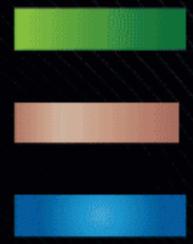


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CERTIFIED HVAC DESIGNER

CHD OVERVIEW

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MODULE

3

The Air- Conditioning Process

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CERTIFIED HVAC DESIGNER CHD OVERVIEW

Air conditioning is a vital technological advancement that improves comfort and productivity in various environments. It operates based on heat transfer and fluid dynamics principles, extracting heat from indoor air and expelling it outside, lowering indoor temperatures and enhancing comfort

Learning Objectives

- Introduction
- HVAC Fundamentals
- **The Air-Conditioning Process**
- HVAC System Concepts and Process
- HVAC Systems Design
- Engineering, Economics, and Design Decision-Making
- Certified HVAC Designer (CHD) Specialty Certification
- Summary and Resources
- Certified HVAC Designer - CHD Practice Test V.4.1



INTRODUCTION

- Operates based on heat transfer and fluid dynamics principles to extract heat from indoor air and expel it outside.
- Divided into four stages: evaporation, compression, condensation, and expansion.
- Evaporation: Warm indoor air draws over the evaporator coil, absorbing heat energy and causing the refrigerant to change from a low-pressure liquid to a low-pressure gaseous state.
- Compression: The compressor, usually outside the building, receives the refrigerant and compresses it into a high-pressure, high-temperature gas.
- Condensation: The high-pressure, high-temperature gas flows into the condenser coil, releasing the heat absorbed during evaporation.
- Expansion: The refrigerant passes through an expansion valve or capillary tube, reducing its pressure and allowing it to expand and lower its temperature before re-entering the evaporator coil.



AIR AND ITS PROPERTIES IN HVAC SYSTEMS

Composition of Air

- Air primarily consists of nitrogen, oxygen, argon, carbon dioxide, and trace gases.
- The presence of water vapor significantly influences its properties.
- The composition of air can vary depending on location, altitude, and environmental conditions.



Physical Properties of Air

- Density: Defined as mass per unit volume, influenced by temperature and pressure.
- Specific Heat Capacity: The amount of heat required to raise the temperature of a unit mass of air by one degree Celsius at constant pressure.
- Humidity and Moisture Content: Expressed as absolute humidity, relative humidity, and specific humidity.

AIRFLOW CHARACTERISTICS +

- Velocity and Volume Flow Rate: Determines how effectively air is transported through ductwork.
- Pressure Loss: The Darcy-Weisbach equation is used to calculate pressure loss due to friction.

