GENERAL REQUIREMENTS OF THE CONTRACT

Bid Release 3

Date: January, 2016

A. Preconstruction Item Checklist:

Date:
Time:
Project Title / Location:
Project Number:

FOR
(Contractor's name)

1. **Introductions:** All project members are to introduce themselves including their name, organization, title, and role on the project.

   A. Joliet Junior College Personnel:
      1. Construction Manager:
         a. Phone:
         b. Cell:
         c. Fax:
         d. Email:

      2. Alternate Contact:
         a. Phone:
         b. Cell:
         c. Fax:
         d. Email:

   B. Contractor Personnel
      - Project Manager:
         a. Phone:
         b. Cell:
         c. Fax:
         d. Email

      - Construction Superintendent:
         a. Phone:
         b. Cell:
         c. Fax:
         d. Email:

B. Communications:

1) Communications related to the project between Joliet Junior College and the Contractor shall be conducted through the Joliet Junior College Construction Manager (CM) only, unless directed otherwise.

2) In the event of an emergency the Contractor is to contact Campus Police at 815-280-2234, or may pick-up any campus phone and dial 2911.

3) RFI's: Requests for Information (RFI's): All Requests for Information shall be in written form to JJC's CM with a copy to the A/E when required. All responses will come from JJC or the A/E in writing addressed to the Contractor's Project Manager

4) Correspondence: All correspondence shall be directed to the Construction Manager

Joliet Junior College
Facilities Services Department
ATTN: _____
1215 Houbolt Road
Joliet, IL 60431

Include Project Title, Project Number, Purchase Order Number on ALL correspondence.

C. Performance:

Commencement, Prosecution & Completion of Work

1. Purchase order/notice to proceed received:_____
2. Contract Amount:_____
3. Total Amount of Alternates Accepted:_____
4. Proposed start/mobilization date :_____
5. Preconstruction Submittals Received: Check one Y_____ N_____
6. Bonding & Insurance Requirements Received: Check one Y_____ N_____
7. Completion date: _____
8. Delays and time extensions: The Contractor is responsible for the completion of project work within the time designated above and in the construction schedule. Justified change orders may qualify a delay and require a time extension which must be discussed and approved by the JJC CM. Failure to complete the project on time will result in a negative evaluation of Contractor performance on the JJC project close-out documents.

9. When the shutdown of utilities is required, the Contractor shall coordinate with the JJC CM to schedule the shutdown process. Allow a minimum of 5 days' notice to allow for a shut down. Unless otherwise stated during the bidding process, a utility shut down will be required between the hours of 10:00 p.m. to 6:00 a.m.

10. The contractor is to consider any loud construction noise that may be disruptive to classes, faculty, students and staff (including but not limited to loud demolition, hammer drilling, concrete cutting/drilling, rock breaking, shooting of metal stud track into floors and ceilings, etc.). Such work shall be performed during the maintenance hours of 10:00 p.m. to 6:00 a.m.

11. Contractor Evaluation:
    At the completion of the project, the JJC CM will complete a contractor evaluation. This evaluation is kept on file and is taken into consideration when considering the Contractor for future projects

D. Mobilization: Prior to the Contractor mobilizing on site, the following requirements must be met and reviewed. Contractor check-in with Facility Services. The Contractor's employees are required to obtain vehicle tags and I.D. badges. Any ticketing by Campus Police as a result of no vehicle tag will be the responsibility of the Contractor.

E. Conduct and Behavior:

The Contractor's employees must take into consideration the environment around them when holding conversations with fellow employees as well as JJC staff as to not interrupt classes that may be in session, or students in concourses that may be studying. Profanity/foul language, derogatory remarks or harassment of students will not be tolerated and will be an immediate means for the employee dismissal from the project.

F. Progress Payments/Invoicing and Change Orders:

1) A "pencil" copy of progress invoicing shall be submitted to the JJC CM by the first Monday of every month for review and approval. Final invoicing shall be in by the second week of the month for processing and board approval. No invoice will be processed without lien waiver(s) and certified payroll.

2) Any extra work done by the Contractor will be considered performed at no extra cost to JJC unless a written JJC change order form has been fully executed and signed by the Director of Business and Auxiliary Services. A contractor shall not be entitled to any compensation for extra work/material based on verbal conversations or email exchanges

(the contractor is considered proceeding with extra work at their own risk without a fully executed JJC change order form). It is the contractor's responsibility to obtain a fully executed change order form from JJC. A change order, or a combination of multiple change orders may not exceed 10% of the original contract without JJC seeking approval from the Board of Trustees.

G. Miscellaneous:

1) Soliciting or canvassing and posting or distributing printed material (except as permitted by law) is prohibited.

2) Smoking is restricted to designated signed areas outside. The use of any tobacco products (including chewing) indoors is prohibited, and must be done in the designated outdoor smoking areas during break time.

3) Drinking, using, possessing or being under the influence of alcohol or controlled substances are prohibited, and a cause for immediate dismissal.

4) No radios, CD Players or MP3 players shall be used during normal working hours.

5) The Contractor shall perform his/her work in accordance to no less than the minimum requirements as established by the Occupational Safety and Health Association. Personal Protection equipment shall be provided by the Contractor and worn at all times.

6) The Contractor will be responsible for securing materials and tools and shall be solely responsible for any such theft or damage.

By signing below, the Contractor certifies that he, his employees, subcontractors, or assigns will abide to this Preconstruction Conference Checklist during the course of the project.

Contractor: _____
Print name: _____
Sign name: _____
Title: _____
Date signed: _____

JJC CM: _____
Sign name: _____
Date signed: _____

1.0 CONTROL LINES AND LAYOUT

Site survey coordinates, selected baselines on each floor (after foundations and floors are placed), and benchmarks only will be provided by the Construction Manager. Trade Contractors shall perform their own layout from these coordinates or baselines and shall be responsible for the accuracy of all lines, elevations and measurements, grading, utilities, and other work executed under the trade contracts. The Trade Contractor shall exercise proper precautions to verify figures shown on the drawings or indicated in approved shop drawings before laying out the work. Contractors shall report any perceived inconsistency or error in drawings or layout to the Construction Manager for verification.

2.0 CONSTRUCTION SCHEDULES

The Trade Contractor's work is to be accomplished in accordance with the contract schedule. If the schedule requires out of sequence work or phasing of work including temporary work, such work is to be performed at no additional cost by the Trade Contractor to achieve the necessary job progress and accommodate the Owner's and Construction Manager's needs.

Within fourteen days of award of the Trade Contract, the Trade Contractor shall submit to the Construction Manager a draft of the Trade Contractor’s schedule. This schedule shall be in the format of a standard horizontal bar chart and shall identify separately activities for each class of work, each work activity by area of the project, and each major long-lead item. Activities shall also indicate interfaces between the work of the Trade Contractor and other contractors. Dates for shop drawings, approval, and fabrication shall also be included and shall identify the projected submittal date, fabrication duration, and expected delivery date. Contractors shall allow at least 25 days for each review and return of submittals after receipt by the Construction Manager. After the Construction Manager reviews and accepts the Trade Contractor’s schedule it shall be used by the Trade Contractor to monitor progress on the project. The Trade Contractor shall submit monthly updates of its schedule with the Application for Payment.

3.0. PROJECT MEETINGS

3.1. The Construction Manager will schedule, pre-construction meetings, weekly progress meetings, progress/payment meetings, safety meetings and any special meetings as required throughout the progress of the Work. Representatives of the Trade Contractors, subcontractors and suppliers appropriate to the agenda of the meeting shall attend these meetings. The representative shall be qualified and authorized to act on behalf of the entity each represents.

3.2. Each Trade Contractor shall be responsible for the scheduling and administration of weekly safety "Tool Box" meetings required throughout the progress of the work. The Trade Contractor shall prepare the agenda for the meetings, record and distribute both the minutes and attendance to the Construction Manager. The minutes shall include all complaints and suggestions relating to safety. Each Trade Contractor shall ensure the attendance of all employees, including subcontractors and suppliers affected under his contract. The Construction Manager may, at his option, attend these meetings and the attendance of the Construction Manager shall not be limited.

4.0 PHOTOGRAPHS OF THE SITE

The Trade Contractor shall not take, or shall not cause any photographs to be taken of the school

job site without express written approval of the Owner.

The Trade Contractor shall not issue any press releases or disseminate any information concerning this project to the news media without the prior approval of the Owner.

5.0 RECORD DOCUMENTS

The Trade Contractor shall maintain a set of record documents. Each document shall be labeled in neat large printed letters "PROJECT RECORD". Record information concurrently with construction progress and do not conceal any work until the required information is recorded.

Record drawings shall be legibly marked to record actual construction; depths of various elements of foundation in relations to finish floor datum; horizontal vertical locations of underground utilities and appurtenances referenced to permanent surface improvements; location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure; field changes of dimension and detail; changes made by Field Order or by Change Order; details not on original Contract Drawings.

The Trade Contractor shall make available all "Record Documents" to the Construction Manager for periodic review of compliance. The frequency of review shall be at the Construction Manager's discretion and maintenance of these "Record Documents" may be tied to monthly invoices if they are not being maintained properly at the project.

At Substantial Completion, the Trade Contractor shall deliver a reproducible sepia and two prints of the Record Documents to the Construction Manager accompanied by a transmittal letter, in duplicate, containing the Project title and number, the Trade Contractors name and address, title and number of each record documents, certification that each document is complete and accurate and the signature of the Trade Contractor or his authorized representative.

Record specifications and addenda shall be legibly marked in each section to record: the manufacturer, trade name, catalogue number, and supplier of each product and item of equipment actually installed; changes made by field order or by change order.

6.0 ELECTRONIC DATA AND DOCUMENTATION SUBMITTAL SPECIFICATIONS

a) Definitions

Project participants - Contractor(s), sub-contractors, tier-Trade Contractors, vendors, testing and balancing firms, and any Commissioning Agents.

OEM - Original Equipment Manufacturer

Maintained assets - Items on drawings or specification documents that require the submittal of electronic data. Such asset data include but are not limited to doors, escalators, elevators, plumbing fixtures, air handling units, fans, pumps, heat exchangers, boilers, chillers, compressors, exhaust hoods, kitchen equipment, sub-stations, switchgear, transformers, panels, motor control centers, emergency generators, fire alarm systems, fire pumps, biomedical equipment, laboratory equipment, hospital gas systems, roofing system, security systems, cameras, badge readers, computers, and vehicles. Bulk and general construction items such as concrete, structural steel, siding, casework, and

wall, floor or ceiling materials will not be included with the exception of roofing or any other element requiring routine or scheduled periodic maintenance in accordance with the manufacturer's written recommendations.

Electronic Documentation – Software based originals of hard copy documents resident in formats such as word processing, spreadsheet, graphic, or read-only applications.

Electronic Data – Information elements of measurable, extractable, and/or sortable value. This information will typically be delivered in spreadsheets, database tables, or, in less typical cases, tables within word processing documents.

b) **General Requirements**

Trade Contractors shall provide construction documentation in electronic documentation format as specified below. The intent is to support the Owner's computerized asset, maintenance, or space management systems. Each Trade Contractor is responsible to pursue, obtain and furnish to JJC Construction Manager the complete asset data required from project participants that are under their Subcontract Work.

