b>104416</b>	<b>FIRE EXTINGUISHERS</b>										
	Product Data										
	Product										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Warranty										
<b>114700</b>	<b>ice machines</b>										
	Product Data										
	Product										
	Coordination Drawings										
	Warranty										
<b>116853</b>	<b>FIELD SAFETY PADS</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Product										
	Product Test Reports										
	Warranty										
<b>123661.16</b>	<b>SOLID SURFACING COUNTERTOPS</b>										
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Verification										
	Product										
	Qualification Statements										
<b>123661.19</b>	<b>QUARTZ AGGLOMERATE COUNTERTOPS</b>										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Product Data										
	Shop Drawings										
	Samples										
	Samples for Verification										
	Product										
	Qualification Statements										
<b>133419</b>	<b>METAL BUILDING SYSTEMS</b>										
	Shop Drawings – Anchor Rod Plans and Structural Framing Drawings										
	Analysis Data										
	Qualification Data										
	Welding Certificates										
	Letter of Design Certificates										
	Material Test Reports										
	Source quality-control reports										
	Field quality-control reports										
	Sample Warranties										
<b>211313</b>	<b>WET-PIPE SPRINKLER SYSTEMS</b>										
	Product Data										
	Shop Drawings / Delegated Design Submittal										
	Field Test Reports										



Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Field Quality Control Reports										
	Operation and Maintenance Data										
	Extra Materials										
<b>220500</b>	<b>COMMON WORK RESULTS FOR PLUMBING</b>										
	Shop Drawings										
	Product Data										
	Welder's Certificates										
	Schedules										
<b>220515</b>	<b>BASIC PIPING MATERIALS AND METHODS</b>										
	Product Data										
	Welder's Certificates										
<b>220519</b>	<b>METERS AND GAUGES FOR PLUMBING PIPING</b>										
	Product Data										
	Certificates										
<b>220523</b>	<b>GENERAL-DUTY VALVES FOR PLUMBING PIPING</b>										
	Product Data										
<b>220529</b>	<b>HANGERS AND SUPPORTS FOR PLUMBING PIPING</b>										
	Product Data										
	Installation Instructions										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Welder's Certificates										
	Certificates										
<b>220535</b>	<b>DE-ICING SYSTEM FOR ROOFS AND GUTTERS</b>										
	Shop Drawings										
	Product Data										
	Wiring Diagrams										
	Installation Instructions										
<b>220553</b>	<b>IDENTIFICATION FOR PLUMBING PIPING &amp; EQUIPMENT</b>										
	Product Data										
	Material Samples										
	Schedules										
<b>220700</b>	<b>PUMBING INSULATION</b>										
	Product Data										
	Schedules										
<b>221100</b>	<b>WATER DISTRIBUTION PIPING AND SPECIALTIES</b>										
	Product Data										
	Welder's Certificates										
	Certificates										
<b>221111</b>	<b>MECHANICALLY JOINED PLUMBING PIPING SYSTEMS</b>										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Product Data										
	Welder's Certificates										
	Certificates										
<b>221116</b>	<b>ELECTROMAGNETIC WATER METERS</b>										
	Shop Drawings										
	Product Data										
	Performance Data										
	Wiring Diagrams										
<b>221300</b>	<b>SANITARY DRAINAGE AND VENT PIPING AND SPECIALTIES</b>										
	Product Data										
<b>221489</b>	<b>SUMP PUMPS</b>										
	Shop Drawings										
	Product Data										
	Performance Data										
	Wiring Diagrams										
<b>223300</b>	<b>DOMESTIC EQUIPMENT</b>										
	Product Data										
	Performance Data										
	Wiring Diagrams										
	Special Warranties										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
<b>224000</b>	<b>PLUMBING FIXTURES</b>										
	Product Data										
	Wiring Diagrams										
	Spare Parts List										
<b>227000</b>	<b>NATURAL GAS SYSTEMS</b>										
	Shop Drawings										
	Product Data										
	Performance Data										
	Coordination Drawings										
	Installation Instructions										
	Welder's Certificates										
<b>227010</b>	<b>MECHANICALLY JOINED NATURAL GAS PIPING SYSTEMS</b>										
	Product Data										
	Installation Instructions										
	Certificates										
	Spare Parts List										
<b>230500</b>	<b>COMMON WORK RESULTS FOR HVAC</b>										
	Product Data										
	Shop Drawings										
	Welder's Certificates										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Schedules										
<b>230510</b>	<b>BASIC PIPING MATERIALS AND METHODS</b>										
	Product Data										
	Schedules										
	Certificates										
	Shop Drawings										
<b>230513</b>	<b>COMMON MOTOR REQUIREMENT FOR HVAC EQUIPMENT</b>										
	Product Data										
<b>230529</b>	<b>HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT</b>										
	Product Data										
	Installation Instructions										
	Welder's Certificates										
	Certificates										
<b>230550</b>	<b>VIBRATION ISOLATION FOR HVAC</b>										
	Product Data										
	Schedules										
<b>230553</b>	<b>IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT</b>										
	Product Data										
	Installation Instructions										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
<b>230700</b>	<b>HVAC INSULATION</b>										
	Product Data										
	Installation Instructions										
<b>230923</b>	<b>DIRECT-DIGITAL CONTROL FOR HVAC</b>										
	Shop Drawings										
	Product Data										
<b>232300</b>	<b>REFRIGERANT PIPING</b>										
	Product Data										
	Shop Drawings										
	Installation Instructions										
	Brazer's Certificates										
<b>233113</b>	<b>METAL DUCTS</b>										
	Product Data										
	Shop Drawings										
	Welder's Certificates										
<b>233300</b>	<b>AIR DUCT ACCESSORIES</b>										
	Product Data										
	Shop Drawings										
<b>233413</b>	<b>AXIAL HVAC FANS</b>										
	Product Data										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Shop Drawings										
	Wiring Diagrams										
<b>233413</b>	<b>CENTRIFUGAL HVAC FANS</b>										
	Product Data										
	Shop Drawings										
	Wiring Diagrams										
<b>233600</b>	<b>AIR TERMINAL UNITS</b>										
	Product Data										
	Shop Drawings										
	Wiring Diagrams										
<b>233713</b>	<b>DIFFUSERS, REGISTERS AND GRILLES</b>										
	Product Data										
	Coordination Drawings										
	Color Samples										
<b>237413</b>	<b>OUTDOOR PACKAGED HEATING AND COOLING UNITS</b>										
	Product Data										
	Shop Drawings										
	Wiring Diagrams										
	Warranties										
<b>238126</b>	<b>SPLIT SYSTEM AIR-CONDITIONERS</b>										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Product Data										
	Shop Drawings										
	Wiring Diagrams										
	Warranties										
<b>238313</b>	<b>ELECTRIC SNOW AND ICE MELTING SYSTEM</b>										
	Product Data										
	Shop Drawings										
	Samples										
<b>260500</b>	<b>COMMON WORK RESULTS FOR ELECTRICAL</b>										
	Product Data										
<b>260504</b>	<b>PROVISIONS FOR ELECTRICAL UTILITY SERVICE</b>										
	Product Data										
	Shop Drawings										
<b>260519</b>	<b>LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES</b>										
	Product Data										
	Qualification Data										
<b>260526</b>	<b>GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS</b>										
	Product Data										
<b>260529</b>	<b>HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS</b>										
	Product Data										



Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Welder's Certificates										
<b>260533</b>	<b>RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS</b>										
	Product Data										
<b>260543</b>	<b>UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS</b>										
	Product Data										
<b>260553</b>	<b>IDENTIFICATION FOR ELECTRICAL SYSTEMS</b>										
	Product Data										
<b>260573</b>	<b>OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY</b>										
	Product Data										
	Product Certificates										
	Qualification Data										
	Coordination Study Reports										
<b>260910</b>	<b>CENTRALIZED DIMMING SYSTEM</b>										
	Product Data										
	Wiring diagrams										
<b>260923</b>	<b>LIGHTING CONTROL DEVICES</b>										
	Product Data										
	Shop Drawings										
<b>262200</b>	<b>LOW-VOLTAGE TRANSFORMERS</b>										
	Product Data										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Shop Drawings										
<b>262413</b>	<b>SWITCHBOARDS</b>										
	Product Data										
	Shop Drawings										
	Fault Current Study										
	Qualifications										
<b>262416</b>	<b>PANELBOARDS</b>										
	Product Data										
	Shop Drawings										
	Schedules										
<b>262726</b>	<b>WIRING DEVICES</b>										
	Product Data										
<b>262813</b>	<b>FUSES</b>										
	Product Data										
<b>262816</b>	<b>ENCLOSED SWITCHES AND CIRCUIT BREAKERS</b>										
	Product Data										
	Shop Drawings										
<b>262913</b>	<b>ENCLOSED CONTROLLERS</b>										
	Product Data										
	Shop Drawings										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Wiring Diagrams										
<b>262923</b>	<b>VARIABLE FREQUENCY MOTOR CONTROLLERS</b>										
	Product Data										
	Shop Drawings										
<b>263600</b>	<b>TRANSFER SWITCHES</b>										
	Product Data										
	Shop Drawings										
	Qualification Data										
<b>264113</b>	<b>LIGHTNING PROTECTION FOR STRUCTURES</b>										
	Product Data										
	Shop Drawings										
	Delegated Design Submittal										
<b>264313</b>	<b>SURGE PROTECTIVE DEVICES</b>										
	Product Data										
	Product Certificates										
<b>265100</b>	<b>INTERIOR LIGHTING</b>										
	Product Data										
	Qualification Data										
<b>265300</b>	<b>INDOOR FIELD LIGHTING</b>										
	Product Data										
	Delegated Design Submittal										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Shop Drawings										
	Wiring Diagrams										
<b>265600</b>	<b>EXTERIOR AREA LIGHTING</b>										
	Product Data										
	Qualification Data										
<b>270500</b>	<b>COMMON WORK RESULTS FOR COMMUNICATIONS</b>										
	Product Data										
	Shop Drawings										
<b>270543</b>	<b>UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS</b>										
	Product Data										
	Shop Drawings										
<b>271000</b>	<b>STRUCTURED CABLING SYSTEM</b>										
	Qualifications										
	Warranty										
	Product Data										
	Shop Drawings										
<b>274100</b>	<b>AUDIO VIDEO SYSTEM</b>										
	Product Data										
	Shop Drawings										
<b>274116</b>	<b>AUDIO VIDEA SYSTEM EQUIPMENT</b>										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Product Data										
	Shop Drawings										
<b>280501</b>	<b>COMMON WORK RESULTS FOR ELECTRONIC SECURITY</b>										
	Product Data										
	Shop Drawings										
<b>281000</b>	<b>ELECTRONIC SECURITY SYSTEMS</b>										
	Qualifications										
	Product Data										
	Shop Drawings										
<b>281010</b>	<b>CONDUCTORS AND CABLES FOR ELECTRONIC SECURITY</b>										
	Product Data										
	Shop Drawings										
<b>281015</b>	<b>TELECOMMUNICATIONS REQUIREMENTS FOR ELECTRONIC SECURITY</b>										
	Qualifications										
	Product Data										
	Shop Drawings										
	Parts List										
	Schedule										
<b>281300</b>	<b>ACCESS CONTROL</b>										
	Qualifications										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Product Data										
	Shop Drawings										
<b>282000</b>	<b>VIDEO SURVEILLANCE</b>										
	Qualifications										
<b>284621</b>	<b>ADDRESSABLE FIRE-ALARM SYSTEMS</b>										
	Product Data										
	Shop Drawings / Delegated Design Submittal										
	Field Quality Control Reports										
	Operation and Maintenance Data										
	Software and Firmware Operational Documentation										
	Extra Materials										
	Warranty										
<b>316100</b>	<b>FOOTINGS</b>										
	Submittal Schedule										
	Footing Construction Methods										
	Installer Qualifications										
	Shop drawings										
	Construction Log										
	Contractor's Survey Report										
	Mill Certificates										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Owner's Concrete Testing Reports										
	Product Data										
<b>316616</b>	<b>SOIL NAIL WALL</b>										
	Earth Retention System Designer's Qualifications										
	Soil Nail Wall Installer's Qualifications										
	Contractor's independent soil nail testing firm's qualifications										
	Earth retention system supervisor's qualifications										
	Letter of Design Certificates										
	Shop Drawings										
	Calculations										
	Construction Contingency Plan										
	Sequence of Installation and Removal of temporary earth retention systems										
	Design Lateral pressures										
	Soil Nail Installation Procedures and Results										
<b>321216</b>	<b>CONCRETE PAVING</b>										
	Product Data:										
	Shop Drawings:										
<b>321313</b>	<b>CONCRETE PAVING</b>										
	Product Data:										
	Shop Drawings:										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
<b>321373</b>	<b>PAVEMENT MARKINGS</b>										
	Product Data:										
	Product Certificates										
	Samples										
<b>321723</b>	<b>PAVEMENT MARKINGS</b>										
	Product Data:										
	Quality Control Submittals										
	Samples										
<b>322000</b>	<b>EARTH MOVING</b>										
	Product Data:										
	Project Record Documents										
	Blasting Plan										
	Reports of blasing and vibration monitoring										
	Soil Testing Reports										
<b>323123</b>	<b>VINYL COATED CHAIN LINK FENCE</b>										
	Product Data:										
	Shop Drawings:										
	Samples										
<b>323223</b>	<b>SEGMENTAL RETAINING WALLS</b>										
	Product Data:										



Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Shop Drawings:										
	Project Record Documents.										
	Samples.										
	Wall Design Engineer Qualifications.										
	Wall Contractor Qualifications										
	Design Calculations										
<b>334100</b>	<b>SANITARY UTILITY SEWEREAGE PIPING</b>										
	Product Data:										
	Shop Drawings:										
	Project Record Documents.										
<b>334100</b>	<b>SANITARY UTILITY SEWEREAGE PIPING</b>										
	Product Data:										
	Shop Drawings:										
	Project Record Documents.										
<b>334100</b>	<b>STORM UTILITY DRAINAGE PIPING</b>										
	Product Data:										
	Shop Drawings:										
	Project Record Documents.										
<b>334600</b>	<b>SUBDRAINAGE</b>										
	Product Data:										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
	Shop Drawings:										
	Samples										
	Project Record Documents.										
<b>334613</b>	<b>SUBDRAINAGE</b>										
	Product Data:										
	Shop Drawings:										
	Samples										
	Project Record Documents.										
<b>337313</b>	<b>LIQUID FILLED UTILITY TRANSFORMERS</b>										
	Product Data										

OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

Project: New Indoor Practice Facility  
 Project Number: CP210981  
 Contractor:

Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
014500	STRUCTURAL TESTING AND INSPECTION							
031000	CONCRETE FORMWORK							
032000	CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES							
033000	CAST-IN-PLACE CONCRETE							
033713	SHOTCRETE							
051200	STRUCTURAL STEEL							
053000	STEEL DECK							
133419	METAL BUILDING SYSTEMS				x			
211313	WET-PIPE SPRINKLER SYSTEMS	x		x	x			x
220500	COMMON WORK RESULTS FOR PLUMBING	X						
220515	BASIC PIPING MATERIALS AND METHODS	X						
220516	EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING	X						
220519	METERS AND GAUGES FOR PLUMBING PIPING	X			X			
220523	GENERAL-DUTY VALVES FOR PLUMBING PIPING	X			X	X		
220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING	X						
220535	DE-ICING SYSTEM FOR ROOFS AND GUTTERS	X					X	X

Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
220550	VIBRATION ISOLATION FOR PLUMBING PIPING AND EQUIPMENT	X					X	
220553	IDENTIFICATION FOR PLUMBING PIPING & EQUIPMENT	X						
220700	PUMBING INSULATION	X						
221100	WATER DISTRIBUTION PIPING AND SPECIALTIES	X			X	X		
221111	MECHANICALLY JOINED PLUMBING PIPING SYSTEMS	X			X	X		
221300	SANITARY DRAINAGE AND VENT PIPING AND SPECIALTIES	X						
221400	STORM DRAINAGE PIPING AND SPECIALTIES	X						
221489	SUMP PUMPS	X	X		X	X	X	X
223300	ELECTRI DOMESTIC WATER HEATERS	X	X		X	X	X	X
224000	PLUMBING FIXTURES	X			X	X		X
227000	NATURAL GAS SYSTEMS	X				X	X	
227010	MECHANICALLY JOINED NATURAL GAS PIPING SYSTEMS	X				X		
230500	COMMON WORK RESULTS FOR HVAC	X						
230510	BASIC PIPING MATERIALS AND METHODS	X		X	X			
230513	COMMON MOTOR REQUIREMENT FOR HVAC EQUIPMENT	X		X	X			X
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT	X		X	X			
230550	VIBRATION ISOLATION FOR HVAC	X						
230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT	X		X				

Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
230700	HVAC INSULATION	X		X				
230923	DIRECT-DIGITAL CONTROL FOR HVAC	X						
232300	REFRIGERANT PIPING	X		X	X			
233113	METAL DUCTS	X						
233300	AIR DUCT ACCESSORIES	X			X			
233413	AXIAL HVAC FANS	X	X	X	X	X		X
233413	CENTRIFUGAL HVAC FANS	X	X	X	X	X		X
233600	AIR TERMINAL UNITS	X	X		X	X		
233713	DIFFUSERS, REGISTERS AND GRILLES	X			X	X		
237413	OUTDOOR PACKAGED HEATING AND COOLING UNITS	X	X		X	X		X
238126	SPLIT SYSTEM AIR-CONDITIONERS	X	X	X	X	X		X
238313	ELECTRIC SNOW AND ICE MELTING SYSTEM	X	X	X	X	X		X
238500	ELECTRIC HEATING UNITS	X	X	X	X			X
260500	COMMON WORK RESULTS FOR ELECTRICAL	X						
260504	PROVISIONS FOR ELECTRICAL UTILITY SERVICE	X						
260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES	X						
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS	X						
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS	X						
260533	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS	X						
260543	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS	X						

Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS	X						
260573	OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY	X					X	
260910	CENTRALIZED DIMMING SYSTEM	X	X					X
260923	LIGHTING CONTROL DEVICES	X						X
262200	LOW-VOLTAGE TRANSFORMERS	X	X		X			X
262413	SWITCHBOARDS	X			X			X
262416	PANELBOARDS	X			X			X
262726	WIRING DEVICES	X						
262813	FUSES	X			X	X		X
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS	X			X			X
262913	ENCLOSED CONTROLLERS	X	X					
262923	VARIABLE FREQUENCY MOTOR CONTROLLERS	X		X	X			X
263600	TRANSFER SWITCHES	X			X			X
264113	LIGHTNING PROTECTION FOR STRUCTURES	X	X		X			
264313	SURGE PROTECTIVE DEVICES	X			X			X
265100	INTERIOR LIGHTING	X			X			X
265300	INDOOR FIELD LIGHTING	X	X		X			X
265600	EXTERIOR AREA LIGHTING	X			X			X
270500	COMMON WORK RESULTS FOR COMMUNICATIONS	X						
270543	UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS	X						
271000	STRUCTURED CABLING SYSTEM	X			X			X

Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
274100	AUDIO VIDEO SYSTEM	X	X		X			X
274116	AUDIO VIDEA SYSTEM EQUIPMENT	X			X			X
270501	COMMON WORK RESULTS FOR ELECTRONIC SECURITY	X						
281000	ELECTRONIC SECURITY SYSTEMS	X	X		X			X
281010	CONDUCTORS AND CABLES FOR ELECTRONIC SECURITY	X						
281015	TELECOMMUNICATIONS REQUIREMENTS FOR ELECTRONIC SECURITY	X	X		X	X		X
281300	ACCESS CONTROL	X			X	X		X
284621	ADDRESSABLE FIRE-ALARM SYSTEMS	x	x	x	x			x
316100	FOOTINGS							
316616	SOIL NAIL							
337313	LIQUID FILLED UTILITY TRANSFORMERS	X			X			X

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# CP210981 New Indoor Practice Facility Quality Assurance List

	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
Commissioning Items by CSI Division	Name	Firm				
<b>1</b>						
<b>Building System Commissioning</b>						
Commissioning Agent - Conduct pre-installation meetings per specifications.					Meeting Minutes	<input checked="" type="checkbox"/>
<b>31100</b>						
<b>Concrete Formwork</b>						
Notify Owner's Representative prior to removal of formwork						<input checked="" type="checkbox"/>
Notify Owner's Representative upon installation of formwork and accessories.						<input checked="" type="checkbox"/>
<b>32000</b>						
<b>Concrete Reinforcement</b>						
Ensure plastic tipped accessories are used at exposed surfaces.						<input type="checkbox"/>
<b>33000</b>						
<b>Cast-In-Place Concrete</b>						
Hold Pre-Concrete conference as specified					Meeting Minutes	<input checked="" type="checkbox"/>
Provide a Copy Of Field Cured Concrete Cylinder Test Report to Owner's Rep Prior to Stripping Any Load Bearing Formwork					Test Report From Independent Testing Lab	<input type="checkbox"/>
Submit concrete mix designs prepared by a qualified testing laboratory for approval prior to placement.					mix design reports	<input type="checkbox"/>
<b>33713</b>						
<b>Shotcrete</b>						
Help Perform Quality Assurance section of specifications					Third Party Test Report	<input checked="" type="checkbox"/>

Commissioning Items by CSI Division	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
<b>42000</b>						
<b>Unit Masonry</b>						
Help Perform Field Quality Control section of specifications					Third Party Test Reports	<input checked="" type="checkbox"/>
Provide mock-ups per specifications.					Inspection Report	<input checked="" type="checkbox"/>
<b>51200</b>						
<b>Structural Steel</b>						
Provide welder qualification report for each welder on site					Welder Qualifications	<input checked="" type="checkbox"/>
<b>53000</b>						
<b>Steel Deck</b>						
Provide welder qualification report for each welder on site					Welder Qualifications	<input checked="" type="checkbox"/>
<b>54000</b>						
<b>Cold-Formed Metal Framing</b>						
Help Perform Field Quality Control section of specifications					Third Party Test Report	<input checked="" type="checkbox"/>
Hold Preinstallation Meetings as specified					Meeting Minutes	<input checked="" type="checkbox"/>
Obtain Welders Certificates					Welders Certificates	<input checked="" type="checkbox"/>
<b>55000</b>						
<b>Metal Fabrications</b>						
Obtain Welders Certificates					Welders Certificates	<input checked="" type="checkbox"/>

Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
Commissioning Items by CSI Division	Name	Firm			
<b>55113</b>					
<b>Metal Pan Stairs</b>					
Obtain Welders Certificates				Welders Certificates	<input checked="" type="checkbox"/>
<b>57300</b>					
<b>Decorative Metal Railings</b>					
Help Perform Field Quality Control section of specifications				Third Party Test Report	<input checked="" type="checkbox"/>
Obtain Welders Certificates				Welders Certificates	<input checked="" type="checkbox"/>
Perform Preconstruction Testing section of specs				Test Report	<input checked="" type="checkbox"/>
Provide mock-ups per specifications..				Inspection Report	<input checked="" type="checkbox"/>
Schedule Pre-Installation Conference as specified				Meeting Minutes	<input checked="" type="checkbox"/>
<b>64116</b>					
<b>Plastic-Laminate-Faced Architectural Cabinets</b>					
Check all cabinet doors and drawers for smooth operation, correct hardware, fit & finish					<input type="checkbox"/>
<b>71326</b>					
<b>Self-Adhering Sheet Waterproofing</b>					
Contact Owner's Representative prior to backfilling to allow for inspection of damp/waterproofing.					<input checked="" type="checkbox"/>
Perform Field Quality Control section of specifications				test report	<input checked="" type="checkbox"/>

Commissioning Items by CSI Division	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
<b>71900</b>						
<b>Water Repellents</b>						
Build Mockups as specified					Inspection Report	<input checked="" type="checkbox"/>
Hold Preinstallation Meetings as specified					Meeting Minutes	<input checked="" type="checkbox"/>
<b>72726</b>						
<b>Fluid-Applied Membrane Air Barrier</b>						
Help Perform Field Quality Control section of specifications					Third Party Test Report	<input checked="" type="checkbox"/>
Hold Preinstallation Meetings as specified					Meeting Minutes	<input checked="" type="checkbox"/>
Provide mock-ups per specifications.					Inspection report	<input checked="" type="checkbox"/>
<b>74113</b>						
<b>Standing-Seam Metal Roof Panels</b>						
Perform Field Quality Control section of specifications					test report	<input checked="" type="checkbox"/>
<b>74213</b>						
<b>Insulated Metal Wall Panels</b>						
Build Mockups as specified					inspection report	<input checked="" type="checkbox"/>
Hold Preinstallation Meetings as specified					Meeting Minutes	<input checked="" type="checkbox"/>
Perform Field Quality Control section of specifications					test report	<input checked="" type="checkbox"/>

Commissioning Items by CSI Division		Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
<b>75419</b>							
<b>Polyvinyl-Chloride (PVC) Roofing</b>							
Help Perform Field Quality Control section of specifications						Third Party Report	<input checked="" type="checkbox"/>
Hold Preinstallation Meetings as specified						Meeting Minutes	<input checked="" type="checkbox"/>
<b>76200</b>							
<b>Sheet Metal Flashing and Trim</b>							
Hold Preinstallation Meetings as specified						Meeting Minutes	<input checked="" type="checkbox"/>
<b>78413</b>							
<b>Penetration Firestopping</b>							
Do not enclose firestopping with other construction until inspection has been completed.						Inspection Report	<input checked="" type="checkbox"/>
Perform Field Quality Control section of specifications						Test Report	<input checked="" type="checkbox"/>
<b>78443</b>							
<b>Joint Firestopping</b>							
Hold Preinstallation Meetings as specified						Meeting Minutes	<input checked="" type="checkbox"/>
Perform Field Quality Control section of specifications						certification	<input checked="" type="checkbox"/>
<b>79200</b>							
<b>Joint Sealants</b>							
Perform Adhesion Tests per Field Quality Control section of specifications						field report	<input checked="" type="checkbox"/>

Commissioning Items by CSI Division	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
<b>81113</b>						
<b>Hollow Metal Doors and Frames</b>						
Check Fire labels on fire rated doors and frames					Door List	<input checked="" type="checkbox"/>
<b>83323</b>						
<b>Overhead Coiling Doors</b>						
Perform Demonstration section of specs. 3.5					Sign in sheet	<input checked="" type="checkbox"/>
Provide Startup By Factory Rep.					field report	<input checked="" type="checkbox"/>
<b>83416</b>						
<b>Hangar Doors</b>						
Perform Demonstration section of specs. 3.5					Sign in sheet	<input checked="" type="checkbox"/>
Perform Field Quality Control section of specifications					field report	<input checked="" type="checkbox"/>
Provide Startup By Factory Rep.					Field Report	<input checked="" type="checkbox"/>
<b>83613</b>						
<b>Sectional Doors</b>						
Perform Demonstration section of specs					Sign in sheet	<input checked="" type="checkbox"/>
Perform Startup Services section of specs					Startup Report	<input checked="" type="checkbox"/>

Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
Commissioning Items by CSI Division	Name	Firm			
<b>84113</b>					
<b>Aluminum-Framed Entrances and Storefronts</b>					
Help Perform Field Quality Control section of specifications				Third Party Report	<input checked="" type="checkbox"/>
<b>84413</b>					
<b>Glazed Aluminum Curtain Walls</b>					
Help Perform Field Quality Control section of specifications				Third Party Report	<input checked="" type="checkbox"/>
<b>84513</b>					
<b>Structured-Polycarbonate-Panel Assemblies</b>					
Build Mockups as specified				Inspection Report	<input checked="" type="checkbox"/>
Help Perform Field Quality Control section of specifications				Third Party Report	<input checked="" type="checkbox"/>
Hold Preinstallation meeting as specified				Meeting Minutes	<input checked="" type="checkbox"/>
<b>87111</b>					
<b>Door Hardware</b>					
Perform Demonstration and Training section of specifications 3.7				Sign In sheet	<input checked="" type="checkbox"/>
Perform Field Quality Control section of specifications				Test Report	<input checked="" type="checkbox"/>
Provide Maintenance Service section of specs				Transmittal	<input checked="" type="checkbox"/>

Commissioning Items by CSI Division	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
<b>88000</b>						
<b>Glazing</b>						
Build Mockups as specified					Inspection Report	<input checked="" type="checkbox"/>
Hold Preinstallation meeting as specified					Meeting Minutes	<input checked="" type="checkbox"/>
<b>92116</b>						
<b>Gypsum Board Shaft Wall Assemblies</b>						
Verify fire rating compliance is maintained, including all wall penetrations.					Inspection Report	<input checked="" type="checkbox"/>
<b>92900</b>						
<b>Gypsum Board</b>						
Build Mockups as specified. 1.3A1					Inspection Report	<input checked="" type="checkbox"/>
<b>93013</b>						
<b>Ceramic Tiling</b>						
Build Mockups as specified					Inspection reports	<input checked="" type="checkbox"/>
Hold Preinstallation meeting as specified					Meeting Minutes	<input checked="" type="checkbox"/>
<b>95113</b>						
<b>Acoustical Panel Ceilings</b>						
Complete all above ceiling inspections prior to installation of tiles						<input checked="" type="checkbox"/>
Hold Preinstallation meeting as specified					Meeting Minutes	<input checked="" type="checkbox"/>



Verified by:						
Commissioning Items by CSI Division	Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
Perform Field Quality Control section of specifications					Test Report	<input checked="" type="checkbox"/>
<b>95423</b>						
<b>Linear Metal Ceilings</b>						
Build Mockups as specified					Inspection Report	<input checked="" type="checkbox"/>
Hold Preinstallation meeting as specified					Meeting Minutes	<input checked="" type="checkbox"/>
Perform Field Quality Control section of specifications					test reports	<input checked="" type="checkbox"/>
Provide Extra Material as specified					Transmittal	<input checked="" type="checkbox"/>
<b>96113</b>						
<b>Floor Sealers</b>						
Hold Preinstallation meeting as specified					Meeting Minutes	<input checked="" type="checkbox"/>
Provide Extra Material as specified					Transmittal	<input checked="" type="checkbox"/>
<b>96516</b>						
<b>Resilient Sheet Flooring</b>						
After installation maintain ambient temperature of not less than 55 deg F or more than 95 deg F.						<input type="checkbox"/>
Furnish Extra Material as specified					Transmittal	<input checked="" type="checkbox"/>
Perform pH, Chloride (moisture) and bond tests per manufacturer. Do not proceed until all manufacturing requirements are met.					test reports	<input checked="" type="checkbox"/>

Commissioning Items by CSI Division	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
<b>96536</b>						
<b>Static-Control Resilient Flooring</b>						
Perform Field Quality Control section of specifications					Test Report	<input checked="" type="checkbox"/>
Provide Extra Material as specified					Transmittal	<input checked="" type="checkbox"/>
<b>96813</b>						
<b>Tile Carpeting</b>						
Provide Extra Stock as specified					Transmittal	<input checked="" type="checkbox"/>
<b>97200</b>						
<b>Wall Coverings</b>						
Furnish Extra Material as specified					Transmittal	<input checked="" type="checkbox"/>
<b>97723</b>						
<b>Fabric-Wrapped Panels</b>						
Hold Preinstallation meeting as specified					Meeting Minutes	<input checked="" type="checkbox"/>
<b>97800</b>						
<b>Interior Wall Panel Systems</b>						
Hold Preinstallation meeting as specified					Meeting Minutes	<input checked="" type="checkbox"/>
<b>99113</b>						
<b>Exterior Painting</b>						
Build Mockups as specified					Inspection Report	<input checked="" type="checkbox"/>

Verified by:						
Commissioning Items by CSI Division	Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
Periodically Check Wet Film Thickness To Assure Conformance With Manufacturer's Requirements To Achieve Dry Film Thickness Per Field Quality Control section of spec					field report	<input checked="" type="checkbox"/>
<b>99123</b>						
<b>Interior Painting</b>						
Periodically Check Wet Film Thickness To Assure Conformance With Manufacturer's Requirements To Achieve Dry Film Thickness Per Field Quality Control section of spec					field report	<input checked="" type="checkbox"/>
<b>102123</b>						
<b>Cubicle Curtains and Track</b>						
Furnish Extra Materials as specified					Transmittal	<input checked="" type="checkbox"/>
<b>104413</b>						
<b>Fire Protection Cabinets</b>						
Hold Preinstallation Conference as specified					Meeting Minutes	<input checked="" type="checkbox"/>
<b>114700</b>						
<b>Ice Machines</b>						
Perform Demonstration section of spec. 3.3					Sign in Sheet	<input checked="" type="checkbox"/>
<b>116853</b>						
<b>Field Safety Pads</b>						
Build Mockups as specified					Inspection Report	<input checked="" type="checkbox"/>
Hold Preinstallation Meetings as specified.					Meeting Minutes	<input checked="" type="checkbox"/>

Commissioning Items by CSI Division		Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
<b>142400</b>							
<b>Hydraulic Passenger Elevators</b>							
Perform Instruction and Maintenance section of specs 3.5						Sign in sheet	<input checked="" type="checkbox"/>
Perform specified load test, firemans recall operation, test limit switches Per Field Quality Control						Elevator test report	<input checked="" type="checkbox"/>
Verify no hydraulic leaks							<input type="checkbox"/>
<b>211313</b>							
<b>Wet-Pipe Sprinkler Systems</b>							
Perform Demonstration section of specifications 3.12						Sign Up Sheet	<input checked="" type="checkbox"/>
Perform Field Quality Control section of specifications						test report; NFPA 13 Certification	<input checked="" type="checkbox"/>
Provide Extra Stock as specified						Transmittal	<input checked="" type="checkbox"/>
<b>220010</b>							
<b>General Plumbing Requirements</b>							
Contractor to pull all permits as specified. Including Pressure Vessel Permits						Permit	<input checked="" type="checkbox"/>
Provide Spare Parts as specified						Transmittal	<input checked="" type="checkbox"/>
<b>220500</b>							
<b>Common Work Results for Plumbing</b>							
Conduct start-up and tests per specifications							<input checked="" type="checkbox"/>

Verified by:						
Commissioning Items by CSI Division	Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
Hold MEP pre-installation meeting(s).					Meeting Minutes and Sign-up Sheet	<input checked="" type="checkbox"/>
<b>220523</b>						
<b>General-Duty Valves for Plumbing Piping</b>						
Adjust or replace packing after piping system testing and put into service prior to testing and balancing						<input type="checkbox"/>
Perform Field Quality Control section of specifications					Test Report	<input checked="" type="checkbox"/>
<b>220553</b>						
<b>Identification for Plumbing Piping and Equipment</b>						
Install valve tags on valves and control devices per specifications					Valve Schedule framed/posted	<input checked="" type="checkbox"/>
Provide spare parts as specified. 5% of each type (not less than 3)					Transmittal	<input checked="" type="checkbox"/>
<b>221100</b>						
<b>Water Distribution Piping and Specialties</b>						
Perform Field Quality Control section of specifications. Including pressure tests. Minimum-100 psi					Test Report	<input checked="" type="checkbox"/>
Provide spare parts as specified. 1 valve key for each keyed valves					Transmittal	<input checked="" type="checkbox"/>
<b>221111</b>						
<b>Mechanically Joined Plumbing Piping Systems</b>						
Perform Field Quality Control section of specifications. Including pressure tests. Minimum-100 psi					Test Report	<input checked="" type="checkbox"/>

Commissioning Items by CSI Division		Verified by:	Date compl	Coord Initial	Documentation Required	Owner Witness Required
		Name	Firm			
<b>221116</b>						
<b>Electromagnetic Water Meters</b>						
Provide spare parts as specified. Spare parts that match products installed					Transmittal	<input checked="" type="checkbox"/>
<b>221123</b>						
<b>Domestic Water Pumps</b>						
Align all pumps to within manufacturer's published tolerances					test report	<input type="checkbox"/>
Flush systems until strainers are clean, change strainers and clean vents. Bacteria test					Bact test report	<input type="checkbox"/>
Perform all checks described in "Field Quality Control" section of specification					test report	<input checked="" type="checkbox"/>
Perform all checks described in "Startup" section of specification					Startup report	<input checked="" type="checkbox"/>
Provide spare parts as specified. 1 mechanical seal for each pump					Transmittal	<input checked="" type="checkbox"/>
<b>221300</b>						
<b>Sanitary Drainage and Vent Piping and Specialties</b>						
Perform all checks described in "Field Quality Control" section of specification. Including leak test at 10 ft head.					test reports	<input checked="" type="checkbox"/>
<b>221400</b>						
<b>Storm Drainage Piping and Specialties</b>						
Perform all checks described in "Field Quality Control" section of specification. Including leak test at 10 ft head.					Test Report	<input checked="" type="checkbox"/>

Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
Commissioning Items by CSI Division	Name	Firm			
<b>221489</b>					
<b>Sump Pumps</b>					
Perform Field Quality Control section of spec				Test Report	<input checked="" type="checkbox"/>
Perform Startup section of spec				Startup Report	<input checked="" type="checkbox"/>
<b>223300</b>					
<b>Electric Domestic Water Heaters</b>					
Perform Field Quality Control section of spec				Test Report	<input checked="" type="checkbox"/>
Provide adjustment and start-up in presence of factory rep, per "field quality control" section of spec. Verify proper regulation and control.				field report	<input checked="" type="checkbox"/>
Pull Pressure vessel permit from state, if applicable				PV Permit	<input checked="" type="checkbox"/>
<b>224000</b>					
<b>Plumbing Fixtures</b>					
Perform Field Quality Control section of specifications				Test Report	<input checked="" type="checkbox"/>
Provide Spare Parts as specified				Transmittal	<input checked="" type="checkbox"/>
<b>227000</b>					
<b>Mechanically Joined Natural Gas Systems</b>					
Perform Field Quality Control section of specifications. Test at 60 psi for 1 hour				Test Report	<input checked="" type="checkbox"/>
<b>Natural Gas Systems</b>					
Perform Field Quality Control section of specifications. Test at 60 psi for 1 hour				Test Report	<input checked="" type="checkbox"/>

