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**ONLINE TRAINING BY KRISHNAJI PAWAR**

**LEED AP(BD+C), GSAS CGP, GCP, ISO 14001**

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**3L1**

# HVAC Systems – Application of basic HVAC functions

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# COMMISSIONING CERTIFIED TECHNICIAN CXCT REFRESHER

The heating, ventilation, and air-conditioning (HVAC) system is a common building system that comprises three subsystems: heating, cooling, and ventilation. An automatic temperature control (ATC) system is used to control the operation of HVAC systems in modern buildings. Building automation systems (BAS) or building management systems (BMS) can incorporate the ATC system, allowing operations and maintenance staff to control multiple building systems.

# Learning Objectives

- **Course Overview and Introduction**
- **CCxT's Technical, Communication, and Commissioning Skills - Working knowledge of Procedural Standards**
- **HVAC Systems - Application of basic HVAC functions**
- **Basics of field TAB verification, HVAC systems and controls**
- **CxT Responsibilities by Phase**
- **Pre-function tests include sheet checking and installation tests.**
- **Point-to-point calibrate MEP and sensor systems.**
- **Verify TAB pre-functional tests and CxT responsibilities**



## INTRODUCTION

- HVAC systems are a common building system comprising three subsystems: heating, cooling, and ventilation.
- An automatic temperature control (ATC) system controls the operation of HVAC systems.
- Building automation systems (BAS) or building management systems (BMS) can incorporate the ATC system, allowing operations and maintenance staff to control multiple building systems.
- HVAC controls are essential for HVAC equipment scheduling and operation, ensuring the HVAC system maintains indoor environmental quality (IEQ) in compliance with Owner's Project Requirements (OPR) or Current Facility Requirements (CFR).
- HVAC systems consume the largest share of energy in the average building, making them a target for energy efficiency.
- The scope of HVAC system commissioning depends on the specific devices, components, equipment, assemblies, and controls included in a project.
- The scope of HVAC system commissioning depends on the Owner's Project Requirements (OPR) or Current Facility Requirements (CFR).
- The Commissioning and Testing (CxP) should consider the OPR or CFR when commissioning the HVAC system's equipment and controls.
- The Building Systems Commissioning Guideline provides guidance for commissioning the most common types of HVAC equipment and controls installed in commercial buildings.

# INTRODUCTION TO HVAC FUNDAMENTALS

- HVAC systems are crucial for maintaining indoor environmental quality.
- Understanding basic functions and formulas is essential for effective design, operation, and troubleshooting.
- The National Environmental Balancing Bureau (NEBB) provides a comprehensive Formula Chart for HVAC professionals.



# BASIC HVAC FUNCTIONS

- Heating: Elevates indoor temperature to a desired level, compensating for heat loss through walls, windows, and ventilation.
- Cooling: Reduces indoor temperatures and maintains comfort during warm seasons.
- Ventilation: Maintains indoor air quality by exchanging stale indoor air with fresh outdoor air.



# UNDERSTANDING HVAC FORMULAS

- Heat Load Calculation: Uses the formula  $Q = U \times A \times \Delta T$  to calculate heat transfer (BTU/hr), overall heat transfer coefficient (BTU/hr·ft<sup>2</sup>·°F), area of the surface (ft<sup>2</sup>), and temperature difference between indoor and outdoor environments (°F).
- Airflow Calculation: Uses the formula CFM to calculate airflow in cubic feet per minute, heating or cooling load (BTU/hr), and temperature change across the system (°F).
- Energy Efficiency Ratio (EER): Measures how efficiently a cooling system operates.



# PRACTICAL APPLICATIONS

- Understanding these formulas aids in the design and analysis of HVAC systems and serves as a basis for decision-making.
- In a commercial building with multiple zones requiring different heating and cooling loads, applying the heat load calculation for each zone while considering local climate data optimizes the system to ensure comfort and efficiency.



