



Sustainable Building Operation via ASHRAE Standard 189.1

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Code of Ethics and Diversity Commitments

Code of Ethics Commitment

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DL Program

- **Please no commercialism**
- **Please fill out the DL forms**
- **Try to expand your thinking**
- **Feel free to ask questions**

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EDUCATION PARTNER

Sustainable Building Operation via Standard 189.1

By Douglas F Zentz

GBCI cannot guarantee that course sessions will be delivered to you as submitted to GBCI. However, any course found to be in violation of the standards of the program, or otherwise contrary to the mission of GBCI, shall be removed. Your course evaluations will help us uphold these standards.

Course ID:

Approved for:

1

General CE hours



1

LEED-specific hours



Learning Objectives

- **To illustrate the mandatory requirements within section 10 of ASHRAE Standard 189.1-2014 related to building operation and maintenance**
- **To illustrate why proper building testing and commissioning creates the foundation for sustainable building operation**
- **To illustrate why the Building Operational Plan (BOP) is critical to owner expectations of sustainable building operation**
- **To illustrate lessons learned with direct experience with “High Performance Buildings” and their sustainable operation**

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Sustainable Buildings

- **How do we define Sustainable**
 - **Balance** environmental responsibility, resource efficiency, occupant comfort and well being and community sensitivity, plus
 - Support the goal of development that **meets the need of the present without compromising** the ability of future generations to meet their own needs



Standard 189.1 – Section 10

Construction and Plans for Operation

- Everything within this section is “***Mandatory***”
- Subsection 10.3.1 – “*Construction*”
- Subsection 10.3.2 – “*Plans for Operation*”

Building Acceptance Testing

- **10.3.1.1.1 – Activities Prior to Building Permit**
 - Designate an ***acceptance representative*** to lead review, and oversee completion of acceptance testing and activities
 - Construction documents shall indicate who is to perform acceptance testing and details of such tests
 - The ***acceptance representative*** shall review construction documents for verification to all relevant control items and sequences

Building Acceptance Testing

- **10.3.1.1.2 – Activities Prior to Building Occupancy**
 - Verify proper installation and start-up of all systems
 - Perform Acceptance Testing
 - Verify that a “*systems manual*” has been prepared which includes: (applicable to all building systems)
 - O & M documentation
 - Full warranty information
 - Any other relevant documentation

Building Acceptance Testing

- **10.3.1.1.3 – Systems**

- Mechanical Systems – HVAC, IAQ & Refrigeration
- Lighting Systems – all non-natural lighting and the control of such systems
- Fenestration Control Systems – control of shading and dynamic glazing
- Renewable Energy – all such systems
- Water Measurement Systems – devices responsible for measurement
- Energy Measurement Systems – devices responsible for measurement

Building Project Commissioning

- 10.3.1.2 – Building Commissioning

“A commissioning process shall be incorporated into the predesign, design, construction, and first year occupancy of the building project that verifies that the delivered building and its components, assemblies, and systems comply with documented owner’s project requirements (OPR).”

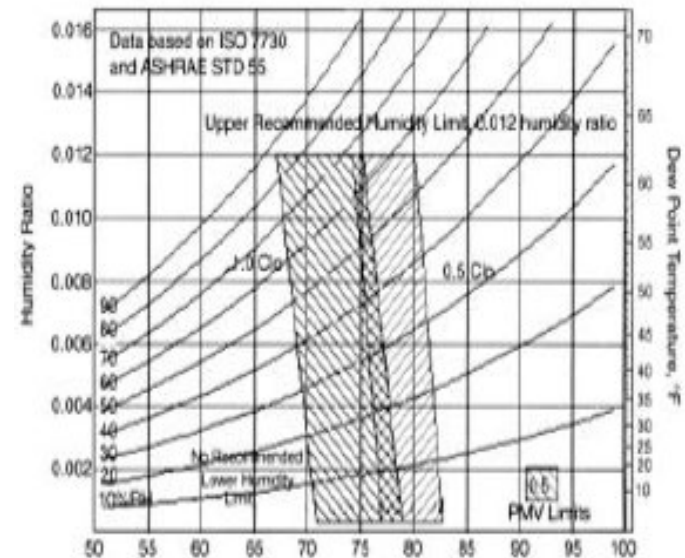
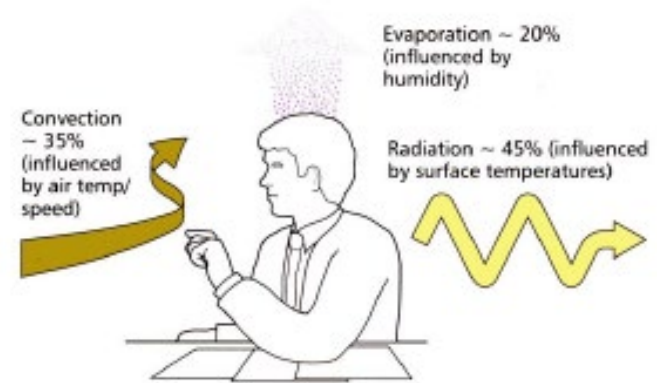
Building Project Commissioning

- **10.3.1.2.1 – Activities Prior to Building Permit**
 - Designate a *project commissioning authority (CxA)* to lead, review and oversee the entire commissioning process
 - The owner and design team shall develop the **OPR** during the predesign stage
 - The design team shall develop the *Basis of Design (BoD)* documentation in accordance with all relevant ASHRAE standards and local codes
 - The **CxA** shall review both the **OPR** and the **BoD** for any conflicts and use professional judgement
 - Construction phase commissioning shall be included along with a plan for the entire commission process (**CxA Plan**)