Commissioning Items by CSI Division	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
Provide Spare Parts as specified					Transmittal	<input checked="" type="checkbox"/>
<b>260519</b>						
<b>Low-Voltage Electrical Power Conductors and Cables</b>						
Ensure wires are color coded per specifications						<input type="checkbox"/>
Perform Field Quality Control section of specifications					Test Report	<input checked="" type="checkbox"/>
<b>260526</b>						
<b>Grounding</b>						
Perform resistance test as described in "Field Quality Control" section of spec					test report	<input checked="" type="checkbox"/>
<b>260553</b>						
<b>Identification for Electrical Systems</b>						
Verify all equipment, panels, conduits and conductors are correctly labeled.						<input type="checkbox"/>
<b>260573</b>						
<b>Overcurrent Protective Device Studies</b>						
SKM data to be e-mailed to MU Commissioning Engineer					SKM Data	<input checked="" type="checkbox"/>
Train owners representatives in setting of overcurrent devices					Sign-up Sheet	<input checked="" type="checkbox"/>
<b>262213</b>						
<b>Transformers</b>						
Perform checks and tests as noted in "Testing" section of spec					test report	<input checked="" type="checkbox"/>



Commissioning Items by CSI Division	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
<b>262416</b>						
<b>Panelboards</b>						
Perform checks per "Field Quality Control" and "Testing" section of spec					Test Reports	<input checked="" type="checkbox"/>
Provide Extra Materials as specified					Transmittal	<input checked="" type="checkbox"/>
<b>262813</b>						
<b>Fuses</b>						
Test for continuity and short circuits prior to energization						<input type="checkbox"/>
<b>263600</b>						
<b>Transfer Switches</b>						
Perform tests per "Demonstration" section of spec					sign in sheet	<input checked="" type="checkbox"/>
Perform tests per "Field Quality Control" section of spec					Test Report	<input checked="" type="checkbox"/>

Please see following website for suggested commissioning forms:

<https://operations.missouri.edu/facilities/commissioning-forms>

# Construction Management Checklist for Energizing Utilities

(Contractor to initial each item upon completion and provide completed form to the Owner's Representative prior to energizing utility)

AM #1

## **Water – turned on to the first valve past Energy Management's last valve.**

- Review all piping and equipment being turned on for proper installation and completed testing.
- Insulation installed (preferred but not required)
- Meter properly installed, working, and in readable location.
- Contractor has swabbed out with chlorine all piping from the backflow preventer to the source while installing.
- All bacteriological tests have been completed and passed.
- Backflow preventer installed and tested. (will need water pressure to test)
- Pressure test completed in piping being turned on.
- Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- Consultant has signed off

## **Steam – turned on to the first valve past Energy Management's last valve.**

- Review all piping, equipment, valves, reducing stations, relief valves, etc. for proper installation and complete testing.
- Piping protected from the weather.
- Insulation must be installed.
- All hangers and bolts have been installed.
- Meter installed, working and in readable location. (Don't need metasys to turn on.)
- All needed traps are installed and able to be tested as they are turned on.
- Condensate system is installed and operating including the pumping system.
- Pressure test completed in piping being turned on.
- Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- Consultant has signed off

## **Condensate – turned on to the first valve past Energy Management's last valve.**

- Review all piping and equipment being turned on for proper installation and completed testing.
- Piping protected from the weather.
- Insulation installed (preferred but not required)
- Pressure test completed in piping being turned on.
- Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- Consultant has signed off

## **Electric – turned on to the first breaker past 13.8kV transformer.**

- Review all wiring and equipment being turned on for proper installation and completed testing
- GFCI set and tested.
- Breakers set and tested.
- All needed permanent grounds are installed.
- Meter installed, working and in readable location.
- Main switchgear protected from the weather.
- Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- Consultant has signed off

## **Chilled Water – turned on to the first valve inside of building.**

- Review all piping and equipment being turned on for proper installation and completed testing.
- Pressure test completed in piping being turned on.
- Insulation must be installed.
- Meter installed, working and connected to Metasys.
- Building pump and automatic isolation/control valve must be installed and under control.
- If chillers are installed, automatic loop pump isolation must be installed.
- Control valves must be installed and automatically controlled on all loads.
- Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- Consultant has signed off

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SECTION 1.F

INDEX OF DRAWINGS

Drawings referred to in and accompanying Project Manual consist of following sheets dated July 13, 2021.

GENERAL

G001 LIFE SAFETY CODE ANALYSIS  
G101 LIFE SAFETY FLOOR PLAN - LEVEL 1  
G102 LIFE SAFETY FLOOR PLAN - LEVEL 2  
G103 LIFE SAFETY FLOOR PLAN - LEVEL 3  
G110 VARIANCES

SURVEY

SUR1 SITE SURVEY - 1  
SUR2 SITE SURVEY - 2  
SUR3 SITE SURVEY - 3  
SUR4 SITE SURVEY - 4  
SUR5 SITE SURVEY - 5  
SUR6 SITE SURVEY - 6

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END OF SECTION

## SECTION 01 45 00 - QUALITY ASSURANCE: STRUCTURAL TESTING AND INSPECTION

### PART 1 - GENERAL

#### 1.1 GENERAL

- A. Quality assurance is testing and inspection to assist the Owner in evaluating the Contractor's performance and quality control in the fabrication shop and field. It is not a substitute for the testing and inspection which is required as part of the Contractor's quality control program.
- B. Cost: Except as specifically noted otherwise, the testing agency for quality assurance shall be engaged and paid by the Owner.
  - 1. The Owner has negotiated inspection services based upon the assumption that all fabrication work shall be performed at one single fabrication shop. Costs associated with work being performed in additional shops will require reimbursement to the Owner.
- C. Definitions:
  - 1. See Sections 033000 and 051200.
  - 2. The term "Testing Agency" in this Specification section is defined as an independent testing and inspection service engaged by the Owner for quality assurance testing and inspection of structural construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.
  - 3. The term "Geotechnical Engineer" in this Specification section is defined as an independent geotechnical engineering service engaged by the Owner for quality assurance testing and inspection of the actual soil conditions to verify compliance with the geotechnical conditions, recommendations and design values described in the Project Geotechnical Report and used as the basis of design for the most current Contract Documents.

#### 1.2 SCOPE

- A. Testing Agency shall provide qualified personnel at the site to test and inspect materials installed by and work performed by the Contractor, for the following structural items as indicated in Part 3 of this Specification section:
  - 1. Section 031000 Concrete Formwork
  - 2. Section 032000 Concrete Reinforcement and Embedded Assemblies
  - 3. Section 033000 Cast-In-Place Concrete
  - 4. Section 033713 Shotcrete
  - 5. Section 042200 Concrete Masonry Units

6. Section 051200 Structural Steel
  7. Section 053000 Steel Deck
  8. Section 316100 Footings
- B. Refer to the drawings for Special Inspections requirements for the Project. The Special Inspections shown on the drawings may contain additional testing and inspection that is not listed in this specification section.

### 1.3 TESTING AGENCY QUALIFICATIONS

- A. Testing Agency shall be an independent agency with the experience and capability to conduct testing, inspection and sampling as indicated in accordance with ASTM E 329.
- B. Testing Agency shall be an agency approved by the local building official to perform Special Inspections and other related services as outlined in the governing project Building Code.
- C. Testing, inspection, and sampling shall be done in accordance with the applicable ASTM standards.
- D. Personnel performing visual inspection and non-destructive testing of welds shall meet the requirements of AWS D1.1 for weld inspectors and shall have current certification as an AWS Certified Welding Inspector.

### 1.4 TESTING AGENCY RESPONSIBILITIES

- A. Provide qualified personnel at the site to test and inspect structural construction as the work progresses using the most current Contract Documents and approved shop drawings.
- B. Provide additional testing and inspection as needed due to the following:
  1. Work performed contrary to Drawings and Specifications
  2. Work performed with improper supervision
  3. Work performed without prior notice
- C. Report deficiencies to Contractor, Owner, Design Professionals within 24 hours.
- D. Rejection: The Testing Agency has the right to reject any material at any time, when it is determined that the material or workmanship does not conform to the Contract Documents and shall immediately notify the Owner, Design Professionals, and Contractor of deficiencies. Failure to detect any defective work or material shall not prevent later rejection when such a defect is discovered nor shall it obligate Design Professionals for final acceptance.
- E. Noncompliance Log: Indicate to the Contractor where remedial work must be performed and maintain a current log of work not in compliance with the Contract Documents. This noncompliance log shall be submitted to the Design Professionals and Owner on a weekly basis.

- F. Reports: Prepare daily inspection, observation, and/or test reports as required herein and provide an evaluation statement in each report stating whether or not the work conforms to requirements of Specifications and Drawings and shall specifically note deviations from them. The daily reports shall be collected and submitted for record to the Design Professionals, **The Building Department** and Owner weekly.
- G. Certification: Upon completion of work and resolution of remedial items, certify in a letter to the Design Professionals and Owner, that the installation is in accordance with the requirements of the Drawings and Specifications.

## 1.5 CONTRACTOR RESPONSIBILITIES

- A. The Contractor shall have sole responsibility for coordinating their work with the Testing Agency to assure that all test and inspection procedures required by the Contract Documents and Public Agencies are provided. The Contractor shall cooperate fully with the Testing Agency in the performance of their work and shall provide the following:
  - 1. Information as to time and place of starting shop fabrication and field construction/erection, at least one week prior to the beginning of the work.
  - 2. The most up to date construction schedule.
  - 3. At least 24 hours advance notice of work requiring testing and inspection.
  - 4. Access to areas as required for testing and inspection.
  - 5. Site File: At least one copy of the most current Contract Documents and approved shop drawings shall be kept available in the contractor's field office. Drawings not bearing evidence of approval and release for construction by the Design Professionals shall not be kept on the job. Provide drawings for the work to be performed in the shop or field one week prior to the start of work.
  - 6. Representative material samples requested by the Testing Agency for testing, if necessary.
  - 7. Full and ample means of assistance for testing and inspection of material.
  - 8. Facilities for proper storage of material samples as required.
  - 9. Proper facilities, including scaffolding, temporary work platforms, safety equipment etc., for inspection of the work in shop and field.
- H. Immediately notify the Owner's Testing Agency and Design Professionals in writing of conditions that will adversely affect the work.
- I. Materials and installed work may require testing and retesting at any time during progress of work, as directed by Design Professionals. Tests, including retesting of rejected materials for installed work will be done at Contractor's expense.

## PART 2 - PRODUCTS (NOT USED)

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Testing Agency shall provide qualified personnel at site to test and inspect structural construction using the latest Contract Documents and approved submittals as indicated in the following sections.

### **3.2 CONCRETE FORMWORK**

- A. Quality Assurance:
  - 1. Prior to placement of reinforcement, inspect formwork for grade, quality of material, absence of foreign matter, and other imperfections that might affect concrete placement and tolerances stated herein.
  - 2. Inspect formwork for shape, location and dimensions of the concrete member being formed.
  - 3. Inspect formwork for compliance with specified tolerances, block outs, camber, shoring ties and seal of form joints.
  - 4. Verify condition of bond surfaces, locations and sizes of all accessories, embedment items, and anchorage for prevention of displacement.
  - 5. Verify proper use/application of form release agents.
  - 6. Verify in-situ concrete strength meets requirements for formwork removal in specification section 031000 prior to removal of shores and formwork from beams and structural slabs.
  - 7. Inspect concrete surfaces immediately after removal of formwork and prior to any patching or repair work.

### **3.3 CONCRETE REINFORCEMENT AND EMBEDDED ITEMS**

- A. Quality Assurance:
  - 1. Prior to placement, inspect reinforcement and embeds for grade, quality of material, absence of foreign matter, and for suitable storage.
  - 2. Provide continuous inspection of reinforcement and embedded assemblies during placement and immediately prior to concreting operations for: size, quantity, vertical and horizontal spacing and location, correctness of bends and splices, mechanical splices, clearances, compliance with specified tolerances, security of supports and ties, concrete cover, and absence of foreign matter.
  - 3. Inspect epoxy-coated reinforcement for coating damage and required applied coatings.

4. Provide continuous inspection of adhesive anchors installed in horizontal or upwardly inclined orientations and those marked (CERT) on the latest Drawings.
5. Adhesive anchors shall be proof tested in tension as follows:
  - a. Testing Agency shall submit an adhesive anchorage proof testing plan to the SER for review and approval prior to performing the anchor proof testing. The anchorage testing plan shall meet the requirements as specified in this section and indicate which anchors have been selected for testing.
  - b. Proof testing shall be performed as a confined tension test in accordance with the guidelines of ASTM E488 and the requirements of ACI 355.4.
  - c. Testing shall be performed after the minimum curing period specified by the manufacturer.
  - d. **10** percent of each type and size of an adhesive anchor assembly and 100 percent of anchors marked (CERT) shall be proof tested in tension by the Owner's Testing Agency.
  - e. All anchors selected for proof testing shall be production anchors. Sacrificial anchors are not acceptable for inclusion in the proof testing plan unless specifically approved by the SER prior to performance of the testing.
  - f. The adhesive anchors proof tension loads shall be as specified in the general notes of the structural drawings.
  - g. Anchors shall have no visible indications of displacement or damage during or after proof load application. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure.
  - h. If more than **10%** of the tested adhesive anchors fail to achieve the specified proof load, **100%** of the anchors of the same diameter and type as the failed anchor shall be proof tested, unless otherwise direct in writing by the SER. Immediately notify the SER of all failed proof tests.
6. Mechanical post-installed anchors shall be proof tested as follows:
  - a. Testing Agency shall submit a mechanical anchorage proof testing plan to the SER for review and approval prior to performing the anchor proof testing. The anchorage testing plan shall meet the requirements as specified in this section and indicate which anchors have been selected for testing.
  - b. **10** percent of each type and size of mechanical anchor shall be proof tested by the Owner's Testing Agency. The required proof test for the anchors is as follows:
  - c. For torque-controlled mechanical anchors, a proof torque shall be applied to the anchor using a calibrated torque wrench and the proof torque shall be achieved with no more than one-half turn of the anchor nut.
  - d. [For displacement-controlled mechanical anchors, proof of set is to be achieved by inserting the proper setting tool into the anchor and verifying that full set has been achieved.]

- e. The required proof torque load for torque-controlled mechanical anchors shall be as specified in the general notes of the structural drawings.
  - f. All anchors selected for proof testing shall be production anchors. Sacrificial anchors are not acceptable for inclusion in the proof testing plan unless specifically approved by the SER prior to performance of the testing.
  - g. Concrete cracking in the vicinity of the anchor during or after proof torque load application shall be considered a failure.
  - h. If more than **10%** of the tested mechanical anchors fail to achieve the specified proof torque load or set, **100%** of the anchors of the same diameter and type as the failed anchor shall be proof tested, unless otherwise direct in writing by the SER. Immediately notify the SER of all failed proof tests.
7. Periodic inspection for post-installed adhesive and mechanical anchors shall be provided in accordance with the building code except that continuous inspection shall be provided for the conditions identified in section A.4. The inspector shall observe all aspects of the anchor installation and shall, at a minimum, verify the following items:
- a. Hole drilling method in accordance with the Manufacturer's Published Installation Instructions (MPII) and these installation requirements.
  - b. Anchor spacing and edge distance.
  - c. Hole diameter and depth.
  - d. Hole cleaning in accordance with the MPII.
  - e. Anchor element type, material, diameter, and length.
  - f. For adhesive anchors, adhesive identification and expiration date.
  - g. For adhesive anchors, adhesive installation in accordance with the MPII.
  - h. For torque-controlled mechanical anchors, the number of turns required to achieve the anchor set torque per the MPII.
  - i. For displacement-controlled mechanical anchors, the proper setting tool is used to achieve the anchor set per the MPII.

### 3.4 CAST-IN-PLACE CONCRETE

A. Quality Assurance:

- 1. Monitor concrete placement as follows:
  - a. Verify use of required design mix
  - b. Record location of point of concrete discharge of each batch truck tested, cross referenced to grid lines.



- c. Record temperature of concrete at time of placement.
  - d. Record weather conditions at time of placement, including temperature, wind speed, relative humidity, and precipitation.
  - e. Record types and amounts of admixtures added to concrete at the project site.
  - f. Record amount of water added at the site and verify that total water content does not exceed amount specified in the mix design. Addition of water at the site is subject to prior approval by the Design Professional.
  - g. Monitor consistency and uniformity of concrete.
  - h. Monitor preparation for concreting operations, placement of concrete, and subsequent curing period for conformance with Specifications for following procedures:
    - 1) Concrete curing.
    - 2) Hot weather concreting operations.
    - 3) Cold weather concreting operations.
2. Conduct tests of concrete as follows and in accordance with ASTM C 1077:
- a. Testing frequency: Sample sets for all tests listed below of each concrete design mix placed each day shall be taken not less than once a day, nor less than once for each **50** cubic yards. (**40** cubic meters) of concrete, nor less than once for each **2500** square feet (500 [**250**] square meters) of surface area for slabs or walls. Additional tests shall be performed if deemed necessary by the Owner's Testing Agency and Design Professionals. In addition, sample each truckload used for columns, regardless of other frequencies listed above.
  - b. Obtain each test sample from different batches selected on a strictly random basis before commencement of concrete placement. Record location in structure of sampled concrete.
  - c. Determine air content of normalweight concrete in accordance with either ASTM C 231 or ASTM C 138. Determine air content of lightweight concrete in accordance with ASTM C 173. Conduct one test for air content for each strength test required or for every 50 cubic yards (40 cubic meters) of fly ash concrete placed, whichever is less.
  - d. Determine unit weight of lightweight concrete in accordance with ASTM C 567.
  - e. Test water content of freshly mixed concrete on a random basis, a minimum of once per 100 cubic yards (75 cubic meters) or every 5000 square feet (500 square meters) of concrete placement, during placement in accordance with AASHTO T 318 for the following concrete types:
    - 1) Hard troweled slabs exposed to view

- 2) Slab to receive a bonded finish floor material
  - 3) Slabs with specified concrete compressive strength exceeding 6000 psi (42MPa)
- f. Conduct slump tests in accordance with ASTM C 143.
- g. Slump indicated in mix designs shall be achieved at point of placement. Correlation between slump at point of initial discharge from truck and point of placement must be established to determine amount of slump loss which occurs between initial discharge and point of placement. Adjustment may be necessary to achieve slump indicated in mix designs at point of placement.
- h. Conduct slump tests for Self Consolidating Concrete (SCC) as follows
- 1) In accordance with ACI 237, where SCC is used, perform slump flow and visual stability index tests in accordance with ASTM C1611 on the first batch of SCC, and then consecutive batches until two consecutively produced batches are within specification. SCC with a visual stability index value of 2 or 3 shall be stabilized, where possible, with a viscosity modifying admixture or rejected at the discretion of the Engineer and Ready Mix Quality Control Representative. The Ready Mix Producer shall be responsible for adjusting the mix to provide desired flow and stability. After establishing the consistency of the SCC mix, testing shall continue in accordance with the requirements of the above paragraph.
  - 2) In accordance with ACI 237, where SCC is used, perform slump flow tests in accordance with ASTM C1621 using a J-ring to determine the passing ability of the SCC mix around reinforcement. If the reinforcing bars retain the coarse aggregates inside the ring, the mixture has a high potential for blocking and should be reportioned at the direction of the Engineer and Ready Mix Quality Control Representative.
- i. Conduct strength tests of concrete as follows:
- 1) Secure sample sets in accordance with ASTM C 172.
  - 2) Mold cylinders in accordance with ASTM C 31 and cure under standard moisture and temperature conditions in accordance with ASTM C 31, Section 7 (a). Quantity of cylinders listed below is based on a cylinder size of 4 inch (100mm) diameter x 8 inches (200mm) long. If 6 inch (150mm) diameter by 12 inch (300mm) long cylinders are used, the total quantity of cylinders may be reduced by one with two cylinders instead of three tested at the age designated for determination of  $f'_c$ .
  - 3) Test cylinders in accordance with ASTM C 39. For specified concrete strength of 10,000 psi (70MPa) and above, cylinders shall be ground and not capped.
  - 4) For 28 day mixes mold six cylinders. Test two cylinders at seven days and three cylinders at 28 days. The 28 day strength shall be the average of the three 28 day cylinders. One cylinder shall be retained in reserve for later testing if required.

