



ASHRAE Guideline 1.5-2017R

Public Review Draft

Revision of Guideline 1.5-2017, Technical Commissioning Requirements for Smoke Control Systems

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(Draft Shows Complete Proposed Standard)

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FOREWORD

The Commissioning (Cx) Process is a quality-oriented process for verifying and documenting that the performance of facilities, systems, and assemblies meet defined objectives and criteria. The Cx Team uses a variety of methods and tools to verify that a project is achieving the Owner's Project Requirements (OPR), including code requirements and inspections of the authority having jurisdiction (AHJ) throughout the delivery of the project.

Cx Process procedures and requirements are fully covered in ASHRAE Standard 202 and ASHRAE Guideline 0. Those documents provide adequate guidance for implementing the Cx Process for all building smoke control assemblies and systems—for both new and existing buildings.

To further assist Owners; design teams; Cx Process teams; contractors; and building/facility engineering, operations, and maintenance (EOM) teams or staff, several supporting Cx Process technical guidelines have been developed or are under development. This guideline provides specific guidance on applying the Cx Process to smoke control systems in buildings and facilities.

Guideline 1.5 follows the format of Guideline 0 and incorporates committee experience on projects where smoke control systems and components were expected to work from the day the project was turned over to the Owner, while meeting the requirements of Owners, occupants, users of processes, and facility operating-maintenance-service organizations at a high level of satisfaction.

Emphasis is placed on documentation of the OPR at the inception of a project and the proper transfer of this information from one party to the next throughout the life of a project. The Cx Process has been structured to coincide with the phases of a generic project with Predesign, Design, Construction, and Occupancy/Operations Phases. Beginning the Cx Process at project inception will achieve maximum benefits. If circumstances require Owners to adopt the Cx Process during the Design, Construction, or the first year of the Occupancy/Operations Phase of a project, later implementation must capture the information that would have been developed had the Cx Process begun at project inception or during the Predesign Phase. This is required for successful Occupancy/Operations Phase documentation and continuous or ongoing Cx of the smoke control systems and components for the life of the facility.

Due to the integration and interdependency of most facility systems, a performance deficiency in one system can result in less-than-optimal performance by other systems. Although Guideline 1.5 focuses on smoke control systems, a successful total building Cx Process will carefully validate interfaces and possible interferences between all building systems. Even if smoke control is the primary focus of the Cx Process, coordination among disciplines is essential for success.

Appendices are included in this guideline to assist in the implementation of the Cx Process for smoke control systems and components. The annexes are based on actual project experience, with details based on current practice, and illustrate application of the Cx Process for smoke control systems and components. The annexes should be viewed as examples of how to develop and define ongoing communications; OPR, Basis of Design (BoD), and Cx Plan documents; and verification, testing requirements, and training. This is not intended to be a complete user's manual but is instead intended as a guideline.

Note: *This document references annexes hosted on the ASHRAE website. Annexes are documents that constitute a subordinate, informative part of more than one commissioning standard or guideline. They are maintained as unique documents and referenced by number in relevant commissioning standards and guidelines.*

For example, the annex describing the issues and resolution log is used in multiple documents, since it applies in most applications of the Cx. It is therefore referenced by multiple standards and guidelines in the ASHRAE SSPC 300 family but exists as a single document for easier maintenance and better clarity.

All annexes in the ASHRAE SSPC 300 family can be found at www.ashrae.org/SSPC300annexes.

1. PURPOSE

- 1.1 The purpose of this guideline is to describe the technical requirements for the application of the Commissioning (Cx) Process, described in ASHRAE Guideline 0 and Standard 202, that will verify that the smoke control

system fulfills the Owner's Project Requirements (OPR).

2. SCOPE

- 2.1 The procedures, methods, and documentation requirements in this guideline describe the application of the Commissioning (Cx) Process for each project delivery phase, from Pre-design through Occupancy/Operations, for all types and sizes of smoke control systems, to support the Cx Process activities described in ASHRAE Guideline 0 and Standard 202. Requirements include the following:
- a. Smoke control systems to fully support the Cx Process activities
 - b. Verification during each phase of the Cx Process
 - c. Acceptance during each phase
 - d. Documentation during each phase
 - e. A systems manual
 - f. Training for operations and maintenance (O&M) personnel and occupants
- 2.2 The procedures, methods, and documentation requirements apply to new construction and ongoing Cx Process activities or requirements of all or portions of buildings and facilities. They also can be applied to rehab, retrocommissioning, or recommissioning projects.

3. UTILIZATION

- 3.1 The application of this guideline depends on the OPR and how the project is designed, built, and operated and the requirements of the authority having jurisdiction (AHJ). This guideline is supplemental to the Commissioning (Cx) Process as detailed in ASHRAE Guideline 0 and Standard 202. This guideline must be used in conjunction with Guideline 0; it is not intended to be a stand-alone document.
- 3.2 This guideline describes specific details required to properly implement the Cx Process as it relates to smoke control systems. This includes documentation, test procedures, and checklists.

4. NOMENCLATURE

4.1 DEFINITIONS

Definitions for general Commissioning (Cx) Process terms are found in ASHRAE Guideline 0 and Standard 202. Additional smoke-control-related terms are defined as follows.

smoke control: an engineered system that is intended to modify the movement of smoke.

smoke barrier: a continuous barrier, which may or may not have a flammability rating, that is designed and installed to restrict the movement of smoke.

firefighter's smoke control station (FSCS): a device that is provided for use by the fire department that provides graphical indication and manual override capability over equipment that can be used to modify the movement of smoke within a building.

4.2 ABBREVIATIONS

AHJ	authority having jurisdiction
BAS	building automation system
BoD	Basis of Design
Cx	commissioning
CxP	Commissioning Provider
EOM	engineering, operations, and maintenance

FSCS	firefighter's smoke control station
O&M	operations and maintenance
OEM	original equipment manufacturer
OPR	Owner's Project Requirements
QA/QC	quality assurance/quality control
TAB	testing, adjusting, and balancing

5. PREDESIGN PHASE

5.1 Introduction

5.1.1 Predesign is a preparatory phase of the project delivery process in which the Owner's Project Requirements (OPR) are developed and defined. Information about the project is gathered, including

- a. program requirements (e.g., facility interior conditions and uses),
- b. codes and regulations (e.g., building codes, National Fire Protection Association and Underwriters Laboratories standards, local amendments),
- c. requirements of the authority having jurisdiction (AHJ),
- d. site and climate information (e.g., site location and layout, outdoor air design conditions),
- e. facility context and function (e.g., office, hospital, refrigerated warehouse),
- f. cost,
- g. schedule, and
- h. clients' (Owners', occupants', operators', and maintenance personnel's) needs and capabilities.

5.1.2 Predesign Phase Commissioning (Cx) Process objectives related to smoke control systems include the following:

- a. Developing the OPR
- b. Identifying a scope and budget for the Cx Process
- c. Developing the initial Cx Plan
- d. Accepting the Predesign Phase Cx Process activities

5.2 Predesign Cx Process Activities

5.2.1 Cx Team Members. In addition to those detailed in ASHRAE Guideline 0, Section 5.2.1.3, the essential members of the Cx Team related to smoke control systems during the Predesign Phase include the following:

- a. Facilities engineer
- b. Owner's automatic controls and building automation technicians
- c. Facility information technology network manager or technician
- d. Owner's HVAC&R technician (if HVAC&R equipment will be used as nondedicated smoke control equipment)
- e. Architect and engineers
- f. Smoke control design professional
- g. Electrical and fire alarm design professional

If known or present, additional members of the Cx Team related to smoke control systems during the Predesign Phase can include the following:

- a. HVAC&R equipment suppliers
- b. HVAC&R contractors
- c. Testing agencies, including testing, adjusting, and balancing (TAB) agencies
- d. Electrical contractors

- e. Automatic controls and building automation contractors
- f. Fire alarm contractor
- g. Information technology contractor
- h. Security contractor
- i. AHJ
- j. Special inspector, if required

Refer to Guideline 0, Informative Annex F, for details on the roles and responsibilities of the above team members.

5.2.2 Owner's Project Requirements (OPR) Document. The OPR forms the basic requirements from which all design, construction, acceptance, and operation decisions are made. Objectives and functional requirements of smoke control systems that should be considered include the following:

- a. **Project budget and schedule.** A description of the Owner's approach to allocating resources for the smoke control systems. This includes a narrative of the relative importance of capital investment, life of systems, operating costs, and maintenance costs as well as use of life-cycle costing for selection of the systems. Sufficient time must be allocated for design, construction, proper start-up, testing, tuning, and periodic retesting of smoke control systems.
- b. **Cx Process scope and budget.** A listing of smoke control components and systems that are the focus of the Cx Process and the budget to accomplish the Cx Process activities.
- c. **Project documentation requirements.** A narrative of what documentation is required to properly install, start-up, test, operate, troubleshoot, and maintain smoke control systems for the life of the facility. Also included is the format of the documentation (electronic or paper) and any specific features.
- d. **Owner directives.** A listing of the Owner's predefined directives on what systems, components, and operating conditions will be required. It is critical, when directives are given, that the Owner's intent be understood. For example, the Owner may expect the smoke control system to protect high-value products or equipment in addition to its life-safety role. Or, if an Owner states that only a specific manufacturer or type of equipment shall be used, it is important to understand that this directive relates to the need to simplify maintenance due to the use of that manufacturer on their other facilities.
- e. **Restrictions and limitations.** Identification and documentation of specific preexisting or new restrictions and limitations on the smoke control systems. For example, integration with adjacent buildings systems.
- f. **User requirements.** An understanding of how the users (including fire protection personnel) will operate a safe and functional system.
- g. **Occupancy classification.** An understanding of how the various spaces within the building will be used, including activities that would present transient fuel loads. Document smoke control requirements for each occupancy, area, zone, and hazard.
- h. **Space use requirements and schedules.** An understanding of how the smoke control system interfaces with the normal building HVAC system's sequence of operation.
- i. **Training requirements for Owner's personnel.** Documentation of the current level of knowledge of the Owner's personnel and the intent to provide an adequate level of training on smoke control systems in general and the specifics regarding operation of the smoke control system being installed. This is important to ensure that the design of the smoke control system is within the Owner's current and future capabilities to operate and maintain the system.
- j. **Warranty requirements.** A listing of the requirements for warranties on the smoke control system and components, including start of warranty, period, and conditions.
- k. **Benchmarking requirements.** A listing of verified system operation and benchmarks for future comparison. For example, record of airflows and/or pressure differences measured during acceptance testing of the smoke control system.
- l. **Operations and maintenance (O&M) criteria.** A narrative of how the smoke control systems are to be operated and maintained, including how the O&M personnel approach resolution of problems (i.e., fix upon fail, manufacturer's recommendations, or Owner internal frequencies), and the source (in house

