

SECTION 01 91 00.15 20

TOTAL BUILDING COMMISSIONING
02/21

PART 1 GENERAL

Total Building Commissioning (TBCx) is a systematic, quality-focused process for enhancing the delivery of a project that focuses on verifying and documenting that all of the commissioned systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the project requirements. The purpose is to reduce the cost and performance risks associated with delivering facilities projects, and to increase value to owners, occupants, and users.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 202 (2018) Commissioning Process for Buildings
and Systems

1.2 DEFINITIONS

Commissioning Process (Cx) - a quality-focused process for enhancing the delivery of a project. Refer to ASHRAE 202 for a comprehensive description of the commissioning process.

Commissioning Provider (CxA) - The entity who leads, plans, and coordinates the Commissioning Team. The terms Commissioning Provider, Commissioning Firm, Lead Commissioning Specialist, Commissioning Specialist, and Commissioning Authority (CA or CxA) when used by sustainable Third Party Certification (TPC) programs, are interchangeable.

1.3 COMMUNICATION WITH THE GOVERNMENT

The Government Commissioning Provider (CxA) must submit all plans, schedules, reports, and documentation directly to the Contracting Officer's Representative concurrent with submission to the QC Manager.

The QC Manager must communicate directly with the CxA and Contracting Officer's Representative regarding all elements of the commissioning process; however, the CxA has no direct contract authority.

1.4 SYSTEMS TO BE COMMISSIONED

Coordinate commissioning and quality control activities for the following systems, equipment, and associated controls. System-specific requirements are located in the associated specification Sections. Commission the following systems, equipment, and associated controls in accordance with this section and the inspection, testing, and quality control requirements of their respective sections:

Heating, ventilating, air-conditioning, and refrigeration systems
(mechanical and passive) and associated controls

Air-curtain systems

Lighting systems: automatic and manual daylighting controls, occupancy
sensing devices, automatic shut-off controls, time switching, and
other lighting control devices, and dimming systems

Electrical systems: emergency and normal power to include automatic
transfer switches, emergency generator, pier unit substations,
switchboard, uninterruptible power supply, MTS, and panelboards.

Domestic hot-water systems and controls

Energy and building management and demand-control systems

Building Envelope: air tightness for the entire building envelope
(systems, components, and assemblies).

1.5 COMMISSIONING TEAM

The Commissioning team will include, but is not limited to the following
team members.

Ensure all Construction Activities for systems to be commissioned are
coordinated with the appropriate commissioning team members.

- a. Lead Commissioning Specialist (CxA)
- b. Quality Control Manager (QCM)
- c. Sub-Contractor Representatives for each trade responsible for
construction/installation of systems to be commissioned
- d. Construction Manager (CM)
- e. Designer of Record (DOR)
- f. Technical Commissioning Specialists for each system to be commissioned
- g. TAB Representative
- h. Equipment manufacturer representatives
- i. Contracting Officer
- j. Government Acceptance Testing Representatives
- k. Installation Maintenance Representative
- l. Facility End User

1.6 PROJECT SCHEDULE

Include the following tasks in the project schedule required by Section
01 32 17.00 20 COST-LOADED NETWORK ANALYSIS SCHEDULES (NAS). Ensure
sufficient time is scheduled to complete each item. The order of items
listed below is not intended to imply a specified sequence:

- e. Commissioning Kickoff Coordination Meeting
- f. Regular Commissioning Coordination Meetings
- g. Installation of permanent utilities (gas, water, electric)
- h. Manufacturer's Equipment Start-Up for each of the systems to be commissioned
- i. Submission and approval of the Completed Pre-Functional Checklists
- j. Submission and approval of Certificate of Readiness for each system to be commissioned
- k. Functional Performance Testing for each system to be commissioned
- l. Post-test deficiency correction for each system to be commissioned
- m. Re-Testing
- n. Training for each of the systems to be commissioned
- p. Seasonal Testing

1.7 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Completed Pre-Functional Checklists; G

SD-07 Certificates

Certificate Of Readiness; G

1.8 GOVERNMENT COMMISSIONING PROVIDER

The Commissioning Provider (CxA) is employed by Government under separate contract. Incorporate key milestones of the Commissioning process into the Project Schedule identified in this Section.