The submittal of all specified data in electronic format is to occur concurrently with the progress of the work. Timely and accurate submittals of requisite data will be a condition precedent for issuance of monthly payments. All submittals shall be completed a minimum of 30 days prior to substantial completion or Owner Occupancy, whichever occurs first. Any performance related data should be submitted no later than 30 days after its measurement and recording in the field. Any deviations identified by JJC Construction Manager are to be promptly corrected by the submitting project participant(s) and resubmitted.

c) **Equipment Tagging**

The Trade Contractor shall ensure that manufacturer's equipment tags are fixed to all maintainable equipment items and easily accessible after equipment installation. These permanent tags include, but are not limited to, equipment model number and serial number.

d) **Updated As-Built Drawings**

Any revisions or updated as-built drawings shall be provided in AutoCAD format on CD 30 days prior to Owner occupancy of the facility.

e) **Submittal of Construction Documents**

All documents provided in paper format shall be provided to JJC Construction Manager in an electronic format (electronic documentation such as MS Word, MS Excel, or Adobe PDF) on CD or USB flash drive. Documents that need to be provided in electronic format include:

- Drawings (e.g. as-builts, shop drawings, floor plans)
- Submittals
- Operations and Maintenance manuals
- Testing and Balancing reports
- Commissioning report

f) **Asset Data Collection**

The following need to be delivered to JJC Construction Manager in electronic data format

1. **Maintained Assets** - The following criteria can be used to identify maintained assets. Any questions can be referred to the JJC Construction Manager Representative for clarification (only one of the criteria need apply):

   a. The asset requires some form of periodic maintenance and/or inspections. The unit, assembly or building feature is the subject of a separate and distinct warranty provision.

   b. The item needs to be tracked per regulatory requirements, including, but not limited to, fire extinguishers and emergency lighting.

   c. Unit or assembly cost greater than $2,000 or group purchases in excess of $25,000.

   d. The item is clearly distinct from other items surrounding it and therefore not a part of a larger assembly.

   e. The item, although part of a major system, could be disconnected from the system without disabling the systems operation.

      Some equipment items consist of large assemblies. If the manufacturer provides separate operation and maintenance manuals, with separate and distinct planned maintenance schedules for the equipment elements comprising that large assembly, then each equipment element should be separately identified by equipment tags, and electronic data should be provided for each. An example would be cooling towers and the associated pumps. Conversely, if all components of a large assembly are covered by a single O&M manual, which includes all appropriate planned maintenance schedules, then this could be considered one maintainable asset.

2. **Vendors.** Identify the contractor, Trade Contractor, supplier, distributor and manufacturer – responsible for the installation, service and warranty of each maintainable asset. Data shall include the firm's name, address, contact person, phone number, e-mail address, web site address, date of acceptance, warranty provider, warranty term and any other pertinent information necessary for the owner to obtain service.

3. **Preventive Maintenance.** The project participants shall identify all original equipment manufacturer (OEM) recommended preventive maintenance (PM) tasks and steps associated with each maintainable asset. The PM tasks shall be structured as annual, semi-annual, quarterly, monthly, weekly, daily or as otherwise recommended by the OEM. Each PM task, the annual PM for example, shall contain all the individual steps necessary to complete that task without referencing other tasks or documents. Each PM task shall also list any required or recommended consumable materials and replacement or spare parts that may be used during the performance of the task. Typical data elements would include a description, manufacturer, manufacturer's part number, order quantity

and expected cost. Additionally any pertinent information regarding environmental, health and safety precautions, including MSDS sheets, special tools, or special training requirements shall be provided In the event that multiple identical assets are provided it will only be necessary to provide the PM task or other repetitive information for one asset and identify the other assets the information applies to.

4. **Spare Parts**. In addition to the spare parts specified by the OEM and identified in the preventive maintenance procedures, the project participants shall identify any attic stock materials required under contract such as lamps, filters and other such items.

a) **Typical Maintainable Assets**

A representative list of Maintainable Assets is shown below. This list is not inclusive of all types of maintainable assets required for electronic data submittal. It is provided to give the project participants an understanding of the types of assets and data to be provided in electronic data formats. JJC Construction Manager will work with the project participants to identify the final data requirements and format of the electronic data worksheets.

Typical Maintainable Assets	Base Asset Data	Motor specific data	PM data	Spare Parts data	Company Contact data
Doors and Windows					
Roll-up or coiling doors	X	X	X	X	X
Handicap access doors	X	X	X	X	X
Electrically operated doors or windows	X	X	X	X	X
Revolving doors	X	X	X	X	X
Hardware, locks and keys	X				X
Specialties					
Display systems	X		X		X
Large internal / external signage	X		X		X
Pedestrian control devices (e.g. turnstiles, metal detectors)	X		X		X
Fire protection, local (e.g. extinguishers, cabinets)	X		X		X
Operable partitions	X		X		X
Security and emergency equipment (e.g. cameras, alarms)	X		X		X
Miscellaneous equipment					
Kitchens / food-prep / cafeterias	X		X		X
Barber / beauty shops	X		X		X
Laundry equipment	X		X		X
Vending machines (food, beverage, ATM's)	X		X		X
Audio / visual equipment	X		X		X
Vehicles	X		X		X
Parking gates	X		X		X
Ticket / key and card control units	X		X		X

Loading dock equipment	X		X		X
Solid waste handling equipment	X		X		X
Water supply and treatment equipment	X		X		X
Fluid waste treatment and disposal	X		X		X
Dark room equipment	X		X		X
Athletic, recreational and therapeutic equipment	X		X		X
Office equipment	X		X		X
Medical equipment	X		X		X
Conveying Systems					
Elevators	X	X	X	X	X
Escalators	X	X	X	X	X
Hoists and cranes	X	X	X	X	X
Mechanical					
Fire protection					
Pumps	X		X	X	X
Water towers	X	X	X	X	X
Plumbing (potable water)					
Circulation pumps	X	X	X	X	X
Backflow Preventers	X		X		X
Water heaters	X		X		X
Sewage pumps	X	X	X	X	X
Drinking fountains (self-contained refrigeration)	X		X		X
Fixtures (count and type)	X				X
Heating, Ventilation and Air Conditioning					
Pumps	X		X	X	X
Expansion Tanks	X		X		X
Chemical Water Treatment	X		X		X
Heat Exchangers	X		X		X
Boilers	X	X	X	X	X
Furnaces	X	X	X	X	X
Water Chillers	X	X	X	X	X
Refrigeration Systems	X	X	X	X	X
Energy Storage Devices	X		X	X	X
Air Compressors	X	X	X	X	X
Cooling Towers	X	X	X	X	X
Heat Pumps	X	X	X	X	X
Split Systems	X	X	X	X	X
Packaged Air Conditioning Units	X	X	X	X	X
Humidifiers / Dehumidifiers	X	X	X	X	X
Air Handling Units	X	X	X	X	X
Make-up Air Units	X	X	X	X	X
Air Terminal Units – (e.g. VAV's, FCU's)	X	X	X	X	X
Unit Heaters	X	X	X	X	X
Fans – (e.g. supply, return, exhaust)	X	X	X	X	X
Vacuum Systems	X	X	X	X	X

Electrical					
Substations	X		X		X
Switchgear	X		X		X
Transformers	X		X		X
Panels	X		X		X
Motor Control Centers	X		X		X
Emergency lighting	X		X		X
Uninterrupted Power Supplies	X		X		X
Emergency Generators	X		X		X
Automatic Transfer Switches	X		X		X
Battery Power Systems	X		X		X
Communication – telephone systems	X		X		X
Public Address	X		X		X
Lighting fixtures (count and type)	X		X		X
Controls					
Lighting	X		X		X
Environmental Systems	X		X		X
Building Management Systems	X		X		X
Energy Management Systems	X		X		X

b) **e.DOC Data Formats (Spreadsheet Headers)**

These are the MS Excel column headers representing the desired data elements for the electronic data to be provided by the Trade Contractors or vendors that supply or install any maintainable assets during the construction project. Any fields not easily defined (as agreed to by Trade Contractor and JJC Construction Manager), or is not applicable can be left blank.

Base Asset Data

The Trade Contractor will provide the basic asset data in MS Excel format for all maintainable assets they provide during the construction project.

Spec or Dwg ID	Drawing Reference	Equipment ID (Asset Tag)	Description	Manufacturer

Model Number	Serial Number	Classification	Year Built	Vendor	Original Cost	Condition

Bldg	Floor	Room	Parent Asset	Building System	Warranty Provider	Warranty Start	Warranty Period (Yrs)

Motor specific data

The Trade Contractor will provide the basic motor data in MS Excel format for any motors greater than 5Hp.

Equipment ID	Motor Mfg	Frame	Model	Motor Serial Number	Horse-power	Volts/Phase	Amps	Motor RPM

PM data

The Trade Contractor or vendor will provide the operations and maintenance manuals for each maintainable equipment asset in electronic format. Only one electronic copy and two hard copies of each O&M manual are required. The data that will be extracted from the O&M manuals include.

Equipment ID	PM Name	PM Description or Document #	Frequency	Shop	Task #	Task Description
Est. Hrs.	Parts Required	Tools Required	Hazmat Warnings	Comments		

Spare Parts data

The Trade Contractor or vendor will provide the spare parts listing for each maintainable equipment asset in electronic format. The data that will be extracted from the spare parts lists will include:

Equipment ID	Part Number	Part Description	Qty	Vendor Name	Unit of Measure	Unit Cost	MSDS Reference	Comments

Company Contact data

The Trade Contractor will provide the basic vendor or manufacturer contact information in MS Excel format for all maintainable assets they provide during the construction project.

Equipment ID	Company Name	Contact Name	Address	City	State	Zip	Phone	Fax	Email Address	Website

the Construction Manager accompanied by a transmittal letter, in duplicate, containing the Project title and number, the Trade Contractors name and address, title and number of each record documents, certification that each document is complete and accurate and the signature of the Trade Contractor or his authorized representative.

Record specifications and addenda shall be legibly marked in each section to record: the manufacturer, trade name, catalogue number, and supplier of each product and item of equipment actually installed; changes made by field order or by change order.

8.0 WARRANTIES AND BONDS

Each Trade Contractor shall assemble and submit to the Construction Manager all warranties, bonds, and service and maintenance contacts as specified in the respective sections of the Specifications before Substantial Completion will be granted. The table of contents for this submittal shall include the product or work items; the firm, with the name of the principal, address and telephone number; scope, date of beginning of the warranty, bond or service and maintenance contract; duration; information for the Owner's personnel providing the proper procedure in case of failure and instances which might affect the validity of the warranty or bond.

9.0 WORKING HOURS

Normal work hours for contractors in the college are 7:00 a.m. to 3:30 p.m. Monday through Friday. If necessary, work may be performed outside of these hours or on weekends if scheduled in advance with the Construction Manager. Contractors are responsible for any overtime costs or

shift differentials required to complete work outside normal working hours.

Certain activities of work that may be disruptive to school activities such as demolition, occupancy of classrooms or offices, or work involving harsh chemicals or objectionable odors (example: epoxy or drywall paints, roofing kettles, etc.) shall be performed on school holidays, off hours, or weekends to eliminate or minimize the effect on school operations. Any additional costs to accommodate this are incidental to the contract sum.

All work and deliveries are to be sequenced and scheduled so as to not interfere with the normal operation of the School. No deliveries are to be made to the JJC receiving dock.

Where possible, utility shutdowns and work within occupied areas of the school are to be performed on school holidays, off hours, or on weekends to avoid interference with the school. Any additional costs to accommodate this are incidental to the contract sum.

10.0 PROJECT REPORTS

Without limiting the reports required, the following reports shall be submitted to the Construction Manager:

1. Daily Force and Activity Reports shall be prepared and submitted by each Trade Contractor including similar data for each Trade Subcontractor. Daily reports will be on a form approved by the Construction Manager and will indicate Supervisors, Journeymen, Laborers, Helpers, and Apprentices and, by crew, the activities related to the Trade Contractor's schedule that are being performed. Daily reports shall also include information on material deliveries, test performed, accidents, and other significant events. Daily reports shall be submitted to the Construction Manager no later than 9:00 a.m. the next succeeding business day. Failure to submit timely daily reports will result in the monthly payment requisition being reduced by 10% for each violation.
2. Weekly Toolbox Safety Meeting Minutes including an attendance list of those personnel present and the topic discussed.
3. Time and Material Tickets for documentation of extra work being performed by the Trade Contractor shall be submitted to the Construction Manager for verification by 9:00 the next succeeding business day after the work was performed. Failure to submit Time and Material Tickets the next day may result in rejection of any costs for work performed.
4. Cost Breakdown Reports for record and tax purposes shall be submitted if and as required by the Owner for investment, tax credit, financing, and other purposes.
5. Accident Reports. The First Report of Accident shall be submitted to the Construction Manager within 24 hours of any accident or safety incident. Additional information, including doctors' reports and witness' statements shall be submitted as soon as possible or as requested by the Construction Manager.