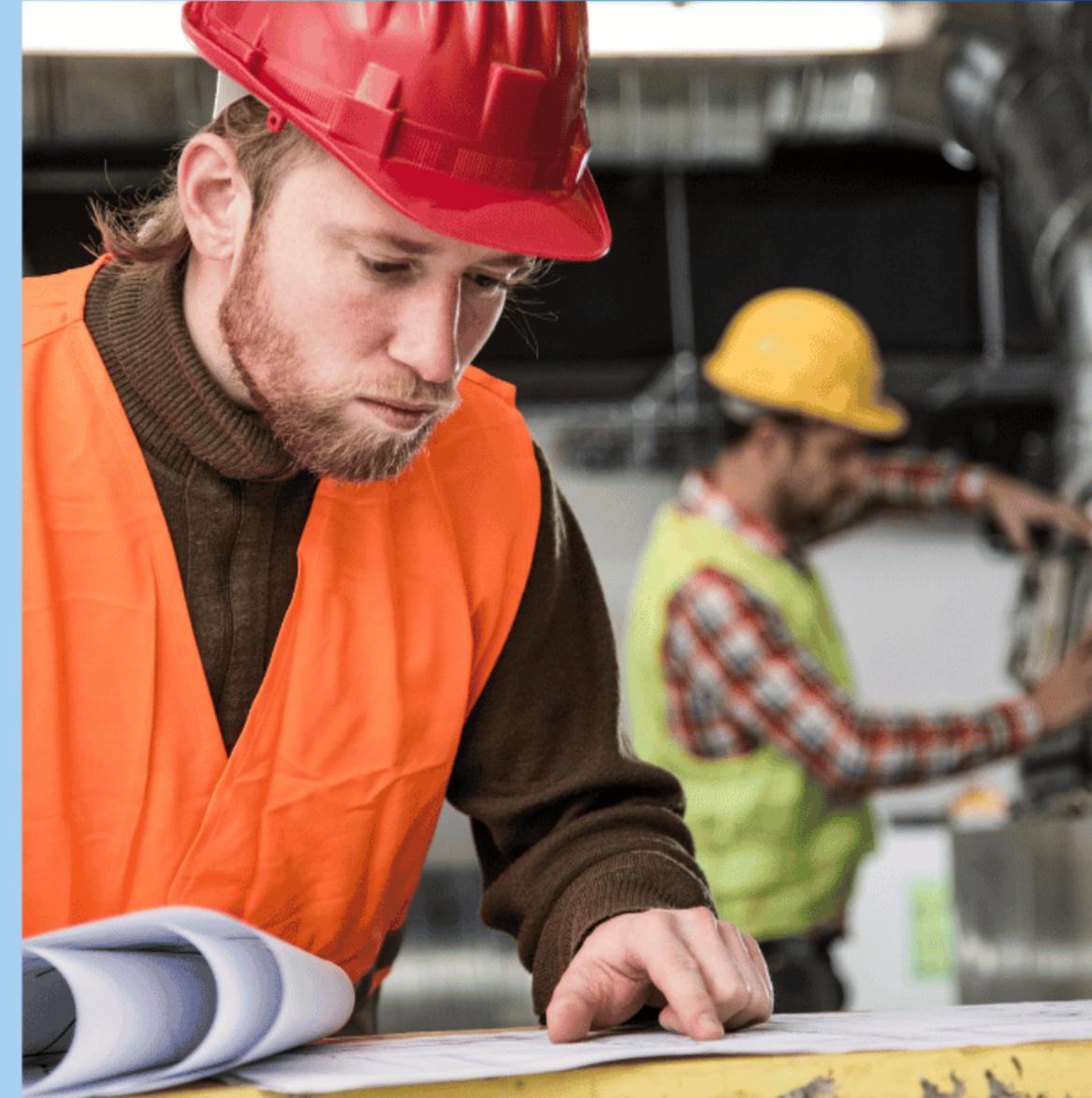
Thermodynamic Properties of Air

- Enthalpy: Represents the total energy of the air, including internal energy and the product of pressure and volume.
- Psychrometric Properties: A graphical representation of the thermodynamic properties of moist air.



THERMODYNAMIC WET-BULB TEMPERATURE IN FIELDS

- Crucial parameter in meteorology, HVAC, and agriculture.
- Understanding humidity and temperature interactions is vital for optimizing processes and systems.
- Methods of measuring and analyzing wet-bulb temperature include the psychrometer and psychrometric chart.
- A psychrometer measures air moisture content, consisting of a dry-bulb thermometer and a wet-bulb thermometer.
- The psychrometric chart provides a graphical representation of the thermodynamic properties of moist air.
- Effective use of the psychrometric chart involves locating the dry-bulb temperature, tracing vertically to find the corresponding wet-bulb temperature line, and determining properties like relative humidity, specific humidity, and enthalpy.
- The psychrometric chart aids in quick analysis of air properties during heating, cooling, and humidifying, understanding indoor comfort levels, and optimizing energy use in HVAC systems.



TYPICAL AIR-CONDITIONING PROCESSES OVERVIEW

- Air conditioning (AC) is a crucial technology for maintaining thermal comfort in indoor environments.
- The refrigeration cycle, a thermodynamic cycle, is the backbone of AC systems.
- The compressor, condenser, expansion valve, and evaporator are the main components of the refrigeration cycle.
- The compressor compresses the refrigerant, raising its pressure and temperature, transforming it from a low-pressure gaseous state to a high-pressure gaseous state.
- The condenser receives the compressed refrigerant, which releases heat to the surrounding environment and condenses into a high-pressure liquid.
- The expansion valve experiences a rapid drop in pressure, causing the refrigerant to cool significantly.
- The evaporator absorbs heat from the indoor air and transforms back into a low-pressure gas, creating a cooling effect



HEAT EXCHANGE PROCESSES +

- The efficiency of an air conditioning system is heavily reliant on the heat exchange processes in the evaporator and condenser.
- The evaporator coil maximizes surface area for heat absorption, absorbing heat from the air flowing over the coil.
- The condenser coil expels the heat absorbed indoors, influenced by ambient temperature and airflow.



CONTROL SYSTEMS +



- Modern air conditioning systems use sophisticated control systems to manage temperature, humidity, and airflow.
- Thermostats are the primary control devices in HVAC systems, measuring the indoor air temperature and activating the cooling system when the temperature exceeds a preset threshold.
- Humidity control features are often included in many air conditioning systems, extracting moisture from the air to enhance comfort and prevent mold growth.

PSYCHROMETRIC ANALYSIS IN HVAC APPLICATIONS

- Psychrometric analysis is crucial in understanding the thermodynamic properties of moist air, especially in HVAC applications.
- It combines principles of thermodynamics with the physics of air and moisture to analyze air-water vapor mixtures.
- Key attributes of moist air include Dry Bulb Temperature (DBT), Wet Bulb Temperature (WBT), relative humidity (RH), Dew Point Temperature (DPT), Specific Humidity (SH), and Enthalpy (h).
- The psychrometric chart is a graphical representation of the thermodynamic properties of moist air, plotting dry bulb temperature against moisture content.
- The first step in psychrometric analysis is to identify system conditions, then define desired conditions like cooling, heating, humidification, or dehumidification.
- The psychrometric chart calculates changes in air properties and the total enthalpy change, representing the energy transfer required for the air to reach its desired state.
- Psychrometric analysis aids in designing efficient systems that meet specific thermal and humidity requirements, contributing to energy efficiency and indoor air quality.



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