



Building Codes and Commissioning

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Course Description

The Commissioning Process is now being included as a requirement in multiple ICC codes, along with many guidelines, and standards. This session explains the commissioning process for commercial projects and how it is used in many of the ICC codes, along with the related enforcement activities.

Learning Objectives

1. Determine National ICC Building Codes Now Including Commercial Project Commissioning and the Variations
2. Review the Commissioning Process, & Documentation
3. Understand the Utilization of Commissioning in Codes
4. Review the Code Commissioning Enforcement Process
5. Review the Commissioning Provider and Team Participation and Need for Qualifications

Building Code Adoption of Commissioning - Need and Response

- Buildings Design, Construction, and Operation Becoming More Complex
- Need for Better Organized and Performed Inspection, and Functional and Performance Testing
- Increased Requirements for Interior Environment Control and Performance.
- Increased Requirements in Codes and Laws for Building Energy Efficiency and Building Performance.

International Code Council -Commissioning Resource/Publication-



ICC G4 -2018 Guideline for Commissioning

Building Codes and Standards

- Building Codes
 - Building, Mechanical, Plumbing, Electrical
- Energy Codes
 - Energy Code (IECC-2021) - ASHRAE Standard 90.1-2019
- Green Codes and Programs
 - International Green Construction Code (IGCC-2021) - ASHRAE 189.1-2020, Standard for Design of High-Performance Green Buildings
 - LEED, Green Globes, WELL, FITWEL, Living Building Challenge, Etc.
- NOTE: Underlined Codes shown in RED include commissioning requirements.

International Code Council Building Codes Interrelationship

ICC Building Code (IBC)

- Mechanical (IMC), and Plumbing (IPC) Codes
- Energy Code (IECC)
 - Green Code (IGCC)

ICC Building Code - 2021

- “Commissioning” Not Specifically Defined
- Chapter 9, Fire Protection and Life Safety Life Safety, 901.5 and 901.6.2, System acceptance and testing required
- Section 909, Smoke Control, 909.3, “Special Inspection and test requirements” requires commissioning for smoke control systems as “proper commissioning of the smoke control design and its final installed condition.”

“Such commissioning shall be in accordance with generally accepted engineering practice.”

References performance terms in Section 1704

ICC Building Code - 2021

Chapter 17, Special Inspections and Tests

Section 1703.1 defines “approved agency” to include:

- Objective, Competent and Independent from Contractor
- Adequate Calibrated Equipment
- Experienced and Educated Personnel

Section 1705.13.6 requires “Periodic special inspection of plumbing, mechanical and electrical components” for a list of specific items.

ICC Mechanical Code - 2021

- “Commissioning” not defined or specifically included.
- Section 108, Inspections and Testing
 - 108.2 Mechanical systems inspection and testing is required and can be done by “approved agencies...that satisfy the requirements as to qualifications and reliability”

ICC Plumbing Code - 2021

- “Commissioning” not defined or specifically included.
- Section 108, Inspections and Testing
 - 108.2.4 Mechanical systems inspection and testing is required and can be done by “approved inspection agencies...that satisfy the requirements as to qualifications and reliability”

IECC -2021 - Energy Code

- BUILDING COMMISSIONING DEFINITION:
- A process that verifies and documents that the selected building systems have been designed, installed and function in according to the owner's project requirements, and and to minimum code requirements.

IECC-2021 Section C402.5.1.5

Building Envelope Performance Verification

Continuous air barrier verified by code official, registered design professional or approved agency with:

1. Review of construction documents and supporting data
2. Inspection of air barrier components and assemblies
3. Final commissioning report provided to owner identifying deficiencies found during reviews, inspections, and corrective measures taken.

IECC-2021 Section C408

Maintenance Information and System Commissioning

- C408.1 Building Operations and Maintenance Information
 - Provided to Owner in Documents
 - Specifications and designs
 - Manufacturer's information – submittals
 - Programming procedures and data points
 - Installation, maintenance and operation procedures
 - Equipment labeled with title, publication # and location of operation and maintenance (Systems) manual

IECC-2021 Section C408.2

Mechanical Systems Commissioning & Completion

- Construction documents shall include system operation requirements, and commissioning and completion requirements.
- Commissioning Plan drafted by Commissioning Provider prior to permit.
- Prior to final inspection design professional or approved agency shall provide evidence of mechanical system commissioning and completion to owner and to AHJ if requested.

