

**Course 441: Heat Pumps**

Introduces the heat pump concept and related terminology. Covers water-to-water, water-to-air, ground-to-air, air-to-air, solar-assisted, geothermal, dual-fuel, and split systems, as well as packaged units. Defines balance points, coefficient of performance, energy efficiency ratio, and degree days. Covers components, controls, installation, checkout, and startup.

TPC Training is accredited by IACET to offer **0.7 CEU** for this program.

**Lesson 1: Introduction to Heat Pumps***Topics*

What Is a Heat Pump?; Basic Heat Pump Operation; Advantages of Heat Pumps; Heat Pump Cycles; Cooling Cycle; Heating Cycle; Defrost Cycle; Kinds of Systems; Balance Point; Degree-Days; Unit Sizing; Operating Costs

*Objectives*

- Explain how a heat pump differs from standard air-conditioning equipment.
- List the benefits of heat pump systems.
- Describe the heating, cooling, and defrost heat pump cycles.
- Define degree-day.
- List considerations in sizing heat pumps.

**Lesson 2: Heat Pump Systems***Topics*

Heat Pump System Designations; Water-to-Water Systems; Water-to-Air Systems; Ground-to-Air Systems; Air-to-Air Systems; Solar-Assisted Systems; Geothermal Systems; Dual-Fuel Systems; Split Systems and Packaged Units

*Objectives*

- Compare the operation of water-to-water and water-to-air heat pump systems.
- Compare the operation of ground-to-air and air-to-air heat pump systems.
- Describe the operation of solar-assisted heat pump systems.
- Describe the operation of geothermal heat pump systems.
- Describe the operation of dual-fuel heat pump systems.
- Discuss the differences in configuration and installation of split and packaged heat pump units.

**Lesson 3: Balance Points and Cost of Operation***Topics*

Balance Points and System Capacity; Determining Balance Points; Supplemental Heating Control; Performance Ratings; Heating Seasonal Performance Factor (HSPF); Coefficient of Performance (COP); Seasonal Energy Efficiency Ratio (SEER); Energy Efficiency Ratio (EER); Operating Costs; Estimating Costs by Heating Degree-Day Method; Estimating Costs by Cooling Degree-Day Method; Estimating Costs by Bin Method; Common Heating-Mode Problems

*Objectives*

- Determine heat pump system balance points and explain their relationship to system capacity.
- Discuss the use and control of supplemental heat.
- Discuss ARI single-point and seasonal heating and cooling ratings for heat pump equipment.
- Explain how several common variables affect heat pump operating costs.
- Describe how to use the heating degree-day, cooling degree-day, and bin methods of estimating heat pump system energy use.
- Describe common problems of heat pump systems in the heating mode.

**Lesson 4: Heat Pump Components***Topics*

Accumulator; Indoor and Outdoor Coils; Indoor Unit; Heat Pump Compressors; Reversing Valve; Check Valves; Equalizer Tank; Heat Exchanger; Filter-Driers; Indoor Thermostat; Outdoor Thermostat; Optional Controls; Defrost Control Methods

*Objectives*

- Explain why heat pump systems include an accumulator.
- Describe the indoor and outdoor coils, indoor air handling components, and various metering (flow-control) devices.
- Briefly discuss the requirements of reciprocating and scroll compressor operation as used in heat pump systems.
- Discuss the use and operation of the reversing valve and check valves in heat pump systems.
- Explain the functions of the equalizer tank, heat exchanger, and filter-driers in heat pump systems.
- Briefly describe indoor and outdoor controls and popular defrost control systems.

## Heat Pumps

### Lesson 5: Heat Pump Controls

#### Topics

Defrost Controls; Pressure Differential Defrost; Temperature Differential Defrost; Timed Defrost; Time-and-Temperature Defrost; Solid-State Defrost; Pressure Controls; Heat Sequencers; Emergency Heat Relay; Starting Components; Lockout Relays; Transformer and Contactors; Overload Protectors

#### Objectives

- Describe the operation of the pressure differential and temperature differential defrost methods.
- Compare the advantages and disadvantages of the timed defrost and time-and-temperature defrost methods.
- Compare the construction and operation of electromechanical and solid-state defrost controls.
- Explain the functions of pressure controls, heat sequencers, and the emergency heat relay in heat pump systems.
- Describe typical starting and lockout devices used on heat pumps and explain why systems include transformers, contactors, and overload protectors.

### Lesson 6: Heat Pump Installation

#### Topics

Outdoor Unit; Indoor Unit; Air Distribution System; Refrigerant Lines; Condensate Drain Line; Electrical System; Packaged Heat Pumps

#### Objectives

- Discuss considerations in selecting the best location for outdoor unit installation.
- Discuss considerations in selecting the best location for indoor unit installation.
- Describe installation practices that help the air distribution system fulfill its purpose.
- Discuss procedures for installing refrigerant lines and primary and auxiliary drain lines.
- Discuss the requirements for installing electrical wiring.
- Describe additional requirements for installing a packaged heat pump unit.

### Lesson 7: Heat Pump Checkout and Startup

#### Topics

Crankcase Heater; Air Distribution System; Mountings; Leak Test and Charging; Insulation; Piping; Electrical System; Miscellaneous Post-Installation Checks; System Thermostat; Defrost Controls; Electrical Connections; Blower Output; Operator Instructions

#### Objectives

- Describe basic checkout procedures for the compressor crankcase heater, air distribution system, and all heat pump mountings.
- Describe basic steps in leak testing and charging a heat pump unit and discuss basic requirements for post-installation checkout of heat pump insulation and piping.
- Describe both the general post-installation checkout of the electrical system and tests to check specific electrical connections.
- Explain how to check the operation of the system thermostat, outdoor thermostats, and defrost controls.
- Name ways to increase blower output and explain why operator instructions are important.