

# Monitor

Engineering, Scientific, and Architectural News

## HVAC Systems Commissioning

**Are you planning a building renovation or a new building? If so—be aware!**

One of the most common problems reported by owners of newly constructed or renovated buildings is that the heating, ventilating, and air-conditioning (HVAC) systems do not function as intended.

The unfavorable results:

- Occupant discomfort and decreased productivity.
- Owner and staff dissatisfaction and frustration.
- Potential increased energy and repair costs.
- Increased maintenance staff costs reacting to comfort complaints and other, potentially very expensive, problems.



### **HVAC systems commissioning is the way to avoid these problems**

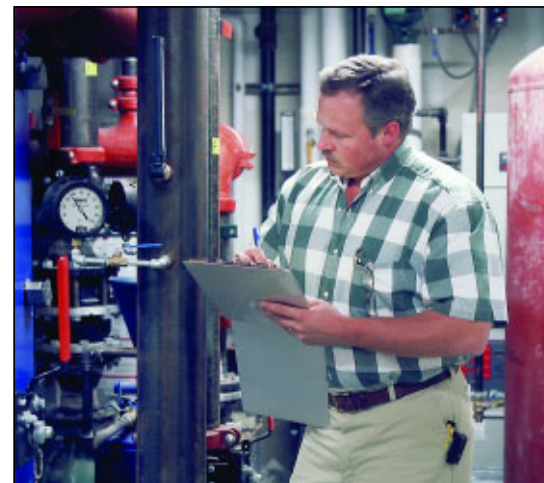
HVAC systems commissioning is a proactive process that ensures your building starts out at optimal performance and helps it stay operating that way.

Commissioning provides:

- Minimized energy usage.
- Lower repair and operating costs.
- Increased occupant comfort and productivity.
- Decreased potential for indoor air quality problems and liability.

Often times owners seek to economize by omitting commissioning services. This is a false economy as **Problem Avoidance = Cost Savings.**

Studies have shown that the problem avoidance available through HVAC systems commissioning provides enough cost savings to pay for the commissioning services. With HVAC systems commissioning, you increase your return on your overall building project investment.





## Benefits

### Reduced Operating and Maintenance Costs

HVAC systems typically incorporate many energy-saving features. Some stand alone, others rely heavily on complex interactions with other features to achieve their intended purpose. The methodical process of commissioning confirms that all such interactions occur properly. Without commissioning, many of these features often operate well below their full potential. The owner is unaware and continually wastes energy dollars.



Maintenance costs are kept to a minimum when systems are operating properly as maintenance staff can spend less time and money reacting to equipment malfunctions and more time performing valuable preventative maintenance tasks. This, in turn, decreases the frequency of breakdowns.

The training aspect of commissioning produces knowledgeable operators who are

better able to diagnose problems and achieve prompt and low-cost corrective actions. The focused training also develops proper operation and maintenance practices that will serve the facility for years to come and minimize life cycle costs.



### Better Indoor Air Quality and Comfort

Indoor air quality and occupant comfort are directly controlled by HVAC systems. Various features of these systems are specifically designed to address air quality and space comfort. By ensuring these features operate properly, problems associated with sick building syndrome are avoided.

In addition, properly operating HVAC systems maximize occupant comfort and thereby increase staff productivity. Also, the documentation provided with commissioning is a valuable resource if owners are faced with air quality and comfort questions.

### Extended Equipment Life

By requiring trend logging of critical data as part of commissioning, subtle operational irregularities can be exposed and enhancements can be immediately implemented. Verification of scheduling and operational strategies prevents excessive and improper equipment operation. This maximizes equipment life.



## Definitions

**Commissioning (Cx)\*:** The process of ensuring that systems are designed, installed, functionally tested, and capable of being operated and maintained to perform in conformity with the design intent.