IECC-2021 Section C408.2

Maintenance Information and System Commissioning

- C408.2.1 Commissioning Plan:
 - Provided by Design Professional or Approved Agency
 - Include narrative description of Cx activities and team
 - Include list of specific equipment and required tests
 - Some system sizes excluded
 - Functions to be tested includes calibrations and economizers
 - Include testing conditions
 - Include measurable criteria for performance

IECC-2021 Section C408.2

Maintenance Information and System Commissioning

- C408.2.2 Systems Adjusting and Balancing
 - HVAC Systems balanced to accepted industry standards
 - Air Systems balancing – each air outlet and terminal equipped with means for balance per Mechanical Code
 - Hydronic Systems balancing – individual heating and cooling coils equipped with means for balancing and measuring flow.
 - Written test and balance report required
 - Reviewed by Cx Provider, Included in Systems Manual, Available to Building Official

IECC-2021 Section C408.2

Maintenance Information and System Commissioning

- C408.2.3 Functional Performance Testing Required
 - Demonstrate installation and operation to approved plans and specifications including all modes and sequence of operation
 - Control systems tested to document calibration and adjustment to operate to approved plans
 - Economizers to undergo functional tests

IECC-2021 Section C408.2

Maintenance Information and System Commissioning

- C408.2.4 Preliminary Commissioning Report
 - Required prior to project final inspection and CO
 - Test results provided to building owner
 - Provided by Design Professional or Approved Agency
 - Include performance test procedures used including measurable criteria for acceptance.
 - Include itemization of deficiencies not corrected
 - Include deferred test with climatic conditions required for final testing
 - Include results of functional performance tests

IECC-2021 Section C408.2

Maintenance Information and System Commissioning

- C408.2.5 Final Commissioning Report
 - Provided to Owner within 90 days of project CO
 - Final test and balance report
 - Report of test procedures
 - Results of functional performance tests
 - Disposition of deficiencies including corrective measures

IECC-2021 Section C408.3

Lighting System Commissioning

- Functional testing of lighting controls required prior to final inspection. Reports certified by registered design professional or approved agency.
- Testing and reports include:
 - Occupancy sensors
 - Time switch controls
 - Daylight responsive controls
 - Drawings and O&M manuals
 - Reports

IECC - 2021 – Chapter 5

Existing Buildings

- C502 Additions shall conform to new construction requirements
- C503 Alterations shall comply with new construction requirements with some variations
 - New HVAC, hot water, and lighting systems in additions and alterations shall comply with new construction reqmts.
- C504 Repairs not normally required to comply.
- C505 Change in Occupancy requires IECC compliance if energy use is increased

IGCC – 2021

International Green Construction Code

- DEFINITIONS: Chapter 3
 - Commissioning (Cx) Process: A quality focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the owner's project requirements.

IGCC – 2021

International Green Construction Code

- DEFINITIONS: Chapter 3
 - Commissioning (Cx) Provider: an entity identified by the owner and approved by the AHJ, who manages the commissioning team to implement the building commissioning process.
 - Commissioning (Cx) Plan: a document that outlines the organization, schedule, allocation of resources, and documentation requirements of the building commissioning process.

IGCC – 2021

International Green Construction Code

- DEFINITIONS: Chapter 3
 - Owner's Project Requirements (OPR): a document that specifies the functional requirements of a project and the expectation of how it will be used and operated, including project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, training requirements, documentation requirements, and supporting information.

IGCC – 2021

International Green Construction Code

- DEFINITIONS: Chapter 3
 - Basis of Design: (BoD): a document that records the concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

Building Design and Operations Data

- Systems Manual: a system-focused composite document that includes the OPR, BoD, design and construction documentation, Facility Guide and operation manual, equipment submittals, maintenance information, training information and records, Cx and testing plans, records and reports, and additional information of use to the Owner during occupancy and operations.