12.0 INSTRUCTION OF OWNER'S PERSONNEL

Prior to final inspection and Substantial Completion, The Trade Contractor must coordinate with the Construction Manager and fully instruct the Owner's designated operating and maintenance

personnel of all products, equipment and systems. The instruction time will be sufficient to instruct all shifts of the Owner's operation and maintenance personnel.

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13.2 In the event of serious or lost time accidents, representatives of the Trade Contractor and Trade Subcontractor, as applicable, shall attend an accident review meeting with the Construction Manager. The Trade Contractor shall be represented by its Project Manager and Project Superintendent or such other representative as required by the Construction Manager. Wherever possible, employees that are involved in an accident shall return to work or shall be placed on light duty at the Trade Contractor's expense. All employees that have received direction from a medical doctor of restricted work or light duty shall be placed on light duty.

14.0 PUNCHLISTS AND COMPLETION

A. Trade Contractors are required to perform their own inspections and punchlists prior to requesting an inspection by the Construction Manager or Architect/Engineer. Reasonable evidence of failure to do so shall make the Trade Contractor responsible for all costs incurred by the Construction Manager and Architect/Engineer during inspection.

B. Trade Contractors shall submit copies of its punchlist upon request of the Construction Manager. It is strongly advised that inspections and punchlists be performed on an ongoing basis.

C. Contractors shall diligently prosecute and complete all work on their punchlist. Contractors shall make every effort to ensure punchlist work is completed within thirty (30) calendar days of the date the punchlist was issued. Substantial progress and completion of punchlist work shall be achieved before retainage is reduced below 5%.

15.0 DAMAGE TO THE WORK OF OTHERS

Trade Contractors are responsible for any damage they cause deliberately or accidentally, to the work of other contractors. Contractors shall promptly repair damaged work with or without knowledge of the party that damaged the work. The Construction Manager or Owner is not responsible for damage to installed work caused by other contractors.

16.0 UNDERGROUND UTILITIES

The following procedure shall be followed when any excavation or utility work is to be performed:

a. At least seven (7) days prior to the start of excavation or utility work, notify the Construction Manager of the nature and the schedule of work to be performed.
b. Trade Contractors shall contact JULIE (if required) for utility locating and provide the Construction Manager with the DIG number for the utility locate. The Trade Contractor shall also request at least seven (7) days prior to start of excavation work that the Owner locate any underground utilities in the vicinity of the proposed excavation. The Trade Contractor shall remain responsible for any damage to utilities if either of these two notifications are not made.

Trade Contractors are responsible to utilize safe excavating techniques while working around existing

utilities and remain responsible for any damage or disruption of existing utilities.

18.0 MISCELLANEOUS PROVISIONS

1. Contractors are permitted to park in designated parking areas only.

2. Contractors shall verify existing conditions and work constructed by others (including tolerances permitted by the governing standards of the work performed by others) and shall build to and accommodate same.

3. Contractors shall take all necessary precautions to protect its finished work as well as the work of adjoining trades.

4. Unless indicated otherwise in the Contract Documents, the electrical trade contractor will make all electrical connections to equipment provided by other contractors. Other Trade Contractors shall cooperate with the electrical contractor by providing all specific electrical requirements to the electrical contractor for each piece of equipment. Should the electrical requirement for a piece of equipment provided by other contractors differ from the electrical services indicated in the electrical drawings, the Trade Contractor providing the equipment shall make arrangements and pay all costs to assure the Trade Contractor's furnished equipment matches the electrical services indicated on the drawings and installed by the electrical contractor.

5. All trade contractors requiring access doors or access panels through masonry, drywall partitions, drywall ceilings, or other non-accessible partition or wall shall furnish the appropriate access door or panel to the masonry trade contractor, drywall contractor, or ceiling contractor, etc. for installation by that contractor in the normal flow of its work. Locations of access panels shall be identified by the Trade Contractor prior to construction of the wall or ceiling. Failure to do locate or furnish the appropriate access panel will cause it to be installed by others at the offending party's expense. Access panels shall be of the proper type and size for the application.

6. Contractors using any chemicals, paints, or other products with objectionable, noxious or poisonous fumes (dryfall paint, epoxies, etc.) shall work off hours or weekends if possible. Contractors shall also provide all means of containing dust resulting from their operations by means of temporary dust partitions. If this is not possible or practical, contractors shall supply means of exhausting the fumes or dust and providing for a fresh flow of outside air into the space chemicals are being used. Work activities that permit the transmission of fumes, dust, or vapor will be stopped until corrective measures are taken or work will be rescheduled for off hours/weekends. Any additional costs necessary to comply with this requirement are incidental to the contract sum.

7. There will be no hoist provided on the Project. Further, the permanent elevator will not be made available for use by the Trade Contractors. Each Trade Contractor will be responsible for his own hoisting and material handling.

8. Available areas for stored material on the project site are limited. Trade Contractors shall not store material on site that will not be installed within two weeks without the specific

approval of the Construction Manager. Under no circumstances are access roadways or sidewalks to be used for storage of materials. Trade Contractors shall immediately relocate any materials as required to permit other trades to perform their work, any materials not stored in appropriate areas, or any material that interferes with any contractor's work.

9. Trade Contractor shall bear all costs for standby trades should the Trade Contractor work prior to or later than normal hours, Saturdays, Sundays or Holidays.

10. The Trade contractor is required to provide all required fire safeing materials for its respective work.

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EXHIBIT "A"

Your firm was recently awarded a Contract for the above referenced project. In order to expedite the payments and to avoid any misunderstanding as to the proper billing procedures we request that the following instruction be diligently adhered to:

1. **The following are the items that the subcontractor must comply with immediately following the contract award for issuance of payment.**

   A. Submit for approval a listing of all Trade Contractors and major Suppliers to be listed each month on the Contractor's Sworn Statement.

   B. **Schedule of Values**

   Submit for approval a detailed Schedule of Values of your contract amount on the JJC form within 15 days of contract award. This breakdown shall be divided into both labor and material line items for each major area of work in your contract specifications. Amendments to your contract must be listed separately by amendment and change request number (the change request number is indicated on the amendment), leaving a subtotal for original contract amounts. Once this schedule is approved by JJC Construction Manager, it is to be used on all progress billings indicating percentage of completion applicable to each item.

   C. Return to our Purchasing Department your signed contract, performance bond, drug certification letter, and certificate of insurance. These items must be received prior to commencement of any jobsite activity or processing of payment applications.

   D. **Material Status Reports**

   Submit initial report in format corresponding to Schedule of Values within 15 days of Contract Award.

2. **Billing Instructions:**

   Applications for payment are to be submitted to the JJC Construction Manager Project site office located at the following address:

   - **TBD**

   A. JJC Construction Manager uses a pencil copy procedure to determine your work in place percentages on each monthly progress billing. The procedures are as follows:

      1. The pencil copy (draft) of your Schedule of Values must be submitted to the JJC Construction Manager project staff by the 1st of the month. Your work in place percentages should be projected through the end of the current billing period. (Typically the 15th of the month).The percentages indicated on your pencil copy will be verified by our project staff and you will be notified of any necessary changes or revisions.

      2. Once your pencil copy is approved, you should submit your formal billing to the project office by the dates indicated on the attached schedule.

      NOTE: In order to meet the Owner's payment schedule, incomplete or late applications will be held for the next billing period.

   B. Contractor's application for payment will consist of the following in triplicate:

1. Cover Sheet– Application and Certificate for Payment.

2. Invoice Voucher.

3. Contractors Affidavit and Sworn Statement.

4. Contractor's Waiver of Lien. On the affidavit section of this form you will list your Subcontractors and Suppliers.

    a. Contractor's Waivers are to be totaled cumulatively, i.e. total net amount of payments received by your firm to date.

    b. Sub-sub and Supplier's Waivers confirmation will be submitted as verification of payments noted on the previous month's sworn statements.

    c. Waivers of Lien are not required for your initial payments requests, but are **MANDATORY** as part of all future payments requests. Subsequent progress payments will not be released until these documents for prior payments are received. Also include sub-sub and suppliers waivers.

    d. Certified Payrolls must be current with monthly utilization report for previous month. (Submit weekly payroll reports).

5. Updated monthly Material Status Report.

3. **Extra Work**

A. Daily Time and Material Slips will be processed only **if they are signed on a daily basis by the** JJC Construction Manager/**Project Manager or his designee.** Original invoices for material and equipment, certified payrolls and a labor rate breakdown will be required as back up to any authorized time and material work.

4. **Off-Site Stored Materials**

In order to invoice for materials stored off-site, the following documents must be submitted. JJC Construction Manager will provide a Stored Material Request package, which consists of the following for your execution.

A. Stored Materials Request – Request should be submitted 25 days prior to the established billing date.

B. A fully executed Bill of Sale naming the Owner as purchaser and a guarantee of delivery to the project site. Schedule "A" to the Bill of Sale will list the material to be sold and the total dollar value.

C. Any material stored off-site must carry additional insurance (All Risk Ryder) for the full invoiced value of the items. The certificate holder should be JJC, The insured party, the payee in case of loss, will be the Owner.

1. There will be no deductible attached and the policy will provide a minimum of thirty (30) days notice of cancellation to the certificate holder.

2. All certificates must list the Owner as "Additional Insureds"

3. Provide photographs of the material clearly show identification labels.

D. Provide arrangements for a designated JJC Construction Manager employee to inspect the material at its stored location.

E. **Retention on off-site stored materials is 25%**

5. <u>Contract Close-Out</u>

A. When your contract has reached substantial completion, request for contract closeout should be made in writing to the Project Manager. The final billing should include:

a. General Release and Waiver of Lien
b. General Guarantee
c. Contractor's Affidavit / Final Waiver
d. Subs/Supplier's Final Waivers
e. Final Consent of Surety (provided by the Bonding Company)

If you have any questions as to the proper execution or use of these forms or any questions concerning these instructions, do not hesitate to call the jobsite or myself.

By earnestly following these instructions a significant contribution will be made to the success of the project to the benefit of all concerned.

END OF GENERAL REQUIREMENTS OF THE CONTRACT

SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifically identifies the requirements of the Project Commissioning Team, which includes the Commissioning Provider (CxP), Owner, General Contractor, Installation Contractors, Equipment Suppliers and Vendors in the execution of the commissioning process. A Commissioning Plan shall be provided by the CxP early in the Construction Phase to outline the Commissioning Process, including roles and responsibilities of the Project Commissioning Team. The plan shall also identify the logistics, schedules and management protocols associated with the commissioning process. The plan shall be updated by the CxP as required to accommodate project logistical changes.

B. This Section shall delineate the requirements of the GC and Installation Contractors for the execution of the commissioning process for the following activities:
   1. Participation in Commissioning Meetings
   2. Commissioning submittal requirements
   3. Installation verification and start-up for system components.
   4. Functional operational demonstration of system performance
   5. Commissioning field deficiencies and test deficiencies.
   6. The GC and Installation Contractors shall:
      a. Verify installation and perform quality control.
      b. Provide project scheduling that coordinates commissioning activities with installation contractors' activities
      c. Execute the Training Plan
      d. Perform equipment installation verification and start up. Contractor shall verify the functional readiness of systems to be tested, using pre-functional performance tests, prior to scheduling and demonstrating the functional operational performance in the presence of the CxP.
      e. Conduct functional performance testing
      f. Correct deficiencies
      g. Conduct functional performance retesting, as necessary
      h. Provide documentation of the effort.

C. The Owner, Architect/Engineer, and CxP are not responsible for construction means, methods, job safety, or management function related to commissioning on the job site.