# BUILDING SYSTEMS COMMISSIONING PROCESS AND HVAC SYSTEM



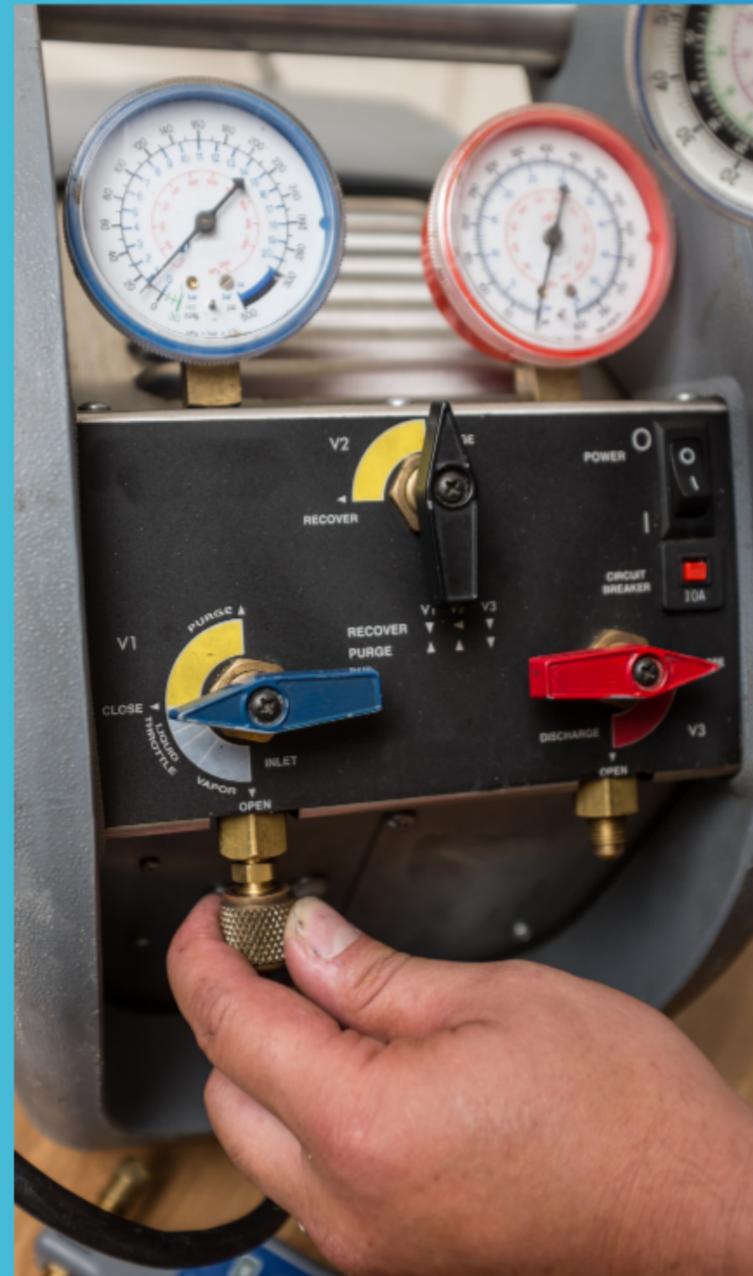
- The Commissioning Provider (CxP) ensures that the HVAC system meets the Owner's Project Requirements (OPR) or Current Facility Requirements (CFR).
- The CxP is involved in the project during the project initiation phase to identify potential obstacles to meeting the project schedule and goals.

# UNDERSTANDING HVAC SYSTEM SUBSYSTEMS

- The heating subsystem provides space heating, consists of a primary heat-generating source and the distribution apparatus that moves the heated medium throughout the building.
- The distribution apparatus includes piping networks, pumps, and valves that facilitate the flow of the heated medium.
- The cooling subsystem provides space cooling, with smaller buildings using standalone packaged air-conditioning units and large buildings using a chiller unit.
- Direct expansion (DX) cooling uses a refrigerant to directly cool the air, eliminating the need for a secondary coolant loop.
- The ventilation subsystem transports air to conditioned spaces, brings fresh air into the building, and exhausts stale air outside the building.
- Fans move air from one place to another place, with dampers and fans on the air side distributing heated or cooled air throughout the building.
- Building codes specify the amount of outside air that the ventilation system must introduce to interior spaces.
- HVAC controls decide how much heating, cooling, and humidification or dehumidification the air needs to achieve the desired conditions.



# MAINTAINING AIR PRESSURE



- Maintaining the overall air pressure within the building relative to outdoor air pressure within the design parameters is critical for building health, occupant comfort, and energy efficiency.
- The owner should outline their expectations for the HVAC system's operation in the OPR or CFR.
- The CxP and Commissioning Team commission the HVAC equipment to verify that its performance complies with the OPR or CFR.

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