- or contracted) and expected level of manpower (current, new, additional) for the O&M staff and known frequencies of maintenance items.
- m. **Equipment and system maintainability expectations.** A summary of the assumptions for accessibility to smoke control systems and equipment (e.g., the maintenance space should be the manufacturer recommendations or x% greater). Further, special requirements for maintenance and access should be listed (e.g., gages, test ports, permanent ladders, catwalks, etc.).
 - n. **Quality requirements of materials and construction.** A description of the level of quality, in concurrence with the life-cycle cost approach, of the smoke control system equipment and ductwork, including the durability and time expectancy between failures/replacement. Document the general expectations of the Owner for the quality of construction (e.g., industry average, above average, or best workmanship).
 - o. **Allowable tolerance in facility system operations.** A documentation of the tolerance that will be allowed in the operation of the smoke control systems. Minimum and maximum airflow or pressures during smoke control operations should be specified.
 - p. **Energy efficiency goals.** A listing of the goals of the smoke control systems. As life-safety systems, smoke control systems may not have energy efficiency requirements when responding to a smoke emergency. However, there may be energy efficiency goals that nondedicated equipment must meet when operating in non-smoke-control mode.
 - q. **Adaptability.** Documentation of the adaptability requirements for the smoke control systems to be modified, expanded, or relocated for future needs.
 - r. **Systems integration requirements.** A discussion of the need to integrate the smoke control systems with other systems, such as fire alarm, life safety, and security, over and above code requirements.
 - s. **Applicable codes and standards.** A detail of the known smoke control codes and standards that will be followed for the project, including the year of publication and the specific option to be used (e.g., pressurization, airflow, exhaust methods, etc.). Also identify any acceptance testing and/or periodic maintenance requirements contained in the applicable codes or standards.
 - t. **Seismic requirements.** An understanding of the seismic requirements and expectations for the smoke control systems.
 - u. **Accessibility.** Documentation of any unique requirements for placement of smoke control system components to meet the needs of emergency response personnel and maintenance staff, such as the location of the firefighters smoke control station (FSCS).
 - v. **Security.** A narrative on the need for security of the smoke control system relative to the use of the facility and potential threats to the facility and equipment. For example, this may include limiting physical access to smoke control equipment using locked doors or keyed covers, or it may include methods to restrict unauthorized users from accessing the smoke control system via networks or operator terminals.
 - w. **Functionality.** Documentation of the objectives and the relationship of the smoke control system to the overall fire protection and life-safety strategies for the facility. Specific details should be provided describing the operation of the smoke control system in response to each activation signal.
 - x. **Aesthetics.** Defined restrictions on the location of smoke control equipment and the location or visibility of intake and/or exhaust openings.
 - y. **Constructability.** A narrative on any known restrictions that would limit the size of the equipment.
 - z. **Communications.** A description of whether the smoke control system communicates over a shared backbone/network or whether it must operate over a separate network. Also describe restrictions on accessing the smoke control system from outside the facility.
 - aa. **Controls.** A description of the controls for the smoke control systems, which are key to the design, installation, and operation of these systems. The OPR needs to clearly define the level of control and interoperability of systems. Control system performance needs to be defined during the Predesign Phase. In some facilities, this may require a brief preliminary control predesign workshop. This is required for both budgeting the project cost and providing programming information for the design team and Cx Team during all phases of project delivery.

5.2.3 Scope and Budget

5.2.3.1 The focus of the Cx Process for smoke control systems typically involves the following:

- a. Energy supply (including primary power supplies and the availability of backup power, if required)
- b. Coordination of fire protection and other life-safety systems (including arrangement of detection, suppression, and smoke control zone boundaries as well as methods and responsibilities for the interface to the smoke control system)
- c. Building construction features (including location of fire and smoke barriers and integrity of firestopping or sealing for any openings in these barriers)
- d. Smoke control instrumentation and controls (including electric, electronic, pneumatic, and self-powered systems). Consideration of whether the BAS is used for smoke control (in which case, it is required to be executed with UUKL-listed components) or whether a dedicated smoke control system is used. Consideration of interfaces between the smoke control system and the BAS where separate.
- e. HVAC&R equipment and controls that may be used as nondedicated smoke control equipment
- f. Other special life-safety systems, equipment, and controls (e.g., fire dampers, door operators, fire fighters control panels, etc.)

5.2.4 Cx Plan

5.2.4.1 General requirements for the Cx Plan are covered in ASHRAE Guideline 0 and SSPC 300 Informative Annex 05, “Commissioning Process Plan”.

5.2.4.2 Milestones. During the Predesign Phase, it is critical to document key Cx Process milestones related to the smoke control systems during Design, Construction, and Occupancy/Operations Phases. These could include the following:

- a. The smoke control report defined in the BoD
- b. Initial smoke control system acceptance
- c. Testing of integration between architectural, electrical, mechanical, fire alarm, and smoke control systems
- d. Receipt of Cx Process Report from special inspector, if required
- e. Final smoke control system acceptance
- f. Operator and maintenance personnel training for special requirements of smoke control systems

5.2.4.3 Roles and Responsibilities. The roles and responsibilities of the Cx Team members related to smoke control systems, as detailed in Section 5.2.1, should be included in the Cx Plan.

5.2.4.4 Predesign Checklists. Example Predesign Phase checklist formats are presented in ASHRAE Guideline 0, Informative Appendix M. Specific Predesign Phase checklists required for smoke control systems and components will be developed by the Cx Team.

5.2.4.5 Design Checklists. Example Design Phase checklist formats are presented in ASHRAE Guideline 0, Informative Appendix M. Specific Design Phase checklists required for smoke control systems and components will be developed by the Cx Process team and the programming team during the development of the initial Cx Plan during the Predesign Phase. These checklists should include assemblies and systems that are essential for a successful smoke control system installation. The checklists will define the expectations at each design submittal and will emphasize the OPR, BOD, and documentation expectations throughout the Design Phase.

5.2.4.6 Construction Checklists. The requirement for construction checklists must be included in the Predesign Phase documentation to define the project needs for the design team. Generic Predesign Phase checklist formats are presented in ASHRAE Guideline 0, Informative Appendix M. Determine whether checklists will be in paper or electronic format for contractor completion. Specific construction checklists required for smoke control systems and components and supporting systems and assemblies will be determined during the Design Phase.

5.2.4.7 Communication Channels. The communication process between the Cx Team and the CxP; the smoke

control, HVAC&R, and electrical design professionals; the architect; the Owner; occupants and users; facility engineering staff (must include O&M staff); general contractors; mechanical contractors; electrical contractors; and others, as applicable, must be defined. This process will facilitate the review of predesign requirements, design requirements, the resolution of issues, and the exchange of documentation. The designation of those involved may vary, and participants may take on various names. For example, the Owner may be defined as the project manager, or the contractor may be defined as the construction manager. The communication plan must include contact information for the Cx Team members and all other key project participants. For an existing building Cx or retrocommissioning project, this may include an outside funding contact, such as the financing entity or a utility.

5.2.5 Issues Log Items. See ASHRAE Guideline 0, Section 5.2.5, for examples of information that should be captured in the issues and resolution logs.

5.3 Predesign Phase Acceptance Requirements. During the Predesign Phase, the Cx Process should include the formal acceptance by the Owner of the OPR and the Cx Plan. Additional information is provided in ASHRAE Guideline 0, Informative Annex H.

5.4 Predesign Phase Documentation. See ASHRAE Guideline 0, Section 5.4, for documentation listings. Additional information is provided in SSPC 300 Informative Annex 01, “Commissioning Process Documentation Matrix.”

5.5 Predesign Phase Training Identification Requirements. See ASHRAE Guideline 0, Section 5.5, for training identification procedures. Additional information is provided in ASHRAE Guideline 1.3, *Building Operation and Maintenance Training for the HVAC&R Commissioning Process*.

6. DESIGN PHASE

6.1 Introduction

6.1.1 During the Design Phase of the project delivery process, the Owner’s Project Requirements (OPR) are translated into construction documents. A document called the Basis of Design (BoD) is created by the design team that clearly conveys the assumptions made in developing a design solution that fulfills the intent and criteria in the OPR document. Narrative descriptions of smoke control systems are developed and included in the BoD, and the Commissioning (Cx) Plan is expanded to include the details of Construction Phase and Occupancy/Operations Phase activities.

6.1.2 Design Phase Cx Process objectives related to smoke control systems include all the requirements of ASHRAE Guideline 0, Section 6.1.2, plus the following:

- a. Verify that the smoke control systems selected by the design team meet all the objectives and functional requirements listed in Section 5.2.2 of this guideline that are included in the OPR.
- b. In addition, the following are specific to the success of smoke control systems:
 1. Verify that systems and components are maintainable and accessible; because smoke control systems are life-safety systems, they need regular verification and maintenance.
 2. Verify that the smoke control system components are rated for smoke control functions and operation.
 3. Verify that the smoke control system acceptance, periodic, and automatic self-test requirements have been developed.
 4. Verify that the proposed final smoke control test procedure is acceptable to the authority having jurisdiction (AHJ).
 5. Verify that the design of the building automation systems (BAS), if used for both building automation and smoke control, is rated for smoke control operation and is compatible with and can fulfill the control requirements defined in the OPR and BoD. Ensure that the interface between systems is clarified; typically, this involves designers from Division 25 (BAS), Division 26 (Emergency Power), and Division 28 (Fire Alarm), as well as the project code consultant.
 6. Verify that control systems requirements are clearly defined.
 7. Verify that the FSCS layout has been approved by the local AHJ.
 8. Verify that sequence of operations and sequence of control are clear and documented.

Documentation should include location of smoke zones, method of activation, activation schedule, control sequence under automatic, manual, and FSCS control.

9. Verify that the requirements of related support systems and assemblies are included in the design and that integration is adequately addressed.
- 6.1.3** The validation of installation and functional performance testing of smoke control systems and components should be 100% inspected.