1.9 ISSUES LOG

The Commissioning Specialist develops and maintain an Issues Log for the systems to be commissioned. The issues log documents and tracks resolution of deficiencies identified during submittal reviews, inspection, and testing. At any point during construction, any commissioning team member finding deficiencies may communicate those deficiencies in writing to the Commissioning Specialist for inclusion into the Issues Log. For each issue, the Issues Log includes, but is not limited to, a unique reference number, description of the issue with contract requirement referenced, location of or equipment name/tags exhibiting the issue, the initials of the individual's name whom reported the issue, the date of first observation, the proposed resolution of the

issue and date proposed, the date of any subsequent observations with applicable additional information, and the date of implementation of the final resolution of the issue as confirmed by the Commissioning Specialist and Contracting Officer. Issues must not be deleted from the issues log.

1.10 CERTIFICATE OF READINESS

Prior to scheduling Functional Performance Tests, the Quality Control Manager must issue a Certificate of Readiness for each system, certifying that pre-functional checks have been completed, open issues have been resolved, and the system is ready for Functional Performance Testing. The Certificate of Readiness must include, for each system to be commissioned, equipment and system start-up reports; the Air Leakage Test Reports and Diagnostic Test Reports; completed Pre-Functional Checklists; Testing, Adjusting, and Balancing (TAB) Report; Issues Log; and HVAC Controls Start-Up Reports to the extent applicable to the system. Sign and date the Certificate of Readiness, and include signatures and dates from the CxA; the Quality Control Representative; the Mechanical, Electrical, Controls, and TAB subcontractor representatives.

Submit the Certificate of Readiness for each system 14 calendar days prior to Functional Performance Tests of that system. Do not schedule Functional Performance Tests for a system until the Certificate of Readiness is approved by the Government.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 CONSTRUCTION SUBMITTAL REVIEWS

Coordinate construction submittal document reviews for commissioned systems and assemblies with the CxA. The commissioning submittal review does not replace the designer of record (DoR) or Government submittal review.

The CxA is responsible for identifying construction submittals to be provided by the contractor for the commissioned systems. The CxA is responsible for evaluating construction submittals for compliance with the contract documents.

3.2 COMMISSIONING KICKOFF MEETING

The CxA is responsible for conducting a Commissioning Kickoff Meeting no later than 60 days following construction notice to proceed to discuss the commissioning process including contract requirements, lines of communication, roles and responsibilities, schedules, documentation requirements, inspection and test procedures, and logistics as specified in this section.

The Quality Control team, Designer of Record, and the Government must attend this meeting. Invite the User and a Public Works Division Representative to attend this meeting.

3.3 REGULAR COMMISSIONING COORDINATION MEETINGS

Participate in monthly commissioning coordination meetings led by the CxA

when installation of commissioned systems begins. Provide status of commissioned systems, open issues log items, outstanding submittals, and upcoming commissioning activities. Participate in bi-weekly commissioning coordination meetings within 30 days of the scheduled date for functional performance testing.

3.4 CONSTRUCTION PHASE COMMISSIONING PLANS

The Interim Construction Phase Commissioning Plan identifies the commissioning and testing standards and outline the overall commissioning process, the commissioning schedule, the commissioning team members and responsibilities, lines of communication, documentation requirements for the construction phase of the project. Provide a list of team members for systems to be commissioned with contact information, a list of tests as required by Section 01 33 00 SUBMITTAL PROCEDURES, and project schedule as required by Section 01 32 17.00 20 COST-LOADED NETWORK ANALYSIS SCHEDULE for inclusion in the Final Construction Phase Commissioning Plan no later than 14 calendar days after the Commissioning Coordination Meeting.