1.2 RELATED SECTIONS

A. Section 01 91 14 – Functional Testing Requirements

B. Division 14 – Conveying Equipment

C. Division 21 – Fire Protection

D. Division 22 – Plumbing

E. Division 23 – Heating, Ventilation and Air Conditioning

F. Division 26 – Electrical

G. Division 28 – Electronic Safety and Security

1.3 EQUIPMENT AND SYSTEMS INCLUDED IN COMMISSIONING PROGRAM

A. The following is a list of the equipment and system test requirements included in this section:
   1. Division 14 – Conveying Equipment
      a. Elevators
   2. Division 21 – Fire Protection
      a. Fire Protection System
   3. Division 22 - Plumbing
      a. Sump Systems
      b. Water Supply Including Circulation Systems & Auto Valves
   4. Division 23 - Heating Ventilating and Air Conditioning
      a. Rooftop Unit With DX Cooling
      b. Computer Room Air Conditioning Units
      c. Variable Air Volume Boxes
      d. Fan Coil Units
      e. Cabinet Heaters
      f. Unit Heaters
      g. Toilet Exhaust
      h. Gas Fired Rooftop Units
      i. Boilers
      j. DDC Building Control System (HVAC System, Security Systems & Emergency Power)

   5. Division 26 - Electrical
      a. Lighting Control Including Time Settings & Sensitivity on Sensors
      b. Power Monitoring & Control
      c. Variable Frequency Drives
      d. Electrical Distribution, Greater Than 400A
      e. Automatic Transfer Switches
      f. Photovoltaic System
   6. Division 28 – Electronic Safety
      a. Fire Alarm System

1.4 DEFINITIONS

A. Acceptance Phase: Phase of construction after startup and initial checkout when Functional Performance Testing, O&M documentation review, and facility and user training occur.

B. Basis of Design (BOD): Documentation of design criteria and decisions made to meet design intent. Describes systems, components, conditions, and methods chosen to define the intent of the Owner.

C. Building Automation System (BAS): The system used to control building system in accordance with specifies sequenced of operation**.**

D. Commissioning Plan (CP): A manual providing documentation of roles and responsibilities and provides structured means of scheduling, coordination and documentation for the commissioning process.

E. Commissioning Provider (CxP): The consultant who facilitates the commissioning program and directs and coordinates day-to-day commissioning activities. Acts as the objective advocate for the Owner. The CxP is contracted by the Owner.

F. Commissioning Team (CT): The Project Team including the Owner, General Contractor, Design Professional, Installation Contractors and equipment manufacturer representatives (as needed).

G. Deferred Functional Test: Functional performance test performed after substantial completion due to conditions that preclude test from being performed in normal sequential order of project delivery. Also includes seasonal testing of environmental systems.

H. Deficiency: Condition of a component, piece of equipment, or system that is not in compliance with Contract Documents. The CxP shall conduct a series of construction phase site visits to observe the progress of installation of building systems in the Commissioning Program. Deficiencies identified by the CxP shall be reviewed by the Design Professionals to determine if the deficiency is a non-conformance issue. If the issue is a non-conformance issue, the Design Professionals shall include the issue in their non-conforming issues report to the contractors.

I. Design Professional (A/E): The design team, generally the Architect, Mechanical Engineer and Electrical Engineer.

J. Factory Testing: Testing of equipment at factory by the Manufacturer.

K. Functional Performance Test (FPT): Test of dynamic function and operation of equipment and systems. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. Systems are run through all specified sequences of operation. Components are verified to be responding in accordance with contract documents. Functional Performance Tests are witnessed by the CxP and executed by the responsible contractor after installation certification forms and start-ups and Pre-Functional Test documentation.

L. Functional Performance Test Document: Protocols and instructions provided for and described in the Commissioning Plan and specifications that describe process required to document Functionality Testing process for each system. Also includes the Systems Integration Tests to confirm that various inter-related systems respond as intended. . CxP develops Functional Performance Test procedures in sequential written form, coordinates, oversees and documents actual testing, which is usually performed by installing contractor or vendor.

M. General Contractor (GC): The prime contractor responsible for the construction of the facility in accordance with contract documents. Responsible for oversight and coordination of all sub-contractor activities to ensure on-time project delivery and compliance with the commissioning program.

N. Installation Certification Form (ICF): Document used by the GC to certify that they have inspected the work of the installing contractors and determined that it is in full compliance with the contract requirements. This form is required on each piece of equipment or component prior to functionally testing the system. Monitoring: Recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or trending capabilities of control systems.

O. Installation Contractor (Sub-Contractor): Contractor who is under contract to General Contractor who provides and/or installs building components and systems.

P. Phased Commissioning: Commissioning completed in phases due to size of structure, construction phasing, availability of systems, etc.

Q. Pre-Functional Testing (PFT): Testing performed by the responsible contractor utilizing the functional performance test protocol This testing is a prerequisite to the Functional Performance Test witnessed and documented by the CxP.

R. Seasonal Performance Evaluation: Functional Performance evaluation executed at the time of year such that system(s) experience conditions closer to design conditions. Includes a combination of trend log analysis and possibly on-site testing as appropriate.

S. Specifications: Construction specifications of Contract Documents.

T. Startup: Initial start or activation of dynamic equipment, including executing the Installation Certification Form and completing a manufacturer's start-up and form where applicable.

U. Trending: Monitoring controls points of systems as a function of time using building control system.

V. Vendor: Supplier of equipment.

1.5 COORDINATION

A. Perform commissioning services to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.

B. CxP shall provide overall coordination and management of the commissioning program as specified herein.

C. Commissioning Team:
   1. The Commissioning Team (CT) is comprised of representatives from the project team who shall be the primary contact for commissioning activities:
      a. Commissioning Provider (CxP)
      b. Owner's Representative(s) (OR)
      c. General Contractor
      d. Design Professional (A/E)
      e. Finishes Contractors
      f. Equipment Installation Contractors
      g. Mechanical Contractor (MC)
      h. Electrical Contractor (EC)
      i. Test and Balance Contractor (TAB)
      j. Controls Contractor (CC)
      k. Equipment Suppliers and Vendors

D. The CxP may witness test activities specified in Division 1 and the technical specifications as well as select construction tests (e.g. piping pressure tests, duct leakage test, etc.) and equipment start-up tests. The OR shall witness commissioning activities as appropriate. Contractors shall provide a minimum five (5) working days advanced notice when tests are scheduled.

E. Contractor shall provide written timely notice to GC and CxP of any changes in date, time, and location or anticipated duration of start-up and test activities. For the purpose of this paragraph written notice shall be received by a minimum of 48 hours in advance to be considered timely.

F. Tests that are not performed as scheduled shall be considered a failed test unless notification of cancellation or rescheduling was received by all parties. The notification shall be received 48 hours prior to the scheduled arrival of the CxP on site to witness functional testing. Contractor shall reimburse Owner for actual costs incurred by the Owner as the result of failure to provide timely notice, per preceding paragraph, of changes in date, time, location, or anticipated duration of start-up and test activities. The actual costs incurred by the Owner shall include costs associated with the CxP involvement.

G. Meeting:

1. Within 90 days after all installation contractors involved in the commissioning program have been awarded a contract for the project, the CxP shall plan, schedule, and conduct a commissioning kickoff meeting with designated project team commissioning representatives in attendance. Responsibilities of the commissioning team shall be clarified at this meeting. The CxP shall distribute meeting minutes to all parties.
2. Commissioning meetings shall be held on a monthly basis as a minimum during the construction installation phase of work. The frequency of these meetings shall increase as construction and acceptance activities require. Designated project team commissioning representatives shall attend the meetings as appropriate based upon the agenda topics to be discussed.
3. Commissioning meetings shall be held weekly during the functional performance testing phase to review status of testing discrepancies and scheduling of retests and back checks.

H. Scheduling:

1. Once a master construction schedule is issued, the CxP shall provide for incorporation to the schedule, commissioning milestone activities linked to specific predecessor construction activities. As construction progresses, more specific activities and milestones shall be incorporated into the master construction schedule.
2. Approximately 6 to 8 weeks prior to the commencement of equipment start-ups, the CxP shall conduct a commissioning functional testing schedule workshop with all commissioning representatives. The purpose of this workshop is to establish a coordinated approach to the integration of the function testing activities with the master construction schedule to ensure substantial completion can be achieved as scheduled.
3. In cooperation with the CxP, the GC shall integrate commissioning activities into the master construction schedule.
4. Scheduling issues shall be resolved at monthly commissioning meetings.

1.6 SUBMITTALS

A. General: Submit the following in accordance with requirements of Section 01 33 00.

B. Start-up plan: For each piece of equipment or system, the GC and Installation Contractors shall submit a start-up plan. Obtain approval of the plan prior to beginning activities. The plan should include, but not be limited to, the following:

1. Start-up schedule
2. Names of firms/individuals required to participate
3. Detailed manufacturer start-up procedures
4. Manufacturer start-up data forms

C. Installation Certification Form (ICF): Installation contractors shall provide CxP, through the GC a completed ICF and a completed manufacturer's start-up form for each piece of equipment or component of a building system included in the commissioning program. These documents shall be used to determine the readiness of the building system for functional performance testing.

D. Pre-Functional Performance Test Documentation: Responsible contractor shall execute the pre-functional performance test and document the satisfactory results of the testing. The completed test shall be provided to the CxP through the GC for review and approval. Final scheduling of the functional performance test on a building system shall not be established until the pre-functional performance test documentation is approved.

E. Temporary Use of Permanent Equipment Operations and Maintenance Plan: Should the contractor receive authorization from the OR to utilize permanent equipment per Section 01 9113-3.2, an Operations and Maintenance Plan shall be submitted for review and approval prior to temporary use of permanent equipment. The Plan shall include a temporary sequence of operations.

F. Submit the final program logic and as-built control sequences used to control all systems included in the commissioning program. As-built control sequences shall also include all system setpoints and reset schedules.

G. The CxP shall review submittals for criteria as related to commissioning. Review is primarily intended to aid in development of functional testing procedures and secondarily to verify compliance with equipment specifications. The CxP notifies the GC**,** OR and A/E of missing items or where issues may exist.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Installation contractors shall provide all specialized tools, test equipment, and instruments required to execute startup, checkout, field calibration and functional performance testing of equipment under their contract.

B. Test equipment shall be of sufficient quality and accuracy (greater accuracy than specified for component) to test and/or measure system performance according to specified tolerances. Test equipment is to have been calibrated within the previous 12 months. Calibration shall be NIST traceable. Equipment shall be re-calibrated when dropped or damaged. Calibration tags shall be affixed or certificates be readily available for review by the CxP.

C. Datalogging equipment or software required to test equipment will be provided by the CxP, but shall not become the property of the Owner.

PART 3 - EXECUTION

3.1 COMMISSIONING OVERVIEW

A. The following provides a brief overview of typical commissioning tasks during construction and general order in which they occur.

1. Commissioning kick-off meeting held within 90 days after all installation contractors involved in the commissioning program have been awarded a contract for the project.
2. Contractor's submittals for equipment and system components included in the commissioning program are reviewed by the A/E and the CxP as specified and in accordance with the requirements of other sections of this project manual.

3. CxP completes development of Functional Performance Tests protocols based on submittals and approved sequence of operations and submits to Project Team for review and comment. Final format of testing protocols, based on review comments, are prepared by CxP and distributed in sufficient time to allow the responsible contractor to complete the pre-functional performance test.
4. During the Construction Phase, the CxP shall make periodic site visits to observe installation progress, conduct commissioning meetings and follow-up on open issues from past visits. Frequency of visits shall increase as systems are nearing start-up and functional testing. Observation reports shall be issued after each site visit.
5. The GC and sub-contractors document proper installation and start-up of equipment utilizing the Installation Certification Form (ICF) developed by the CxP. Supplemental start up documentation and manufacturer authorized representatives start up documentation shall also be attached to the ICF.
6. CxP receives the completed ICF along with the completed manufacturer's start-up form for each respective piece of equipment and/or system. During site visits, CxP may conduct random review of equipment included in completed ICF's.
7. Prefunctional Performance Test documentation. After the system components have been properly installed and started in accordance with the ICF and manufacture representative start up activities, the responsible contractor shall perform a prefunctional performance test on the system utilizing the functional performance test protocols. This test shall not be witnessed by the CxP but is required prior to scheduling the FPT.
8. Contractor and Owner develops Training Plan including training agendas in coordination with the OR and GC.
9. Functional Performance Testing for a system shall be scheduled upon completion of the ICF's for each piece of equipment and component in a building system and Prefunctional Performance Testing. The contractor with responsibility for the functionality of a system demonstrates system functionality to CxP. The CxP shall document the results of the testing.
10. CxP recommends acceptance of performance and functionality or recommends remedial action and re-testing.
11. GC and sub-contractors shall be responsible for providing training in accordance with the Training Plan. Training Plan schedule is coordinated with the OR by the GC.
12. Final Commissioning Report.
13. Deferred Testing.
    a. Unforeseen Deferred Tests.
    b. Seasonal Testing.
    c. End-of-Warranty Review.