- 5) For 56 day mixes mold seven cylinders. Test one cylinder at seven days, two cylinders at 28 days, and three cylinders at 56 days. The 56 day strength shall be the average of the three 56 day cylinders. One cylinder shall be retained in reserve for later testing if required.
  - 6) For 90 day mixes mold eight cylinders. Test one cylinder at seven days, one at cylinder at 28 days, two cylinders at 56 days, and three cylinders at 90 days. The 90 day strength shall be the average of the three 90 day cylinders. One cylinder shall be retained in reserve for later testing if required.
  - 7) When early age concrete strength verification is required by the Contractor for formwork removal or stressing of post-tensioning tendons, strength shall be verified, at the Contractor's expense, by additional compression tests of field-cured cylinders or by the maturity method in accordance with ASTM C1074.
  - 8) If one cylinder in a test manifests evidence of improper sampling, molding or other damage, discard cylinder and base test results on that of remaining cylinder.
3. Evaluate concrete for conformance with Specifications as follows:
- a. Slump:
    - 1) Maintain a slump moving average, comprised of the average of all batches or most recent five (5) batches tested, whichever is fewer.
  - b. Strength test:
    - 1) Maintain a compressive strength moving average, comprised of three (3) consecutive strength test results, for each mix design used in work.
    - 2) Strength level of concrete will be considered satisfactory provided averages of all sets of three (3) consecutive strength test results (i.e. moving average) equal or exceed specified 28-day strength, and no individual strength test result falls below specified 28-day strength by more than 500 psi (3.5MPa).
    - 3) If strength tests fail to meet minimum requirements, concrete represented by such tests shall be considered questionable and shall, if deemed appropriate by the SER, be subject to further evaluation by core testing as specified herein or other testing methods.
    - 4) Maintain a log that contains the results of all concrete strength tests. The log shall include the results of each test performed, be in electronic spreadsheet format, and updated and submitted along with concrete test data. See example log attached at the end of this Specification Section.
  - c. Conduct core tests on questionable concrete in accordance with ACI 318 and ASTM C 42.
    - 1) Location of cores shall be coordinated with Design Professionals so as to least impair strength of structure. Before testing cores, discard and replace

any that show evidence of having been damaged subsequent to or during removal from structure or which have reinforcement present.

- 2) Cores from structure exposed to soil or constant moisture in service (e.g. basement walls, retaining walls, slab-on-grade, piers, footings, etc.) shall be tested in a fully saturated condition. Cores for all other concrete may be tested dry. Prior to commencement of coring, verify with Design Professionals whether cores are to be tested wet or dry.
  - 3) Fill core holes with low slump concrete or mortar with a strength equal to or greater than that specified for area cored.
- d. Concrete in area represented by core test will be considered adequate if average strength of cores is equal to at least 85% of, and if no single core is less than 75% of specified strength.
4. Floor flatness and levelness tolerance compliance testing is to be performed within 72 hours of concrete placement by Testing Agency, and prior to the removal of shores and forms.
    - A. Testing Agency to test and report flatness ( $F_F$ ), levelness ( $F_L$ ) prior to shoring removal. For slabs that include camber, do not test for levelness ( $F_L$ ). Perform  $F_F/F_L$  testing in accordance with ASTM E 1155 requirements.

EXAMPLE CONCRETE STRENGTH SPREADSHEET LOG

PROJECT:  
 DATE:  
 ARCHITECT:  
 STRUCTURAL ENGINEER:

SPECIME N I.D.	TICKET NO.	PLACEMENT LOCATION	MIX I.D.	CURE TYPE*	DATE TESTED	AGE AT TEST (DAYS)	AVERAGE DIAMETER (IN)	AVERAGE CROSS-SECTIONAL AREA (IN <sup>2</sup> )	BREAKING LOAD (LB)	BREAK TYPE **	AVERAGE COMPRESSIVE STRENGTH (PSI)
S0002	1234	First Floor Slabs and Beams	H3651	I, CA, CB	3/8/2106	7	4	12.56	165990	Type 1	13210
						14					
						28					
						56					

\*FIELD CURING CONDITIONS: NCB=NO CURING BOX, CB=CURING BOX, I=INSULATED, CO=COOLED, HE=HEATED, CA=CAPPED, IC=ICED, O=OTHER  
 \*\*BREAK TYPES (AS CLASSIFIED BY ASTM C39):



### 3.5 CONCRETE MASONRY UNITS

#### A. Quality Assurance:

##### 1. Testing Requirements:

###### a. Mortar:

- 1) Testing Frequency: At the beginning of all masonry work take at least one test sample on three successive working days and at least one week intervals thereafter. Additional samples shall be taken whenever any change in materials or job conditions occur.
- 2) Test compressive strength and air content test in conformance with ASTM C780.

###### b. Grout: The following testing requirements are for grout proportions determined by specified compressive strength only:

- 1) Testing Frequency: Samples of grout shall be taken for each mix design, each day grout is placed, and not less than every 5,000 square feet (465 square meters) of masonry wall surface area or fraction thereof.
- 2) Test compressive strength in conformance with ASTM C1019.
- 3) For self-consolidating grout also perform slump flow and Visual Stability Index (VSI) in conformance with ASTM C1611.

###### c. Compressive strength of masonry ( $f'_m$ ), unit strength method:

- 1) Testing Frequency: Prior to masonry construction and for every 5,000 square feet (465 square meters) of masonry wall surface area or fraction thereof.
- 2) Sample and test units to verify conformance with ASTM C90.
- 3) Thickness of bed joints does not exceed 5/8" (15.9 mm)
- 4) Verify grout conforms to ASTM C476.

##### 2. Inspection Requirements:

###### a. Inspect and verify the following items periodically unless otherwise noted as continuous. Periodic inspections shall be random and unannounced and shall occur at least once per week. Where items are noted as continuous, inspections shall be performed whenever and wherever the work is being performed.

- 1) Compliance with approved submittals
- 2) At beginning of CMU construction, verify the following:
  - a) Proportions of site-prepared mortar.

- b) Construction of mortar joints.
  - c) Location of reinforcement and connectors.
  - d) Block unit size.
- 3) Prior to grouting, verify the following:
- a) Grout space.
  - b) Grade, type, and size of reinforcement and anchor bolts.
  - c) Placement of reinforcement and connectors.
  - d) Proportions of site-prepared grout.
  - e) Construction of mortar joints.
  - f) Bond pattern.
  - g) Tie-in at intersecting walls.
  - h) Condition of block units after placement.
  - i) Bond beam and/ or tie beam locations, reinforcement, and lap splice lengths.
- 4) During CMU construction, verify the following:
- a) Size and location of structural elements.
  - b) Type, size, and location of anchors and/or embedments, including other details of connection of masonry to structural members, frames, or other construction.
  - c) Welding of reinforcement (continuously inspect).
  - d) Preparation, construction, and protection of masonry during cold weather or hot weather. For cold and hot weather requirements see Section 042200.
  - e) Placement of grout (continuously inspect).
  - f) Lintel size, location, and bearing lengths.
- 5) Observe preparation of grout specimens, mortar specimens, and/or prisms.
- b. Inspections will also include verification that:
- 1) Materials are properly stored.
  - 2) Installation is within specified construction tolerances.

- 3) Proper mortar ingredients and mixing techniques are being used.
- 4) Mortar time on board is within specified limits.
- 5) Joints are being properly tooled.
- 6) Flashing assembly is being properly fabricated and installed.
- 7) Weeps and vents are being installed and are functional.
- 8) Control joints are being installed as indicated, or, as specified.

### 3.6 STRUCTURAL STEEL

#### A. Quality Assurance:

1. Shop inspection shall include alignment and straightness of members, camber, preparation for connections, dimensional checks, testing of shop bolts, witnessing of welding procedures, testing of cuts, weld access holes and copes of Heavy Sections as defined in this Specification, examination and testing of completed welds, headed studs and deformed bar anchors, cutting of Heavy Sections, finishing of column ends, cleaning, painting and storage of material. All shop fabrication shall be inspected in the shop. Camber shall be verified in a minimum of 10% of all members requiring camber. If, in the opinion of the SER and Testing Agency this testing discloses a large ratio (10% or more) of unacceptable cambers, the required percentage of tested cambers may be increased by the SER to 100% at no expense to the Owner. Where testing is required for less than 100% of locations, select test locations at random and throughout the project.
2. Field inspection shall include connections, proper tensioning of bolts, levelness, plumbness and alignment of the frame, conformance to AWS welding methods, examination of surface before welding, examination and testing of completed welds, headed studs and deformed bar anchors and field painting, including touch-up. Where testing is required for less than 100% of locations, select test locations at random and throughout the project.
3. Review the following items in the shop and field:
  - a. Welding certificates, procedures, and personnel
  - b. Stud welding setup and operators; bolting procedure and crew
  - c. Bolting procedure and crew
  - d. Visually inspect seam welds of tube and pipe for evidence of cracking or lack of fusion. At each end piece of tube or pipe, inspect interior face of seam weld for evidence of cracking, lack of fusion, or less than full flashing.
  - e. Mill certifications for compliance with the Contract Documents.
4. Inspect high strength bolted construction in accordance with RCSC "Specification for Structural Joints using ASTM A 325 or A 490 Bolts," including but not limited to:



- a. Surface preparation and bolt type conforms to plans and Specifications prior to start of bolting operations.
  - b. Proper bolt storage and handling procedures per codes and standards referenced by this Specification are being followed.
  - c. Visually inspect all bolted connections.
  - d. For all bolted connections that are indicated as snug tight, connections are properly compacted and brought to the snug tight condition progressing outward from the most rigid part.
  - e. For all bolted connections that are indicated as pretensioned or slip critical, pre-installation verification testing is performed by the inspector in cooperation with the contractor in accordance with RCSC section 9.2 and section 7.
  - f. For all bolted connections that are indicated as pretensioned or slip critical, through routine observation, as defined in RCSC 9.2.1, 9.2.3 or 9.2.4, that the pretensioning methods of RCSC 8.2.1, 8.2.3, or 8.2.4, as appropriate, are performed.
    - 1) "Routine observation" is defined as observation of 10 bolts for every 100 bolts with a minimum of 2 bolts per connection.
  - g. Retest bolted connections that fail initial inspection after correction by the Fabricator or Erector.
5. Test and inspect welding and welded construction including but not limited to:
- a. Review of submittals:
    - 1) Review all Welding Procedures prepared by the Contractor's Engineer or Certified Welding Engineer. Verify the accuracy of all essential variables of the Welding Procedure including but not limited to confirmation that weldability and heat induction for Heavy Sections and high restraint welds comply with AWS requirements.
    - 2) Review of welding procedures including prequalification, qualifications test and, for Heavy Sections and High Restraint Welds, the welding procedure prepared by the Contractor's Engineer or Welding Consultant
    - 3) Submit for record a report indicating that the Welding Procedures have been reviewed as indicated above to the Design Professionals.
  - b. Test all complete joint penetration welds for soundness by means of either radiographic or ultrasonic testing in accordance with AWS D1.1 and ASTM E164 procedures. All flaws in plate or flange material revealed during such tests shall be repaired and retested by the Contractor at the Contractor's expense.
  - c. Test all partial joint penetration welds for soundness by means of visual and magnetic particle inspection, unless other methods are specified in the Contract Documents. All flaws in plate or flange material revealed during such tests shall be repaired and retested by the Contractor at the Contractor's expense.

- d. Testing of welds at Heavy Sections and High Restraint Welds shall be performed not less than 48 hours after the weld has been completed.
  - e. Visually inspect all fillet welds. In addition test ten percent (10%) of all fillet welds using a non-destructive method, such as dye penetrant or magnetic particle. Select test locations randomly throughout the structure, but test at least one weld in each location with 6 or more welds per connection. If, in the opinion of the SER and Testing Agency this testing discloses a large ratio (10% or more) of unacceptable welds, the required percentage of tested welds may be increased by the SER to 100%, all at the Contractor's expense.
  - f. Inspection and Testing by the Testing Agency of High Restraint Welds and where Heavy Sections are to be joined by partial or complete joint penetration welds in tension:
    - 1) Joint Preparation: Monitor fit up and joint preparation (bevel angle, etc.) for conformance to the submitted welding procedures including preheat and interpass temperature. Monitor base metal temperature during welding operations.
    - 2) Test Complete Joint Penetration Welds in accordance to the requirements of this Specification section, ultrasonically in accordance with AWS D1.1 procedures. On T or corner joints, pay careful attention to the heat affected zone and base metal where the weld shrinkage stresses are in the through thickness direction.
    - 3) Test Partial Joint Penetration Butt Joints in accordance with this Specification section by the magnetic particle method. At T or corner joints, in addition to the magnetic particle testing, ultrasonically scan the heat affected zone and adjacent base metal from face "C" per AWS D1.1 Table 6.7 and Annex Q7 to detect lamellar tears and shall be done with a compression wave. The Testing Agency shall submit a testing procedure that includes evaluation (acceptance criterion) procedures to the Design Professionals for review.
  - g. At Heavy Sections and High Restraint Welds: provide pre-production sample testing of heat treatment, observe fabrication, welding and heat treatment of the samples for conformance with submitted welding procedures. Establish locations of testing coupons following AWS procedures. Test coupons following AWS procedures to verify satisfactory results using the welding procedure and heat treatment.
6. Visually inspect all headed studs and deformed bar anchors for complete fusion and full 360-degree weld flash (or fillet).
- a. Check all studs with incomplete fusion, and at random five studs at each of six beams per floor, by bending to an angle of 15 degrees from its original axis (away from any missing flash). If more than twenty percent of studs fail on one member, check all studs on member. In addition, for each member with any defective studs, test an additional member.
  - b. Contractor to replace any studs that crack or break. Contractor to only straighten studs that would foul other work or have less than 1 inch (25mm) cover in bent position.

7. Cleaning & Painting:
  - a. Examine shop painting to verify conformance with this Specification.
  - b. Examine loading and unloading of steel to visually observe that damage does not occur during shipping and handling.

Table 1-1: Nondestructive Testing (NDT) Requirements

Weld Category	Nondestructive Testing Requirements	
	Complete-Joint-Penetration Welds <sup>1</sup>	Partial-Joint-Penetration Welds and Fillet Welds
SFRS welds not described below	MT 25% of joints, full length <sup>2</sup> and UT 100% of joints, full length <sup>2</sup>	MT 25% of fillet welds, 6" length at random <sup>2</sup>  MT 100% of partial-joint penetration welds <sup>2</sup>
Top-flange joints at cantilever beam connections <sup>3</sup> Splices in beam flanges	MT 100% of joints, full length and UT 100% of joints, full length	MT 100% of joints, full length
Demand Critical Welds; Butt joints in SFRS column splices	MT 100% of joints, full length <sup>2</sup> and UT 100% of joints, full length <sup>2</sup>	MT 100% of joints, full length <sup>2</sup>

Notes:

1. UT is required only when the weld thickness is  $\frac{5}{16}$ " or greater.
2. Reduction of the rate of UT and MT testing per AISC 341 Section J6, items (2g) and (2h) is permissible if approved by SER.
3. Test joint on each side of cantilever beam or column support.

### 3.7 STEEL DECK

A. Quality Assurance:

1. Decking is subject to inspection and testing once connected in place:
  - a. Expense of removing and replacing any portion of decking for testing purposes will be borne by the Owner if connections are found to be satisfactory.
  - b. Contractor shall remove work found to be defective and provide acceptable work at no additional cost to the Owner.
2. Field inspect all steel deck after erection for the following:
  - a. Proper deck profile, type (acoustic, cellular, vented), gage and finish
  - b. Correct deck orientation, alignment, bearing and laps (if applicable)
  - c. Supplementary items including secondary supports, closures, pour stops, sumps and their connections to deck and to other members
  - d. Damage of members during transportation, storage and erection
  - e. Proper installation and erection
  - f. Proper deck to supporting member and deck to deck connections (quantity, size, spacing and quality of welds/fasteners) including inspection of deck welding
3. Field inspect headed studs (shear connectors) as follows:
  - a. At the start of each day's operations for welding headed studs, the Contractor shall first weld a minimum of two studs to demonstrate proper welding set up for that day's typical deck and support conditions. Testing Agency to observe Contractor hammer-bending the studs to an angle 15 degrees from the vertical without weld failure.
  - b. Should failure occur in the weld zone of either stud, Contractor shall adjust welding set up and repeat the test until two consecutive studs are, tested and found satisfactory before any production welding of studs may begin.
  - c. Perform demonstration tests at each significant change in conditions including deck thickness, deck coating (painted to galvanized) or number of deck layers.
  - d. Do not weld studs through more than one layer of steel deck, except where cellular deck is specified.
  - e. Failed test studs shall be removed and replaced by production studs.
  - f. During production installation, bend testing of headed studs is required where incomplete weld flash is observed, and at random locations on each floor. For production testing requirements see Section 051200.

### 3.8 FOOTINGS

- A. Quality Assurance by Geotechnical Engineer (or Testing Agency if the same entity):
1. Review Contractor's proposed footing installation methods, sequences, and procedures.
  2. Verify bearing stratum and bearing capacity of each footing; verify levelness of footing end bearing surface.
  3. Determine final bearing elevation at each footing location.
  4. Observe, record, and report footing as-built plan location, footing size and final elevations of bottom (where possible) and top of completed footings.
  5. Coordinate with Testing Agency.
- B. Quality Assurance by Testing Agency:
1. Inspection of Batch Plant: As required to ensure that concrete delivered to job complies with Specifications and design mix. Batch plant inspection shall be required once at start of job and thereafter if concrete falls below Specifications.
  2. Inspection of Reinforcement: Provide continuous visual inspection of site fabrication. Record the steel reinforcement bar sizes, grade, length, and number of bars.
  3. Inspection of Concrete and Reinforcement Placement: Provide continuous visual inspection of installation of reinforcement and concrete placement including verification of laitance removal at top of footings.
  4. Check ready mix delivery tickets for correct concrete mix design number. Record batch to placement time. Check slump, temperature, and batch to placement time for each set
  5. Slump Tests: ASTM C143. Make one test from each truck.
  6. Concrete Compressive Strength Tests: Testing agency will take a minimum of one sample set of concrete cylinders per 20 cubic yards of concrete. See CAST-IN-PLACE CONCRETE section of this specification for requirements. Cure cylinders to simulate same curing conditions as concrete in footings. Reports of cylinder tests shall state footing location(s), laboratory or site curing, compression strength, type of fracture, age at testing, concrete supplier, mix specification strength, any other pertinent information, test results, and conclusions.
  7. Additional Tests: Perform additional testing if, in the opinion of the Design Professionals, concrete of poor quality has been placed based on cylinder strengths below Specification requirements or visual defects. Tests may be compression tests on cored cylinders, ASTM C42, and load tests as outlined in ACI 318, or as directed by the Design Professionals. Complete continuous coring of footings will be required, at Contractor's expense, where verification of quality of concrete is not otherwise attainable.