6.2 Design Phase Cx Process Activities

6.2.1 Design Phase Cx Process Responsibilities

6.2.1.1 In addition to those detailed in Section 5.2.1 of this guideline, other members of the Cx Team related to smoke control systems during the Design Phase may include, but are not limited to, the following:

- a. Construction manager
- b. General contractor
- c. Design-build contractor
- d. Sprinkler contractor
- e. Mechanical HVAC contractor
- f. Test and balance contractor
- g. Controls contractor
- h. Electrical contractors (including low voltage)
- i. Fire alarm contractor
- j. Security contractor
- k. Special inspector
- l. AHJ

6.2.2 BoD Documentation

6.2.2.1 The BoD for smoke control systems should include, but is not limited to, the following:

- a. A description of the BASs, a full table of users' access levels, interoperability and connectivity, and capabilities of systems and subsystems.
- b. Assumptions for calculations/sizing, material densities that affect air leakage, etc.
- c. Analytical procedures and tools used during design, including manual and software (including version) analysis and simulation models (duct pressure, duct sizing, control strategies).
- d. The equipment features and performance requirements needed.
- e. Operational assumptions, including facility and space use, testing, O&M budget, and personnel capabilities.
- f. Narrative system and assembly descriptions. These generally describe how the designer intends to meet the smoke control related OPR and are updated and made more detailed as the design progresses. The narrative should describe general systems and equipment (e.g., air handlers, air distribution) and an outline sequence of operations. SSPC 300 Informative Annex 06, "Basis of Design", provides more information on the BoD documents that should contain these descriptions.
- g. Codes, standards, guidelines, regulations, and other references that influenced the design of the smoke control systems.
- h. Owner guidelines and directives that influenced the design of the smoke control systems.
- i. Fulfillment of the OPR, including a specific listing of how each requirement is addressed in the construction documents.

6.2.3 Update Cx Plan

6.2.3.1 General requirements for updating the Cx Plan during the Design Phase are covered in SSPC 300 Informative Annex 05, "Commissioning Process Plan," and ASHRAE Guideline 0, Section 6.2.3. The Cx Plan must be updated to reflect changes in the OPR and include additional information developed during the Design Phase.

- 6.2.3.2** During the Design Phase, the following are added to or updated in the Cx Plan related to smoke control systems:
- a. Systems and assemblies to be verified and tested. These typically include (but are not limited to) the following:
 1. Primary and secondary energy supply
 2. Safety, including alarms, fire, security, and power failure
 3. Damper requirements (control, fire, smoke)
 4. Smoke and fire barrier construction (where required by the BoD)
 5. Air supply and exhaust
 6. Air distribution leakage and system static pressure
 7. Supply air velocity (for atrium systems)
 8. Supply and exhaust fan units
 9. Instrumentation and controls
 - b. Schedule of smoke control related Cx Process activities for the Construction Phase and for the Occupancy/Operations Phase. The schedule should identify critical times for witnessing testing activities, smoke control systems and equipment accessibility for maintenance and verification, completion of construction checklists, and activities related to substantial completion/project closeout.

6.2.3.3 Milestones

- 6.2.3.3.1** During the Design Phase, it is critical to update and elaborate documentation on the key milestones related to the smoke control systems. These include the following:
- a. Predesign meeting (as a completed activity)
 - b. Design review (multiple)—including the BoD
 - c. Updated Cx Plan
 - d. Construction prebid meeting
 - e. Preconstruction meeting
 - f. Cx meetings
 - g. Submittal (including manufacturers' O&M documentation) review
 - h. Systems manual (A specific time for completion of this activity after submittal acceptance should be established based upon project complexity.)
 - i. Submission of automatic control and building automation controls software (A specific time for completion of this activity after submittal acceptance should be established based upon project complexity.)
 - j. Training program implementation plan
 - k. Construction checklist completion and tracking
 - l. Equipment placement review
 - m. Testing procedure development (update Cx Plan)
 - n. Initial automatic controls and building automation system (BAS) acceptance
 - o. Pretesting, adjusting, and balancing report and verification
 - p. Final automatic controls and BAS acceptance
 - q. Acceptance testing for the AHJ
 - r. Final systems manual submission
 - s. Operator training
 - t. Turnover of systems/smoke control systems acceptance, start of warranties
 - u. Issue Acceptance Test Report to AHJ, client, engineer of record, and construction contractor
 - v. Commissioning Provider (CxP) site visits during first year of operation
 - w. Seasonal testing

x. Lessons learned meeting

6.2.4 Cx Process Requirements in the Construction Documents

- 6.2.4.1 Integrate specific component performance documentation requirements and use of construction checklists into the relevant smoke control specification sections (and others as appropriate) with appropriate cross references.
- 6.2.4.2 Integrate smoke control Cx Process activities into the relevant electrical, mechanical, and other specification divisions as required.
- 6.2.4.3 See ASHRAE Guideline 0, Section 6.2.4, for general requirements. Template text that may be included in the relevant specification divisions for smoke control Cx Process requirements is provided in Informative Appendix B of this guideline.

6.2.5 Construction Checklists

- 6.2.5.1 The smoke control system designer should develop a checklist.
- 6.2.5.2 General requirements for construction checklists are presented in SSPC 300 Informative Annex 10, “Testing and Reporting,” and ASHRAE Guideline 0, Section 6.2.5. See Section 7.2 for further information.

6.2.6 Systems Manual

- 6.2.6.1 See also ASHRAE Guideline 1.4, *Preparing Systems Manuals for Facilities*, on creation of a systems manual.
- 6.2.6.2 A smoke control systems manual should be included in the building systems manual or provided in addition to the general building systems manual. The format of these manuals should be clearly stated in the construction documents.
- 6.2.6.3 The sections in the smoke control systems manual are developed for each major system or function. These typically include (but are not limited to) the following:
 - a. Description of supply air and exhaust systems that are part of the smoke control system
 - b. Instrumentation and controls (including electric and electronic, pneumatic, self-powered systems)
 - c. Activation schedule describing the automatic operation of all outputs in response to each smoke control activation signal
 - d. Methods of manual activation of the smoke control system, if provided
 - e. Description of system operation in response to each activation signal from the firefighter’s smoke control system (FSCS)
 - f. Method of resetting the system at conclusion of need for smoke control
- 6.2.6.4 The requirements for contractor-supplied information for the smoke control systems manual should be clearly stated in the construction documents.

6.2.7 Training Requirements

- 6.2.7.1 General requirements for development of training requirements during the Design Phase are outlined in ASHRAE Guideline 1.3, *Building Operation and Maintenance Training for the HVAC&R Commissioning Process*, and ASHRAE Guideline 0, Section 6.2.7. In general, smoke control training will address a range of knowledge sets and should be provided through a variety of formats tailored to the needs and capabilities of the Owner’s operating personnel as expressed in the OPR. Smoke control training should cover overall systems as well as individual equipment.
- 6.2.7.2 Training on overall smoke control systems concepts and intents should be done in a classroom setting and actively involve the smoke control design professionals. Topics should include the smoke control basis of design, smoke control systems operation (normal, emergency, limitations, cold start), and similar big-picture issues.
- 6.2.7.3 Training on specific smoke control equipment should be provided in appropriate forms (including classroom, field, and factory settings, as warranted). Major equipment (fans, dampers, controls) training should address preventive maintenance, operations, and troubleshooting. The type and level of training should relate to the Owner’s approach to O&M (in house, contract, or a combination) described in the OPR. Training on secondary equipment will vary from component to component and should also relate

to the Owner's O&M approach.

6.2.7.4 Training should occur throughout the Construction Phase and into the Occupancy/Operations Phase as appropriate to the construction schedule, equipment types, and Owner's needs. Training should include periodic review of system self-tests and periodic operator testing of systems as defined in the smoke control systems manual.

6.2.7.5 Training requirements and responsibilities should be clearly stated in the construction documents and professional services agreements. The design professionals, contractors, control contractor/vendor, manufacturers, other vendors, and CxP will be involved in training on smoke control systems. The scope and training expectations should be clearly stated in the specifications and other contract agreements, especially the coordination role with the contractor. There should be consideration for manufacturer's training on controls systems, software, and integrated systems (fire/life safety integration with the smoke control system). Training should involve operator training, maintenance training, repair training, and ongoing training for smoke control systems. In addition to the factory training elements, variable-frequency drives, dampers, fans, pumps, air handlers, and terminal boxes always have on-site training requirements. Additional guidance on training is provided in ASHRAE Guideline 0, Section 6.2.7.

6.2.8 Design Review of Construction Documents

6.2.8.1 The process for accomplishing design reviews for verifying fulfillment of the OPR is described in SSPC 300 Informative Annex 08, "Design Review and Report," and ASHRAE Guideline 0, Section 6.2.8. Specific to smoke control systems, the following guidance is provided for the four-step review process, as described in ASHRAE Guideline 0, Section 6.2.8.2. The intent of the design review by the Cx Team is to determine if there are systematic errors, not to fully check the drawings and specifications. The responsibility for complete checking of the drawings and specifications for coordination and accuracy remains with the design team.

6.2.8.1.1 General Quality Review. The general quality review for smoke control systems should focus on completeness, organization, and readability of drawings and specifications with attention to details, schedules, controls, ductwork, fire protection piping, equipment rooms, legends, pressure sensors, smoke dampers, power source, and equipment identification.

6.2.8.1.2 Coordination Review. Key system elements (such as fans, dampers, power sources, control systems, and sequence of controls) of the smoke control systems are reviewed to evaluate the coordination accomplished within and among disciplines. This includes reviewing for interfaces among disciplines (e.g., fire detection system interface to the control system) and checking the design against the OPR (e.g., ensuring access to the smoke control components for servicing).

6.2.8.1.3 Smoke Control System-Specific Review. Within the areas selected for review, verify that the design complies with the OPR. Specific issues to consider include coordination of the zones between the fire system and smoke system and verification that fan capacities, pressure differences, and air velocities are appropriate for the stated assumptions. Functions, including wind effects and seasonal variations, should also be considered.

6.2.8.1.4 Smoke Control Specification Review. A review of the specification is performed to determine completeness, applicability to the project, and compliance with the OPR. Items checked include applicability of the smoke control section of the specification to the project, Cx Process requirements, submittal requirements, applicability of equipment to the project, training requirements, coordination with other sections of the specification, and coordination with the drawings.

6.3 Design Phase Acceptance Requirements. The Cx Process should include the formal acceptance of the BoD and the updated OPR.

6.4 Design Phase Documentation Requirements

6.4.1 Refer to ASHRAE Guideline 0, Section 6.4, for Design Phase documentation requirements.

6.4.2 The applicable local codes may have additional documentation requirements.

6.5 Design Phase Training Identification Requirements

6.5.1 Training requirements for the Owner, the system operator, maintenance personnel, and fire department

personnel are addressed during the Design Phase by the completion of a training requirements identification workshop, development of the Construction-Phase and Occupancy/Operations Phase training programs, and inclusion of the training program requirements in the Cx Plan and construction documents.