3.2 TEMPORARY USE OF PERMANENT BUILDING SYSTEMS DURING CONSTRUCTION

A. Temporary use of permanent building systems shall be authorized only by the Owner in coordination with the A/E and GC.

B. An Operations and Maintenance Plan shall be developed and submitted for review and approval. Should the temporary operation of the system include a Sequence of Operations that does not conform fully to the contract requirements, this temporary Sequence of Operations shall be in the Operations and Maintenance Plan. The temporary Sequence of Operations shall include all safeties to ensure the permanent equipment is protected against failure or damage. A/E and CxP shall review and approve the temporary Operations and Maintenance Plan prior to the contractor energizing and operating the system in the temporary mode.

C. As the construction progresses it may be necessary to utilize building systems for temporary environmental control within the building. Should systems be used for temporary environmental control, this activity shall be sequenced into the system delivery process and involve temporary start-up and functional operations testing. Temporary conditions shall not be fully functionally tested to the extent that a duplication of effort must occur for final delivery to the Owner, once the system is fully operational and balanced. Temporary conditions must, at a minimum, meet the intent of the documentation regarding functionality, hydronic flow rates and space pressurization. The sub-contractor shall utilize the ICF for documenting the readiness of the system to be temporarily operated based upon an approved Operations and Maintenance Plan for the temporary use. The contractor shall be responsible to verify that all temporary conditions meet the requirements of the design documents.

D. A formal verification process for temporary systems will be at the discretion of the Owner and the A/E in the event the need becomes apparent. A formal process is defined as the responsible contractor demonstrating comprehensive functionality to a representative of the Owner, CxP or A/E. The Owner shall not bear additional cost for this demonstration and the demonstration shall occur at the request of the Owner or A/E.

E. The above applies to systems that serve areas of phased construction. Testing shall occur piecewise as determined prudent by the project team for conditions of a system considered to be permanent. The intent is to not repeat the formal functional testing process on a system except as deemed prudent for effective delivery to the Owner.

3.3 RESPONSIBILITIES

A. Responsibilities of contractors are provided as follows (the project Commissioning Plan shall include a comprehensive list of responsibilities of all project parties):

1. General Contractor (GC):
    a. Include requirements for commissioning in each purchase order or subcontract written.
    b. Ensure acceptable representation, with the means and Provider to assist the CxP in the coordination and execution of the commissioning program.
    c. Attend commissioning kick-off meeting and other commissioning team meetings. Ensure appropriate representation at these meetings by sub-contractors.
    d. Incorporate commissioning milestones and activities including functional performance testing into master construction schedule. Maintain and update schedule, as needed, such that it is an accurate representation of construction progress through the completion of functional performance testing and resolution of all punch list issues. Also incorporate durations for scheduled training in the schedule.
    e. Review and provide comment on the Commissioning Plan and Functional Performance Test protocols developed by CxP.
    f. Take lead role in coordinating completion and documentation of the Installation Certification Form for equipment and components of building systems included in the Commissioning Program.
        1). Coordinate this activity with knowledgeable staff of.
        2). Once all ICF's are completed for a building system, GC shall forward them ICF's to CxP as a system package.
    g. Coordinate the execution of prefunctional performance test documentation with the responsible contractors.
    h. Coordinate Contractor participation in execution of the Training Plan.
    i. Provide CxP with required documentation from commissioning activities and submittal requests.

j. Schedule, coordinate and assist CxP in seasonal or deferred testing and deficiency corrections required by specifications.

2. Installation Contractors:
   a. Ensure acceptable representation on the commissioning team, with the means and Provider to assist the CxP in the coordination and execution of the commissioning program.
   b. Attend commissioning kick-off meeting and other commissioning team meetings scheduled by CxP.
   c. Assist CxP with developing a comprehensive commissioning schedule during regularly scheduled commissioning meetings. Participate in the functional test scheduling workshop.
   d. Complete commissioning activities as scheduled in master construction schedule.
   e. Complete Installation Certification Form along with respective manufacturer's start-up form and submit with supporting documentation to the GC.
   f. Address deficiencies identified during construction phase site visits in a timely manner. Within two (2) work days of notification of a deficiency, acknowledge the deficiency and implement action required to address the issue. Within five (5) work days of notification of a deficiency have deficiency corrected.
   g. Provide certified and calibrated instrumentation to field calibrate all sensors and devices and assist during Functional Performance Testing.
   h. Ensure installation work is complete, in compliance with Contract Documents, in accordance with approved submittals and meets or exceeds industry standards and ready for Functional Performance Testing.
   i. Execute the prefunctional performance test successfully. Resolve any performance issues with the A/E.
   j. Execute inspections, tests, and Functional Performance Tests as described in contract documents and Commissioning Plan. Operate systems and equipment to demonstrate proper sequences of operation.
   k. Review Commissioning Plan and Functional Performance Test procedures.
   l. Provide required training for Owner personnel utilizing qualified and experienced instructors.
   m. Provide documentation according to contract documents.
   n. Address deficiencies identified during functional testing in a timely manner. Within one (1) work day of notification of a deficiency, acknowledge the deficiency and implement action required to address the issue. Within two (2) work days of notification of a deficiency have deficiency corrected unless an extension is approved by the OR and CxP.
   o. Execute seasonal or deferred Functional Performance Testing.
3. Controls Contractor:
   a. Ensure acceptable representation, with the means and Provider to assist the CxP in the coordination and execution of the commissioning program.
   b. Completely install and thoroughly inspect, startup, test, adjust, field calibrate, and document systems, equipment, devices, sensors, etc. controlled by the building automation system. Provided documented point-to-point check out of the system prior to functional performance testing. Field calibration of sensors and devices shall be performed even though factory calibration documentation has been provided.
   c. Address deficiencies identified during construction phase site visits in a timely manner. Within two (2) work days of notification of a deficiency, acknowledge the deficiency

and implement action required to address the issue. Within five (5) work days of notification of a deficiency have deficiency corrected.

d. Complete prefunctional performance tests for all sequence of operations controlled by the Building Automation System.

e. Assist CxP during Functional Performance Testing. Assistance shall generally include the following:

1). Attend Cx progress and coordination meetings

2). Complete Installation Certification Forms (ICF's) with supporting documentation and submit to the GC**.**

3). Prepare and submit required draft forms and systems information.

4). Set up trend logs of system operation at discretion of CxP.

5). Demonstrate system operation to the CxP.

6). Address deficiencies identified during functional testing in a timely manner. Within one (1) work day of notification of a deficiency, acknowledge the deficiency and implement action required to address the issue. Within two (2) work days of notification of a deficiency have deficiency corrected unless an extension is approved by the OR and CxP.

7). Provide onsite programmer(s), in addition to those dedicated to functional testing, to correct deficiencies in control sequences during the commissioning period. Minor adjustments to program logic may be made during the functional testing at the discretion of the CxP. All other programming issues shall be completed either after hours or by utilizing additional controls technicians.

8). Provide instrumentation, in calibration, necessary for field verification of all sensors and devices and Functional Performance Testing.

9). Manipulate control systems to facilitate verification and Functional Performance Testing.

10). Provide at least one dedicated controls technician who is totally familiar with the controls installation and program logic on the project to work with the CxP during the functional performance testing.

11). Provide an as-programmed copy of the control logic for each system controlled by the Building Automation System and provide an as-built sequence of operations for each system.

4. Test Adjust Balance (TAB) Subcontractor:

a. Ensure acceptable representation, with the means and Provider to assist the CxP in the coordination and execution of the commissioning program.

b. Attend Commissioning meetings.

c. Both air and hydronic balancing of systems supporting a building system shall be completed prior to the functional performance test of the system.

d. Once TAB record is completed, coordinate with the CxP to verify up to 10**%** of the record. Contractor shall utilize equipment used during initial TAB balancing for the TAB verification.

e. Rebalance deficient areas identified during commissioning.

3.4 COMMISSIONING TEAM MEETINGS

A. Commissioning Team Meetings shall be held periodically as determined by CxP with frequency increasing as construction advances and systems become operational. Three days prior to a scheduled meeting the CxP shall issue an Agenda and a list of meeting participants. Not all meetings will require all team members to be present. Attendance is mandatory for Contractors

on the agenda participant list. CxP shall chair Commissioning Team Meetings and issue meeting minutes within two (2) days of the meeting.

B. Discussions held in Commissioning Team Meetings shall include but not be limited to system / equipment start-up, progress, scheduling, testing, documentation, training, deficiencies, and problem resolution.

3.5 BUILDING SYSTEM MAINTENANCE/SERVICE POINT ACCESS REQUIREMENTS

A. Each trade contractor shall be responsible for flagging all maintenance points that are located above the ceiling. Construction warning ribbon (1" minimum width) shall be securely attached to the maintenance point and, where applicable, extended down to the ceiling height level such that it is highly visible by all trades. If the location has no ceiling the ribbon shall extend a minimum of 3 feet.

B. All trades shall ensure that unobstructed access to the maintenance point is maintained from floor level up to the point of service. Unobstructed access shall include full body access to the service point should that be required for maintenance activities. Any trade who installs systems encroaching upon the unobstructed access shall be required to relocate their material, systems and/or equipment at no additional cost to the Owner.

3.6 INSTALLATION CERTIFICATION FORM (ICF)

A. The purpose of this certification form is to formally document the contractor's quality assurance effort as it relates to the installation and start-up of the specified piece of equipment or system component. The installing contractor responsible for the system shall be responsible for coordinating the completion of this form with the other trades supporting the installation and start-up. The individual signing this certification shall have the Provider to sign on behalf of the contractor and shall have direct personal knowledge of the equipment or system component installation. Any contractor start-up forms or manufacturer specified start-up procedures and documentation shall be attached to this certification form. The completed ICF shall be submitted to the GC**.**

B. The GC shall coordinate the effort. When an installing contractor completes an ICF and submits it to the GC**,** the GC representative shall sign the ICF after inspecting the installation and confirming the equipment/system component, as installed, meets the requirements of the project documents and is ready for functional performance testing. The GC shall compile all ICF's for equipment/system components then submit a system package to the CxP for review.

C. At appropriate milestones, the GC shall review the status of the completion of the ICF's with each contractor to ensure progress in completing this documentation does not delay the start of functional testing.

D. Lead Trade Contractor and supporting trade contractors shall execute the ICF and provide the GC with an original signed and dated form. Only individuals with the Provider to sign as the contractor representative and having direct knowledge of the installation and start-up of the equipment or system component shall sign Installation Certification Form. The CxP receives completed ICF's from the GC as system packages. Once all equipment and system component certification forms have been submitted for a building system the contractor shall proceed with the Pre-Functional Performance Testing.

E. The OR, A/E or CxP reserve the right to witness any startup and preliminary equipment testing.

3.7 FUNCTIONAL PERFORMANCE TESTING

A. General:

1. Refer to Section 01 9114 for additional details regarding the functional performance testing.

B. Objectives and Scope:

1. Each system shall be operated through all modes of operation (normal operation, failure/recovery operation, seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, etc.) where there is a specified system response. Verifying each sequence in the specified sequence of operation is required including responses to conditions such as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. The first step in achieving these objectives is the successful execution of the FPT by the responsible contractor as a prefunctional performance test prior to demonstrating the system operation to the CxP.
2. The contractor responsible for the dynamic operation of a system shall demonstrate comprehensive functionality of that system. All contractors that have contributed to the installation of the same system shall not be required to directly participate in the functional testing activity but shall be required to be immediately available for reconciliation of issues that fall within their scope and responsibility during testing.
3. Functional Performance Testing witnessed by the CxP shall be considered successful when repeatable acceptable outcomes meeting the Basis of Design criteria are achieved.