LEVEL B REQUIRED VERIFICATION AND INSPECTION OF MASONRY CONSTRUCTION					
INSPECTION TASK		FREQUENCY <sup>(a)</sup>		REFERENCE FOR CRITERIA	
		CONTINUOUS	PERIODIC	TMS 402/ACI 530 /ASCE 5	TMS 602/ACI 530.1 /ASCE 6
1. VERIFY COMPLIANCE WITH THE APPROVED SUBMITTALS.		—	X	—	ART. 1.5
2. AS MASONRY CONSTRUCTION BEGINS, THE FOLLOWING ARE IN COMPLIANCE:					
A.	PROPORTIONS OF SITE-PREPARED MORTAR	—	X	—	ART. 2.1, 2.6A
B.	CONSTRUCTION OF MORTAR JOINTS	—	X	—	ART. 3.3B
C.	GRADE AND SIZE OF PRESTRESSING TENDONS AND ANCHORAGES	—	X	—	ART. 2.4B, 2.4H
D.	LOCATION OF REINFORCEMENT, CONNECTORS, AND PRESTRESSING TENDONS AND ANCHORAGES	—	X	—	ART. 3.4, 3.6A
E.	PRESTRESSING TECHNIQUE	—	X	—	ART. 3.6B
F.	PROPERTIES OF THIN-BED MORTAR FOR AAC MASONRY	X <sup>(b)</sup>	X <sup>(c)</sup>	—	ART. 2.1C
3. PRIOR TO GROUTING, VERIFY THAT THE FOLLOWING ARE IN COMPLIANCE:					
A.	GROUT SPACE	—	X	—	ART. 3.2D, 3.2F
B.	GRADE, TYPE, AND SIZE OF REINFORCEMENT AND ANCHOR BOLTS, AND PRESTRESSING TENDONS AND ANCHORAGES	—	X	SEC. 1.16	ART. 2.4, 3.4
C.	PLACEMENT OF REINFORCEMENT, CONNECTORS, PRESTRESSING TENDONS AND ANCHORAGES	—	X	SEC. 1.16	ART. 3.2E, 3.4, 3.6A
D.	PROPORTION OF SITE-PREPARED GROUT AND PRESTRESSING GROUT FOR BONDED TENDONS	—	X	—	ART. 2.6B, 2.4G.1.B
E.	CONSTRUCTION OF MORTAR JOINTS	—	X	—	ART. 3.3B
4. VERIFY DURING CONSTRUCTION:					
A.	SIZE AND LOCATION OF STRUCTURAL ELEMENTS	—	X	—	ART. 3.3F
B.	TYPE, SIZE AND LOCATION OF ANCHORS, INCLUDING OTHER DETAILS OF ANCHORAGE OF MASONRY TO STRUCTURAL MEMBERS, FRAMES OR OTHER CONSTRUCTION.	—	X	SEC. 1.16.4.3, 1.17.1	—
C.	WELDING OF REINFORCEMENT	X	—	SEC. 2.1.7.7.2, 3.3.3.4(c), 8.3.3.4 (b)	—
D.	PREPARATION, CONSTRUCTION AND PROTECTION OF MASONRY DURING COLD WEATHER (TEMPERATURE BELOW 40°F (4.4°C)) OR HOT WEATHER (TEMPERATURE ABOVE 90°F (32.2°C)).	—	X	—	ART. 1.8C, 1.8D
E.	APPLICATION AND MEASUREMENT OF PRESTRESSING FORCE.	X	—	—	ART. 3.6B
F.	PLACEMENT OF GROUT AND PRESTRESSING GROUT FOR BONDED TENDONS IS IN COMPLIANCE	X	—	—	ART.3.5, 3.6C
G.	PLACEMENT OF AAC MASONRY UNITS AND CONSTRUCTION OF THIN-BED MORTAR JOINTS	X <sup>(b)</sup>	X <sup>(c)</sup>	—	ART. 3.3B.8
5. OBSERVE PREPARATION OF GROUT SPECIMENS, MORTAR SPECIMENS, AND/OR PRISMS		—	X	—	ART. 1.4B.2.A.3, 1.4B.2.B.3, 1.4B.2.C.3, 1.4B.3, 1.4B.4

(a) FREQUENCY REFERS TO THE FREQUENCY OF INSPECTION, WHICH MAY BE CONTINUOUS DURING THE TASK LISTED OR PERIODICALLY DURING THE LISTED TASK, AS DEFINED IN THE TABLE.

(b) REQUIRED FOR THE FIRST 5000 SQUARE FEET (465 SQUARE METERS) OF AAC MASONRY.

(c) REQUIRED AFTER THE FIRST 5000 SQUARE FEET (465 SQUARE METERS) OF AAC MASONRY.

REQUIRED VERIFICATION AND INSPECTION OF CONCRETE CONSTRUCTION				
VERIFICATION AND INSPECTION	CONTINUOUS	PERIODIC	REFERENCED STANDARD	CBC REFERENCE
1. INSPECTION OF REINFORCING STEEL, INCLUDING PRESTRESSING TENDONS, AND PLACEMENT.	—	X	ACI 318: 3.5, 7.1-7.7	1910.4
2. INSPECTION OF REINFORCING STEEL WELDING IN ACCORDANCE WITH TABLE 1705.2.2, ITEM 2B.	—	—	AWS D1.4, ACI 318: 3.5.2	—
3. INSPECTION OF ANCHORS CAST IN CONCRETE WHERE ALLOWABLE LOADS HAVE BEEN INCREASED OR WHERE STRENGTH DESIGN HAS BEEN USED.	—	X	ACI 318: 8.1.3, 21.2.8	1908.5, 1909.1
4. INSPECTION OF ANCHORS POST-INSTALLED IN HARDENED CONCRETE MEMBERS.	—	X	ACI 318: 3.8.6, 8.1.3, 21.2.8	1909.1
5. VERIFYING USE OF REQUIRED DESIGN MIX.	—	X	ACI 318: Ch. 4, 5.2-5.4	1904.2, 1910.2, 1910.3
6. AT THE TIME FRESH CONCRETE IS SAMPLED TO FABRICATE SPECIMENS FOR STRENGTH TESTS, PERFORM SLUMP AND AIR CONTENT TESTS, AND DETERMINE THE TEMPERATURE OF THE CONCRETE.	X	—	ASTM C 172, ASTM C 31, ACI 318: 5.6, 5.8	1910.10
7. INSPECTION OF CONCRETE AND SHOTCRETE PLACEMENT FOR PROPER APPLICATION TECHNIQUES.	X	—	ACI 318: 5.9, 5.10	1910.6, 1910.7 1910.8
8. INSPECTION FOR MAINTENANCE OF SPECIFIED CURING TEMPERATURE AND TECHNIQUES.	—	X	ACI 318: 5.11-5.13	1910.9
9. INSPECTION OF PRESTRESSED CONCRETE:				
A. APPLICATION OF PRESTRESSING FORCES.	X	—	ACI 318: 18.20 ACI 318:18.18.4	—
B. GROUTING OF BONDED PRESTRESSING TENDONS IN THE SEISMIC-FORCE-RESISTING SYSTEM.	X	—		
10. ERECTION OF PRECAST CONCRETE MEMBERS.	—	X	ACI 318: CH.16	—
11. VERIFICATION OF IN-SITU CONCRETE STRENGTH, PRIOR TO STRESSING OF TENDONS IN POST-TENSIONED CONCRETE AND PRIOR TO REMOVAL OF SHORES AND FORMS FROM BEAMS AND STRUCTURAL SLABS.	—	X	ACI 318: 6.2	—
12. INSPECT FORMWORK FOR SHAPE, LOCATION AND DIMENSIONS OF THE CONCRETE MEMBER BEING FORMED.	—	X	ACI 318: 6.1.1	—



REQUIRED VERIFICATION AND INSPECTION OF STEEL CONSTRUCTION					
VERIFICATION AND INSPECTION		CONTINUOUS	PERIODIC	REFERENCED STANDARD	CBC REFERENCE
<b>1. MATERIAL VERIFICATION OF HIGH-STRENGTH BOLTS, NUTS AND WASHERS:</b>					
A.	IDENTIFICATION MARKINGS TO CONFORM TO ASTM STANDARDS SPECIFIED IN THE APPROVED CONSTRUCTION DOCUMENTS.	—	X	AISC 360, SECTION A3.3 AND APPLICABLE ASTM MATERIAL STANDARDS	—
B.	MANUFACTURER'S CERTIFICATE OF COMPLIANCE REQUIRED.	—	X	—	—
<b>2. INSPECTION OF HIGH-STRENGTH BOLTING:</b>					
A.	SNUG-TIGHT JOINTS	—	X	AISC 360, SECTION M2.5	—
B.	SLIP-CRITICAL CONNECTIONS.	X	X		
C.	PRETENSIONED AND SLIP-CRITICAL JOINTS USING TURN-OF-NUT WITH MATCHMARKING, TWIST-OFF BOLT OR DIRECT TENSION INDICATOR METHODS OF INSTALLATION.	X	—		
<b>3. MATERIAL VERIFICATION OF STRUCTURAL STEEL AND COLD-FORMED STEEL DECK:</b>					
A.	FOR STRUCTURAL STEEL, IDENTIFICATION MARKINGS TO CONFORM TO AISC 360.	—	X	AISC 360, SECTION A3.1H	2203.1
B.	FOR OTHER STEEL, IDENTIFICATION MARKINGS TO CONFORM TO ASTM STANDARDS SPECIFIED IN THE APPROVED CONSTRUCTION DOCUMENTS.	—	X	APPLICABLE ASTM MATERIAL STANDARDS	—
C.	MANUFACTURER'S CERTIFIED MILL TEST REPORTS.	—	—	ASTM A 6 OR ASTM A 568	—
<b>4. MATERIAL VERIFICATION OF WELD FILLER MATERIALS:</b>					
A.	IDENTIFICATION MARKINGS TO CONFORM TO AWS SPECIFICATION IN THE APPROVED CONSTRUCTION DOCUMENTS.	—	—	AISC 360, SECTION A3.5 AND APPLICABLE AWS A5 DOCUMENTS	—
B.	MANUFACTURER'S CERTIFICATE OF COMPLIANCE REQUIRED.	—	X	—	—
<b>5. INSPECTION OF WELDING:</b>					
A.	STRUCTURAL STEEL AND COLD-FORMED STEEL DECK:	—	—	AWS D1.1	1705.2.1
1.	COMPLETE AND PARTIAL PENETRATION GROOVE WELDS.	X	—		
2.	MULTIPASS FILLET WELDS.	X	—		
3.	SINGLE-PASS FILLET WELDS > 5/16"	X	—		
4.	PLUG AND SLOT WELDS.	X	—		
5.	SINGLE-PASS FILLET WELDS ≤ 5/16"	—	X		
6.	FLOOR AND ROOF DECK WELDS.	—	X		
B.	REINFORCING STEEL:	—	—	AWS D1.4, ACI 318: 3.5.2	—
1.	VERIFICATION OF WELDABILITY OF REINFORCING STEEL OTHER THAN ASTM A 706.	—	X		
2.	REINFORCING STEEL-RESISTING FLEXURAL AND AXIAL FORCES IN INTERMEDIATE AND SPECIAL MOMENT FRAMES, AND BOUNDARY ELEMENTS OF SPECIAL REINFORCED CONCRETE SHEAR WALLS AND SHEAR REINFORCEMENT.	X	—		
3.	SHEAR REINFORCEMENT.	X	—		
4.	OTHER REINFORCING STEEL.	—	X		
<b>6. INSPECTION OF STEEL FRAME JOINT DETAILS FOR COMPLIANCE WITH APPROVED CONSTRUCTION DOCUMENTS:</b>					
	DETAILS SUCH AS BRACING AND STIFFENING.	—	X	—	1705.2.1
B.	MEMBER LOCATIONS.	—	X		
C.	APPLICATION OF JOINT DETAILS AT EACH CONNECTION.	—	X		

REQUIRED VERIFICATION AND INSPECTION OF SOILS		
VERIFICATION AND INSPECTION TASK	CONTINUOUS DURING TASK LISTED	PERIODICALLY DURING TASK LISTED
1. VERIFY MATERIALS BELOW SHALLOW FOUNDATIONS ARE ADEQUATE TO ACHIEVE THE DESIGN BEARING CAPACITY.	—	X
2. VERIFY EXCAVATIONS ARE EXTENDED TO PROPER DEPTH AND HAVE REACHED PROPER MATERIAL.	—	X
3. PERFORM CLASSIFICATION AND TESTING OF COMPACTED FILL MATERIALS.	—	X
4. VERIFY USE OF PROPER MATERIALS, DENSITIES AND LIFT THICKNESSES DURING PLACEMENT AND COMPACTION OF COMPACTED FILL.	X	—
5. PRIOR TO PLACEMENT OF CONTROLLED FILL, OBSERVE SUBGRADE AND VERIFY THAT SITE HAS BEEN PREPARED PROPERLY.	—	X

REQUIRED VERIFICATION OF STEEL CONSTRUCTION OTHER THAN STRUCTURAL STEEL				
VERIFICATION AND INSPECTION TASK		CONTINUOUS	PERIODIC	REFERENCED STANDARD
1. MATERIAL VERIFICATION OF COLD-FORMED STEEL DECK:				
A	IDENTIFICATION MARKINGS TO CONFORM TO ASTM STANDARDS SPECIFIED IN THE APPROVED CONSTRUCTION DOCUMENTS	—	X	APPLICABLE ASTM MATERIAL
B	MANUFACTURER'S CERTIFIED TEST REPORTS	—	X	STANDARDS
2. INSPECTION OF WELDING:				
A	COLD-FORMED STEEL DECK:			
B	1. FLOOR AND ROOF DECK WELDS	—	X	AWS D1.3
	REINFORCING STEEL:			
B	1. VERIFICATION OF WELDABILITY OF REINFORCING STEEL OTHER THAN ASTM A706	—	X	AWS D1.4, ACI 318: CBC SECTION 3.5.2
	2. REINFORCING STEEL RESISTING FLEXURAL AND AXIAL FORCES IN INTERMEDIATE AND SPECIAL MOMENT FRAMES, AND BOUNDARY ELEMENTS OF SPECIAL STRUCTURAL WALLS OF CONCRETE AND SHEAR REINFORCEMENT	X	—	
	3. SHEAR REINFORCEMENT	X	—	
	4. OTHER REINFORCING STEEL	—	X	

REQUIRED VERIFICATION – EARTH MOVING				
VERIFICATION AND INSPECTION TASK		CONTINUOUS	PERIODIC	REFERENCED STANDARD
1	Refer to specification section 31 20 00 - 3.14 Field Quality Control. Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections. Contractor will be responsible for coordinating and scheduling inspection.			
B.	Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.		X	
C.	Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Geotechnical Engineer.		X	
D.	Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 6938, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:		X	
1	Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.		X	ASTM D 1556, ASTM D 2167, ASTM D 6938, and ASTM D 2937
2	Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.		X	
3	Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.		X	

REQUIRED VERIFICATION – ASPHALT PAVING				
VERIFICATION AND INSPECTION TASK		CONTINUOUS	PERIODIC	REFERENCED STANDARD
1	Refer to specification section 32 12 16 - 3.8 Field Quality Control. Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections. Contractor will be responsible for coordinating and scheduling inspection.			
B.	Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.		X	ASTM D 3549
C.	Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.		X	
D.	Asphalt Traffic-Calming Devices: Finished height of traffic-calming devices above pavement will be measured for compliance with tolerances.		X	
E.	In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.		X	ASTM D 979 or AASHTO T 168
1	Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.		X	ASTM D 2041
	In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.		X	ASTM D 1188 or ASTM D 2726
	a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than three cores taken.		X	
	b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.		X	ASTM D 2950, ASTM D 1188, ASTM D 2726

REQUIRED VERIFICATION – CONCRETE PAVING				
VERIFICATION AND INSPECTION TASK		CONTINUOUS	PERIODIC	REFERENCED STANDARD
A.	Refer to specification section 32 13 13 - 3.12 Field Quality Control. Tests: Owner will retain the services of an engineering inspection and testing firm. Contractor will be responsible for coordinating and scheduling inspection. Tests will include the following: strength, air entrainment, temperature, and slump tests. Test results will be specified to be sent directly to the Contractor, Engineer and Owner's representative.			
1	Testing agency shall perform sampling and testing of concrete specified in ACI 301 Sections 16.3, 16.4, and as follows:		X	ACI 301 Sections 16.3, 16.4
a.	Test data from concrete cylinder breaks will be evaluated using procedures of the American Concrete Institute (latest edition of ACI 214) to determine if the compressive strength of the concrete tested is acceptable.		X	ACI 214
b.	Concrete will be tested at the minimum rate of one test for the first 25 cubic yards [CY] placed each day, and one test for each additional 50 CY placed. Concrete may be tested more often at the discretion of the Owner's Representative.		X	
1)	One additional set of test cylinders will be taken during cold weather, and as directed by Engineer, cured at Project Site under same conditions as concrete it represents.		X	
c.	Slump, ASTM C143: 1 per each set of compressive cylinders.		X	ASTM C143
d.	Air content, ASTM C173: 1 per every 50 cubic yards, or portion thereof.		X	ASTM C173
e.	Unit weight, ASTM C138: 1 per every 50 cubic yards, or portion thereof.		X	ASTM C138
f.	Concrete temperature, ASTM C1064: 1 measurement for every slump test.		X	ASTM C1064
g.	Casting of compressive cylinders, ASTM C39: 1 set of 4 cylinders for every 50 cubic yards, or portion thereof.		X	ASTM C39

REQUIRED VERIFICATION – SEGMENTAL RETAINING WALLS				
VERIFICATION AND INSPECTION TASK		CONTINUOUS	PERIODIC	REFERENCED STANDARD
1	Refer to specification section 32 32 23 - 3.10 Field Quality Control. The Owner will retain an engineering inspection and testing firm for the following tests:		X	
a.	One test for every 2 feet (vertical) of fill placed and compacted, for every 50 lineal feet of retaining wall.		X	
b.	Vary compaction test locations to cover the entire area of the reinforced soil zone, including the area compacted by the hand-operated compaction equipment.		X	