Building Project Commissioning

- **10.3.1.2.2 – Activities Prior to Building Occupancy**

- Verify the installation and performance of the systems to be commissioned, including completion of construction checklists



Building Project Commissioning

- **10.3.1.2.3 – Post-Occupancy Activities**
 - Complete any commissioning called out by the **CxA Plan** for systems whose commissioning can only be completed after building occupancy (example: trend logging)
 - Verify owner training requirements have been completed
 - Complete a final **commissioning report**

Building Project Commissioning

- 10.3.1.2.4 – **Systems**

- HVAC and Refrigeration
- Building Envelope
- Lighting
- Fenestration Control
- Irrigation
- Plumbing
- Domestic and Process Water
- Service Water Heating
- Renewable Energy
- Water and Energy Measurement



Building Project Commissioning

- **10.3.1.2.5 – Building Envelope Airtightness**
 - The whole building pressurization testing shall be conducted in accordance with ASTM E779, CAN/CGSB-149.10-M86, CAN/CGSB-149.15-96, or equivalent
 - An air-barrier commissioning program consistent with generally accepted engineering standards shall be implemented



Building Project Commissioning

- **10.3.1.3 – Erosion and Sedimentation Control (ESC)**
 - Develop and implement an ESC plan for all construction activities
 - Shall conform to USEPA NPDES general permit for storm water discharge from construction activities
 - Meet local erosion requirements



Building Project Commissioning

- **10.3.1.4 – Indoor Air Quality (IAQ) Construction Management**

- Air conveyance materials/equipment shall not be used (should be stored and covered) during the construction phase
- After construction ends, prior to occupancy, complete a full flush-out to meet the maximum levels of potential contaminants (VOC)

TABLE 10.3.1.4 Maximum Concentration of Air Pollutants Relevant to IAQ

Contaminant	Maximum Concentration, $\mu\text{g}/\text{m}^3$ (Unless Otherwise Noted)
Nonvolatile Organic Compounds	
Carbon monoxide (CO)	9 ppm and no greater than 2 ppm above outdoor levels
Ozone	0.075 ppm (8-hr)
Particulates (PM _{2.5})	35 (24-hr)
Particulates (PM ₁₀)	150 (24-hr)
Volatile Organic Compounds	
Acetaldehyde	140
Acrylonitrile	5
Benzene	60
1,3-Butadiene	20
t-Butyl methyl ether (Methyl-t-butyl ether)	8000
Carbon disulfide	800
Caprolactam *	100
Carbon tetrachloride	40
Chlorobenzene	1000
Chloroform	300

Building Project Commissioning

- **10.3.1.5 – Moisture Control**
 - Material which are absorptive shall be protected from moisture during the construction phase
 - Building materials which show visual evidence of biological growth due to the presence of moisture shall not be installed



Plans for Operation

- **10.3.2.1.1 – Site Sustainability**
 - Develop an operational plan for trees and vegetation growth and health
 - Develop a maintenance plan for roofing in accordance with material manufacturers to keep roofing clean



Plans for Operation

- **10.3.2.1.2 – Water Use Efficiency**

- Initial Measurement and Verification – establish acceptance and initial certification
- Track and Assess Water Use – create plans and reports of water usage for benchmarking
- Create Assessment Reports – for trending and future anticipation of water usage



Plans for Operation

- **10.3.2.1.3 – Energy Efficiency**
 - Initial Measurement and Verification – establish acceptance and initial certification
 - Track and Assess Energy Use – create plans and reports of energy usage for benchmarking
 - Create Assessment Reports – for trending and future anticipation of energy usage



Plans for Operation

- **10.3.2.2 – Maintenance Plan**
 - Plan in accordance with ANSI/ASHRAE Standard 180 for building HVAC and plumbing systems
 - Integrate inspection and calibration PM plans for all control items per manufacturer's recommendations
 - Verify operation of building systems within building PM programs

Plans for Operation

- **10.3.2.3 – Service Life Plan**
 - Per table 10.3.2.3 develop a building envelope and hardscape repair/replacement plan for the service life of the building (many are 50 years)
 - Include an anticipated frequency of inspection, repair and/or replacement
 - Assemble a list of materials and/or products involved with building assemblies which will be included
- Develop the Building Operating Plan (**BOP**) for the building owner

Building Operating Plan

- **BOP** Consists of:
 - **OPR**
 - **BoD**
 - **CxA Plan & Final Commissioning Report**
 - **Maintenance Plan**
 - **Service Life Plan**
 - **Detailed description which links these elements together and provides the building owner with “why the various rooms in the building are designed, controlled and maintained in specific ways” – this illustrates if building room use changes are made, the entire process needs to be re-evaluated**

Suggestions

- **Look to the IGCC and ASHRAE Standard 189.1**
- **Think about the CxA and it's role – this is the future!**



Lessons Learned

- **Control System PM Planning**

- Annual PM programs need to include control system components
- Sensors can easily deviate
- Actuators do not stay consistent forever
- Sequences may need modification (or other elements updated)

Lessons Learned

- **Hydronic Systems – PM Needs**
 - Water based systems change over time – chemical balance & percent of fluid (for viscous based solutions)
 - Testing should occur on a regular basis

Lessons Learned

- **Filter changes – Addressing Real Needs**
 - Calendar dates or hours of operation should not dictate filter change
 - Real measurement of “**filter life**” should be implemented (APD – loading of filter effectiveness)

Lessons Learned

- **Know Your Owner**
 - Understand realistic building owner wants, beliefs, and limitations for continued building operation
 - Given known building owner expectation (wants, beliefs and limitations), design and provide the appropriate training and documentation tailored for a higher success of true sustainable operation

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Q & A