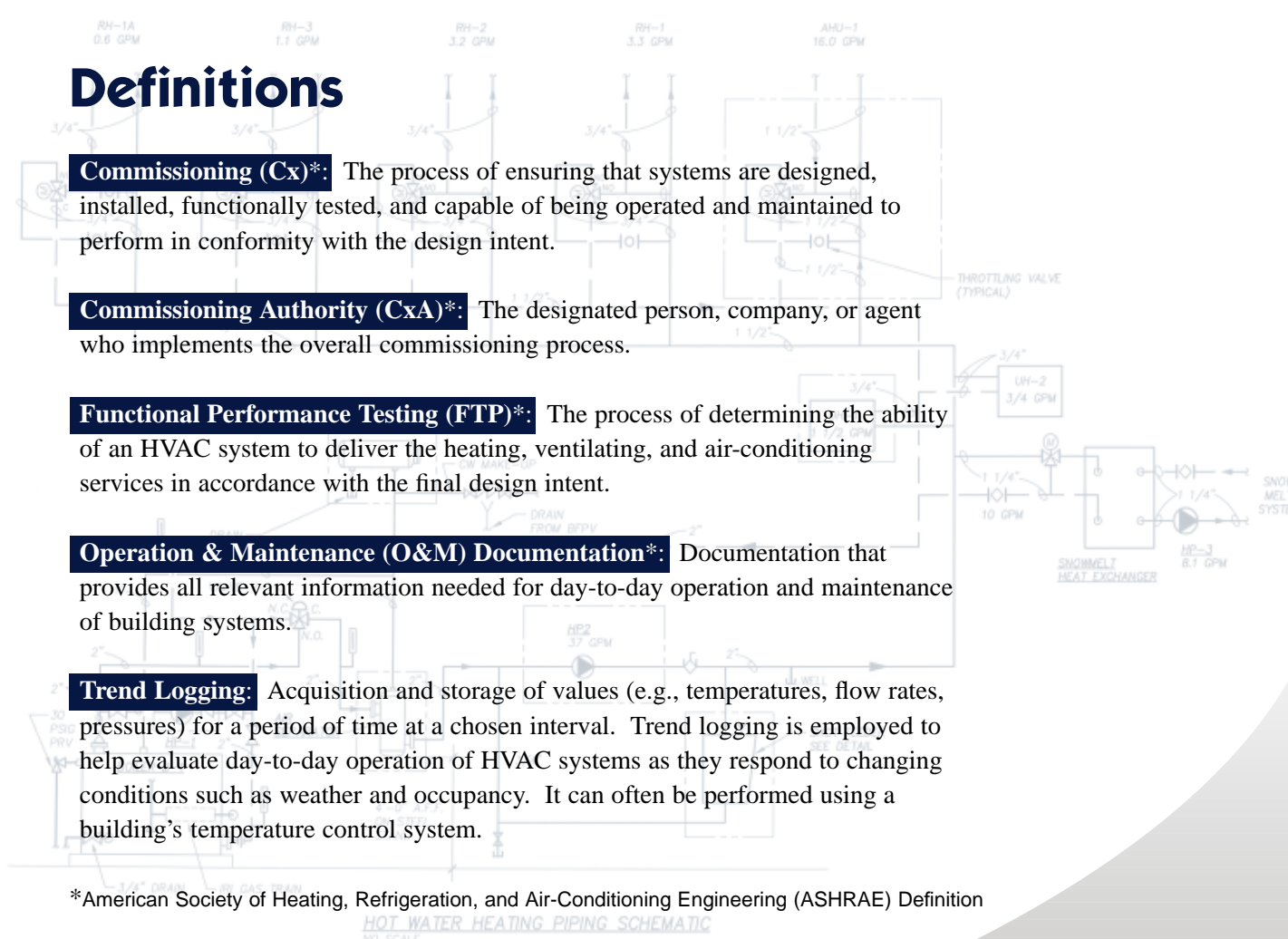
**Commissioning Authority (CxA)\*:** The designated person, company, or agent who implements the overall commissioning process.

**Functional Performance Testing (FTP)\*:** The process of determining the ability of an HVAC system to deliver the heating, ventilating, and air-conditioning services in accordance with the final design intent.

**Operation & Maintenance (O&M) Documentation\*:** Documentation that provides all relevant information needed for day-to-day operation and maintenance of building systems.

**Trend Logging:** Acquisition and storage of values (e.g., temperatures, flow rates, pressures) for a period of time at a chosen interval. Trend logging is employed to help evaluate day-to-day operation of HVAC systems as they respond to changing conditions such as weather and occupancy. It can often be performed using a building's temperature control system.

\*American Society of Heating, Refrigeration, and Air-Conditioning Engineering (ASHRAE) Definition





## ...Benefits (continued)

### Commissioning Ensures and Documents Proper Building Systems Operation

An integral part of the commissioning process is thorough documentation of each functional performance test step:

- Initial conditions, e.g., flow rates, temperatures, pressures, valve positions.
- What specific actions were taken for the test step.
- What were the results, e.g., final conditions.
- How did the actual results differ from the expected results.
- What changes were made to provide needed results.

This documentation forms written proof to the owner that the contractors have indeed provided what they were paid to provide.

Construction contracts that contain just the standard systems startup language, i.e., with no provision for commissioning, generally do not require this expanded level of documentation.



## Some Tools of the Trade

**Hydronic Flow Rate/Differential Pressure Meter**  
Used to determine heating water and chilled water flow rates through pipes and coils.



**Liquid (Primary Reference) Manometer**  
Used for instrument calibration checks.



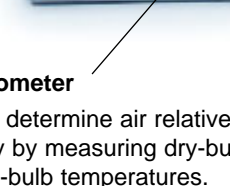
**Test Plugs**  
Used for plugging air velocity and pressure test holes in ducts and air handling units.