REQUIRED VERIFICATION OF ARCHITECTURAL COMPONENTS				
VERIFICATION AND INSPECTION TASK		CONTINUOUS	PERIODIC	REFERENCED STANDARD
1. TESTING OF UNIT MASONRY MATERIALS				
A.	CONCRETE MASONRY UNITS	—	X	ASTM C 140
B.	MORTAR AGGREGATE RATIO	—	X	ASTM C 780
C.	MORTAR AIR CONTENT AND COMPRESSIVE STRENGTH	—	X	ASTM C 780
D.	GROUT COMPRESSIVE STRENGTH	—	X	ASTM C 1019
2. TESTING OF COLD-FORMED METAL FRAMING				
A.	FIELD AND SHOP WELDS	—	X	—
3. TESTING OF DECORATIVE METAL RAILINGS				
A.	RAILING ASSEMBLIES PERFORMANCE FOR EACH DIFFERENT TYPE OF RAIL	—	X	ASTM E 894 & ASTM E 935
4. INSPECTION SELF-ADHERING SHEET WATERPROOFING				
A.	SUBSTRATE CONDITIONS, SURFACE PREPARATION, MEMBRANE APPLICATION, FLASHINGS, PROTECTION, DRAINAGE COMPONENTS	—	X	—
5. TESTING AND INSPECTION FLUID-APPLIED MEMBRANE AIR BARRIERS				
A.	AIR-LEAKAGE-LOCATION TESTING	—	X	ASTM E 1186
B.	AIR-LEAKAGE-VOLUME TESTING	—	X	ASTM E 783
C.	ADHESION TESTING	—	X	ASTM D 4541
D.	CONTINUITY OF AIR-BARRIER SYSTEM (NO GAPS OR HOLES)	—	X	—
E.	AIR-BARRIER WET FILM THICKNESS	—	X	—
F.	CONTINUOUS STRUCTURAL SUPPORT OF AIR-BARRIER	—	X	—
G.	MASONRY AND CONCRETE SURFACES ARE SMOOTH, CLEAN, FREE OF CAVITIES, PROTRUSIONS AND MORTAR DROPPINGS.	—	X	—
H.	SITE CONDITIONS FOR APPLICATION	—	X	—
I.	MAXIMUM EXPOSURE TIME OF MATERIALS TO UV DETERIORATION	—	X	—
J.	STRIPS AND TRANSITION STRIPS LAP AND ADHERENCE TO SUBSTRATE	—	X	—
K.	COMPATIBLE MATERIALS HAVE BEEN USED	—	X	—
L.	TERMINATION OF MASTIC, TRANSITIONS AT CHANGE IN DIRECTION, CONNECTIONS BETWEEN ASSEMBLIES, AND SEALING OF PENETRATIONS	—	X	—
6. TESTING AND INSPECTION STANDING SEAM METAL ROOF PANELS				
A.	ROOF PANEL INSTALLATION INCLUDING ACCESSORIES	—	X	—
7. TESTING AND INSPECTION INSULATED METAL WALL PANELS				
A.	WATER-SPRAY TEST OF ASSEMBLY	—	X	AAMA 501.2
B.	METAL WALL PANEL INSTALLATION INCLUDING ACCESSORIES	—	X	—
8. TESTING AND INSPECTION POLYVINYL-CHLORIDE (PVC) ROOFING				
A.	LOW-VOLTAGE ELECTRICAL CONDUCTANCE	—	X	—
B.	FINAL ROOF INSPECTION	—	X	—
9. TESTING AND INSPECTION PENETRATION FIRESTOPPING				
A.	PENETRATION FIRESTOPPING SYSTEM COMPLIANCE	—	X	ASTM E 2174
10. TESTING AND INSPECTION JOINT FIRESTOPPING				
A.	JOINT FIRESTOPPING SYSTEM COMPLIANCE	—	X	ASTM E 2393

11. TESTING AND INSPECTION JOINT SEALANTS				
A.	JOINT SEALANT ADHESION TO SUBSTRATE	—	X	ASTM C 1193 METHOD A, APPENDIX X1 OR ASTM C 1521 METHOD A
B.	SEALANT JOINT CAVITIES FREE OF VOIDS, JOINT DIMENSIONS AND CONFIGURATION COMPLIANCE,	—	X	—
12. INSPECTION HANGAR DOORS				
A.	HANGAR DOOR AND COMPONENTS ASSEMBLY, INSTALLATION	—	X	—
13. TESTING AND INSPECTION ALUMINUM-FRAMED ENTRANCE AND STOREFRONTS				
A.	WATER-SPRAY TEST OF ASSEMBLY	—	X	AAMA 501.2
B.	STRUCTURAL SEALANT ADHESION	—	X	ASTM C 1401, METHOD A, APPENDIX X2
14. TESTING AND INSPECTION GLAZED ALUMINUM CURTAIN WALLS				
A.	WATER-SPRAY TEST OF ASSEMBLY	—	X	AAMA 501.2
B.	AIR INFILTRATION	—	X	ASTM E 783
15. TESTING AND INSPECTION STRUCTURED-POLYCARBONATE PANEL ASSEMBLIES				
A.	WATER-SPRAY TEST OF ASSEMBLY	—	X	AAMA 501.2
16. INSPECTION STATIC-CONTROL RESILIENT FLOORING				
A.	FULLY CURED AND STABILIZATION TO AMBIENT CONDITIONS	—	X	—
17. INSPECTION EXTERIOR PAINTING				
A.	DRY FILM THICKNESS	—	X	—
18. INSPECTION INTERIOR PAINTING				
A.	DRY FILM THICKNESS	—	X	—

END OF SECTION

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## SECTION 07 72 53 - SNOW GUARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Rail-type, seam-mounted snow guards.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for snow guards.
- B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.
  - 1. Include calculation of number and location of snow guards based on snow load, roof slope, roof type, components, spacings, and finish.
- C. Samples: Base, bracket, and 12-inch-long rails, in color and finish indicated.
  - 1. Submit samples with metal roofing sample submittal for color approval.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of snow guard, for tests performed by manufacturer and witnessed by a qualified testing agency.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Structural Performance:
  - 1. Snow Loads: As indicated on Drawings.

## 2.2 RAIL-TYPE SNOW GUARDS

### A. Seam-Mounted Rail-Type Snow Guard:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Alpine SnowGuards; a division of Vermont Slate & Copper Services, Inc.
    - 1) Basis-of-Design: ASG4025 - Mini Standing Seam Two-Pipe Snow Guard.
  - b. S-5! Attachment Solutions; Metal Roof Innovations, Ltd.
  - c. Sno Shield.
  - d. TRA SNOW AND SUN, INC.
2. Description: 3/8-inch snow guard rails fabricated from metal pipes, bars, or extrusions, anchored to brackets and equipped with two rails.
3. Material, Finish, and Color: Aluminum; fluoropolymer or powder-coated finish matching metal roofing.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.
  1. Verify compatibility with and suitability of substrates including compatibility with existing finishes or primers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and prepare substrates for bonding snow guards.
- B. Prime substrates according to snow guard manufacturer's written instructions.

### 3.3 INSTALLATION

- A. Install snow guards according to manufacturer's written instructions. Space rows as recommended by manufacturer.
- B. Attachment for Standing-Seam Metal Roofing:

1. Do not use fasteners that will penetrate metal roofing, or fastening methods that void metal roofing finish warranty.
2. Seam-Mounted Rail-Type Snow Guards: Stainless steel or aluminum clamps attached to vertical ribs of standing-seam metal roof panels.

**END OF SECTION**

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## SECTION 01 91 90

### GENERAL COMMISSIONING REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 COMMISSIONING DESCRIPTION

- A. Various sections of the project specifications require equipment startup, testing, and adjusting services. Requirements for startup, testing, and adjusting services specified in the Division 22 and Division 23 series sections of these specifications are intended to be provided in coordination with the commissioning services and are not intended to duplicate services. The Contractor shall coordinate the work required by individual specification sections with the commissioning services requirements specified herein.
- B. Where individual testing, adjusting, or related services are required in the project specifications and not specifically required by this commissioning requirements specification, the specified services shall be provided and copies of documentation, as required by those specifications shall be submitted to the University and the Commissioning Authority to be indexed for future reference.
- C. Where training or educational services for the University are required and specified in other sections of the specifications, including but not limited to Division 22 and Division 23 series sections of the specification, these services are intended to be provided in addition to the training and educational services specified herein.
- D. Commissioning is a systematic process of verifying that the building systems perform interactively according to the construction documents and the University's operational needs. The commissioning process shall encompass and coordinate the system documentation, equipment startup, control system calibration, testing adjusting and balancing, performance testing and training. Commissioning during the construction and post- occupancy phases is intended to achieve the following specific objectives according to the contract documents:
  - 1. Verify that the applicable equipment and systems are installed in accordance with the contact documents and according to the manufacturer's recommendations.
  - 2. Verify and document proper integrated performance of equipment and systems.
  - 3. Verify that Operations & Maintenance documentation is complete.
  - 4. Verify that all components requiring servicing can be accessed, serviced and removed without disturbing nearby components including ducts, piping, cabling or wiring.

5. Verify that the University's operating personnel are adequately trained to enable them to operate, monitor, adjust, maintain, and repair building systems in an effective and energy-efficient manner.
  6. Document the successful achievement of the commissioning objectives listed above.
- E. The commissioning process does not take away from or reduce the responsibility of the Contractor to provide a finished and fully functioning product.

## **1.2 CONTRACTUAL RELATIONSHIPS**

- A. For this construction project, the University of Missouri contracts with a Contractor to provide construction services.
- B. In this project, only two contract parties are recognized and communications on contractual issues are strictly limited to University Project Managers (PM) and the Contractor. It is the practice of the University to require that communications between other parties to the contracts (Subcontractors and Vendors) be conducted through the PM and Contractor. It is also the practice of the University that communications between other parties of the project (Commissioning Authority and Architect/Engineer) be conducted through the PM.
- C. Whole Building Commissioning is a process that relies upon frequent and direct communications, as well as collaboration between all parties to the construction process. By its nature, a high level of communication and cooperation between the Commissioning Authority and all other parties (Architects, Engineers, Subcontractors, Vendors, third party testing agencies, etc.) is essential to the success of the Commissioning effort.
- D. With these fundamental practices in mind, the commissioning process described herein has been developed to recognize that, in the execution of the Commissioning Process, the Commissioning Authority must develop effective methods to communicate with every member of the construction team involved in delivering commissioned systems while simultaneously respecting the exclusive contract authority of the Contracting Officer and PM. Thus, the procedures outlined in this specification must be executed within the following limitations:
  1. No communications (verbal or written) from the Commissioning Authority shall be deemed to constitute direction that modifies the terms of any contract between the University of Missouri and the Contractor.
  2. Commissioning Issues identified by the Commissioning Authority will be delivered to the PM and copied to the designated Commissioning Representatives for the

Contractor and subcontractors on the Commissioning Team for information only in order to expedite the communication process. These issues must be understood as the professional opinion of the Commissioning Authority and as suggestions for resolution.

3. In the event that any Commissioning Issues and suggested resolutions are deemed by the PM to require either an official interpretation of the construction documents or require a modification of the contract documents, the Contracting Officer or PM will issue an official directive to this effect.
4. All parties to the Commissioning Process shall be individually responsible for alerting the PM of any issues that they deem to constitute a potential contract change prior to acting on these issues.
5. Authority for resolution or modification of design and construction issues rests solely with the Contracting Officer or PM, with appropriate technical guidance from the Architect/Engineer and/or Commissioning Authority.

### **1.3 RELATED WORK**

- A. COMMISSIONING OF PLUMBING SYSTEMS.
- B. COMMISSIONING OF HVAC SYSTEMS.

### **1.4 SYSTEMS TO BE COMMISSIONED**

- A. Commissioning of a system or systems specified for this project is part of the construction process. Documentation and testing of these systems, as well as training of the Universities Operation and Maintenance personnel, is required in cooperation with the University and the Commissioning Authority.
- B. The following systems will be commissioned as part of this project:

<b>Systems To Be Commissioned</b>	
<b>System</b>	<b>Description</b>
<b>HVAC</b>	
Direct Digital Control System**	Operator Interface Computer, Operator Work Station (including graphics, point mapping, trends, alarms), Network Communications Modules and Wiring, Integration Panels. [DDC Control panels will be commissioned with the systems controlled by the panel]
HVAC Air Handling Systems**	Conduct Functional Performance Testing: Surface Mounted Roof Top Units, Roof Top Unit, DDC control panels
HVAC Ventilation/Exhaust Systems	Conduct Functional Performance Testing: General exhaust, toilet exhaust, Destratification Fans
HVAC Terminal Unit Systems**	Conduct Functional Performance Testing: VAV Terminal Units, CAV terminal units, unit heaters, Split System Units,
<b>Plumbing</b>	
Snow Melt System	Witness 3rd party testing, review reports, provide thermal imaging of slab
Instantaneous Hot Water Heaters	Field verify proper operation

### 1.5 COMMISSIONING TEAM

- A. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project Superintendent and subcontractors, installers, schedulers, suppliers, and specialists deemed appropriate by the University and Commissioning Authority.
- B. Members Appointed by Contractor:
  - 1. Contractor's Commissioning Manager: The designated person, company, or entity that plans, schedules and coordinates the commissioning activities for the construction team.
  - 2. Contractor's Commissioning Representative(s): Individual(s), each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions.



C. Members Appointed by the University:

1. Commissioning Authority: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. The University will engage the CxA under a separate contract.
2. User: Representatives of the facility user and operation and maintenance personnel.
3. A/E: Representative of the Architect and engineering design professionals.

**1.6 UNIVERSITY'S COMMISSIONING RESPONSIBILITIES**

- A. Appoint an individual, company or firm to act as the Commissioning Authority.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:
  1. Coordination meetings.
  2. Training in operation and maintenance of systems, subsystems, and equipment.
  3. Testing meetings.
  4. Witness and assist in Systems Functional Performance Testing.
  5. Demonstration of operation of systems, subsystems, and equipment.
- C. Provide the Construction Documents, prepared by Architect and approved by University, to the Commissioning Authority and for use in managing the commissioning process, developing the commissioning plan, systems manuals, and reviewing the operation and maintenance training plan.

**1.7 CONTRACTOR'S COMMISSIONING RESPONSIBILITIES**

- A. The Contractor shall assign a Commissioning Manager to manage commissioning activities of the Contractor, and subcontractors.
- B. The Contractor shall ensure that the commissioning responsibilities outlined in these specifications are included in all subcontracts and that subcontractors comply with the requirements of these specifications.
- C. The Contractor shall ensure that each installing subcontractor shall assign representatives with expertise and authority to act on behalf of the subcontractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
  1. Participate in commissioning coordination meetings.
  2. Conduct operation and maintenance training sessions in accordance with approved training plans.

3. Verify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
4. Evaluate commissioning issues and commissioning observations identified in the Commissioning Issues and Benefits Log, field reports, test reports or other commissioning documents. In collaboration with entity responsible for system and equipment installation, recommend corrective action.
5. Review and comment on commissioning documentation.
6. Participate in meetings to coordinate Systems Functional Performance Testing.
7. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to Commissioning Authority for incorporation into the commissioning plan.
8. Provide information to the Commissioning Authority for developing commissioning plan.
9. Participate in training sessions for University's operation and maintenance personnel.
10. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures to conduct Systems Functional Performance Testing of installed systems.

#### **1.8 COMMISSIONING AUTHORITY'S RESPONSIBILITIES**

- A. Organize and lead the commissioning team.
- B. Prepare the Commissioning Plan.
- C. Review and comment on selected submittals from the Contractor for general conformance with the Construction Documents.
- D. At the beginning of the construction phase, conduct an initial construction phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; Pre-Functional Checklists, Systems Functional Performance Testing; and project completion.
- E. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss status of the commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The Commissioning Authority shall prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning meeting.
- F. Observe construction and report progress, observations and issues. Observe systems and equipment installation for adequate accessibility for maintenance and component

- replacement or repair, and for general conformance with the Construction Documents.
- G. Prepare Project specific Pre-Functional Checklists and Systems Functional Performance Test procedures.
  - H. Coordinate Systems Functional Performance Testing schedule with the Contractor.
  - I. Witness selected systems startups.
  - J. Verify selected Pre-Functional Checklists completed and submitted by the Contractor.
  - K. Witness and document Systems Functional Performance Testing.
  - L. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.
  - M. Review and comment on operation and maintenance (O&M) documentation and systems manual outline for compliance with the Contract Documents.
  - N. Review operation and maintenance training program developed by the Contractor. Verify training plans provide qualified instructors to conduct operation and maintenance training.
  - O. Prepare commissioning Field Observation Reports.
  - P. Prepare the Final Commissioning Report.
  - Q. Return to the site at 10 months into the 12-month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal Systems Functional Performance Testing. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.
  - R. Assemble the final commissioning documentation, including the Final Commissioning Report and Addendum to the Final Commissioning Report.

## **1.9 COMMISSIONING DOCUMENTATION**

- A. Commissioning Plan: A document, prepared by Commissioning Authority, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited, to the following:
  - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved

- submittals must be received without adversely affecting commissioning plan.
2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
  3. Identification of systems and equipment to be commissioned.
  4. Schedule of Commissioning Coordination meetings.
  5. Identification of items that must be completed before the next operation can proceed.
  6. Description of responsibilities of commissioning team members.
  7. Description of observations to be made.
  8. Description of requirements for operation and maintenance training.
  9. Schedule for commissioning activities with dates coordinated with overall construction schedule.
  10. Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.
  11. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.
  12. Preliminary Systems Functional Performance Test procedures.
- B. Systems Functional Performance Test Procedures: The Commissioning Authority will develop Systems Functional Performance Test Procedures for each system to be commissioned, including subsystems, or equipment and interfaces or interlocks with other systems. Systems Functional Performance Test Procedures will include a separate entry, with space for comments, for each item to be tested. Preliminary Systems Functional Performance Test Procedures will be provided to the University, Architect/Engineer, and Contractor for review and comment. The Systems Performance Test Procedure will include test procedures for each mode of operation and provide space to indicate whether the mode under test responded as required. Each System Functional Performance Test procedure, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:
1. Name and identification code of tested system.
  2. Test number.
  3. Time and date of test.
  4. Indication of whether the record is for a first test or retest following correction of a problem or issue.

5. Dated signatures of the person performing test and of the witness, if applicable.
  6. Individuals present for test.
  7. Observations and Issues.
  8. Issue number, if any, generated as the result of test.
- C. Pre-Functional Checklists: The Commissioning Authority will prepare Pre-Functional Checklists. If the contractor wishes to provide their own prefunctional checklists or start up reports, they may do so following approval of blank forms provided to the Cx Authority. Pre-Functional Checklists shall be completed and signed by the Contractor, verifying that systems, subsystems, equipment, and associated controls are ready for testing. The Commissioning Authority will spot check Pre-Functional Checklists to verify accuracy and readiness for testing. Inaccurate or incomplete Pre-Functional Checklists shall be returned to the Contractor for correction and resubmission.
- D. Test and Inspection Reports: The Commissioning Authority will record test data, observations, and measurements on Systems Functional Performance Test Procedure. The report will also include recommendation for system acceptance or non-acceptance. Photographs, forms, and other means appropriate for the application shall be included with data. Commissioning Authority Will compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.
- E. Corrective Action Documents: The Commissioning Authority will document corrective action taken for systems and equipment that fail tests. The documentation will include any required modifications to systems and equipment and/or revisions to test procedures, if any. The Commissioning Authority will witness and document any retesting of systems and/or equipment requiring corrective action and document retest results.
- F. Commissioning Issues and Benefits Log: The Commissioning Authority will prepare and maintain Commissioning Issues and Benefits Log that describes Commissioning Issues and Commissioning Observations that are identified during the Commissioning process. These observations and issues include, but are not limited to, those that are at variance with the Contract Documents. The Commissioning Issues and Benefits Log will identify and track issues as they are encountered, the party responsible for resolution, progress toward resolution, and document how the issue was resolved. The Master Commissioning Issues and Benefits Log will also track the status of unresolved issues.

