

Refrigeration & Air Conditioning Technology  
SIXTH EDITION

## SECTION 7

### AIR CONDITIONING (COOLING)

#### UNIT 39

#### CONTROLS

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## UNIT OBJECTIVES

After studying this unit, the reader should be able to

- Describe the control sequence for an air-conditioning system.
- Explain the function of the 24-v control voltage.
- Describe the space thermostat.
- Describe the compressor contactor.
- Explain the operation of the high- and low-pressure controls.

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## UNIT OBJECTIVES

After studying this unit, the reader should be able to

- Discuss the function of the overloads and motor-winding thermostat.
- Discuss the winding thermostat and the internal relief valve.
- Identify operating and safety controls.
- Compare modern and older control concepts.
- Describe how crankcase heat is applied in some modern equipment.

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## CONTROLS FOR AIR CONDITIONING

- Must correctly control the indoor fan, outdoor fan, and compressor
- Indoor fan must be on when the compressor is operating
- Outdoor fan is often on when compressor operates
- Indoor fan may operate continuously
- Thermostat – Operating control
- High-pressure switch – Safety control

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Circuit Breaker Panel

Thermostat controls compressor, indoor fan motor and outdoor fan motor operation

Low voltage wiring

Air Handler

X-former

Fan relay

230 v @ 20 amps

Condensing Unit

Cooling contactor relay

230 v @ 40 amps

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A non-adjustable high pressure control

Connected to the high pressure side of the system

\* This device is usually connected in the control circuit

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## PRIME MOVERS – COMPRESSORS AND FANS

- Consume the most power
- Operate at high voltage
- Control circuits are usually 24 V
- Electronic controls more economical than before
- Controls for convenience, comfort, and efficiency

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## LOW-VOLTAGE CONTROLS

- Low voltage provided by a transformer
- Controls the operation of devices that, in turn, control the system compressor and fans
- Example: When a low-voltage contactor coil is energized, contacts close, energizing the system compressor

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Line voltage supplied to the primary winding of the transformer

Low voltage (24v) generated at the secondary winding of the transformer

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## OPERATING CONTROLS FOR OLDER AIR-COOLED SYSTEMS

- Thermostat controls space temperature
- Fan relay starts and stops the indoor fan
- Compressor contactor starts and stops the compressor and outdoor fan
- Compressor starting and running circuits