**Electronic Micro-Manometer**  
Used for room pressurization measurements, coil and air filter pressure drop measurements, and duct static pressure measurements.



**Psychrometer**  
Used to determine air relative humidity by measuring dry-bulb and wet-bulb temperatures.

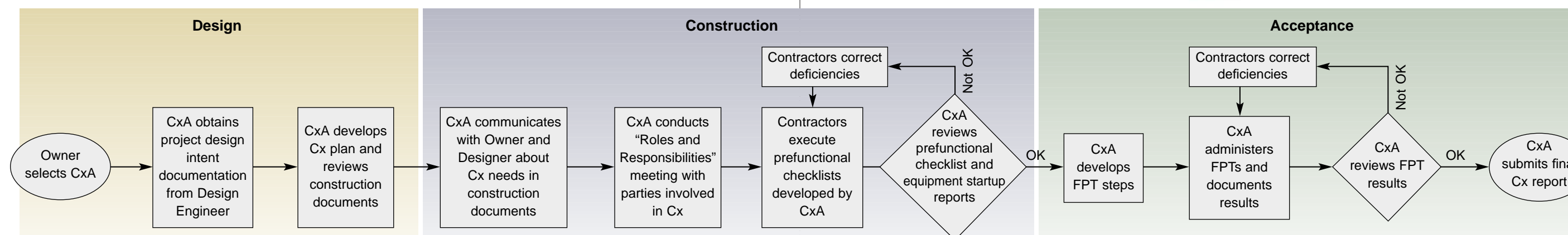


**Hotwire Anemometer**  
Used to measure air flow velocities, as in ducts and at fume hood face openings.



**Air Flow Capture Hood**  
Used to verify supply diffuser and exhaust grille air flow volumes.

### Commissioning Activities Flow Diagram





## How to Get it Done

### When should commissioning work start?

While commissioning work can begin at any stage of the planning/design/construction process, the earlier it starts the better. Early involvement provides maximum benefit to the owner because the sooner problems are identified, the less costly they are to correct. Commissioning involvement during the design phase also ensures that “commissionability” is built into the design. Early involvement also helps foster a spirit of partnership between all involved in the project.

So ideally, the owner selects a CxA before or during the design phase. The CxA’s initial involvement will be to review the design to ensure the mechanical systems will provide the required performance levels and flexibility. Another initial task will be to make sure the construction documents clearly state the commissioning requirements, i.e., what needs to be done and by whom.



### Choosing the CxA

There are two main lines of thought about choosing a CxA. One claims that it is preferable (assuming they are qualified) to have the engineering design firm perform the commissioning. The other suggests it is better to have an outside agency, separate from the designer, do the commissioning. Both approaches have advantages and disadvantages.

The main advantage to having the design firm perform the commissioning is familiarity with the project. This provides a seamless flow of information between the designer and CxA and can save time and money. A disadvantage is a potential loss of objectivity.

The advantage to using an outside agency is the built-in objectivity this approach provides. The disadvantages are increased costs associated with having another agency involved and the time required for them to get familiar the project.

Whichever approach is chosen, most important is a good working relationship and a high level of trust with the CxA. Commissioning experience is another factor to weigh into the decision about whom to select.

### Roles and Responsibilities

All entities involved in the commissioning must understand the intent of the process and act as team members. The team will be working together toward the goal of a project completed on time, within budget, and fully functioning in accordance with the design intent and operational needs.

Specific roles of the primary commissioning team members are as follows:

- Owner:** Choose the CxA.  
Review commissioning documentation.  
Participate in equipment and systems training.  
Participate in the FPT.

- Designer:** Prepare a commissionable design.  
Communicate design intent to CxA.  
Review commissioning documentation.  
Respond to questions.

- Mechanical Contractor:**  
Startup, debug, and otherwise verify equipment readiness.  
Participate in owner training on systems and equipment.  
Assist in preparation of O&M manuals.  
Assist during FPT.

- CxA:** Prepare the commissioning plan.  
Review design documents.  
Develop FPT steps.  
Administer the FPT steps.  
Direct owner training on systems and equipment.  
Review O&M manuals for completeness.  
Prepare the commissioning report.

- Temperature Controls Contractor:**  
Review commissioning documentation.  
Work closely with the CxA to develop the FPT steps.  
Execute the FPT steps.  
Provide training on temperature controls systems operation.

### Defining the Commissioning Scope

A somewhat scaled-back commissioning scope is often appropriate, especially for simple, lower-cost systems that are not critical to life safety. The CxA should work with the building owner to define the appropriate level of commissioning for the optimal balance of cost and performance assurance.

## For More Information...

If, after reading, you have questions or would like additional information on systems commissioning, please contact:

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