- 6.5.2 Prebid Conference.** Refer to ASHRAE Guideline 0, Sections 5.2.2.8 and 7.2.2, for general pre-bid conference orientation. The pre-bid meeting is the opportunity to provide all bidders with an overview of the requirements unique to the smoke control system, and the Cx activities that will occur during construction. It is very important that bidders understand their role in the Cx Process. This is also an opportune time to discuss the reasons for including the OPR and BoD in the bidding documents (as information only and not contract requirements). This information is for the benefit of building operations and ongoing Cx after construction is completed. Bidder questions regarding the Cx requirements should be addressed with appropriate responses to all bidding contractors.

7. CONSTRUCTION PHASE

- 7.1 Introduction.** Cx Process activities to be performed by the various members of the Cx Team during the Construction Phase are described in ASHRAE Guideline 0, Section 7. Additional information on specific activities related to smoke control systems is presented in this section and includes the following:

- a. Updating construction checklists prepared during the Design Phase to reflect the specific equipment/materials approved by the design professionals
- b. Providing or updating test protocols not addressed earlier in the Cx Process because specific product information was not yet received
- c. Verifying that the control logic diagrams and any additional controls programming that has been created can fulfill the Owner's Project Requirements (OPR) for smoke control
- d. Verifying the integration of smoke control system controls and system components with other fire and life-safety systems and with other building systems that may affect or be affected by the smoke control system
- e. Witnessing all pressure tests of duct systems used for smoke control and pressure difference testing of smoke barriers and observing all start-up activities of smoke control components
- f. Verifying the testing, adjusting, and balancing (TAB) work for smoke control systems
- g. Verifying scheduling of seasonal dependent testing

- 7.1.1** An important part of the Cx Process is the training of operations and maintenance (O&M) personnel. These individuals should be available at the site during construction to observe the installation of the smoke control system and to learn about its operation. The Commissioning Provider (CxP) should direct this training.

- 7.1.2** An important part of the Cx Process is the training of the fire department. Fire officers should be available at the site during construction to observe the installation of the smoke control system and to learn about its operation. The CxP should direct this training.

7.2 Construction Phase Cx Process Activities

7.2.1 Construction Phase Cx Process Responsibilities

- 7.2.1.1** Essential smoke control Cx Team members include the CxP, smoke control system design professionals, the fire alarm contractor, electrical contractors, the construction manager and/or general contractor, the mechanical contractor, the controls contractor, fire alarm and smoke control equipment suppliers, sheet metal and piping subcontractors, environmental controls and systems integrators, the TAB contractor, and any other relevant specialists.

- 7.2.1.2** Responsibilities of the smoke control Cx Team include the following:

- a. TAB work should be performed on all the HVAC equipment and smoke control systems prior to acceptance testing. Operational tests should also be conducted on equipment, duct, and control systems to verify that pressures and flow rates meet the design requirements of the smoke control system.
- b. Controls testing and calibration should begin concurrent with, and be completed subsequent to, the TAB work of the smoke control system.
- c. The CxP should observe and verify all start-up, testing, balancing, and calibration activities as part

of the ongoing Cx Process.

7.2.1.3 Forms. The Cx Plan should be prepared following the format described in the contract specifications. It should detail how the Cx Process will be organized, scheduled, and documented and should include all forms for all components and systems submitted on a per-zone basis.

7.2.2 Coordinate Owner’s Representatives’ Participation. Refer to ASHRAE Guideline 0, Section 7.2.3, for a general description. The smoke control system construction Cx Process may include (but is not limited to) the following participants:

- a. Security personnel
- b. Facility engineers
- c. Building controls personnel
- d. Owner’s representative for contractors and outside maintenance

7.2.3 Update Owner’s Project Requirements

7.2.3.1 Refer to SSPC 300 Informative Annex 04, “Owner’s Project Requirements,” and ASHRAE Guideline 0, Section 7.2.4, for general guidance. If proposed smoke control system changes that are at variance with the OPR are approved by the design professionals and Owner, the OPR and BoD should be revised and approved. This provides for continuous updating of the OPR and BoD to reflect the constructed project.

7.2.4 Update the Cx Plan

7.2.4.1 Refer to ASHRAE Guideline 0, Section 7.2.5.

7.2.4.2 Specialists with knowledge of specific systems and equipment may be utilized as resources for the smoke control system Cx Team and listed in the Cx Plan with their roles and responsibilities. Some specialties that may relate to smoke control system Cx Process activities include:

- a. Fire alarm
- b. Security
- c. Electrical
- d. Elevator
- e. Fume hood and laboratory controls
- f. Systems integration
- g. Computerized maintenance management systems

7.2.5 Conduct Preconstruction Cx Process Meeting

7.2.5.1 Refer to ASHRAE Guideline 0, Section 7.2.6.

7.2.5.2 Special issues related to sequencing and early installation of smoke control system equipment located in limited access areas should be discussed.

7.2.6 Verify Submittals

7.2.6.1 Submittals should be reviewed by the CxP using SSPC 300 Informative Annex 09, “Submittal Review,” prior to construction for compliance with the OPR. Submittals should include shop drawings, equipment submittals, and TAB procedures and forms. Submittals should also include the Cx Plan and Cx documentation format.

7.2.6.1.1 A smoke control system review should examine how the smoke control system interacts with, relates to, and is affected by other systems, equipment, and activities, including the following:

- a. Alarm systems (with and without access control)
- b. Security
- c. HVAC
- d. Controls
- e. TAB
- f. Duct and pipe layout

- g. Equipment room layout
- h. Maintenance and troubleshooting parts lists requirements
- i. Ceiling space coordination
- j. Underfloor coordination
- k. Plumbing supply and drains
- l. Electric power equipment and supply for the smoke control system
- m. Fire doors
- n. Firefighting equipment

7.2.6.1.2 Refer to SSPC 300 Informative Annex 02, “Quality Based Sampling Process,” and ASHRAE Guideline 0, Section 7.2.7, for general procedures and sampling strategies.

7.2.6.2 Coordination drawings should be reviewed for the following:

- a. Fire, smoke, and fire and smoke combination dampers are clearly delineated on all drawings.
- b. Smoke detectors, fire detectors, alarm pull stations, control panels, and all interface controls and panels are clearly delineated on all drawings.
- c. Mechanical and electrical equipment involved with any smoke control function are described completely and shown with interconnections to the smoke control system.
- d. Access doors and panels, fire and smoke dampers, sprinkler zones (if necessary), ductwork, conduit, and control elements are clearly shown on all drawings.
- e. Clear spaces for maintenance and operation procedures appropriate to the accepted make and model of smoke control equipment should be shown on coordination drawings.

7.2.6.3 Equipment Submittals

7.2.6.3.1 Fire, smoke control, and associated equipment and component vendor submittals are to be obtained for use by the CxP. This information, when confirmed and approved, will be used in developing the construction checklists and test procedures.

7.2.6.3.2 Equipment submittals should include complete certifications and performance data for each piece of equipment, e.g., capacity, flow rates, velocity, pressure losses, horsepower, revolutions per minute, and electrical data. After review of equipment submittals, the equipment O&M information (including parts lists, installation and start-up instructions, and special tool needs) should be submitted in accordance with specification requirements.

7.2.6.4 Controls Submittals

7.2.6.4.1 Control submittals for the smoke control system should be presented in an approved format.

7.2.6.4.2 Control submittals should be reviewed to ensure that they include all information needed by the O&M staff to keep the control system that is related to the smoke control system adjusted and devices calibrated. Information should include the following:

- a. A completely labeled control piping or wiring schematic, showing point-to-point piping and wiring and including all performance parameters, such as set points, actions, spans, and other control component adjustment or setting data and locations of test ports and electronic drawings
- b. Completely labeled electrical and pneumatic diagrams
- c. A sequence of operation (a narrative description of control system functions) cross-referenced to the control schematics and electrical and pneumatic diagrams
- d. Specification sheets for each control component

7.2.6.5 Review the TAB agency submittal to verify it includes the following:

- a. Specified qualifications and certifications of parties performing TAB work, including experience of site technicians.
- b. Protocol for using the BAS and/or FSCS and/or fire alarm systems for TAB.
- c. Detailed modes of operation for events requiring smoke control system operation. Both control functions and equipment operation should be detailed.

- d. Details of procedures to verify airflow directions and quantities, pressure differentials, and any other factors required for smoke control.
- e. Identification of measuring instruments to be used by type, manufacturer, model, serial number, and their most recent calibration date.

7.2.7 Schedule Construction Phase Cx Process Activities

7.2.7.1 In addition to the general requirements in ASHRAE Guideline 0, Section 7.2.8, the following Cx Process activities for smoke control systems should be scheduled and coordinated with the construction schedule:

- a. Submittals, including, but not limited to, smoke control equipment approval, coordination drawings, and control interface wiring diagrams
- b. Order of smoke control system testing
- c. Duct leak testing; verification of leak testing of ductwork; and cleaning of ductwork, air TAB, fans, dampers, HVAC components, and system testing
- d. Smoke control system equipment installation and startups
- e. Interface between the smoke control system and BAS control system testing
- f. TAB
- g. Cx tests
- h. Test verification

7.2.8 Develop Test Procedures

7.2.8.1 In addition to the general test procedure requirements in ASHRAE Guideline 0, Section 7.2.9, the following apply to smoke control test procedures.

7.2.8.2 List of test procedures and data forms to verify conformance with BoD and achievement of OPR.

- a. Each project requires creation of test procedures unique to that project.
- b. The objective of these procedures is the verification of the OPR. For example,
 - 1. determining code authority testing requirements for the system and
 - 2. verifying the operation of fans and dampers in specific sequence for zoned smoke control.
- c. The first step in developing a test procedure is to determine which of the requirements in the OPR, building code, or other documents require a test procedure for verification.
 - 1. Identify each system involved in smoke control on the project. This includes activation devices (manual and automatic) and both exhaust (fans, vents) and supply or make-up air systems (air-handling units, fans, louver/dampers, operable doors, and other openings).
- d. The second step in developing a test procedure is to identify the key points of evaluation for each test. For example, the following would be evaluated:
 - 1. Stairwell pressurization system
 - 2. Elevator shaft and lobby pressurization system where required by the BoD
 - 3. Floor-by-floor (or zone-to-zone) pressurization system
 - 4. Smoke containment dampers and local smoke detectors
 - 5. Atrium smoke control and extraction system
 - 6. Coordination of zoning of activation signals with zoning of the smoke control system
 - 7. Coordination of priorities and overrides of the system
- e. The third step in developing a test procedure is to identify what information must be documented to show OPR achievement (refer to Section 7.2.10 of this guideline).
- f. The fourth step in developing a test procedure is to identify all the stakeholder parties involved and when their actions are required for a successful project test and close-out. Those who may need to be present during the testing include the following:
 - 1. Building department
 - 2. Fire department

3. Special inspector
4. Fire alarm contractor
5. Building automation system (BAS) contractor
6. Fire sprinkler contractor
7. Electrical contractor
8. Door hardware supplier
9. General/construction manager
10. Engineer of record
11. Owner's representative
12. Architect

7.2.8.3 Sequencing of the Performance of Each Test. The following should be accomplished prior to the start of any Cx Process OPR tests:

- a. Verify that the physical installation of components and systems being tested is in accordance with the contract documents.
- b. Verify all alarm and signaling functions and messages generated on all points with alarm settings.
- c. Verify interactions between the firefighter's smoke control station (FSCS) and smoke control or alarm system panels.
- d. Verify integrated performance of all smoke control system components, including all interlocks and interactions with other equipment and systems.
- e. Verify shutdown and restart capabilities for both scheduled and unscheduled events (e.g., test sequences, proper operation when switching from primary to standby power).
- f. Verify that the FSCS graphics are representative of the systems and that all points and control elements are in the same location on the graphic as they are in the field.
- g. Verify that all penetrations (e.g., ductwork, piping, etc.) of smoke barriers have been sealed using approved sealants.