C. Coordination and Scheduling:

1. Functional Performance Testing is conducted following completion of all installation and start-up contractor activities for all equipment and system components associated with the building system. The ICF's for all system equipment/components shall be completed by the installing contractors, submitted by the GC and reviewed by the CxP prior to performing the Pre-Functional Performance Test. Once both of these tasks are complete and reviewed by the CxP, the Functional Performance Test shall be scheduled.
2. Coordination and final scheduling confirmation of Functional Performance Testing shall occur during regularly scheduled commissioning meetings.
3. All commissioning activities shall be fully integrated into the construction activity schedule. This includes milestone deadlines for completion of installation of major system components and the durations for functional testing of a system.
4. The GC shall provide sufficient notice to CxP regarding changes to the coordinated completion schedule for systems testing.
5. CxP shall witness and document Functional Performance Testing of systems. Designated sub-contractor or vendor responsible for dynamic operation of a system or device shall demonstrate system functionality to CxP.
6. Functional Performance Test discrepancies shall be issued upon completion of a system test, or portion thereof should the deficiency preclude continuation of testing.

D. Test Strategy

1. Each contractor shall comprehensively test and document all building systems in the Commissioning Program for which they are responsible utilizing the Pre-Functional Performance Test Document. Any discrepancies or issues identified during the Pre-Functional Performance Test shall be resolved then retested and documented by the installation contractor.
2. Once the successful Pre-Functional Performance Test has been documented, then the CxP shall witness and document the Functional Performance Test for the record.

3. Systems that contain many repeated identical devices may be selected and demonstrated to the project team based on the sampling strategy indication in paragraph 1.3A of this specification.

E. Non-Conformance:
   1. CxP shall document results of Functional Performance Test to FPT forms. Deficiency or non-conformance issues shall be noted and reported to commissioning team as a punch list item with specific responsibility indicated.
   2. Corrections of minor deficiencies identified may be made during testing at discretion of CxP. In such case, deficiency and resolution shall be documented on procedure form and to punch list as a resolved issue.
   3. Every effort shall be made to expedite testing and minimize unnecessary delays, while not compromising integrity of procedures.
   4. Deficiencies are handled in the following manner:
      a. When there is no dispute on deficiency and Contractor accepts responsibility for remedial action:
         1). CxP documents deficiency and contractor's response and intention. CxP posts issue to action list. Contractor corrects deficiency and resubmits to CxP. Contractor addresses all issues noted on action list by correcting deficiencies or by posting date for completion of resolution of deficiency.
         2). Contractor shall provide a response pertaining to the deficiency within one (1) work day of notification of the deficiency. This response shall include the contractor's intentions for addressing the issue. Contractor shall satisfactorily address the issue including completion of the corrective actions within two (2) work days of the initial notification of the deficiency unless an extension is authorized by the OR and CxP.
         3). The GC reschedules test with CxP and contractor. New test time is posted to project schedule.

      b. When there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
         1). CxP documents deficiency and contractor's response and testing proceeds on subsequent test or sequence. CxP posts issue to punch list and distributes to team.
         2). The GC facilitates resolution of deficiency. Other parties are brought into discussions as needed. Final interpretive Provider is with A/E. Final acceptance Provider is with the Owner.
         3). CxP documents resolution process.
         4). Once interpretation and resolution has been decided, appropriate party corrects deficiency, and CxP is given notice to proceed for retest. The GC and CxP reschedule test. New test time is posted to project schedule.

F. Cost of Retesting:
   1. Cost to contractor to recheck Installation Certification Form, re-execute the prefunctional performance test or the FPT, if they are responsible for deficiency or failure, shall be theirs. If contractor is not responsible, cost recovery for re-visitation shall be negotiated with the GC. Final determination as to whether the ICF, PFT or FPT was properly executed as it relates to the project documents and the Basis of Design falls with the A/E.
   2. Time for CxP to witness and document any retesting required because a specific Installation Certification Form, start-up test item or prefunctional performance test reported to have been successfully completed, but determined during Functional Performance Testing to be faulty, shall be back charged to the contractor.

3. Contractors shall be held responsible for expenses incurred by Owner for retesting due to the contractor's state of reported readiness or lack thereof as represented on the completion of all commissioning documentation required prior to the FPT. Expenses could include, but not be limited to, retesting labor costs, travel expenses, and remobilization for owner and consulting teams.

G. Approval:

1. CxP notes each satisfactorily demonstrated function on test form. CxP, GC, and OR provide formal approval of FPT after review.

3.8 DEFERRED TESTING

A. Unforeseen Deferred Tests:

1. Any testing that is not completed prior to substantial completion due to reasons beyond the control of the GC or at the request of the Owner shall be conducted as soon after substantial completion as possible so as not to disrupt the building occupants when the facility is fully occupied.

B. Opposite Season Testing: Testing procedures shall be repeated and/or conducted as necessary during appropriate seasons. "Opposite season" testing is primarily for environmental systems and shall be required where scheduling prohibits thorough testing in all modes of operation. Opposite season testing may also be required when conditions have been simulated to observe the response of the system. The CxP shall schedule the opposite season testing during the warranty period to coincide with a design day condition when possible. Alternatively, should the testing during the normal testing period demonstrated the acceptability of the program logic for the opposite season, then trending of the system during the opposite season is also an acceptable means of documenting operational performance.

END OF SECTION

SECTION 01 91 14 - FUNCTIONAL TESTING REQUIREMENTS

PART 1 - GENERAL

1.1 INCLUDED SYSTEMS AND EQUIPMENT

A. The following systems and equipment included in commissioning program. The sampling rate shown indicates what percentage of system components shall be tested during the functional performance period.

1.	Division 14 – Conveying Equipment	Sampling Rate
a.	Elevators	100%
2.	Division 21 – Fire Protection	Sampling Rate
a.	Fire Protection System	100%
3.	Division 22 - Plumbing	Sampling Rate
a.	Sump Systems	100%
b.	Water Supply Including Circulation Systems & Auto Valves	100%
4.	Division 23 - Heating Ventilating and Air Conditioning	Sampling Rate
a.	Rooftop Unit With DX Cooling	100%
b.	Computer Room Air Conditioning Units	100%
c.	Variable Air Volume Boxes	20%
d.	Fan Coil Units	20%
e.	Cabinet Unit Heaters	20%
f.	Unit Heaters	20%
g.	Toilet Exhaust	100%
h.	Gas Fired Rooftop Units	100%
i.	Boilers	100%
j.	DDC Building Control System	100%
k.	Test, Adjust and Balance Verification	5%
5.	Division 26 - Electrical	Sampling Rate
a.	Lighting Control System	100%
b.	Power Monitoring & Control	100%
c.	Variable Frequency Drives	100%
d.	Electrical Distribution, Greater Than 40A	100%
e.	Automatic Transfer Switches	100%
f.	Photovoltaic System	100%
6.	Division 28 – Electronic Safety and Security	Sampling Rate
a.	Fire Alarm System	100%

1.2 DESCRIPTION

A. This section specifies the functional testing requirements for, 14, 21, 22, 23, 26, and 28 systems and equipment. From these requirements, the Commissioning Provider (CxP) shall develop step-by-step procedures to be executed by the Subs or the CxP. The general functional testing process,

requirements and test method definitions are described in Section 01 9113. The test requirements for each piece of equipment or system contain the following:

1. The contractors responsible to execute the tests, under the direction of the CxP.
2. A list of the integral components being tested.
3. Functions and modes to be tested.
4. Required conditions of the test for each mode.
5. Special procedures.
6. Required methods of testing.
7. Required monitoring.
8. Acceptance criteria.
9. Sampling strategies allowed.

B. The functional performance testing protocols developed shall be used as follows:

1. The responsible contractor shall perform a Prefunctional Performance Test utilizing the testing protocol. During the execution of test, the contractor may encounter issues or requires clarification to a test procedure that may require coordination with both the A/E and the CxP. Any changes or modifications to the test protocol shall be made by the CxP for use in the final test effort. Any changes to the test protocol that result in changes to the sequence of operation of the system shall require written approval by the A/E. Once written approval is obtained from the A/E, the control sequence changes shall be incorporated into the test protocol by the CxP. The Contractor shall be responsible for performing and documenting the test results should the control sequences be modified.
2. Upon completion of the prefunctional testing documentation by the contractor, the Functional Performance Test protocol shall be updated to reflect any approved changes or modifications and then used by the CxP to witness and document the final testing by the contractor.

1.3 PREREQUISITES

A. The first prerequisite for the start of functional performance testing is the completion and acceptance of the Installation Certification Form (ICF) for each system and/or system component. Refer to Section 01 9113 for information regarding the Installation Certification Form (ICF). The second prerequisite for the start of functional performance testing is the prefunctional performance test documentation from the responsible contractor.

B. The Controls Sub-Contractor shall have completed the BAS network communication for the entire system, verified and completed the BAS graphics package and confirm the availability of a dedicated controls technician knowledgeable with the programming for the project during the functional performance testing.

C. All test and Balance (TAB) work shall be completed for the respective and associated systems that are to be tested.

1.4 MONITORING

A. Monitoring is a method of testing as a stand-alone method or to augment manual testing.

B. All points listed in the required monitoring section of the test requirements that are control system monitored points shall be trended by the Controls Subcontractor. Other points shall be monitored by the CxP using data loggers or other independent stand-alone devices. At the option of the CxP,

some control system monitoring may be replaced with data logger monitoring. At the CxP's request, the Controls Subcontractor shall trend up to 20% more points than listed herein at no extra charge.

C. Systems not controlled by the integrated automation system: Systems like the fire detection system or prepackaged control systems for boilers or chillers, events logs shall be set up by the contractor to record all events and alarms during the period of testing

D. Copies of monitored trend data shall also be provided in electronic format in either Microsoft Excel or Word.

E. Graphical output is desirable, and will be required for all output, if the system can produce it.

PART 2 - PRODUCTS

A. NOT APPLICABLE

PART 3 - EXECUTION

3.1 DIVISION 14 – CONVEYING SYSTEMS

A. Elevator
   1. Obtain documentation indicating correct equipment has been provided and installed as specified. Include all manufacturer and installer certifications as specified.
   2. Perform testing verifying the elevator door operation (open and closing)
   3. Verify operation under fire alarm conditions.
   4. Verify operation during emergency power operations.