IGCC – 2021 Chapter 10

Construction and Plans for Operation

- 1001.3.1 Functional and Performance Testing
 - Required to Generally Accepted Engineering Standards
 - Mandatory on Listed Systems:
 - HVAC and refrigeration systems greater than 180,000 BTU/hr
 - Lighting systems over 5 kW
 - Domestic water-heating systems over 50,000 BTU/hr
 - Water pumping and mixing systems over 5 HP
 - Irrigation Systems over 1,000 gal per day

IGCC – 2021 Chapter 10

Construction and Plans for Operation

- 1001.3.1.1 FPT Requirements Included in Construction Documents and Schedule
- 1001.3.1.2 Activities Prior to Building Permit
 - Designate FPT Providers- may be Owner's employees, independent Cx providers, designers familiar with FPT – must be independent of building system design and construction.
 - FPT Providers shall Review Construction Documents to verify sensor location, control sequences, performance and testing criteria and accessibility.

IGCC – 2021 Chapter 10

Construction and Plans for Operation

- 1001.3.1.3 FPT Activities Prior to Building Occupancy
 - Verify installation and startup of designated systems
 - Perform FPT on designated systems
 - Verify O&M documentation and warranty information
 - Provide complete project design and FPT documentation to owner.
 - Project documentation shall be retained.

IGCC – 2021 Chapter 10

Construction and Plans for Operation

- 1001.3.2 Building Project Commissioning Process for Projects Over 10,000 Sq, Ft.
 - Cx Process performed to ASHRAE STD 202 or generally accepted approved standards
 - Cx Process included in design phases and construction documents
 - Cx documents and building systems comply with OPR& BoD
 - Systems Manual assembled, completed and provided to maintenance staff.

IGCC – 2021 Chapter 10

Construction and Plans for Operation

- 1001.3.2.1 Systems to be Commissioned
 - HVAC and associated controls
 - Air-curtain systems
 - Lighting systems and controls
 - Domestic hot-water systems and controls
 - Water pumping and mixing systems over 5 HP
 - Irrigation systems over 1,000 gal per day and controls
 - Renewable energy generation and storage systems
 - Energy and building management and demand control systems

IGCC – 2021 Chapter 10

Construction and Plans for Operation

- 1001.3.2.2 Cx Activities Prior to Permit
 - Develop and submit Cx Plan per Standard 202 with permit application
 - Owner shall designate an approved Cx Provider with necessary training, experience and equipment
 - Cx requirements included in project documents and specifications.

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Construction and Plans for Operation

- 1001.3.2.3 Cx Activities Prior to Building Occupancy
 - Verify Cx complete including installation verification and FPT for all designated systems with documentation of testing results.
 - Owner provided with Preliminary Cx Report
 - Systems Manual provided to owner with O&M and warranty info

1001.3.2.4 Post-occupancy Cx Activities

- Comply with Cx Plan post occupancy requirements per STD 202
- Complete Cx and update Cx Reports and System Manual

IGCC – 2021 Chapter 10

Construction and Plans for Operation

- 1001.3.2.5.3 Preliminary Commissioning Report
 - Performance of commissioned equipment, and systems
 - Issue and resolution logs of deficiencies found and not corrected
 - Deferred testing
 - Training of maintenance and operations
 - Plan for completion of commissioning

IGCC – 2021 Chapter 10

Construction and Plans for Operation

- 1001.3.2.5.4 Final Commissioning Report
 - Final Commissioning report with updated Systems Manual per Standard 202
 - Provided to Owner prior to project completion.
 - Owner to retain Systems Manual and final Cx report documents

IGCC – 2021 Appendix K

Informative Guidance for FPT and Cx Process

- Provider Qualifications
 - Personnel experience, independence, equipment, and registration or certification
- Overview of Commissioning Process, Table K101.2
 - Cx activity, deliverables, and normally provided by listing

IGCC – 2021 Appendix K

Informative Guidance for FPT and Cx Process

- Documentation Description and Contents for:
 - Owner's Project Requirements
 - Basis of Design
 - Cx Plan
 - Cx Specifications
 - Cx Design Review Report
 - Record Documents
 - Systems Manual
 - Preliminary and Final Cx Report

COMMISSIONING ENFORCEMENT

The AHJ needs assurance that the required commissioning activities are completed before a permit is issued. The AHJ can request a copy of all the documents for review or rely on the approval and summary documents by the Commissioning Provider and/or Owner or owner's representative.