7.2.8.4 Verify operation of the smoke control systems in accordance with procedures in Informative Appendix B.

- a.

7.2.9 Develop Test Data Records

7.2.9.1 In addition to the items listed in ASHRAE Guideline 0, the following smoke control system related items should be included in the test data records:

- a. Trend logs and testing exception issues and resolution logs.
- b. Detailed responses to input changes, including response times if they are critical.
- c. Flows, temperatures, pressures, volumes, capacities, and other required data to confirm equipment and system capabilities
- d. State of each component that could affect the OPR (e.g., the state of the fans, variable-frequency drives, terminal units, the space, and the outdoor conditions)

7.2.9.2 If functional performance test checklists are contained in the approved Cx Plan of the smoke control system, these checklists should be completed and used to document the results of the functional performance testing process.

7.2.10 Cx Team Meetings

7.2.10.1 Cx Team meetings may be required to specifically address issues related to smoke control systems. These meetings should be organized and conducted in accordance with the guidelines established in ASHRAE Guideline 0. The meetings may or may not be conducted within a regularly scheduled Cx meeting. Attendees should include all parties and disciplines affected by the subjects under consideration. Such meetings might include discussion of the following topics:

- a. Smoke control system installation, start-up, and testing
- b. Equipment coordination within the smoke control system
- c. Review of construction checklist procedures
- d. Review of OPR verification test procedures
- e. Control system implementation and coordination
- f. Pre-TAB preparation
- g. Review of TAB report
- h. Review of issues log

7.2.10.2 Special Coordination Meetings

- a. **Verification protocol and construction checklist meetings.** Essential smoke control system Cx Team members include the fire alarm contractor, electrical contractors, general contractor, mechanical contractor, alarm and smoke control system equipment suppliers, sheet metal and piping subcontractors, environmental controls and systems integrators, TAB contractor, and any other relevant specialists.
- b. **Cx Team meetings.** Convene special Cx Team meetings as required to address the control system for smoke control and the TAB activities.
 1. **Controls meeting.** Convene a meeting to review the sequencing, coordination with other controls (for example, fire and life safety, security, lighting), and completion of smoke control system installation activities. Attendees include the fire protection engineer, CxP, mechanical design professional, Owner's O&M representative, general contractor and/or construction manager, mechanical contractor, control contractor, TAB contractor, electrical contractor, and fire alarm contractor. The following items are to be addressed during this meeting:
 - i. Review and discussion of controls issues prior to control programming and controls formal submittal. This meeting should be held early during construction and may include the fire protection designer, fire alarm contractor, smoke control system contractor, mechanical designer, CxP, controls contractor, and Owner. Items that may be covered include system architecture, control drawing format and content, sequences of operation details and logic, the control database, the point naming convention, alarms, graphic screens, locations of critical sensors, and other coordination issues.
 - ii. Control package submittal content requirements and scheduling, including products, sequence of control, control logic diagram, and smoke control software.
 - iii. Ongoing point-to-point control system verification requirements, as well as other information on the construction checklists.
 - iv. Resolution procedures to be followed.
 - v. Documentation submittal requirements and timing.
 - vi. Involvement in Cx test completion at end of the project.
 2. **TAB meeting.** Convene a meeting to review the sequencing, coordination between the control system for smoke control with other controls (for example, other fire and life-safety equipment and controls, BAS, security, emergency lighting, elevators), and completion of control system installation activities. Attendees include the fire protection engineer, smoke control and fire alarm contractors, sprinkler system installer, CxP, mechanical design professional, Owner's O&M representative, general contractor and/or construction manager, mechanical contractor, control contractor, TAB contractor, and electrical contractor. The following items are addressed during this meeting:
 - i. Sequencing of events (equipment construction checklist completion, control system construction checklist completion, system start-up, TAB, TAB verification, and Cx testing completion)
 - ii. TAB contractor test report forms and submission procedures
 - iii. Review of Cx Process checklists, submission procedures, and frequency

- iv. Identification, documentation, and resolution of issues identified by TAB contractor
- v. Interface between contractors, including, but not limited to, smoke control, fire alarm, security, TAB, controls, mechanical, electrical, and sprinkler

7.2.11 Conduct periodic site visits to verify fulfillment of the OPR

7.2.11.1 Coordination of the timing of these system visits should take into account construction progress. Site visits may be triggered by specific milestones such as the following:

- a. Delivery of major pieces of equipment
- b. Completion of rough-in before walls are covered
- c. Completion of above-ceiling equipment before ceilings are installed

7.2.12 Test Execution

7.2.12.1 Participants required for the test may include the following (in addition to the participants listed in ASHRAE Guideline 0):

- a. Smoke control system contractor
- b. Fire alarm system contractor
- c. BAS contractor
- d. Sheet metal contractor
- e. Mechanical piping contractor
- f. Controls contractor
- g. TAB contractor
- h. Mechanical contractor
- i. Electrical contractor
- j. Other contractors and specialists with knowledge of specific systems and equipment that interface with the smoke control system

7.2.12.2 The functional performance testing process should be accomplished for all equipment, subsystems, systems, and system interfaces. Several similar pieces of equipment, systems, etc., may exist for a project. All should be tested for acceptance, and there should be a separate checklist for each to ensure documentation specific to each is complete.

7.2.12.3 Individual components of the smoke control system should be tested for proper operation in response to automatic and manual activation. They include dampers and their actuators as well as other required components, such as local controllers and safety devices. All components should be checked and adjusted as may be required for proper operation and the overall response time required.

7.2.12.4 All control devices should be adjusted and calibrated. All control settings should be verified by comparing actual input and output values to calculated values.

7.2.12.5 TAB work should be substantially complete with reports submitted prior to the Verification and Acceptance Phase.

7.2.12.6 Functional and performance testing will have to consider sequences of testing, starting with components and progressing toward complete systems.

7.2.12.7 Every mode of system operation; all system equipment, components, and zones; and every item in the control sequence description should be proven operational under all normal operational modes, including part and full load, and under abnormal or emergency conditions. Special attention should be given to possible conflicts among energy management systems, normal mode safeties, control priorities, and similar requirements.

7.2.12.8 Each system should be operated through all modes of system operation with all zone scenarios tested (e.g., multiple alarms versus single alarms). Each system should also be observed by including all individual interlocks, conditional control logic, all control sequences, and simulation of any abnormal conditions for which there is a specified system or control response (e.g., multiple alarms, fan shutdown, supply fan shutdown with inlet smoke detector).

- 7.2.12.9** Temporary upsets of systems, such as distribution fault, control loss, set-point change, equilibrium upset, and component failure, should be imposed at different operating loads to determine if the system's stability and recovery time meet the OPR.

7.2.13 Verify Training

- 7.2.13.1** See ASHRAE Guideline 0 for general requirements. Adjust training verification criteria to reflect smoke control system installation if necessary. This may include review of the video recordings of the sessions as well as other advanced documentation methods. This may also include building computerized documentation systems for O&M of the smoke control system and components. This includes staged recordings and manufacturers' training materials.

- 7.2.14 Construction-Phase Cx Process Report.** See SSPC 300 Informative Annex 15, "Commissioning Process Progress Report," and ASHRAE Guideline 0, Section 7.2.15, for requirements.

7.2.15 Verify Systems Manuals Update

See ASHRAE Guideline 1.4 and ASHRAE Guideline 0, Section 7.2.16, for requirements.

7.2.16 Verify Updates to BoD

See SSPC 300 Informative Annex 06, "Basis of Design," and ASHRAE Guideline 0, Section 7.2.17, for requirements.

7.3 Construction-Phase Acceptance Requirements

See ASHRAE Guideline 0, Section 7.3, for requirements.

7.4 Construction-Phase Documentation Requirements

- 7.4.1** See ASHRAE Guideline 0, Section 7.4, for requirements.

- 7.4.2** In addition to the items listed in ASHRAE Guideline 0, the following documentation should be provided:

- a. Shop drawings
- b. As-built drawings
- c. Equipment submittals
- d. Special tools and spare parts lists

7.5 Construction-Phase Training Requirements

See ASHRAE Guideline 1.3 and Section 7.2.14 for requirements.

8. OCCUPANCY/OPERATIONS PHASE

- 8.1 Introduction.** Commissioning (Cx) Process activities described in this section to be performed by the various members of the Cx Team during the Occupancy/Operations Phase are described in ASHRAE Guideline 0, Section 8. Troubleshooting and resolution of the smoke control issues need to be completed during the first year of operation, and as the function of the facilities change, smoke control systems need to be adapted to the changing requirements of occupancy and use. Additional information on specific activities related to smoke control systems is provided in this section and includes the following:

- a. Facilitating the identification, troubleshooting, and resolution of smoke control system issues throughout at least the first year of occupancy, including the involvement of the proper contractor and/or design professional when required.
- b. Verifying ongoing upkeep of project documentation in the systems manual, especially the Owner's Project Requirements (OPR), Basis of Design (BoD), and record drawing sections
- c. Overseeing the completion of seasonal testing of smoke control systems during peak and swing seasons to verify fulfillment of the OPR
- d. Participating in the documentation of lessons learned from this project to improve the Owner's smoke control systems on future projects
- e. Facilitating the updating of smoke control system preventive maintenance schedules with suitable measurement and verification documentation

8.2 Occupancy/Operations-Phase Cx Process Activities

8.2.1 Occupancy/Operations Phase Cx Process Responsibilities

- 8.2.1.1** During the Occupancy/Operations Phase, the key Cx Team members include the Commissioning Provider (CxP) and the operations and maintenance (O&M) personnel. Others that may be involved on the Cx Team on a periodic basis for smoke control systems, in addition to those listed in ASHRAE Guideline 0, Section 8.2.1.2, include the mechanical contractor, HVAC&R controls contractor, fire alarm contractor, systems integrators, and any other specialists (e.g., laboratory subcontractor).
- 8.2.1.2** Responsibilities of the Cx Team are defined in ASHRAE Guideline 0, Informative Annex F.
- 8.2.1.3** A key focus during the Occupancy/Operations Phase is the ongoing verification of the smoke control related OPR, which typically includes maintenance and documentation.