3.2 DIVISION 21 – FIRE PROTECTION

A. Fire Protection System
   1. Parties Responsible to Execute Functional Test
      a. Fire Protection Contractor: to perform testing
      b. Fire Detection Contractor to assist in testing
      c. CxP: direct, witness, and document testing
   2. Integral Components or Related Equipment Being Tested as applicable for the specific unit
      a. Fire Protection System
   3. Functions / Modes Required To Be Tested
      a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
      b. Commissioning testing shall include but not be limited to the following:
         1). Flow and Tamper Switches
         2). Fire Pump
   4. Required Monitoring
      a. None

B. Acceptance Criteria (referenced by function or mode ID)

1. For the conditions, sequences and modes tested, the fire protection system, integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

3.3 DIVISION 22 - PLUMBING

A. Plumbing related systems

1. Parties Responsible to Execute Functional Test
   a. CxP: perform and document testing.
   b. Plumbing contractor: operate the controls to activate the equipment.
2. Integral Components or Related Equipment Being Tested as applicable for the specific unit
   a. Equipment, systems, and associated devices for systems in the commissioning scope of work as listed above in section 1.1
3. Functions / Modes Required To Be Tested
   a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
   b. Commissioning testing shall include but not be limited to the following:
      1). Domestic Water Heaters
         a). Recovery Rate
         b). Temperature Control
         c). Staging
      2). Potable Hot/Cold Systems
         a). Pressure Control
         b). Mixing Valves
         c). Fixture Sensors
         d). Temperature
      3). Sump Pumps
         a). Location of Level Floats
         b). Operation of Pump Staging
         c). Alarms
4. Required Monitoring
   a. None
5. Acceptance Criteria (referenced by function or mode ID)
   a. For the conditions, sequences and modes tested, the heating hot water integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

B. Sump Pumps

1. Parties Responsible to Execute Functional Test
   a. Plumbing contractor: operate the controls to activate the equipment.
   b. Controls Contractor: assist in testing sequences (Monitoring Alarms).
   c. CxA: direct, witness and document testing

2. Integral Components or Related Equipment Being Tested as applicable for the specific unit
    a. Sump Pumps
3. Functions / Modes Required To Be Tested
    a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
    b. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.
    c. Commissioning testing shall include but not be limited to the following:
        1). Verify all alarms and safeties
        2). Verify sensor calibration checks on any controlling equipment
        3). Verify schedules and setpoints to be reasonable and appropriate
        4). Verify floats activate the pumps
        5). Verify high-level water alarm
        6). Verify low-level water alarm
        7). Verify the sequencing of the each pump
        8). Determine the diversity/recovery rate in system (if any) then test to maximum diversity.
4. Acceptance Criteria
    a. For the conditions, sequences and modes tested, the sump pumps, integral components and related equipment respond to varying loads and changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

3.4 DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING

A. General
1. Required Monitoring
    a. All controlled parameters, respective setpoints, and output points/values for controlling devices shall be trended at a sampling rate specified by the Owner. The controls contractor shall program the respective trend logs in the BAS. All other points that are control system monitored points shall be made available for trending and respective trend logs shall be programmed by the Controls Contractor if owner or CxP require these (any or all) points to be (historically) trended. Other points may be monitored by the CxP using data loggers. During Functional Testing, trend log sampling rates may be increased to monitor responses to various control sequences and failure scenarios.
2. Acceptance Criteria for Air Handling Systems
    a. For the conditions, sequences and modes tested, the HVAC equipment and/or other building systems, integral components and related equipment respond to varying loads and changing conditions and parameters appropriately as expected, as specified, and according to acceptable operating practice.
    b. HVAC equipment and supporting systems shall be able to maintain the respective controlled temperature and humidity within specified tolerances either side of the current setpoint without excessive hunting.

c. HVAC equipment and controls shall control the duct static pressure and/or air flows to maintain the controlled parameter within specified tolerances either side of the setpoint value without excessive hunting.

3. Acceptance Criteria for Hydronic Systems
   a. For the conditions, sequences and modes tested, the chilled water system, integral components and related equipment respond to varying loads and changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.
   b. Chiller shall maintain the chilled water supply setpoint to within +/- 1.0F of setpoint deadband without excessive hunting.
   c. Pumping system and controls shall maintain the current desired pressure setpoint to within an amount equal to [5%] of the setpoint value either side of the deadband without excessive hunting.
4. Acceptance Criteria for Building Automation System(BAS) and Test and Balance (TAB) Report
   a. A failure of more than 10% of the randomly selected items shall result in the failure of acceptance of the BAS system or the TAB report.
5. BAS contractor shall be responsible for performing a new point-to-point verification check, provide documentation and repeat the random verifications of the system
6. TAB contractor shall be responsible to rebalance the system, provide a new system TAB report and repeat random verifications of the new TAB report.

B. Humidifiers
   1. Parties Responsible to Execute Functional Test
      a. Controls contractor: operate the controls to activate the equipment as needed.
      b. HVAC mechanical contractor: assist in testing sequences as needed.
      c. CxP: to witness, direct and document testing.
   2. Integral Components or Related Equipment Being Tested as applicable for the specific unit
      a. Air Handling Units
   3. Functions / Modes Required To Be Tested
      a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
      b. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.
      c. Commissioning testing shall include but not be limited to the following:
         1). Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, component failure, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated. This testing shall include the following as applicable:
            a). Sensor activator calibration checks
            b). Device and actuator calibration and stroke checks
            c). Control parameters and setpoints are reasonable and appropriate
         2). Control loops are tuned to eliminate hunting or significant overshoot

3). Alarms

C. Exhaust Fans
1. Parties Responsible to Execute Functional Test
a. Controls contractor: operate the controls to activate the equipment as needed.
b. HVAC mechanical contractor: assist in testing sequences as needed.
c. CxP: to witness, direct and document testing.
2. Integral Components or Related Equipment Being Tested
a. Exhaust fans
3. Functions / Modes Required To Be Tested
a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
b. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.
c. Commissioning testing shall include but not be limited to the following:
1). Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, component failure, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated. This testing shall include the following as applicable:
a). Schedules and setpoints are reasonable and appropriate
b). Interlocks to building pressurization control
2). Sensor and actuator calibration checks: Sensor and actuator calibration completed by contractor in ICF Calibration document. Random sampling checks by CxP during functional testing. (BAS readout against hand-held calibrated instrument or observation must be within specified tolerances)

D. Fan Coil
1. Parties Responsible to Execute Functional Test
a. Controls contractor: operate the controls to activate the equipment as needed.
b. CxP: to witness, direct and document testing.
2. Integral Components or Related Equipment Being Tested as applicable for the specific unit
a. Fan Coil
3. Functions / Modes Required To Be Tested
a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
b. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.
c. Commissioning testing shall include but not be limited to the following:
1). Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, component failure, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated. This testing shall include the following as applicable:

a). Monitor and trend room temperature data

2). Alarms

E. Unit Heaters

1. Parties Responsible to Execute Functional Test
   a. Controls contractor: operate the controls to activate the equipment as needed.
   b. CxP: to witness, direct and document testing.
2. Integral Components or Related Equipment Being Tested as applicable for the specific unit
   a. Unit Heaters
3. Functions / Modes Required To Be Tested
   a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
   b. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.
   c. Commissioning testing shall include but not be limited to the following:
      1). Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, component failure, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated. This testing shall include the following as applicable:
         a). Monitor and trend room temperature data
      2). Alarms

F. Cabinet Unit Heaters

1. Parties Responsible to Execute Functional Test
   a. Controls contractor: operate the controls to activate the equipment as needed.
   b. CxA: direct, witness and document testing
2. Integral Components or Related Equipment Being Tested as applicable for the specific unit
   a. Cabinet Unit Heaters
3. Functions / Modes Required To Be Tested
   a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
   b. Commissioning testing shall include but not be limited to testing each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, component failure, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible. Testing shall include but not be limited to the following:
      1). Verify that airflow is as per schedule
      2). Manipulate terminal devices through all sequences of operation and verify proper operation.
      3). Monitor and trend room temperature sensors.
      4). All alarms

G. Heat Pumps
   1. Parties Responsible to Execute Functional Test
      a. Controls contractor: operate the controls to activate the equipment as needed.
      b. CxP: to witness, direct and document testing.
   2. Integral Components or Related Equipment Being Tested as applicable for the specific unit
      a. Dedicated Outside Air Handling Unit
   3. Functions / Modes Required To Be Tested
      a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
      b. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.
      c. Commissioning testing shall include but not be limited to the following:
         1). Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, component failure, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated. This testing shall include the following as applicable:
            a). Monitor and trend room temperature data
            b). Device and actuator calibration and stroke checks
            c). Control parameters and setpoints are reasonable and appropriate
         2). Control loops are tuned to eliminate hunting or significant overshoot
         3). Alarms

H. Air Terminal Boxes
   1. Parties Responsible to Execute Functional Test
      a. Controls contractor: operate the controls to activate the equipment as needed.
      b. CxP: to witness, direct and document testing.
   2. Integral Components or Related Equipment Being Tested as applicable for the specific unit
      a. Air Terminal Boxes – Office
   3. Functions / Modes Required To Be Tested
      a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
      b. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.
      c. Commissioning testing shall include but not be limited to the following:
         1). Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, component failure, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated. This testing shall include the following as applicable:
            a). Monitor and trend room temperature data
            b). Device and actuator calibration and stroke checks
            c). Control parameters and setpoints are reasonable and appropriate

2). Control loops are tuned to eliminate hunting or significant overshoot

3). Alarms

I. Water Cooled Computer Room Air Conditioning Units

1. Parties Responsible to Execute Functional Test
   a. Controls contractor: operate the controls to activate the equipment as needed.
   b. CxA: direct, witness and document testing
2. Integral Components or Related Equipment Being Tested as applicable for the specific unit
   a. Water-Cooled Computer Room Air Conditioning Units
3. Functions / Modes Required To Be Tested
   a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
   b. Commissioning testing shall include but not be limited to testing each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, component failure, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible. Testing shall include but not be limited to the following:
      1). Activate air conditioning unit using remote wall mounted microprocessor control keypad.
      2). Check that all dampers modulate freely
      3). Verify that condensate drain is functioning properly.
      4). Verify cooling capacity
      5). Verify smoke detector operation

J. Chilled Water System

1. The cooling tower can be tested integrally with the chiller testing. The cooling tower test requirements are listed elsewhere.
2. Parties Responsible to Execute Functional Test
   a. Controls subcontractor: operate the controls as needed.
   b. HVAC mechanical contractor or vendor: assist in testing sequences as needed.
   c. CxP: to witness, direct and document testing.
3. Integral Components or Related Equipment Being Tested
   a. Chilled water piping system
   b. Pumps
   c. Variable Frequency Drives
4. Functions / Modes Required To Be Tested
   a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
   b. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.
   c. Commissioning testing shall include but not be limited to the following:

1). Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, component failure, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated. This testing shall include the following as applicable:

a). Failure and recovery scenarios for pumps

b). Device and actuator calibration and stroke checks

c). Control parameters and setpoints are reasonable and appropriate

2). Control loops are tuned to eliminate hunting or significant overshoot on system pressure and temperature

3). Alarms

K. Heating Hot Water System

1. Parties Responsible to Execute Functional Test
   a. Controls Subcontractor: operate the controls, to activate the equipment as needed.
   b. HVAC Mechanical Contractor or vendor: assist in testing sequences as needed.
   c. CxP: to witness, direct and document testing.
2. Integral Components or Related Equipment Being Tested as applicable:
   a. Heat Exchanger
   b. Supply pumps
   c. Heating water piping system
   d. Variable Frequency Drives
3. Functions / Modes Required To Be Tested
   a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
   b. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.
   c. Commissioning testing shall include but not be limited to the following:
      1). Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, component failure, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated. This testing shall include the following as applicable:
         a). Failure and recovery scenarios for pumps
         b). Staging on and off heat exchangers
         c). Device and actuator calibration and stroke checks
         d). Control parameters and setpoints are reasonable and appropriate
         e). Supply water temperature reset
      2). Control loops are tuned to eliminate hunting or significant overshoot on system pressure and temperature
      3). Alarms

L. Steam and Condensate System

1. Parties Responsible to Execute Functional Test

a. Controls Contractor: operate the controls, as needed.
b. HVAC Mechanical Contractor or vendor: assist in testing sequences.
c. CxP: to witness, direct and document testing.

2. Integral Components or Related Equipment Being Tested as applicable:
   a. Steam/condensate piping system
   b. Steam/condensate piping specialties
   c. Heat Exchangers
3. Functions / Modes Required To Be Tested
   a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
   b. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.
   c. Commissioning testing shall include but not be limited to the following:
      1). Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, component failure, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated. This testing shall include the following as applicable:
         a). Staging steam valves based on steam demand
         b). Staging on and off heat exchangers
         c). Testing steam traps and condensate return pumping units
         d). Steam pressure control
      2). Control loops are tuned to eliminate hunting or significant overshoot on system pressure and temperature
      3). Alarms

M. Building Automation System (BAS)
1. Parties Responsible to Execute Functional Test
   a. Controls Subcontractor: operate the controls to activate the equipment.
   b. CxP: to witness, direct and document testing.
2. Integral Components or Related Equipment Being Tested as applicable:
   a. Building Automation System
   b. Calibration Certification Documents
3. Functions / Modes Required To Be Tested and Test Methods.
   a. A significant part of the BAS functional testing requirements is the successful completion of the functional tests of equipment the BAS controls or interlocks with. Uncompleted equipment functional tests or outstanding deficiencies shall be completed prior to conclusion of the functional testing of the BAS.
   b. Integral or stand-alone controls are functionally tested with the equipment they are attached to, including any interlocks with other equipment or systems and thus are not covered under the BAS testing requirements, except for any integrated functions or interlocks listed below.

c. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.

d. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.

e. Commissioning testing shall include but not be limited to the following:

1). Power failure and battery backup and power-up restart functions

2). Global commands features

3). Security and access codes

4). Occupant over-rides (manual, telephone, key, keypad, etc.)