The Final Construction Phase Commissioning Plan includes the information provided in the Pre-Functional Checklists and Functional Performance Test Checklists for each building, for each system required to be commissioned, and for each component for inclusion in the Final Construction Phase Commissioning Plan. Provide updates to the list of team members for systems to be commissioned with contact information, a list of tests as required by Section 01 33 00 SUBMITTAL PROCEDURES, and project schedule as required by Section 01 32 17.00 20 COST-LOADED NETWORK ANALYSIS SCHEDULE for inclusion in the Final Construction Phase Commissioning Plan within 14 calendar days of a written request from the CxA.

3.4.1 Pre-Functional Checklists

Use the Pre-Functional Checklists prepared by the CxA for physical inspection or testing to demonstrate that installation and start-up of equipment and systems is complete. Refer to paragraph PRE-FUNCTIONAL CHECKS.

3.4.2 Functional Performance Test Checklists

Use the Functional Performance Test Checklists prepared by the CxA that list, step-by-step, the actions and expected results that will demonstrate that the system performs in accordance with the contract. Refer to paragraph FUNCTIONAL PERFORMANCE AND INTEGRATED SYSTEMS TESTS.

3.5 PRE-FUNCTIONAL CHECKS

Complete one Pre-Functional Checklist for each individual item of equipment or system for each system required to be commissioned including, but not limited to, ductwork, piping, equipment, fixtures (lighting and plumbing), and controls. Indicate commissioning team member inspection and acceptance of each Pre-Functional Checklist item by initials. Acceptance of each Pre-Functional Checklist item by each team member indicates that item conforms to the contract documents and accepted design in their area of responsibility. Commissioning Specialist acceptance of each Pre-Functional Checklist item indicates that each item has been installed correctly and in accordance with contract documents and the Owner's Project Requirements (OPR). Submit the initialed and Completed Pre-Functional Checklists no later than 7 calendar days after completion of inspection of all checklist items for each system. Include

manufacturer start-up checklists associated with equipment with the submission of the Pre-Functional Checklists.

3.6 FUNCTIONAL PERFORMANCE TESTS

Demonstrate that all system components have been installed, that each control device and item of equipment operates, and that the systems operate and perform, including interactive operation between systems, in accordance with contract documents and the OPR. Provide all materials, services, and labor required to perform the Pre-Functional Checks and Functional Performance Tests.

Commissioning Specialist's duties include leading and documenting all tests for the systems to be commissioned with appropriate sub-contractors performing the Tests. The representatives listed in the paragraph Commissioning Team must attend the tests.

3.6.1 Test Scheduling and Coordination

Conduct Initial Functional Performance Tests as soon as all contract work is completed, regardless of the season. Develop and implement means of artificial loading to demonstrate, to a reasonable level of confidence, the ability of the HVAC systems to handle peak seasonal loads. Schedule Functional Performance Tests for each system only after the Certificate of Readiness has been approved by the Government for the system. Correct all deficiencies identified through any prior review, inspection, or test activity before the start of Functional Performance Tests.

3.6.2 Testing Procedures

Functional performance testing is conducted by simulating conditions at control devices to initiate a control system response. Over-writing control input values through the control system is not acceptable unless approved by the Contracting Officer. Do not simulate conditions when damage to the system or building may result.

Follow the Functional Performance Test from the approved Final Construction Phase Commissioning Plan. Perform Functional Performance Tests for each item of equipment and each system required to be commissioned. Verify all sensor calibrations, control responses, safeties, interlocks, operating modes, sequences of operation, capacities, lighting levels, and all other performance requirements comply with contract, regardless of the specific items listed within the checklists provided. In general, testing must progress from equipment or components to subsystems to systems to interlocks and connections between systems. Commissioning Specialists are responsible for determining the order of components and systems to be tested. Indicate acceptance of each item of equipment and systems tested by signature of each commissioning team member for each test. The Quality Control Representative, Commissioning Specialists, and Contracting Officer's Representative, if present, must indicate acceptance after the equipment and systems are free of deficiencies.