8.2.2 Coordinate Contractor Callbacks

During the first year of occupancy, there may be issues identified related to the smoke control system and related OPR. Therefore, it is important that the Cx Team facilitates the identification and resolution of these issues to address and document changes to the OPR and BoD and to minimize the number of contractor callbacks. See SSPC 300 Informative Annex 11, “Issues and Resolution Log.”

8.2.3 Verify Seasonal Testing of Facility Systems and Assemblies

- 8.2.3.1** For smoke control systems, the OPR Cx tests for door-opening forces and pressures across barriers need to be accomplished during the peak heating and peak cooling seasons.
- 8.2.3.2** The Cx Team is responsible for working with the O&M staff and Owner’s building manager to schedule these tests. It is recommended that the O&M staff conduct the tests under the supervision of the Cx Team to provide them with hands-on testing experience that they can use periodically to reverify smoke control system performance. The various contractors should be invited to the testing, but their involvement is not required in their scope of work.
- 8.2.3.3** Follow the guidance on OPR testing provided in Section 7.2 of this guideline and in ASHRAE Guideline 0, Section 7.2.

8.2.4 Verify Continual Training of Operation and Maintenance Personnel

The training program was initially planned during the Design Phase (see Section 6.2.7) and created and implemented during the Construction Phase (see Section 7.2.14). During the Occupancy/Operations Phase, any remaining training per the contract documents is completed and verified by the Cx Team. Examples of training typically accomplished during the Occupancy/Operations Phase include the following:

- a. Ongoing training on systems manual upkeep
- b. Periodic training on implementing the ongoing Cx Process during smoke control system changes

8.2.5 Verify Continual Updating of the Systems Manual

- 8.2.5.1** Responsibility for maintaining the accuracy and relevancy of the systems manual is transferred from the contractors to the O&M personnel at the start of the Occupancy/Operations Phase.
- 8.2.5.2** Maintaining and updating the systems manual is required for the life of the facility and includes the following:
 - a. Inclusion of material as the result of completing the Cx Process activities in the Occupancy/Operations Phase
 - b. Inclusion of updated maintenance procedures and schedules, ongoing operational record keeping, and benchmarking results
 - c. Modifying information if changes are made to the smoke control systems, including updating the OPR and BoD
 - d. Keeping the record documents current with changes in walls, equipment, systems, and assemblies

8.2.6 Conduct and Verify Periodic Performance Evaluations of Smoke Control Systems for OPR Fulfillment as Required by the Authority Having Jurisdiction (AHJ)

- 8.2.6.1** HVAC&R systems are dynamic and tend to migrate from their as-installed conditions over time and are

affected by changes to the systems due to new occupant and user requirements. These changes may impact the smoke control system. Therefore, the Cx Team must be involved throughout the first year of operation to help the O&M staff and the Owner's building manager fulfill the OPR on a continual basis.

8.2.6.2 The Cx Team needs to conduct periodic site visits during the first year of operation to work with the O&M staff on all the activities detailed in this phase.

8.2.6.3 During these periodic operational site visits, the Cx Team should do the following:

- a. Meet with the Owner's building manager and O&M staff to identify OPR issues. This is accomplished by reviewing the OPR with them and having them identify areas of concern.
- b. Review the maintenance logs for systemic issues.
- c. Review warranty items. This should be an ongoing activity for each site visit and must, at a minimum, involve a separate site visit to review warranty issues at the 10-month point of the warranties.
- d. Review completion of O&M procedures and upkeep of the systems manual.
- e. Review outstanding Cx Process issues.
- f. Discuss upcoming OPR Cx tests and additional operational site visits.
- g. Create site visit report and document significant findings in the issues log.

8.2.6.4 As part of the first-year site visits, it is also the Cx Team's role to facilitate the integration of the Cx Process activities into ongoing O&M procedures. This includes the following key activities:

- a. Maintaining the OPR document to reflect changes in use and operation of the facility
- b. Maintaining the BoD to reflect changes in smoke control systems and components due to renovations or in response to changes in the OPR
- c. Periodic (seasonal, annual, or biannual) evaluation of fulfillment of the current OPR against previous benchmarks using appropriate tests
- d. Maintaining the systems manual to reflect changes in the OPR, BoD, and systems/assemblies
- e. Ongoing training of O&M personnel on current OPR and BoD changes in smoke control systems and operation, and maintaining current record drawings

8.2.7 Convene Lessons Learned Workshop

8.2.7.1 The attendees of this workshop should all be past Cx Team members.

8.2.7.2 The lessons-learned workshop should be facilitated by someone not directly involved with the project. This avoids conflicts of interest and enables the Cx Team members, including the CxP, to provide their input through the workshop process.

8.2.7.3 For smoke control systems, the following questions may be used to generate workshop discussion:

- a. What aspects of the project (smoke control systems) were successful?
- b. What aspects of the project (smoke control systems) were not successful?

8.2.8 Complete the Final Cx Process Report

Requirements for the final Cx Process Report are detailed in ASHRAE Guideline 0, Section 8.2.5.

8.2.9 Facility Alterations

8.2.9.1 Notify the facility operator, the AHJ, and the fire department of planned alterations.

8.2.9.2 Evaluate the impact of planned alterations to the facility on the smoke control system.

8.2.9.3 Update project documentation, including commission reports, to reflect alterations.

8.3 Occupancy/Operations Phase Acceptance Requirements

The Occupancy/Operations Phase acceptance requirements are detailed in ASHRAE Guideline 0, Section 8.3.

8.4 Occupancy/Operations Phase Documentation Requirements

The Occupancy/Operations Phase documentation requirements are detailed in ASHRAE Guideline 0, Section 8.4.

8.5 Occupancy/Operations Phase Training Requirements

The Cx Process training requirements for the Occupancy/Operations Phase are detailed in ASHRAE Guideline 0, Section 8.5.

9. POSTACCEPTANCE PHASE

9.1 Introduction. Postacceptance commissioning (Cx) ensures effective, ongoing functioning of a facility's smoke control system. As the use and functions of facilities change, smoke control systems need to be adapted to changes in building use. It is necessary to maintain a history of the facility, recording changes and verifying the effect on the previously commissioned system.

9.2 Postacceptance Cx Procedure—Documentation

- 9.2.1** As-built drawings must be reviewed and updated to reflect modifications made to any part of the facility or smoke control system.
- 9.2.2** Any change in use or installed equipment, relocation of walls, etc., should be carefully monitored and documented.
- 9.2.3** Maintenance procedures should be established for periodically verifying the detection system and ensuring that the smoke control system is still operating as designed.

9.3 Facility Alterations

- 9.3.1** Notify the facility operator, the authority having jurisdiction (AHJ), and the fire department of planned alterations.
- 9.3.2** Evaluate the impact of planned alterations to the facility on the smoke control system.
- 9.3.3** Any changes made after Cx should be approved by a design professional and the Owner and should be reinspected and/or retested as determined by the Commissioning Provider (CxP).
- 9.3.4** Update project documentation, including Cx reports, to reflect alterations.
- 9.3.5** Update the systems manuals to reflect any changes in systems.
- 9.3.6** Update the training requirements to reflect any changes in the smoke control system.

9.4 Maintenance Program

- 9.4.1** Regularly maintain and service smoke control systems and equipment. Follow maintenance manuals and keep accurate records of work done.
- 9.4.2** Develop and maintain a standard method of recording:
 - a. maintenance and tests of the smoke control system,
 - b. incidents that cause its actuation,
 - c. discrepancies between predicted performance and actual performance, and
 - d. analyses of the tests of the smoke control system and its operation.
- 9.4.3** Correct discrepancies between predicted performance and actual performance.
- 9.4.4** Maintain an issues and resolution log of deficiencies and associated resolutions.
- 9.4.5 Periodic Testing**
 - 9.4.5.1** Retest the smoke control system periodically to measure the actual performance. Checklists used in the Acceptance Phase should be used as a guide for retesting.
 - 9.4.5.2** Discrepancies between the results obtained during acceptance testing and actual system performance should be investigated and corrected.
 - 9.4.5.3** Local codes may determine the frequency required for testing. Where conflicts exist, consult the AHJ for determination.

10. REFERENCES

1. ASHRAE. 2019. ASHRAE Guideline 0, *The Commissioning Process for New Buildings and New Systems*. Peachtree Corners, GA: ASHRAE.

2. ASHRAE. 2018. ANSI/ASHRAE/IES Standard 202, *Commissioning Process for New Buildings and New Systems*. Peachtree Corners, GA: ASHRAE.
3. ASHRAE. 2019. ASHRAE Guideline 1.4, *Preparing Systems Manuals for Facilities*. Peachtree Corners, GA: ASHRAE.
4. ASHRAE. 2018. ASHRAE Guideline 1.3, *Building Operation and Maintenance Training for the HVAC&R Commissioning Process*. Peachtree Corners, GA: ASHRAE.
5. NFPA. 2024. NFPA 92, *Standard for Smoke Control Systems*. Quincy, MA: National Fire Protection Association.
6. ASHRAE. 2007. ASHRAE Guideline 1.1, *Application of the Commissioning Process for New HVAC&R Systems*. Peachtree Corners, GA: ASHRAE.

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX A—ACCEPTANCE PLAN

It is important to work with the authority having jurisdiction (AHJ) and the property's insurance carrier to ensure that the acceptance testing of smoke control systems is performed in a manner that satisfies their requirements. These will vary with jurisdiction and with a property's occupancy. Smoke control systems are life-safety systems and, as such, should be tested as subsystems and in whole.

Identify all of the subsystems of the overall system, such as the following example subsystems:

- Stairway pressurization
- Zoned smoke control
- Elevator hoistway and lobby pressurization
- Smoke refuge (a specific type of zoned smoke control)
- Atria and large spaces (a specific type of smoke control)
- Fire alarm
- Emergency and normal power distribution
- Elevator recall
- Building automation/temperature control

Identify the specific testing parameters and when they are going to be recorded. For example, acceptance testing should never be the first time a component is tested. Operational testing of each component must be done prior to acceptance testing.