Project Requirements before permit:

- Designation of an *approved* Commissioning Provider
- Commissioning requirements in the project documents
- An acceptable commissioning plan

Code Official (AHJ) Functions

Code Process

1. The initial requirement is to ensure that the Commissioning Process has been included in the project design documentation so the contractor knows the performance and testing requirements.
2. A Cx Plan needs to be written based on OPR and the designers' plan and assumptions to meet those requirements (Basis of Design [BoD]). The review of the Cx Plan is usually sufficient because the CxP has checked the design documents. A check of the design documents by the AHJ is still required to ensure the project meets code requirements and the commissioning requirements are included.

Code Official (AHJ) Functions

3. At the time of permit, the project Owner needs to have selected and retained a CxP that has the necessary skills and meets the AHJ's approval.
4. At the time of project completion, to the extent necessary to obtain a temporary or final certificate of occupancy, the CxP is required to submit a preliminary commissioning report that shows the status of the project equipment operation and related commissioning. This preliminary commissioning report shows current equipment operation status along with a plan for the completion of commissioning.

Code Official (AHJ) Functions

AHJ Verifies

- The CxP is retained,
- Systems to be commissioned are selected,
- OPR and BoD documents are developed and reviewed,
- Cx Plan is written, and commissioning specifications are in the construction documents.
- Commissioning and Reports are completed and reports submitted.

Contract Documents

Commissioning Requirements

- List of equipment to be commissioned
- Performance requirements for that equipment
- Contractor participation
- Verification, Testing, and Commissioning
- Training
- Documentation

IGCC – 2021 Appendix K

Commissioning Plan Contents

- A narrative of the commissioning process developed specifically for the project.
- The roles and responsibilities for the commissioning providers and the commissioning team through final commissioning activities.
- Documentation of communication channels and processes including the distribution of the commissioning plan, logs, testing documents and reports during the design and construction process.
- A detailed description of conditions and schedules of the commissioning process activities, and the list of operations, functions, systems, and assemblies that will be commissioned. Measurable performance criteria shall be included where not shown on the construction documents.

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Commissioning Plan Contents

- The project design documentation and submittal review procedures and reports.
- Inspection checklists and testing forms, issues and resolution log, and commissioning progress reports to be used during the project to communicate and track commissioning and inspection process information, including format, approvals and distribution.
- The procedures to follow for resolution where the commissioning evaluation does not meet the Owner's Project Requirements or design documents.

Code Commissioning Checklist for Permit

- Could be used with permit application
- Lists information normally required by Building Official
- Could be used for project control and scheduling

Code Commissioning Checklist for Permit

Commissioning Documentation for Permit

Project Name: _____
 Project Address: _____ Permit Number: _____
 Commissioning Provider: _____
 Company/Entity Address: _____
 CxP Phone Number: _____ CxP Email Address: _____
 CxP Certification (if required) _____

Commissioning Documentation	Approval
Project Requirements for Commissioning	
Project requirements and design completed, documented, and included in the project documentation, including the list of systems to be commissioned and their performance criteria	
Contractor and Construction Instructions	
Plans and commissioning specifications, with equipment performance requirements shown, completed and included in contract documents	
Design Review	
Commissioning design documents review completed with response from design team	
Commissioning Plan	
Initial Cx plan (for permit) completed with required contents and provided by the CxP for Owner and AHJ review	

Commissioning Provider Acknowledgment

I have reviewed the documents and verified that they meet the Owner's project requirements:

Name: _____ Company
 Name: _____ Signature:
 Date: _____

Owner/Owner's Representative Acknowledgment

The project documents include the items listed in this form and have been approved by the Owner or Owner's representative:

Name: _____
☐ Owner ☐ Owner's Representative
 Company Name: _____
 Signature: _____ Date: _____

Commissioning Compliance Checklist

IECC Figure C408.2.4

Project Information: _____ Project Name: _____

Project Address: _____

Commissioning Authority: _____

Commissioning Plan (Section C408.2.1)

- Commissioning Plan was used during construction and includes all items required by Section C408.2.1
- Systems Adjusting and Balancing has been completed.
- HVAC Equipment Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____
- HVAC Controls Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____

Commissioning Compliance Checklist

IECC Figure C408.2.4

- Economizer Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____
- Lighting Controls Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____
- Service Water Heating System Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____
- Systems Manual, record documents and training have been completed or scheduled
- Preliminary Commissioning Report submitted to owner and includes all items required by Section C408.2.4

I hereby certify that the commissioning provider has provided me with evidence of mechanical, service water heating and lighting systems commissioning in accordance with the 2021 IECC.

Signature of Building Owner or Owner's Representative _____ Date _____

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FINAL COMMISSIONING REPORT

- Delivered to Owner -Not required for Building Official unless requested
- Final Commissioning Report Contents:
 - Functional and performance test procedures with measurable criteria
 - Results of functional and performance tests
 - Disposition of deficiencies and details of corrective measures
 - Other items required by commissioning plans

WHO DOES COMMISSIONING?

IGCC – 2021 Appendix K

- The Commissioning Team managed by the COMMISSIONING PROVIDER
- The COMMISSIONING PROVIDER needs;
 - Independence
 - Experience
 - Testing Equipment
 - Trained Support Personnel
 - Certification

IGCC – 2021 Appendix K

COMMISSIONING PROVIDER

- **1 Independence.** The commissioning provider should be objective, competent and independent from the contractor responsible for the work being inspected and the designer of the systems. The entity shall also disclose possible conflicts of interest so that objectivity can be confirmed.

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COMMISSIONING PROVIDER

2. Experience. The commissioning provider should have commissioning experience in management of the commissioning process and on the type and size of project being considered. The *approved* provider shall have completed the commissioning process on a minimum of two projects of equal or larger scope and complexity, or can demonstrate adequate experience and training in the fundamentals and application of the commissioning process.

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COMMISSIONING PROVIDER

- **3. Equipment.** The commissioning provider shall have (or have access to) adequate equipment to perform the required commissioning and functional and performance testing activities for each system. The equipment shall be periodically calibrated in accordance with manufacturer's specifications.

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COMMISSIONING PROVIDER

- **4. Personnel.** An approved provider shall employ experienced personnel educated in conducting, supervising and evaluating tests, inspections, and commissioning. Some system commissioning requires licenses and other certifications such as elevator and fire protection systems.

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COMMISSIONING PROVIDER

- **5. Certification.** Certification of the commissioning provider could be required according to the provisions of ISO 17024. There are currently several organizations that offer that certification.

Commissioning Process Stakeholders

- Commissioning Team Participants -

- Owner/Developer
- Cx Provider
- Architects
- Engineers
- Designers
- Code Officials
- Contractor/CM
- Sub-contractors
- Installers
- Manufacturers
- Suppliers
- Program Administrators

Commissioning Process Management

- Summary -

- 1. Owner selects systems to be commissioned and selects and hires Commissioning Provider (CxP).
- 2. Owner develops and documents the Owner Project Requirements.
- 3. Design team uses OPR to produce Basis Of Design.
- 4. Design team uses equipment requirements to specify system commissioning requirements.
- 5. CxP develops the commissioning plan and equipment checklists.
- 6. CxP performs design and documents reviews.

Commissioning Process Management

- Summary -

- 7. CxP and project team use Cx building permit checklist to document completion for permit. AHJ reviews.
- 8. Contractors, subs, manufacturers and suppliers use project and equipment checklists to complete installation, testing, systems manuals, and commissioning.
- 9. CxP verifies system performance and assembles project and equipment documentation
- 10. CxP and teams use commissioning report checklists to summarize documentation for certificate of occupancy and on-going commissioning process. Owner approves.

Questions – Comments

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