5). Scheduling features fully functional and setup, including holidays

6). Date and time setting in central computer and verify field panels read the same time

7). All graphic screens and value readouts completed

8). Communications to remote sites

9). Final as-builts or redlines (per spec) control drawings, final points list, program code, setpoints, schedules, warranties, etc. per specs, submitted for O&M's

10). Alarm notification system and alarm priorities

11). Optimum start-stop functions

12). Auto-tuning disabled

N. Test, Adjust and Balance Verification

1. Parties Responsible to Execute Functional Test

a. TAB contractor: perform checks using test instruments

b. Controls subcontractor: operate the controls to activate the equipment.

c. CxP: to witness, direct and document testing.

2. Integral Components or Related Equipment Being Tested as applicable for the specific unit

a. TAB water-side

b. TAB air-side

3. Functions / Modes Required To Be Tested

a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.

b. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.

c. Commissioning testing shall include but not be limited to the following:

1). A random sample of up to 15% the TAB report data shall be selected for verification (air velocity, air or water flow rate, pressure differential, electrical or sound measurement, etc.). The original TAB contractor will execute the checks, witnessed by the CxP. The TAB contractor will use the same test instruments as used in the original TAB work

3.5 DIVISION 26 - ELECTRICAL

A. Normal Power Electric Service Distribution

1. Parties Responsible to Execute Functional Test

a. Electrical Subcontractor: assist in testing sequences, as needed.

b. CxP: to witness, direct and document testing.

2. Integral Components or Related Equipment Being Tested
   a. Switchgear
   b. Unit Substations
   c. Distribution Panelboards
3. Functions / Modes Required To Be Tested
   a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
   b. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.
   c. Commissioning testing shall include but not be limited to the following:
      1). Infrared scan of connections of select components and connections. Any PPE required for the CxP to comply with arc-flash requirements shall be provided by the contractor. Contractor shall also open and reclose all equipment being scanned.
      2). Randomly check trip settings on breakers to confirm they match the settings in the short circuit coordination study
      3). Test the power management control sequence for the switchgear
      4). Spot check phase balance at panelboards after system is under load. Ensure proper, thorough and accurate identification of load. Trip breakers and validate load identified. Test GFI breakers
      5). Spot check circuit labeling by de-energizing circuits while circuit tester is in the receptacle. Labeling shall be checked on the load/receptacle and at the breaker
      6). Receptacle Polarity Test: Spot check receptacles installed or reconnected under this contract with a receptacle circuit tester. Tester shall test for open ground, reverse polarity, open hot, open neutral, hot and ground reversed, hot or neutral and hot open
4. Required Monitoring
   a. None
5. Acceptance Criteria
   a. The normal power system, integral components and related equipment respond to varying parameters appropriately as expected, as specified and according to acceptable operating practice.

B. Emergency Power Distribution
   1. Parties Responsible to Execute Functional Test
      a. Controls Subcontractor: operate the controls
      b. Electrical Subcontractor: Provide load banks and all testing instruments and assist in testing sequences and debugging.
      c. Mechanical Subcontractor: assist in testing sequences and debugging
      d. CxP: to coordinate, witness, direct and document testing.
   2. Integral Components or Related Equipment Being Tested
      a. Emergency generator
      b. Automatic transfer switches

c. Emergency Power distribution panelboards and circuits

d. Emergency Lighting

e. Building Automation System

f. Fire Alarm System

3. Functions / Modes Required To Be Tested

a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.

b. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.

1). Load banks for testing automatic transfer switches shall be provided by the electrical contractor. The load bank shall be sufficiently sized for the maximum load specified for the automatic transfer switch. One load bank can be used and relocated for each individual test if multiple transfer switches are installed

2). Contractor shall provide all necessary labor and material to connect the load bank to the load side of the transfer switch and then after testing removing same from the project site.

c. Commissioning testing shall include but not be limited to the following:

1). Generator safeties and alarms (including high and low oil pressure, high temperature, over-speed, etc.) and interface with BAS

2). Power management control sequence test for loss of normal power, transfer to emergency power then return back to normal power. If authorized by Owner, phase loss scenarios will also be included to confirm specified equipment have phase loss protection.

3). Infrared scan of connections of select components and connections. Any PPE required for the CxP to comply with arc-flash requirements shall be provided by the contractor. Contractor shall also open and reclose all equipment being scanned.

4). Spot check phase balance at panelboards after system is under load. Ensure proper, thorough and accurate identification of load. Trip breakers and validate load identified. Test GFI breakers

5). Spot check circuit labeling by de-energizing circuits while circuit tester is in the receptacle. Labeling shall be checked on the load/receptacle and at the breaker

6). Receptacle Polarity Test: Spot check receptacles installed or reconnected under this contract with a receptacle circuit tester. Tester shall test for open ground, reverse polarity, open hot, open neutral, hot and ground reversed, hot or neutral and hot open

7). BAS sequencing of equipment start-up upon loss and return of power

8). Emergency lighting adequacy for egress routes. Lighting levels for egress paths shall be recorded. Lighting levels for egress paths shall be done at night.

4. Acceptance Criteria

a. For the conditions, sequences and modes tested, the emergency generator, integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

C. Lighting Control System

1. Parties Responsible to Execute Functional Test
    a. Electrical Contractor: assist in testing sequences, as needed.
    b. CxP: to witness, direct and document testing.
2. Integral Components or Related Equipment Being Tested
    a. Lighting Control System
3. Functions / Modes Required To Be Tested
    a. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
    b. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.
    c. Commissioning testing shall include but not be limited to the following:
        1). Spot check occupancy sensor placement and sensitivity for activation/deactivation
        2). Spot check lighting schedules to ensure they are programmed per the owner direction
        3). Check lighting levels
        4). For exterior fixtures, simulate night mode to validate function. Measure and record light level to ensure they meet the requirements and are generally provide adequate security. Check for excessive light level fluctuations or dark spots

3.6 DIVISION 28 - FIRE ALARM SYSTEM

A. Parties Responsible to Execute Functional Test
    1. Fire Alarm contractor: operate the controls to activate the equipment
    2. CxP: to witness, direct and document testing
    3. Fire Marshal: to witness, direct and document testing

B. Integral Components or Related Equipment Being Tested
    1. Fire Pump, Alarm System & Components

C. Functions / Modes Required To Be Tested
    1. Testing requirements for commissioning are in addition to and do not replace any testing requirements elsewhere in this Division.
    2. Test methods shall include manual, auto, emergency operations and monitoring as applicable and feasible.
    3. Testing will be performed concurrent with testing witnessed by Fire Marshal
    4. Commissioning testing shall include but not be limited to the following:
        a. Test equipment shutdown and restart sequence for trouble and supervisory alarms
        b. Test backup battery capacity per requirements

D. Required Monitoring
    1. None

E. Acceptance Criteria

1. For the conditions, sequences and modes tested, the fire alarm system, integral components and relate equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

END OF SECTION

SECTION 23 08 00 - COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Commissioning is the process for ensuring that the HVAC System is installed and performs interactively according to the basis of design criteria and meets the building operational performance expectations as defined in the sequences of operations. The process also provides adequate documentation of installation, start-up and functional testing and ensures that the Owner's maintenance personnel are adequately trained. It provides for discovery of system operational performance deficiencies prior to substantial completion while the responsible contractors can provide a timely response. It establishes testing and communication protocols in an effort to advance the HVAC System from installation to complete dynamic operation and optimization.

B. The commissioning process involves all the parties involved in the design and construction process as well as the Owner and the Commissioning Provider (CxP). Primary elements of Commissioning during the construction, acceptance and warranty phases of the project include:

1. Verify applicable equipment and systems are installed in accordance with manufacturers' instructions and contract documents and receive adequate operational start-up checkout by installing contractors.
2. Demonstrate functional operational performance of equipment and systems in the commissioning program.
3. Verify O&M documentation submitted is complete. Provide required documentation and information to the General Contractor. Verify Owner's maintenance personnel are adequately trained in accordance with specified training plan requirements.
4. Verify systems are interacting and performing optimally in accordance with the system sequence of operations.
5. Furnish labor and material to accomplish HVAC system commissioning and systems' testing as specified herein and other related sections.

1.2 RELATED SECTIONS

A. Section 01 91 13 – General Commissioning Requirements

B. Section 01 91 14 – Functional Testing Requirements

C. Division 23 Sections pertaining to the HVAC Systems included in the commissioning program.

1.3 SUBMITTALS

A. Refer to Section 01 91 13 for commissioning submittal requirements. Provide copies of commissioning submittal requirements to the CxP, in addition to the copies required by the Owner and Design Professional.

1.4 COORDINATION

A. The installation schedule for the components, equipment & systems included in the commissioning program shall be such that the commissioning requirements can be met without impacting the construction schedule. Commissioning Functional Performance Testing is a requirement for Substantial Completion.

B. All maintenance points for components installed by the contractor (or sub-contractors) for building systems servicing shall be flagged utilizing construction marker ribbons if the maintenance point is located where multiple trades will be installing systems, unobstructed access from floor level shall be maintained. Refer to Section 01 9113 for additional information on maintenance/service point access.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Trade contractors shall provide all specialized tools, test equipment, and instruments required to execute startup, checkout, field calibration and functional performance testing of equipment under their contract.

B. Test equipment shall be of sufficient quality and accuracy (great accuracy than specified for component) to test and/or measure system performance according to specified tolerances. Test equipment is to have calibrated within the previous 12 months. Calibration shall be NIST traceable. Equipment shall be re-calibrated when dropped or damaged. Calibration tags shall be affixed or certificates be readily available.

C. Datalogging equipment or software required to test equipment will be provided by the CxP, but shall not become the property of the Owner.

PART 3 - EXECUTION

3.1 COMMISSIONING

A. General Requirements. For additional information regarding general commissioning requirements refer to Section 01 91 13.

B. Installation contractors shall be responsible for executing and documenting equipment installation, start-up and check out for systems and equipment. Contractors shall also be responsible for executing and documenting prefunctional performance tests. All of these documents are required prior to the CxP scheduling the functional performance test. Contractors shall also be responsible for providing training for the Owner’s maintenance personnel in accordance with project requirements.

C. Installation Certification Form (ICF) for each type of equipment and system shall be provided to the installation contractors by the CxP for use by the contractors in documenting the installation and start-up of equipment in the commissioning program.

D. For equipment and system components requiring a manufacturer’s representative for installation verification and start-up, manufacturer documentation of these activities shall be attached to the checklists provided by the CxP.

E. Prefunctional Performance Test procedures for each type of equipment and system shall be provided to the installation contractors by the CxP for use by the contractor in documenting the performance of the prefunctional performance test. Refer to Section 01 9114 for further information.

F. Completed Installation Certification Forms along with completed respective manufacturer’s Start-up forms and prefunctional performance test documentation for all pieces of equipment shall be submitted by contractors to the CxP through the General Contractor prior to the scheduling of the final Functional Performance Test that is witnessed by the CxP. The CxP

will not schedule any testing until all of these documents have been received, reviewed, and approved.

3.2 TRAINING

A. Contractor responsible for the installation of the system shall coordinate the participation of other sub-contractors and manufacturer's representatives in the training program in accordance with requirements of other sections of the project specifications.

3.3 OPERATIONS AND MAINTENANCE DATA

A. Contractor responsible for the installation of the system shall provide operations and maintenance manuals in accordance with requirements of other sections of the project specifications.

3.4 GENERAL SYSTEM TESTING CRITERIA

A. Functional Performance Testing
   1. Refer to Sections 01 91 13 - General Commissioning Requirements and 01 91 14 - Functional Testing Requirements. Installation contractor shall be responsible for providing authorized manufacturer's representatives to demonstrate the operational capabilities of the equipment & systems.

END OF SECTION