It is important that the acceptance testing criteria be discussed and clearly understood during the design of the systems. It is the intent of acceptance testing to demonstrate that the system is complete and functional and meets the design objectives. The criteria should have objectives that are measurable, repeatable, and nondestructive in nature.

Identify interested parties and when they are to be on site for testing. For example, the airflow testing, adjusting, and balancing (TAB) test readings should be documented and reviewed as part of the operational testing of the components. Some AHJs will require test records be submitted for their record prior to scheduling acceptance testing. Likewise, the operational testing of the fire alarm system may include the fire and electrical AHJ but not the building and mechanical AHJ. The installing contractor should have conducted various levels of testing prior to requesting observation by the Owner's representatives or AHJs. The property's insurance carrier may have agents that need to witness portions of operational or acceptance testing.

NFPA 92: Standard for Smoke Control Systems provides acceptance testing procedures for these systems.

It should also be noted to the property Owner that whenever parts of the system are modified or replaced, operational and acceptance testing should be performed. For some of these systems, those modifications could be architectural (such as moving walls or adding doors).

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INFORMATIVE ANNEX B—SPECIFICATIONS

This annex provides an example of how to implement part of ASHRAE Guidelines 0 and 1.5. It is not intended to be a comprehensive representation or a best-practice example. Practitioners applying the Commissioning (Cx) Process should carefully follow Guidelines 0 and 1.5 as well as other applicable Cx technical guidelines tailored to their specific projects.

The following test requirements, or similar requirements, should be included in the test requirements section of the relevant electrical, mechanical, and other specification division, depending on which system is performing the smoke control function.

B1. PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS

Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable firestopping, gaskets, and sealants are installed. Report deficiencies, and postpone testing until after the reported deficiencies are corrected.

Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.

Measure space pressure differential where pressure is used as the design criteria, and measure airflow differential where differential airflow is used as the design criteria for space pressurization.

Measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.

For applications with cascading levels of space pressurization, begin in the most critical space and work to the least critical space.

Test room pressurization first, then zones, and finish with building pressurization.

To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflows to achieve the indicated pressure or airflow difference.

For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.

Compare the values of the measurements taken to the measured values of the control system instruments and report findings.

Check the repeatability of the controls by successive tests designed to temporarily alter the ability to achieve space pressurization. Test overpressurization and underpressurization, and observe and report on the system's ability to revert to the set point.

For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.

In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.

Record indicated conditions and corresponding initial and final measurements. Report deficiencies.

B2. PROCEDURES FOR STAIR TOWER PRESSURIZATION SYSTEM MEASUREMENTS AND ADJUSTMENTS

- A. Before testing, observe the stair tower to verify that construction is complete. Verify the following:
 1. Walls and ceiling are free of unintended openings and are capable of achieving a pressure boundary.
 2. Firestopping and sealants are installed.
 3. Doors, door closers, and door gaskets are installed and adjusted.
 4. If applicable, window installation is complete.
- B. Measure and record wind speed and direction, outdoor air temperature, and relative humidity on each test day.
- C. Test each stair tower as a single system. If multiple fans serve a single stair tower, operate the fans together.
- D. Balance the airflows in the stair tower as described below.

1. Open the doors indicated to be open, and activate the stair tower pressurization fans. Measure, adjust, and record the airflow of each
 - i. stair tower fan and
 - ii. air outlet supplying the stair tower.
 2. For ducted systems, measure the fan airflow by duct pitot tube traverse.
- E. After air balancing is complete, perform stair tower pressurization tests.
1. Establish a consistent procedure for recording data throughout the entire test. Set the stair tower side of the doors as the reference point and the floor side of the doors with positive pressure when higher than the stair tower and negative pressure when lower than the stair tower.
 2. With the HVAC systems operating in their normal mode of operation and the stair tower pressurization systems OFF, measure and record the following:
 - i. Pressure difference across each stair tower door with all doors in the stairwell closed
 - ii. Force necessary to open each door, using a spring scale
 3. With the HVAC systems operating and the stair tower pressurization system activated, perform the following:
 - i. Place building HVAC systems in their normal operating mode, including equipment not used to implement smoke control, such as air-handling units, toilet exhaust fans, fan-coil units, and similar equipment.
 - ii. Measure and record the pressure difference across each stair tower door with all doors in the stair tower closed. Adjust the stair tower pressure relief to prevent overpressurization.
 - iii. Use a spring scale to measure and record the force needed to open the door closest to the fan. With the initial door held in the open position, measure and record the pressure difference across each remaining closed stair tower door.
 - iv. Open additional doors (up to the number indicated) one at a time, and measure and record the pressure difference across each remaining closed stair tower door after the opening of each additional door.
 - v. Open the doors indicated to be open and measure and record the direction and velocity through each of the open doors by a traverse of every 1 ft² (0.093 m²) grid of door opening.
 - vi. Calculate the average of the door velocity measurements. Compare the average velocity to the contract documents and governing code requirements.
 4. Repeat the pressurization tests with the smoke control systems and the HVAC systems operating.
 5. The criteria for acceptance are included in
 - i. the OPR requirements and
 - ii. code requirements.
- F. Perform operational tests as described below.
1. Check the proper activation of the stair tower pressurization systems in response to all means of activation, both automatic and manual.
 2. Verify that each initiating occurrence produces the proper system response under each of the following modes of operation:
 - i. Normal
 - ii. Alarm
 - iii. Manual override of normal mode and alarm
 - iv. Return to normal
 3. Verify that the smoke detector at the stair pressurization fan inlet deenergizes the fan and closes the damper at the fan.
 4. If standby power is provided for stair pressurization systems, test to verify that the stair pressurization systems operate while on both normal and standby power.
 5. Conduct additional tests required by AHJs.
- G. Prepare a complete report of observations, measurements, and deficiencies.

B3. PROCEDURES FOR SMOKE CONTROL SYSTEM TESTING

- A. Before testing smoke control systems, verify that construction is complete, and verify the integrity of each smoke control zone boundary. Verify that windows and doors are closed and that applicable safing, gaskets, and sealants are installed. Report deficiencies, and postpone testing until after the reported deficiencies are corrected.
- B. Measure and record wind speed and direction, outdoor air temperature, and relative humidity on each test day.
- C. Measure, adjust, and record the airflow of each smoke control system with all fans that are a part of the system operating as intended by the design.
- D. Measure, adjust, and record the airflow of each fan. For ducted systems, measure the fan airflow by duct pitot tube traverse.
- E. After air balancing is complete, perform the following pressurization testing for each smoke control zone in the system:
 1. Verify the boundaries of each smoke control zone.
 2. With the HVAC systems in their normal mode of operation and smoke control not operating, measure and record the pressure difference across each smoke control zone. Make measurements after closing doors that separate the zones. Make one measurement across each door. Clearly indicate the high- and low-pressure sides of each door.
 3. With the system operating in the smoke control mode and with each zone in the smoke control system activated, perform the following:
 - i. Measure and record the pressure difference across each door that separates the smoke zone from adjacent zones. Make measurements with doors that separate the smoke zone from the other zones closed. Clearly indicate the high- and low-pressure sides of the door. Doors that have a tendency to open slightly due to the pressure difference should have one pressure measurement made while held closed and another measurement made with the door open.
 - ii. Continue to activate each separate zoned smoke control system, and make pressure difference measurements.
 - iii. After testing a smoke zone's smoke control system, deactivate the HVAC systems involved and return them to their normal operating mode before activating another zone's smoke control system.
 - iv. Verify that controls necessary to prevent excessive pressure differences are functional.
- F. Perform operational tests as described below.
 1. Check the proper activation of each zoned smoke control system in response to all means of activation, both automatic and manual.
 2. Check automatic activation in response to fire alarm signals received from the building's fire alarm and detection system. Initiate a separate alarm for each means of activation to ensure that the proper operation of the correct zoned smoke control system occurs.
 3. Check and record the proper operation of fans, dampers, and related equipment as outlined below for each separate zone of the smoke control system.
 - i. Fire zone in which a smoke control system automatically activates.
 - ii. Type of signal that activates a smoke control system, such as sprinkler water flow or smoke detector.
 - iii. Negative-pressure smoke zones where maximum mechanical exhaust to the outside is implemented and no supply air is provided.
 - iv. Positive-pressure smoke control zones where maximum air supply is implemented and no exhaust to the outside is provided.
 - v. Fans ON as required to implement the smoke control system. Multiple or variable-speed fans should be further noted as "MAX. VOLUME" to verify that the intended control configuration is achieved.
 - vi. Fans off as required to implement the smoke control system.
 - vii. Dampers open where maximum airflow must be achieved.
 - viii. Dampers closed where no airflow should take place.
 - ix. Auxiliary functions to achieve the smoke control system configuration, such as changes or override of normal operating pressure and temperature control set points.
 - x. If standby power is provided for the smoke control system, test to verify that the system functions while

operating under both normal and standby power.

- G. Conduct additional tests required by AHJs. Unless required by AHJs, perform testing without the use of smoke or products that simulate smoke.
- H. Prepare a complete report of observations, measurements, and deficiencies.

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX C—EXAMPLE CHECKLISTS

This annex provides an example of how to implement part of ASHRAE Guidelines 0 and 1.5. It is not intended to be a comprehensive representation or a best-practice example. Practitioners applying the Commissioning (Cx) Process should carefully follow Guidelines 0 and 1.5 as well as other applicable Cx technical guidelines tailored to their specific projects.

This annex provides examples of checklists for the smoke control project requirements during the Predesign, Design, Construction, and Occupancy/Operations Phases of project delivery that can be used as guidance for the Cx practitioners applying the Cx Process.

Following is a listing by topic of the example checklists provided in this annex. These checklists follow the checklist format in ASHRAE Guideline 1.1, *Application of the Commissioning Process for New HVAC&R Systems*, Informative Annex M, but only items relevant to smoke control are included here.

Index of Example Checklists

1. Predesign Checklist: Mechanical Second Review
2. Design Checklist for the Mechanical Engineer's First Design Submittal
3. Exhaust Fan: EF-1
4. Fire/Smoke Damper: FSD-1

1. Predesign Checklist: Mechanical Second Review
(As part of the Architect’s Second Review Submittal)
 ASHRAE Guideline 1.5 Example Checklist

Instructions: **Step 1: Circle Yes or No and fill in with requested information.**
 Step 2: Explain all “No” responses at the bottom of the checklist.