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### NORMALLY OPEN CONTACTS

COIL

NORMALLY CLOSED CONTACTS

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CONTROL CIRCUIT

RELAY

MOTOR

START

RUN

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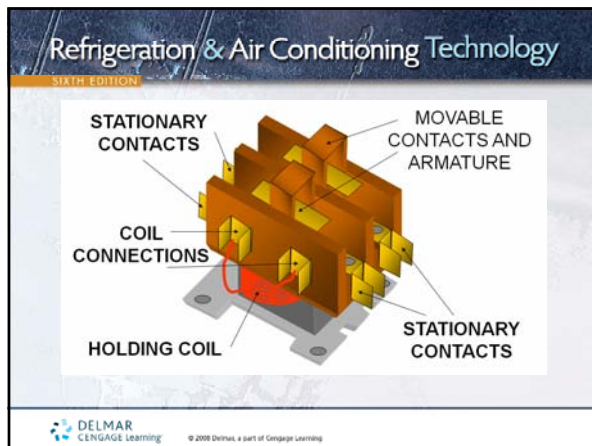
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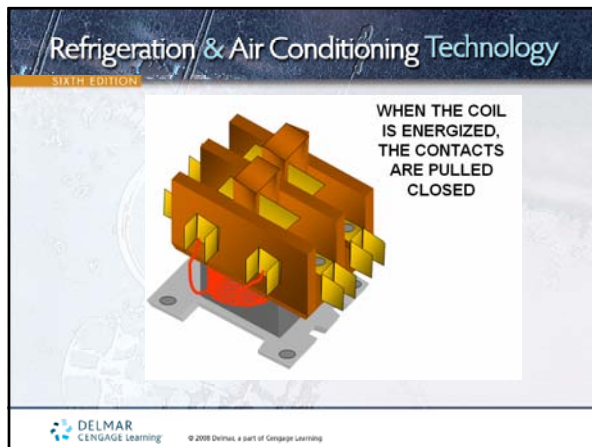
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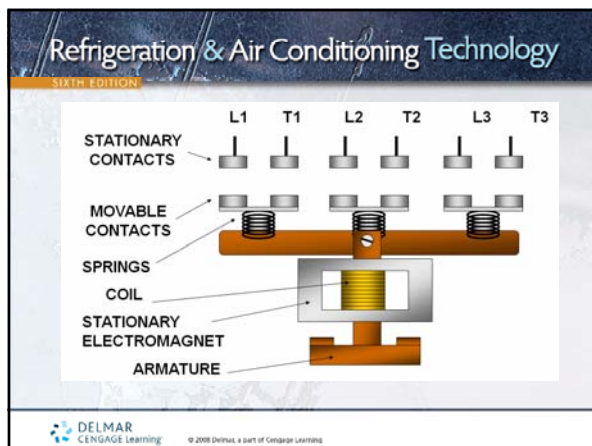
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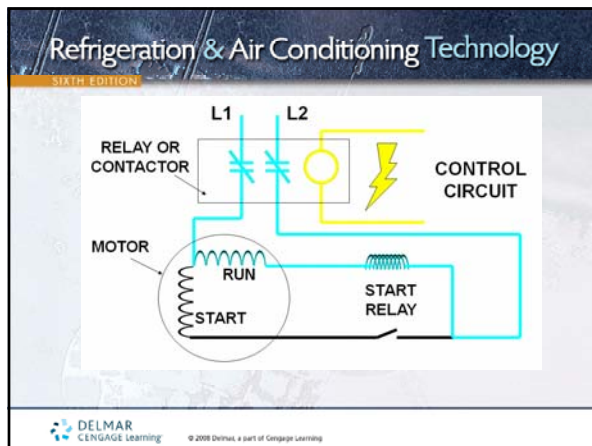
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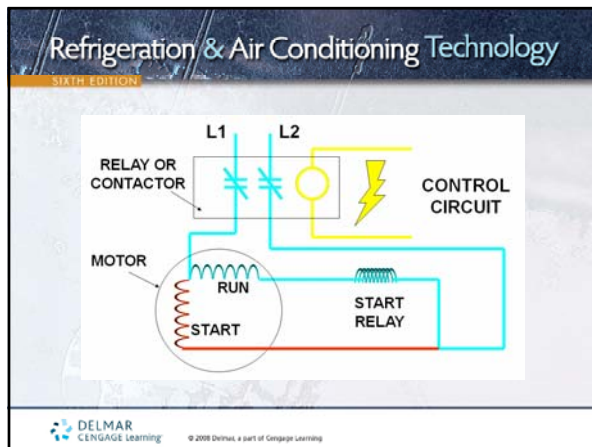
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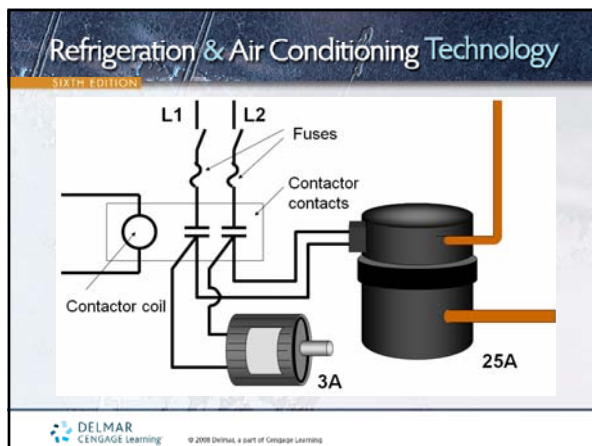
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## SAFETY CONTROLS FOR OLDER AIR-COOLED SYSTEMS

- High-pressure control
- Low-pressure control
- Compressor overload protection
- Internal motor protection
- Short-cycle protection

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## OPERATING CONTROLS FOR MODERN EQUIPMENT

- Electronic programmable thermostats
- Fan relays are smaller than older ones
- Starting circuit
  - Fewer components
  - Run capacitor in series with the start winding
  - PTC-Positive temperature coefficient

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## SAFETY CONTROLS FOR MODERN EQUIPMENT

- Motor temperature control
  - Motor winding thermostat
  - Dirty condenser
  - Overcurrent situations
  - Short cycling
- Loss of charge protection
  - Low pressure cut-out
  - Located in the liquid line

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ELECTRONIC CONTROLS AND AIR-CONDITIONING EQUIPMENT

- Can monitor high-voltage conditions
  - Higher voltages will cause lower currents to flow
  - Overloads will not rip on low current
- Can cut out the compressor during low-voltage conditions
- Some solid-state boards have a self-diagnostic feature

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SUMMARY - 1

- Air conditioning system controls cycle the compressor, condenser fan motor and indoor fan motor on and off at the proper time
- Typically, the outdoor fan motor and indoor fan motor are operating whenever the compressor is in operation
- The thermostat controls the operation of the major system components based on space temperature
- Typical residential systems are controlled by low voltage circuits

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SUMMARY - 2

- Fan relays control the operation of the indoor fan motor
- Contactors control the operation of the compressor and the condenser fan motor
- Safety controls for older air-cooled systems include the high pressure switch, low pressure switch, compressor overload, internal motor protection and short-cycle protection

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## SUMMARY - 3

- Newer systems use motor protection controls in the event of dirty condensers, short cycling, overcurrent conditions or low charge protection
- New electronic thermostats provide more accurate temperature control
- Electronic controls can protect systems from both high and low voltage conditions
- Solid-state controls often have self-diagnosing features

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