3.6.3 Sample Strategy

Perform Functional Performance Tests for all systems and equipment to be commissioned using the sample strategy identified herein. Complete a Functional Performance Test Checklist for each item of equipment or system to be tested. For sample sizes less than 100 percent for similar

equipment, the Contracting Officer's Representative reserves the right to select the specific equipment or system to be tested during testing.

Test all central plant equipment, primary air handling units, and process cooling or heating equipment. Test all system-level equipment serving multiple zones. Twenty percent sample testing is allowed for large groups of identical equipment with identical controllers serving single zones such as air terminal units, fan coil units, unitary equipment, lighting zones, and plumbing fixtures.

3.6.3.1 100 Percent Sample Procedures

Systems or equipment for which 100 percent sample size are tested fail if one or more of the test procedures results in discovery of a deficiency and the deficiency cannot be resolved within 5 minutes during the test.

Re-test to the extent necessary to confirm that the deficiencies have been corrected without negatively impacting the performance of the rest of the system.

3.6.3.2 Less than 100 Percent Sample Procedures

Randomly test each sample group of identical equipment. Sample size must be at least three units. If 10 percent of the units in the first sample fail the functional performance tests, test a second sample group, the same size as the first sample group. The second sample must not include any units from the first sample group.

If 10 percent of the units in the second sample fail, test all remaining units. If at any point frequent failures occur, and testing becomes more troubleshooting than verification, the CxA may stop the testing and require the contractor to perform and document a checkout of the remaining units prior to continuing functional testing.

3.6.4 Aborted Tests and Re-Testing

Abort any test if any deficiency prevents successful completion of the test or if any required commissioning team member is not present for the test. Re-test after all deficiencies identified during the original test have been corrected. Contracting Officer may withhold payment equivalent to lost time, re-testing, and aborted tests. These costs may include salary, travel costs, and per diem for Government commissioning team members.

3.7 TRAINING PLAN

CxA must review the training plan for training associated with the equipment and systems to be commissioned, checking that each plan has the trainer name, trainer contract information, training schedule and location. Submit review at least 30 days prior to the first training event. Incorporate CxA review comments prior to submitting training plan in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI). Update and resubmit the training plan based on any corrective action taken.

Document training attendance using training attendance rosters and submit completed attendance rosters no later than 7 calendar days following the completion of training for each system to be commissioned.

3.7.1 Systems Manual

The Systems Manual includes the Basis of Design, system single line diagrams, as-built sequences of operation and controls drawings, as-built control setpoints, recommended schedule for sensor and actuator calibration, recommended schedule of maintenance when not in the O&M manuals, recommended re-testing schedule with proposed testing forms, and full equipment warranty information for all commissioned systems. Incorporate CxA review comments prior to submitting Systems Manual in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI). Update and resubmit the system manual information based on any corrective action taken during the warranty period.

3.8 COMMISSIONING REPORT

The Commissioning Specialist is responsible for preparing a Commissioning Report following commissioning team acceptance of all Functional Performance Tests and Integrated Systems Tests, with the exception of Seasonal Tests. Provide information including, but not limited to, outstanding deficiencies and recommended resolutions, seasonal testing that must be scheduled for a later date, Completed Building Envelope Inspection Checklists, Pre-Functional Checklists, Training Attendance Rosters, PVT Report, and the approved TAB Report within 14 days of request.

3.9 WARRANTY PHASE SITE VISIT

Notify the Lead Commissioning Specialist at least 28 calendar days prior to visiting building site for the 9 month warranty inspection. Provide updates to any documentation included in the Commissioning Report based on the results of the warranty phase inspection. Provide all warranty phase documentation, such as Seasonal testing results to the Commissioning Specialist.

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