Item	Task Description	Location of Information in the Programming Document	Complete?	
Owner’s Project Requirements				
Key Owner’s Project Requirements				
	1 Project documentation requirements		Yes	No
	2 Owner directives		Yes	No
	3 Sustainability		Yes	No
	4 Do the general requirements match the original OPR? If not, has the OPR been revised? Justification document.		Yes	No
	5 Has information been provided to the Cx Team to update the Cx Plan? What is the current revision number?		Yes	No
Owner’s Objectives				
	1 Are the final control plan, results of control workshop, and interoperability report included with this review?		Yes	No
	2 System accessibility and maintainability		Yes	No
	3 Allowable tolerance in facility system operations		Yes	No
	4 Energy efficiency goals		Yes	No
	5 Environmental and sustainability goals		Yes	No
Owner’s General Needs				
	1 Adaptability for future changes without changing HVAC system and within initial budget		Yes	No
	2 Mechanical rooms space and location coordination with shops		Yes	No
	3 Electrical/communications		Yes	No
	4 Benchmark for smoke control systems		Yes	No
	5 Constructability defined		Yes	No
“No” Responses				
Item	Date	Reason for “No” Response		

**2. Design Checklist for the Mechanical Engineer’s First Design Submittal
 (As part of the Architect’s Second Review Submittal)**

ASHRAE Guideline 1.5 Example Checklist

Instructions: **Step 1: Circle Yes or No and fill in with requested information.**
 Step 2: Explain all “No” responses at the bottom of the checklist.

Item	Task Description	Location of Information in the Programming Document	Complete?	
Owner’s Project Requirements				
Key Owner’s Project Requirements				
	1 Cx Plan updated; provide and enclose with this submittal		Yes	No
	2 Basis of Design for controls completed		Yes	No
	3 Basis of Design for accessibility completed		Yes	No
	4 Sustainability and LEED issues coordination addressed		Yes	No
	5 Do the general smoke control requirements match the current OPR? Has justification been documented and approved by Owner’s project manager?		Yes	No
	6 Control format, BACnet® requirements complete and documented		Yes	No
Owner’s Objectives				
	1 Preliminary mechanical room layout complete		Yes	No
	2 Single line diagrams developed for controls and smoke systems		Yes	No
	3 Report on safety factors and tolerance for facility system operations		Yes	No
	4 Environmental and sustainability initial design complete		Yes	No
Owner’s General Needs				
	1 Are current smoke control system and building control system budgets enclosed and within the initial budget?		Yes	No
	2 Mechanical rooms space and location coordination with shops		Yes	No
	3 Has electrical, plumbing, lighting, and communications coordination been completed?		Yes	No
	4 Does the initial design meet all benchmarks established for smoke control systems? Document?		Yes	No
	5 Constructability and maintainability analysis completed		Yes	No
	6 Control system is UL-listed for smoke control		Yes	No

“No” Responses

Item	Date	Reason for “No” Response
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3. Exhaust Fan EF-1
 ASHRAE Guideline 1.5 Example Checklist

Instructions: **Step 1: Circle Yes or No and fill in with requested information.**
 Step 2: Explain all “No” responses at the bottom of the checklist.

Item	Task Description	Response	
Delivery Book			
	Model Verification	Submitted	Delivered
	1 Manufacturer		
	2 Model		
	3 Serial Number	N/A	
	4 Fan Type		
	5 Capacity / static pressure (cfm / in. wg)	/	/
	6 Motor power / speed (hp / rpm)	/	/
	7 Motor voltage / phase / frequency (V / - / Hz)	/ /	/ /
Physical Checks			
	1 Unit free from physical damage	Yes	No
	2 Air openings are sealed with plastic	Yes	No
	3 All components present (belt guard, motor, damper, spring isolators, etc.)	Yes	No
	4 Installation and start-up manual provided	Yes	No
	5 Unit tags affixed	Yes	No
Construction Checklist			
Installation of Exhaust Fan			
	1 Unit secured as required by manufacturer and specifications	Yes	No
	2 Adequate clearance around unit for service	Yes	No
	3 All components accessible for maintenance	Yes	No
	4 Unit can be removed from building	Yes	No
	5 Shipping bolts have been removed (if applicable)	Yes	No
	6 Belts are tight (if applicable)	Yes	No
	7 Isolation damper installed and moves freely	Yes	No
	8 Protective shrouds for fan and belts in place and secure	Yes	No
	9 Unit labeled and is easy to see	Yes	No
Ductwork			
	1 Adequate locations available for testing and balancing unit	Yes	No
	2 All dampers and sensors are accessible (access panels)	Yes	No
	3 All dampers close tightly and stroke fully and easily	Yes	No
	4 Ductwork is clean and free of debris	Yes	No

3. Exhaust Fan EF-1 (Continued)
 ASHRAE Guideline 1.5 Example Checklist

Item	Task Description	Response	
Electrical			
1	Safety disconnect installed in an accessible location	Yes	No
2	Motor rotation is in correct direction	Yes	No
3	All electrical connections are tight	Yes	No
4	All electrical components are grounded	Yes	No
Controls - Installation			
1	Control panel accessible and labeled properly	Yes	No
2	Damper actuators installed and calibration verified	Yes	No
3	Safety Items installed and verified (high pressure, motor overload, etc.)	Yes	No
Mechanical – Start-up			
1	Unit is clean	Yes	No
2	Internal isolators free to move	Yes	No
3	Fan and motor lubricated and aligned	Yes	No
4	Fan belts have proper tension and are in good condition (if applicable)	Yes	No
5	System starts and runs without any unusual noise or vibration	Yes	No
6	Manufacturer’s start-up checklist completed and attached	Yes	No
Smoke Dampers Controls—Start-Up			
1	Damper opens and closes freely	Yes	No
2	Sequence of control correct in smoke modes	Yes	No
TAB			
1	Air flow, design / actual (cfm) in smoke modes	/	/
2	Pressure drop, design / actual (in. wg)	/	/
3	Fan rotation is in the proper direction	Yes	No
4	Motor overloads verified	Yes	No
5	Motor voltage and amps verified – each phase	Yes	No

“No” Responses

Item	Date	Reason for “No” Response
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4. Fire/Smoke Damper: FSD-1
 ASHRAE Guideline 1.5 Example Checklist

Instructions: **Step 1: Circle Yes or No and fill in with requested information.**
 Step 2: Explain all “No” responses at the bottom of the checklist.

Item	Task Description		Response
Delivery Book			
	Model Verification	Submitted	Delivered
	1 Manufacturer		
	2 Model		
	3 Style		
	4 Width (in.)		
	5 Height (in.)		
	6 Orientation		
Physical Checks			
	1 Unit free from physical damage	Yes	No
	2 All components/accessories present	Yes	No
	3 Installation manual provided	Yes	No
	4 Access to damper and fusible link for replacement and testing	Yes	No
Construction Checklist			
Installation of Fire Damper			
	1 Unit secured as required by manufacturer and specifications	Yes	No
	2 Adequate clearance around unit for maintenance	Yes	No
	3 Unit mounted in correct orientation	Yes	No
Smoke Dampers Controls—Start-Up			
	1 Damper opens and closes freely	Yes	No
	2 Sequence of control correct in smoke modes	Yes	No
“No” Responses			
Item	Date	Reason for “No” Response	

(This appendix is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI).

INFORMATIVE APPENDIX D GUIDELINE 1.5-202X CROSSWALK

The 202X edition of ASHRAE Guideline 1.5 replaces some informative annexes from ASHRAE Guideline 1.5-2017 with ASHRAE SSPC 300 informative annexes; all annexes in the ASHRAE SSPC 300 family can be found at www.ashrae.org/SSPC300annexes. Informative appendices which remain in the standard have been relabeled for contiguity of labels. For the convenience of users of previous editions, Table D-1 shows items that have changed, their original label, and their new label.

Table D-1 Guideline 1.5-202X Crosswalk

Guideline 1.5-2017 Informative Annex		Guideline 1.5-202X
A: Guide for Developing Supplementary Technical Guidelines for the Commissioning Process	→	Deleted
B: Commissioning (Cx) Process Flowchart	→	Refer to ASHRAE Guideline 0, Informative Appendix B, “Commissioning Process Flow Chart”
C: Cost and Benefits of the Commissioning (Cx) Process	→	Refer to ASHRAE Guideline 0, Informative Appendix C, “Costs and Benefits of the Commissioning Process”
D: Commissioning (Cx) Documentation Matrix	→	SSPC 300 Informative Annex 01, “Commissioning Process Documentation Matrix”
E: Commissioning (Cx) Process Request for Qualifications	→	SSPC 300 Informative Annex 19, “Commissioning Process Request for Qualifications”
F: Roles and Responsibilities	→	Refer to ASHRAE Guideline 0, Informative Appendix F, “Roles and Responsibilities”
G: Commissioning (Cx) Plan	→	SSPC 300 Informative Annex 05, “Commissioning Process Plan”
H: Acceptance Plan	→	Informative Appendix A, “Acceptance Plan” Also refer to ASHRAE Guideline 0, Informative Appendix H, “Acceptance Plan”
I: Owner’s Project Requirements (OPR) Workshop Guidance	→	Deleted
J: Owner’s Project Requirements (OPR)	→	SSPC 300 Informative Annex 04, “Owner’s Project Requirements and Current Facility Requirements”
K: Basis of Design (BoD)	→	SSPC 300 Informative Annex 06, “Basis of Design”
L: Specifications	→	Informative Appendix B, “Specifications” Also to refer to SSPC 300 Informative Annex 07, “Commissioning Specifications”
M: Construction Checklists	→	Informative Appendix C, “Construction Checklists”
N: Quality-Based Sampling Examples	→	SSPC 300 Informative Annex 02, “Quality Based Sampling Process”
O: Systems Manual	→	ASHRAE Guideline 1.4, <i>Preparing Systems Manuals for Facilities</i>
P: Training Manual and Training Needs	→	ASHRAE Guideline 1.3, <i>Building Operation and Maintenance Training for the HVAC&R Commissioning Process</i>
Q: Publications, Articles, References, Codes, Regulations, and Standards	→	SSPC 300 Informative Annex 16, “Commissioning Resources”
R: Integration Requirements	→	Deleted

Table D-1 Guideline 1.5-202X Crosswalk

Guideline 1.5-2017 Informative Annex		Guideline 1.5-202X
S: Interference and Coordination with Other Systems and Assemblies	→	Deleted
T: Communications: What, When, and Who	→	Deleted
U: Test Procedures and Data Forms	→	Deleted
V: Predesign Phase Commissioning (Cx) Process Specific Needs	→	Deleted
W: Design Phase Commissioning (Cx) Process Specific Needs	→	Deleted
X: Construction Phase Commissioning (Cx) Process Specific Needs	→	Deleted
Y: Occupancy/Operations Phase Commissioning (Cx) Process Specific Needs	→	Deleted