G. Final Commissioning Report: The Commissioning Authority will document results of the commissioning process, including unresolved issues, and performance of systems, subsystems, and equipment. The Commissioning Report will indicate whether systems, subsystems, and equipment have been properly installed and are performing according to the Contract Documents. This report will be used by the University when determining that systems will be accepted. This report will be used to evaluate systems, subsystems, and equipment and will serve as a future reference document during University occupancy and operation. It shall describe components and performance that exceed requirements of the Contract Documents and those that do not meet requirements of the Contract Documents. The commissioning report will include, but is not limited to, the following:

1. Lists and explanations of substitutions; compromises; variances with the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. Design Narrative documentation maintained by the Commissioning Authority.
2. Commissioning plan.
3. Pre-Functional Checklists completed by the Contractor, with annotation of the Commissioning Authority review and spot check.
4. Systems Functional Performance Test Procedures, with annotation of test results and test completion.
5. Commissioning Issues and Benefits Log.
6. Listing of deferred and off season test(s) not performed, including the schedule for their completion.

#### **1.10 SUBMITTALS**

- A. Commissioning Plan Submittal: Based on the Final Construction Documents and the Contractor's project team, the Commissioning Authority will prepare the Final Commissioning Plan as described in this section. The Commissioning Authority will submit three hard copies and three sets of electronic files of Final Commissioning Plan. The Contractor shall review the Commissioning Plan and provide any comments to the University. The Commissioning Authority will incorporate review comments into the Final Commissioning Plan as directed by the University.
- B. Systems Functional Performance Test Procedure: The Commissioning Authority will submit preliminary Systems Functional Performance Test Procedures to the Contractor,

and the University for review and comment. The Contractor shall return review comments to the University and the Commissioning Authority. The University will also return review comments to the Commissioning Authority. The Commissioning Authority will incorporate review comments into the Final Systems Functional Test Procedures to be used in Systems Functional Performance Testing.

- C. Test and Inspection Reports: The Commissioning Authority will submit test and inspection reports to the University with copies to the Contractor and the Architect/Engineer.
- D. Corrective Action Documents: The Commissioning Authority will submit the Issues and Benefits Log to the University PM with copies to the Contractor and Architect.
- E. Final Commissioning Report Submittal: The Commissioning Authority will submit four sets of electronically formatted information of the final commissioning report to the University. The final submittal will incorporate comments as directed by the University.
- F. Data for Commissioning:
  - 1. The Commissioning Authority will request in writing from the Contractor specific information needed about each piece of commissioned equipment or system to fulfill requirements of the Commissioning Plan.
  - 2. The Commissioning Authority may request further documentation as is necessary for the commissioning process or to support other University data collection requirements, including Construction Operations Building Information Exchange (COBIE), Building Information Modeling (BIM), etc.

### **1.11 COMMISSIONING PROCESS**

- A. The Commissioning Authority will be responsible for the overall management of the commissioning process as well as coordinating scheduling of commissioning tasks with the University and the Contractor. As directed by the University, the Contractor shall incorporate Commissioning tasks, including, but not limited to, Systems Functional Performance Testing (including predecessors) with the Master Construction Schedule.
- B. Within 30 days of contract award, the Contractor shall designate a specific individual as the Commissioning Manager (CxM) to manage and lead the commissioning effort on behalf of the Contractor. The Commissioning Manager shall be the single point of contact and communications for all commissioning related services by the Contractor.
- C. Within 30 days of contract award, the Contractor shall ensure that each subcontractor designates specific individuals as Commissioning Representatives (CXR) to be

responsible for commissioning related tasks. The Contractor shall ensure the designated Commissioning Representatives participate in the commissioning process as team members providing commissioning testing services, equipment operation, adjustments, and corrections if necessary. The Contractor shall ensure that all Commissioning Representatives shall have sufficient authority to direct their respective staff to provide the services required, and to speak on behalf of their organizations in all commissioning related contractual matters.

## **1.12 COORDINATION**

- A. Management: The Commissioning Authority will coordinate the commissioning activities with the University and Contractor. All commissioning team members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.
- B. Scheduling: The Contractor shall work with the Commissioning Authority and the University to incorporate the commissioning activities into the construction schedule. The Commissioning Authority will provide sufficient information (including, but not limited to, tasks, durations and predecessors) on commissioning activities to allow the Contractor and the University to schedule commissioning activities. All parties shall address scheduling issues and make necessary notifications in a timely manner in order to expedite the project and the commissioning process. The Contractor shall update the Master Construction as directed by the University.
- C. Commissioning Meetings: The Commissioning Authority will conduct periodic meetings of the commissioning team to review status of commissioning activities, to discuss the Issues and Benefits Log, and to discuss upcoming commissioning process activities.
- D. Systems Functional Performance Testing Coordination: The Contractor shall coordinate testing activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting. The Contractor shall coordinate the schedule times for tests, inspections, obtaining samples, and similar activities.

## **PART 2 - EXECUTION**

### **2.1 COMMISSIONING PROCESS ROLES AND RESPONSIBILITIES**

- A. The following table outlines the roles and responsibilities for the Commissioning Team members during the Construction



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<b>Construction Phase</b>		CxA = Commissioning Authority				L = Lead	
<b>Commissioning Roles &amp; Responsibilities</b>		PM = PM				P = Participate	
		A/E = Design Arch/Engineer				A = Approve	
		PC = Prime Contractor				R = Review	
						O = Optional	
Category	Task Description	CxA	PM	A/E	PC		Notes
Observation	Construction Commissioning Kick Off	L	A	P	P		
	Commissioning Meetings	L	A	P	P		
	Construction Progress Meetings	P	A	P	L		
Cx Plan and Spec	Final Commissioning Plan	L	A	P	P		
Schedule	Duration Schedule for Commissioning Activities	L	A	R	R		
Document Reviews	TAB Plan Review	L	A	R	R		
	Submittal and Shop Drawing Review	L	A	R	R		
Document Reviews	Review Contractor Equipment Startup Checklists	R	A	R	L		
	Review Change Orders, ASI, and RFI	L	A	R	R		
Observations	Construction Observation Site Visits	L	A	R	R		
Functional Test Protocols	Final Pre-Functional Checklists	L	A	R	R		
	Final Functional Performance Test	L	A	R	R		
Reports and Logs	Status Reports	L	A	R	R		
	Maintain Commissioning Issues and Benefits Log	L	A	R	R		

B. The following table outlines the roles and responsibilities for the Commissioning Team members during the Acceptance Phase:

Acceptance Phase		CxA = Commissioning Authority				L = Lead P = Participate A = Approve R = Review O = Optional	
Commissioning Roles & Responsibilities		PM = PM A/E = Design Arch/Engineer PC = Prime Contractor					
Category	Task Description	CxA	PM	A/E	PC		Notes
Meetings	Commissioning Meetings	L	A	P	P		
	Project Progress	P	A	P	L		
	Pre-Test Coordination Meeting	L	A	P	P		
	Lessons Learned and Commissioning Report	L	A	P	P		
Coordination	Coordinate to ensure that Cx interacts	L	P	P	P		
Cx Plan & Spec	Maintain/Update	L	A	R	R		
Schedules	Prepare Functional Test Schedule	L	A	R	R		
Document Reviews	Review Completed Pre-Functional Checklists	L	A	R	R		
	Pre-Functional Checklist Verification	L	A	R	R		
	Review Operations & Maintenance Manuals	L	A	R	R		
	Training Plan Review	L	A	R	R		

<b>Acceptance Phase</b>		CxA = Commissioning Authority				L = Lead P = Participate A = Approve R = Review O = Optional
<b>Commissioning Roles &amp; Responsibilities</b>		PM = PM A/E = Design Arch/Engineer PC = Prime Contractor				
Category	Task Description	CxA	PM	A/E	PC	Notes
	Warranty Review	L	A	R	R	
	Review TAB Report	L	A	R	R	
Site Observations	Construction Observation Site Visits	L	A	R	R	
	Witness Selected Equipment Startup	L	A	R	R	
Functional Test Protocols	TAB Verification	L	A	R	R	
	Systems Functional	L	A	P	P	
	Retesting	L	A	P	P	
Reports and Logs	Status Reports	L	A	R	R	
	Maintain Commissioning Issues and Benefits Log	L	A	R	R	
	Final Commissioning Report	L	A	R	R	

### 3.2 STARTUP, INITIAL CHECKOUT, AND PRE-FUNCTIONAL CHECKLISTS

A. The following procedures shall apply to all equipment and systems to be commissioned, according to Part 1, Systems to Be Commissioned.

1. Pre-Functional Checklists are important to ensure that the equipment and systems are hooked up and operational. These ensure that Systems Functional Performance Testing may proceed without unnecessary delays. Each system to be commissioned shall have a full Pre-Functional Checklist completed by the Contractor prior to Systems Functional Performance Testing. No sampling strategies are used.
  - a. The Pre-Functional Checklist will identify the trades responsible for completing the checklist. The Contractor shall ensure the appropriate trades complete the checklists.
  - b. The Commissioning Authority will review completed Pre-Functional Checklists and field-verify the accuracy of the completed checklist using sampling

techniques.

2. Startup and Initial Checkout Plan: The Contractor shall develop detailed startup plans for all equipment. The primary role of the Contractor in this process is to ensure that there is written documentation that each of the manufacturer recommended procedures have been completed. Parties responsible for startup shall be identified in the Startup Plan and in the checklist forms.

### **3.3 DEFICIENCIES, NONCONFORMANCE, AND APPROVAL IN CHECKLISTS AND STARTUP**

- A. The Contractor shall clearly list any outstanding items of the initial startup and Pre-Functional Checklist procedures that were not completed successfully, at the bottom of the procedures form. The procedures form and any outstanding deficiencies shall be provided to the University and the Commissioning Authority within two days of completion.
- B. The Commissioning Authority will review the report and will work with the Contractor to correct and verify deficiencies or uncompleted items. The Commissioning Authority will involve the University and others as necessary. The Contractor shall correct all areas that are noncompliant or incomplete. The Contractor shall submit an updated startup report and a Statement of Correction on the original noncompliance report.

### **3.4 PHASED COMMISSIONING**

- A. The project may require startup and initial checkout to be executed in phases. This phasing shall be planned and scheduled in a coordination meeting of the University, Commissioning Authority, and the Contractor. Results will be added to the master construction schedule and the commissioning schedule.
- B.

### **3.5 DDC SYSTEM TRENDING FOR COMMISSIONING**

- A. Trending is a method of testing as a standalone method or to augment manual testing. The Contractor shall trend any and all points of the system or systems as required for the commissioning Functional Testing Procedures.

### **3.6 SYSTEMS FUNCTIONAL PERFORMANCE TESTING**

- A. This paragraph applies to Systems Functional Performance Testing of systems for all referenced specification Divisions.
- B. Objectives and Scope: The objective of Systems Functional Performance Testing is to

demonstrate that each system is operating according to the Contract Documents.

Systems Functional Performance Testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of noncompliant performance are identified and corrected, thereby improving the operation and functioning of the systems. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, fire alarm and emergency power) where there is a specified system response. The Contractor shall verify each sequence in the sequences of operation. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.

- C. Development of Systems Functional Performance Test Procedures: Before Systems Functional Performance Test procedures are written, the Contractor shall submit all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements found in the Contract Documents and approved submittals and shop drawings, the Commissioning Authority will develop specific Systems Functional Test Procedures to verify and document proper operation of each piece of equipment and system to be commissioned. The Contractor shall assist the Commissioning Authority in developing the Systems Functional Performance Test procedures as requested by the Commissioning Authority i.e. by answering questions about equipment, operation, sequences, etc. Prior to execution, the Commissioning Authority will provide a copy of the Systems Functional Performance Test procedures to the University, the Architect/Engineer, and the Contractor, who shall review the tests for feasibility, safety, equipment and warranty protection.
- D. Purpose of Test Procedures: The purpose of each specific Systems Functional Performance Test is to verify and document compliance with the stated criteria of acceptance given on the test form. Representative test formats and examples are found in the Commissioning Plan for this project. (The Commissioning Plan is issued as a separate document and is available for review.) The test procedure forms developed by the Commissioning Authority will include, but not be limited to, the following information:
1. System and equipment or component name(s)
  2. Equipment location and ID number
  3. Unique test ID number, and reference to unique Pre-Functional Checklists and startup documentation, and ID numbers for the piece of equipment

4. Date
  5. Project name
  6. Participating parties
  7. A copy of the specific sequence of operations or other specified parameters being verified
  8. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
  9. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
  10. A section for comments.
  11. Signatures and date block for the Commissioning Authority. A place for the Contractor to initial to signify attendance at the test.
- E. Test Methods: Systems Functional Performance Testing shall be achieved by manual testing (i.e. persons manipulate the equipment and observe performance) and/or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by standalone data loggers. The Contractor and Commissioning Authority shall determine which method is most appropriate for tests that do not have a method specified.
1. Simulated Conditions: Simulating conditions shall be allowed, although timing the testing to experience actual conditions is encouraged wherever practical.
  2. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
  3. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten

values.

4. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the Air Conditioning compressor lockout initiate at an outside air temperature below 54 F, when the outside air temperature is above 54F, temporarily change the lockout setpoint to be 4F above the current outside air temperature.
- F. Setup: Each function and test shall be performed under conditions that simulate actual conditions as closely as is practically possible. The Contractor shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Contractor shall return all affected building equipment and systems, due to these temporary modifications, to their pretest condition.
- G. Testing Prerequisites: In general, Systems Functional Performance Testing will be conducted only after Pre-Functional Checklists have been satisfactorily completed. The air balancing and water balancing shall be completed before Systems Functional Performance Testing of air-related or water-related equipment or systems are scheduled. Systems Functional Performance Testing will proceed from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems will be checked.
- K. Problem Solving: The Commissioning Authority will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractor.

### **3.7 DOCUMENTATION, NONCONFORMANCE AND APPROVAL OF TESTS**

- A. Documentation: The Commissioning Authority will witness, and document the results of all Systems Functional Performance Tests using the specific procedural forms developed by the Commissioning Authority for that purpose.
- B. Nonconformance: The Commissioning Authority will record the results of the Systems Functional Performance Tests on the procedure or test form. All items of nonconformance issues will be noted and reported to the University on Commissioning Field Reports and/or the Commissioning Master Issues and Benefits Log.

1. Corrections of minor items of noncompliance identified may be made during the tests. In such cases, the item of noncompliance and resolution shall be documented on the Systems Functional Test Procedure.
2. Every effort shall be made to expedite the systems functional Performance Testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the Commissioning Authority shall not be pressured into overlooking noncompliant work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so by direction from the University.
3. When there is no dispute on an item of noncompliance, and the Contractor accepts responsibility to correct it:
  - a. The Commissioning Authority will document the item of noncompliance and the Contractor's response and/or intentions. The Systems Functional Performance Test then continues or proceeds to another test or sequence. After the day's work is complete, the Commissioning Authority will submit a Commissioning Field Report to the University. The Commissioning Authority will also note items of noncompliance and the Contractor's response in the Master Commissioning Issues and Benefits Log. The Contractor shall correct the item of noncompliance and report completion to the University and the Commissioning Authority.
  - b. The need for retesting will be determined by the Commissioning Authority. If retesting is required, the Commissioning Authority and the Contractor shall reschedule the test and the test shall be repeated.
4. If there is a dispute about item of noncompliance, regarding whether it is an item of noncompliance, or who is responsible:
  - a. The item of noncompliance shall be documented on the test form with the Contractor's response. The item of noncompliance with the Contractor's response shall also be reported on the Master Commissioning Issues and Benefits Log.
  - b. Resolutions shall be made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive and acceptance authority is with the University of Missouri.
  - c. The Commissioning Authority will document the resolution process.
  - d. Once the interpretation and resolution have been decided, the Contractor shall



correct the item of noncompliance, report it to the Commissioning Authority. The requirement for retesting will be determined by the Commissioning Authority. If retesting is required, the Commissioning Authority and the Contractor shall reschedule the test. Retesting shall be repeated until satisfactory performance is achieved.

- E. Cost of Retesting: The cost to retest a System Functional Performance Test shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

### **3.8 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS**

- A. Training Preparation Conference: Before operation and maintenance training, the Commissioning Authority will convene a training preparation conference to include University's PM, University's Operations and Maintenance personnel, and the Contractor. The purpose of this conference will be to discuss and plan for Training and Demonstration of University Operations and Maintenance personnel.
- B. The Contractor shall provide training and demonstration as required by other Division 23 and Division 26 sections. The Training and Demonstration shall include, but is not limited to, the following:
  - 1. Review the Contract Documents.
  - 2. Review installed systems, subsystems, and equipment.
  - 3. Review instructor qualifications.
  - 4. Review instructional methods and procedures.
  - 5. Review training module outlines and contents.
  - 6. Review course materials (including operation and maintenance manuals).
  - 7. Review and discuss locations and other facilities required for instruction.
  - 8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
  - 9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

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## SECTION 28 46 21 - ADDRESSABLE FIRE-ALARM SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Addressable fire-alarm system.
2. Fire-alarm control unit (FACU).
3. Manual fire-alarm boxes.
4. System smoke detectors.
5. Duct smoke detectors.
6. Heat detectors.
7. Fire-alarm notification appliances.
8. Fire-alarm remote annunciators.
9. Fire-alarm addressable interface devices.
10. Digital alarm communicators and cellular transmitters (DACTs).

B. Related Requirements:

1. Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for cables and conductors for fire-alarm systems.
2. Section 07 84 13 "Penetration Firestopping" for material and methods for firestopping systems.

#### 1.2 DEFINITIONS

- A. DACT: Digital alarm cellular transmitter.
- B. EMT: Electrical metallic tubing.
- C. FACU: Fire-alarm control unit.
- D. NICET: National Institute for Certification in Engineering Technologies.
- E. PC: Personal computer.
- F. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
  2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.
1. Include construction details, material descriptions, dimensions, profiles, and finishes.
  2. Include rated capacities, operating characteristics, and electrical characteristics.
- B. Shop Drawings: For fire-alarm system.
1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
  2. Include plans, elevations, sections, and details, including details of attachments to other Work.
  3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
  4. Annunciator panel details as required by authorities having jurisdiction.
  5. Detail assembly and support requirements.
  6. Include voltage drop calculations for notification-appliance circuits.
  7. Include battery-size calculations.
  8. Include input/output matrix.
  9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
  10. Include performance parameters and installation details for each detector.
  11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  12. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
    - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    - b. Show field wiring required for HVAC unit shutdown on alarm.
    - c. Locate detectors in accordance with manufacturer's written instructions.
    - d. Show air-sampling detector pipe routing.
  13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
  14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- C. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data. Fire alarm shop drawings and calculations shall be signed and sealed by a qualified professional engineer licensed in the State of Missouri who shall be responsible for their preparation.
1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.

2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Qualification Statements: For Installer.
- C. Sample Warranty: Submittal must include line item pricing for replacement parts and labor.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
  1. Include the following and deliver copies to authorities having jurisdiction:
    - a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
    - b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
    - c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
    - d. Riser diagram.
    - e. Device addresses.
    - f. Record copy of site-specific software.
    - g. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
      - 1) Equipment tested.
      - 2) Frequency of testing of installed components.
      - 3) Frequency of inspection of installed components.
      - 4) Requirements and recommendations related to results of maintenance.
      - 5) Manufacturer's user training manuals.
    - h. Manufacturer's required maintenance related to system warranty requirements.
    - i. Abbreviated operating instructions for mounting at FACU and each annunciator unit.
- B. Software and Firmware Operational Documentation:
  1. Software operating and upgrade manuals.
  2. Program Software Backup: On USB media or approved online or cloud solution.
  3. Device address list.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
  2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
  3. Smoke Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
  4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
  5. Keys and Tools: One extra set for access to locked or tamperproofed components.
  6. Audible and Visual Notification Appliances: One of each type installed.
  7. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Personnel must be trained and certified for installation of units required for this Project. **Fire alarm contractor shall be a licensed Honeywell/Notifier provider and installer.**
  2. Installation oversight must be by personnel certified by NICET as fire-alarm Level III technician.
  3. A qualified and licensed electrician may install conduit and back boxes.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.
1. Warranty Period: One year from date of Substantial Completion.

## PART 2 - PRODUCTS

- A. Manufacturers: ~~Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following~~ **Provide products by the following without substitutions:**
1. **Honeywell/Notifier.**
  2. ~~Bosch Security Systems, Inc.~~
  3. ~~Faraday.~~
  4. ~~Fike Corporation.~~
  5. ~~Fire-Lite Alarms, Inc.; a Honeywell International company.~~

- 6. ~~Gamewell FCI by Honeywell.~~
- 7. ~~GE UTC Fire & Security; A United Technologies Company.~~
- 8. ~~Johnson Controls Company (Tyco SimplexGrinnell).~~
- 9. ~~Notifier.~~
- 10. ~~Potter Electric Signal Company, LLC.~~
- 11. ~~Siemens Industry, Inc.; Fire Safety Division.~~
- 12. ~~Silent Knight.~~

## 2.2 ADDRESSABLE FIRE-ALARM SYSTEM

### A. Description:

- 1. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice-and-strobe notification for evacuation.

### B. Performance Criteria:

#### 1. Regulatory Requirements:

- a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.

#### 2. General Characteristics:

- a. Automatic sensitivity control of certain smoke detectors.
- b. Fire-alarm signal initiation must be by one or more of the following devices:
  - 1) Manual stations.
  - 2) Heat detectors.
  - 3) Smoke detectors.
  - 4) Automatic sprinkler system water flow.
- c. Fire-alarm signal must initiate the following actions:
  - 1) Continuously operate alarm notification appliances, including voice evacuation notices.
  - 2) Identify alarm and specific initiating device at FACU and remote annunciators.
  - 3) Transmit alarm signal to remote alarm receiving station.
  - 4) Release fire and smoke doors held open by magnetic door holders.
  - 5) Activate voice/alarm communication system.
  - 6) Switch HVAC equipment controls to fire-alarm mode.
  - 7) Close smoke dampers in air ducts of designated air-conditioning duct systems.
  - 8) Recall elevators to primary or alternate recall floors.
  - 9) Activate elevator power shunt trip.
  - 10) Activate emergency lighting control.
  - 11) Record events in system memory.
- d. Supervisory signal initiation must be by one or more of the following devices and actions:

- 1) Valve supervisory switch
  - 2) Duct smoke detector.
  - 3) Elevator shunt-trip supervision.
  - 4) Zones or individual devices have been disabled.
  - 5) FACU has lost communication with network.
- e. System trouble signal initiation must be by one or more of the following devices and actions:
- 1) Open circuits, shorts, and grounds in designated circuits.
  - 2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
  - 3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
  - 4) Loss of primary power at FACU.
  - 5) Ground or single break in internal circuits of FACU.
  - 6) Abnormal ac voltage at FACU.
  - 7) Break in standby battery circuitry.
  - 8) Failure of battery charging.
  - 9) Abnormal position of switch at FACU or annunciator.
  - 10) Voice signal amplifier failure.
- f. System Supervisory Signal Actions:
- 1) Identify specific device initiating event at FACU and remote annunciators.
  - 2) Record event in system memory.
  - 3) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.
- g. Network Communications:
- 1) Provide network communications for fire-alarm system in accordance with fire-alarm manufacturer's written instructions.
  - 2) Provide network communications pathway per manufacturer's written instructions and requirements in NFPA 72 and NFPA 70.
- h. Device Guards:
- 1) Description: Welded wire mesh of size and shape for manual station, smoke detector, or other device requiring protection.
    - a) Factory fabricated and furnished by device manufacturer.
    - b) Finish: Paint of color to match protected device.
- i. Document Storage Box:
- 1) Description: Enclosure to accommodate standard 8-1/2-by-11 inch manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
  - 2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
  - 3) Color: Red powder-coat epoxy finish.



- 4) Labeling: Permanently screened with 1 inch high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
- 5) Security: Locked with 3/4 inch barrel lock. Provide solid 12 inch stainless steel piano hinge.

### 2.3 FIRE-ALARM CONTROL UNIT (FACU)

- A. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.
- B. Performance Criteria:
  1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
  2. General Characteristics:
    - a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
    - b. Include real-time clock for time annotation of events on event recorder and printer.
    - c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
    - d. FACU must be listed for connection to central-station signaling system service.
    - e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
    - f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
      - 1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.
    - g. Fire-Alarm Annunciator: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
      - 1) Annunciator and Display: LCD, 80 characters, minimum.
      - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands.
    - h. Alphanumeric Display and System Controls: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
      - 1) Annunciator and Display: LCD, two line(s) of 40 characters, minimum.
      - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into system for control of smoke-detector sensitivity and other parameters.
    - i. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

- 1) Pathway Class Designations: NFPA 72, Class B.
  - 2) Pathway Survivability: Level 0.
  - 3) Install no more than 256 addressable devices on each signaling-line circuit. Each floor shall be on a separate circuit(s). An Intelligent Module (IM) shall be provided after every 20 devices.
  - 4) Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.
- j. Serial Interfaces:
- 1) One dedicated RS 485 port for remote station operation using point ID DACT.
  - 2) One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
  - 3) One USB or RS 232 port for PC configuration.
  - 4) ~~One RS 232 port for air-aspirating smoke detector connection.~~
  - 5) One RS 232 port for voice evacuation interface.
- k. Notification-Appliance Circuit:
- 1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72, preceding voice messages.
  - 2) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.
  - 3) Notification appliance circuits shall contain a minimum of 20% spare capacity for future expansion on each circuit.
  - 4) Each floor shall be on a separate circuit(s).
- l. Elevator Recall: Initiate by one of the following alarm-initiating devices:
- 1) Elevator lobby detectors except lobby detector on designated floor.
  - 2) Smoke detectors in elevator machine room.
  - 3) Smoke detectors in elevator hoistway.
- m. Elevator controller must be programmed to move cars to alternate recall floor if lobby detectors located on designated recall floors are activated.
- n. Heat detection alarm in elevator shaft and elevator machine room must shut down elevators associated with location without time delay.
- 1) Heat detection in elevator pit may have delay to allow elevators to move to designated floor.
- o. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls must be connected to fire-alarm system.
- p. Remote Smoke-Detector Sensitivity Adjustment: Controls must select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out final adjusted values on system printer.

- q. Fire alarm system shall interface with any public address (PA), sound systems simulating crowd noise, or other sound-producing equipment to silence equipment upon activation of fire alarm signal.
- r. Fire alarm system shall be provided with a "walk test" feature to allow for testing of the system without activation of notification appliances.
- s. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.
- t. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as special module that is part of FACU.
- u. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of central-control microphone. Amplifiers must comply with UL 1711.
  - 1) Allow application of, and evacuation signal to, indicated number of zones and simultaneously allow voice paging to other zones selectively or in combination.
  - 2) Programmable tone and message sequence selection.
  - 3) Standard digitally recorded messages for "Evacuation" and "All Clear."
  - 4) Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of FACU.
- v. Status Annunciator: Indicate status of various voice/alarm speaker zones and status of elevator two-way telephone communication zones.
- w. Preamplifiers, amplifiers, and tone generators must automatically transfer to backup units, on primary equipment failure.
- x. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory signals must be powered by 24 V(dc) source.
- y. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.
- z. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.
- aa. Batteries: Sealed lead calcium; sealed, valve-regulated, recombinant lead acid; or vented, wet-cell pocket, plate nickel cadmium.
  - 1) Capacity: Batteries shall be sized to operate the system under normal conditions for 24 hours, followed by 15 minutes of alarm at minimum. Battery size shall be a minimum of 125% of the calculated requirement.

C. Accessories:

- 1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.

## 2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show

visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
2. Station Reset: Key- or wrench-operated switch.
3. Able to perform at up to 90 percent relative humidity at 90 deg F.
4. Material: Manual stations made of Lexan polycarbonate.
5. Able to be used in indoor areas.

## 2.5 SYSTEM SMOKE DETECTORS

### A. Photoelectric Smoke Detectors:

1. Performance Criteria:
  - a. Regulatory Requirements:
    - 1) NFPA 72.
    - 2) UL 268.
  - b. General Characteristics:
    - 1) Detectors must be two-wire type.
    - 2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
    - 3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
    - 4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
    - 5) Integral Visual-Indicating Light: LED type, indicating detector has operated.
    - 6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
    - 7) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
      - a) Primary status.
      - b) Device type.
      - c) Present average value.
      - d) Present sensitivity selected.
      - e) Sensor range (normal, dirty, etc.).
    - 8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
    - 9) Color: White.
    - 10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.

- 11) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units must be selectable at FACU for 15 or 20 deg F per minute.
- 12) Fixed-temperature sensing characteristic of combination smoke- and heat-detection units must be independent of rate-of-rise sensing and must be settable at FACU to operate at 135 or 155 deg F.
- 13) Multiple levels of detection sensitivity for each sensor.
- 14) Sensitivity levels based on time of day.

## 2.6 DUCT SMOKE DETECTORS

- A. Description: Photoelectric-type, duct-mounted smoke detector.
- B. Performance Criteria:
  1. Regulatory Requirements:
    - a. NFPA 72.
    - b. UL 268A.
  2. General Characteristics:
    - a. Detectors must be two-wire type.
    - b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
    - c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
    - d. The detector shall be listed for releasing service if used for direct interface with a smoke damper.
    - e. Integral Visual-Indicating Light: LED type, indicating detector has operated.
    - f. Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
    - g. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
      - 1) Primary status.
      - 2) Device type.
      - 3) Present average value.
      - 4) Present sensitivity selected.
      - 5) Sensor range (normal, dirty, etc.).
    - h. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with supplied detector for smoke detection in HVAC system ducts.
    - i. Each sensor must have multiple levels of detection sensitivity.
    - j. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
    - k. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

## 2.7 HEAT DETECTORS

- A. Combination-Type Heat Detectors:

1. Performance Criteria:
  - a. Regulatory Requirements:
    - 1) NFPA 72.
    - 2) UL 521.
  - b. General Characteristics:
    - 1) Temperature sensors must test for and communicate sensitivity range of device.
  - c. Actuated by fixed temperature of 135 deg F or rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
  - d. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  - e. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
  - f. Detector must have functional humidity range of 10 to 90 percent relative humidity.
  - g. Color: White.

## 2.8 FIRE-ALARM NOTIFICATION APPLIANCES

### A. Fire-Alarm Voice/Tone Notification Appliances:

1. Description: Notification appliances capable of outputting voice evacuation messages.
2. Speakers shall be Wheelock series ET or equal.
3. Performance Criteria:
  - a. Regulatory Requirements:
    - 1) NFPA 72.
    - 2) UL 1480.
  - b. General Characteristics:
    - 1) Speakers for Voice Notification: Locate speakers for voice notification to provide intelligibility requirements of "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
    - 2) High-Range Units: Rated 2 to 15 W.
    - 3) Low-Range Units: Rated 1 to 2 W.
    - 4) Mounting: Semi-recessed or surface mounted.
    - 5) Matching Transformers: Tap range matched to acoustical environment of speaker location.
    - 6) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

### B. Fire-Alarm Visible Notification Appliances:

1. Strobes shall be Wheelock RSS series or equal.
2. Performance Criteria:

- a. Regulatory Requirements:
  - 1) NFPA 72.
  - 2) UL 1971.
- b. General Characteristics:
  - 1) Rated Light Output:
    - a) 15/30/75/110 cd, selectable in field.
    - b) Higher candela may be required for playing surface.
  - 2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
  - 3) Mounting: Wall mounted unless otherwise indicated.
  - 4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
  - 5) Flashing must be in temporal pattern, synchronized with other units.
  - 6) Strobe Leads: Factory connected to screw terminals.
  - 7) Mounting Faceplate: Factory finished, red or white.

## 2.9 FIRE-ALARM REMOTE ANNUNCIATORS

- A. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. NFPA 72.
  - 2. General Characteristics:
    - a. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, and testing.
      - 1) Mounting: Flush cabinet, NEMA 250, Type 1.
    - b. Display Type and Functional Performance: Alphanumeric display and LED indicating lights must match those of FACU. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

## 2.10 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

- A. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. NFPA 72.
  - 2. General Characteristics:

- a. Include address-setting means on module.
- b. Store internal identifying code for control panel use to identify module type.
- c. Listed for controlling HVAC fan motor controllers.
- d. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.
- e. Integral Relay: Capable of providing direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.
  - 1) Allow control panel to switch relay contacts on command.
  - 2) Have minimum of two normally open and two normally closed contacts available for field wiring.
- f. Control Module:
  - 1) Operate notification devices.

## 2.11 DIGITAL ALARM CELLULAR TRANSMITTERS (DACTs)

### A. Performance Criteria:

- 1. Regulatory Requirements:
  - a. NFPA 72.
- 2. General Characteristics:
  - a. DACT may be separate or an integral part of the fire alarm control panel.
  - b. DACT must be acceptable to remote central station and must be listed for fire-alarm use.
  - c. Functional Performance: Unit must receive alarm, supervisory, or trouble signal from FACU and automatically transmit to a UL-listed 3<sup>rd</sup> party monitoring service. Transmitter shall support both dynamic (DHCP) or Public and Private Static IP addressing. Communication may be over Ethernet 10/100 Base network connection or GSM as primary. Data shall be secured with industry-standard Advanced Encryption Standard (AES 256 bit). Coordinate transmission methods with University PM. When contact is made with central station(s), signals must be transmitted. If service on any means is interrupted for longer than 45 seconds, transmitter must initiate local trouble signal and transmit signal indicating loss of service to remote alarm receiving station over remaining service means. Transmitter must automatically report service restoration to central station. If service is lost on all means, transmitter must initiate local trouble signal.
  - d. Local functions and display at DACT must include the following:
    - 1) Verification that services are available.
    - 2) Programming device.
    - 3) LED display.
    - 4) Manual test report function and manual transmission clear indication.
    - 5) Communications failure with central station or FACU.
  - e. Digital data transmission must include the following:
    - 1) Address of alarm-initiating device.



- 2) Address of supervisory signal.
  - 3) Address of trouble-initiating device.
  - 4) Loss of ac supply.
  - 5) Loss of power.
  - 6) Low battery.
  - 7) Abnormal test signal.
  - 8) Communication bus failure.
- f. Secondary Power: Integral rechargeable battery and automatic charger.
- g. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

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

#### **3.2 PREPARATION**

- A. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

#### **3.3 INSTALLATION OF EQUIPMENT**

- A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
1. Devices placed in service before other trades have completed cleanup must be replaced.
  2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.
  3. **System shall be installed in accordance with the approved and sealed fire alarm shop drawings. Deviations from approved working plans require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.**

- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inch above finished floor.
- C. Manual Fire-Alarm Boxes:
  - 1. Install manual fire-alarm box in normal path of egress within 60 inches of exit doorway.
  - 2. Mount manual fire-alarm box on background of contrasting color.
  - 3. Operable part of manual fire-alarm box must be between 42 and 48 inches above floor level. Devices must be mounted at same height unless otherwise indicated.
- D. Smoke- and Heat-Detector Spacing:
  - 1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
  - 2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
  - 3. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
  - 4. Lighting Fixtures: Locate detectors not closer than 12 inches from lighting fixture and not directly above pendant mounted or indirect lighting.
- E. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend full width of duct. Tubes more than 36 inches long must be supported at both ends.
  - 1. The detector or tubes within the duct shall be within 5 feet of the damper.
  - 2. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- ~~G. Air Sampling Smoke Detectors: If using multiple pipe runs, runs must be pneumatically balanced.~~
- H. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- ~~I. Single Station Smoke Detectors: Where more than one smoke alarm is installed within dwelling or suite, they must be connected so that operation of smoke alarm causes alarm in smoke alarms to sound.~~
- J. Remote Status and Alarm Indicators: Install in visible location near each smoke device that is not readily visible from normal viewing position.
- K. Audible Alarm-Indicating Devices: Install not less than 6 inches below ceiling. Install speakers on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.
- L. Visible Alarm-Indicating Devices: Install adjacent to each speaker and at least 6 inches below ceiling. Install devices at same height unless otherwise indicated.

### 3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with NFPA 70 and NFPA 72.
- B. Ground equipment in accordance with NFPA 70 and NFPA 72.
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate must be laminated acrylic or melamine plastic signs, as specified NFPA 70 and NFPA 72.

### 3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with NFPA 70 and NFPA 72.
- C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

### 3.6 PATHWAYS

- A. All pathways must be installed in conduit.

### 3.7 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in NFPA 70 and NFPA 72. Connect hardware and devices to fire-alarm system.
  - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inches from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
  - 1. Smoke dampers in air ducts of designated HVAC duct systems.
  - 2. Magnetically held-open doors.
  - 3. Alarm-initiating connection to elevator recall system and components.
  - 4. Alarm-initiating connection to activate emergency lighting control.
  - 5. Supervisory connections at elevator shunt-trip breaker.

### 3.8 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in NFPA 70 and NFPA 72.
- B. Install framed instructions in location visible from FACU.

### 3.9 GROUNDING

- A. Ground FACU and associated circuits in accordance with NFPA 70 and NFPA 72.
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

### 3.10 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by authorities having jurisdiction.
- B. Administrant for Tests and Inspections:
  - 1. Administer and perform tests and inspections.
- C. Tests and Inspections:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
    - b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
  - 2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
  - 4. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
  - 5. Prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

- F. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

### **3.11 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Allow Owner to record training.

### **3.12 MAINTENANCE**

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
  - 1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

### **3.13 SOFTWARE SERVICE AGREEMENT**

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement must include software support for one year.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within one year from date of Substantial Completion. Upgrading software must include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

**END OF SECTION 28 46 21**

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