

Refrigeration & Air Conditioning Technology
SIXTH EDITION

SECTION 7

AIR CONDITIONING (COOLING)

UNIT 41

TROUBLESHOOTING

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UNIT OBJECTIVES

After studying this unit, the reader should be able to

- Select the correct instruments for checking an air conditioning unit with a mechanical problem.
- Calculate the correct operating suction pressures for both standard- and high-efficiency air-conditioning equipment under various conditions.
- Calculate the standard operating discharge pressures at various ambient conditions.
- Select the correct instruments to troubleshoot electrical problems in an air-conditioning system.
- Check the line- and low-voltage power supplies.
- Troubleshoot basic electrical problems in an air conditioning system.
- Use an ohmmeter to check the various components of the electrical system.

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INTRODUCTION

- Troubleshooting air-conditioning equipment involves both the mechanical and electrical systems
- Symptoms may overlap
- Mechanical problems may appear to be electrical and vice versa
- Technicians must diagnose problems correctly


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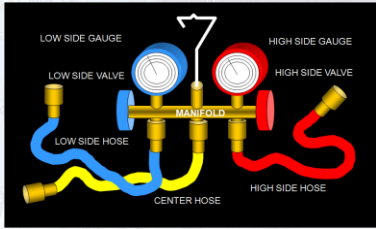
MECHANICAL TROUBLESHOOTING


- Gages and temperature-testing equipment are used when performing mechanical troubleshooting
- Always be aware of the system refrigerant
- R-410a pressures are much higher than R-22
- R-22 gages on R-410a systems will be over pressurized and can become damaged
- Not all refrigerant oils are compatible, so gages should be used on only one type of refrigerant


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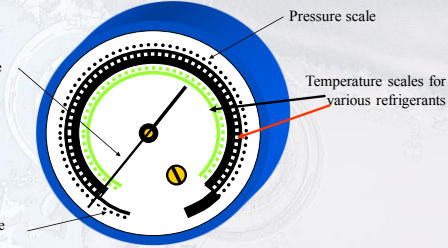



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LOW PRESSURE GAGE



Gages provide temperatures and pressures for *saturated* refrigerants


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GAGE MANIFOLD USAGE

- Displays the low- and high-side pressures while the unit is operating
- These pressures can be converted to the saturation temperatures
- Gage manifolds are used whenever the pressures need to be known for the system
- Gages are connected to service ports
- Used to calculate superheat and subcooling

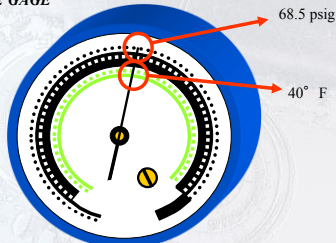
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LOW PRESSURE GAGE



This low side gage indicates a suction pressure of 68.5 psig, which means that the refrigerant is boiling at 40° F in the evaporator

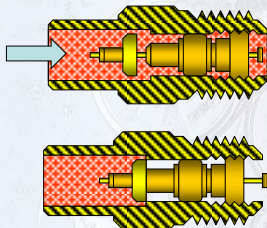
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Schrader valves to access refrigeration circuit

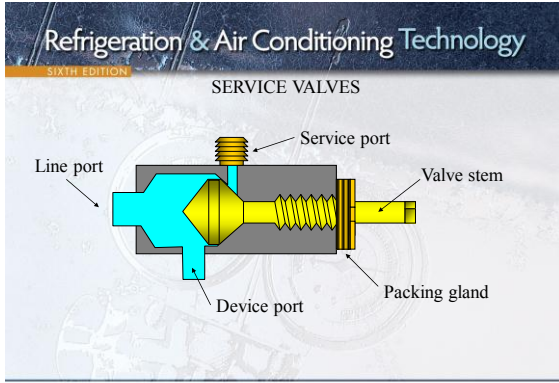


When pin in the valve is pushed in, the valve is open and the refrigerant circuit can be accessed

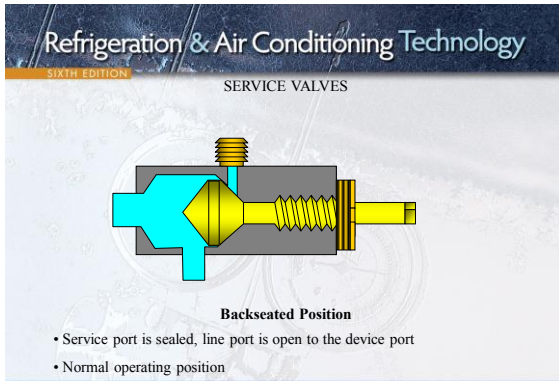
When pressure on the pin is removed, the valve seals itself closed and the refrigerant circuit is once again sealed closed

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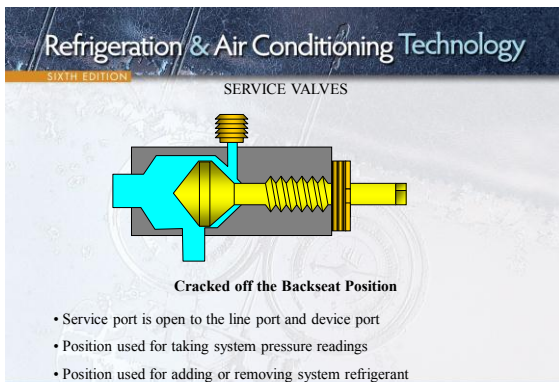
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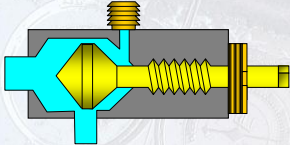
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SERVICE VALVES



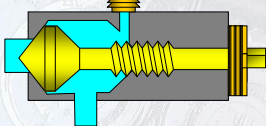
Midseated Position

- Service port is open to the line port and device port
- Position used for system evacuation and leak checking

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SERVICE VALVES



Frontseated Position

- Service port is open to the device port
- Line port is sealed off
- Position used for pumping the system down

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WHEN TO CONNECT THE GAGES

- Gage manifolds should not be connected every time a system is serviced
- Small amounts of refrigerant escape each time the gages are connected and removed from a sealed system
- Short gage hoses will limit the amount of refrigerant lost
- Low-loss fittings should be used

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LOW-SIDE GAGE READINGS

- Used to compare the actual evaporating pressure to the normal evaporating pressure
- Standard-efficiency systems usually have a refrigerant boiling temperature of about 35° F cooler than the entering air temperature
- Under increased loads, the evaporator is absorbing extra sensible and latent heat from the air
- Gage readings when the system is operating in or close to design range will verify system's true performance

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HIGH-SIDE GAGE READINGS

- Used to check the relationship of the condensing refrigerant to the ambient air temperature
- Standard efficiency air-cooled condensers condense the refrigerant at no more than 30° F higher than the ambient temperature
- High-efficiency condensers normally condense the refrigerant at a temperature as low as 20° F higher than the ambient temperature

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TEMPERATURE READINGS

- For determination of the system's superheat and subcooling temperatures
- Common temperatures used for evaluation are:
 - Indoor air wet-bulb and dry-bulb temperatures
 - Outdoor air dry-bulb temperature
 - Suction-line temperature
 - Condenser outlet temperature
 - Compressor discharge line temperature

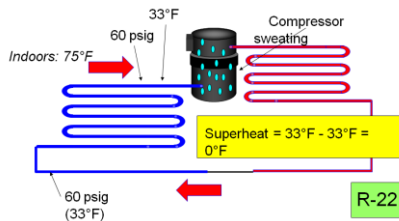
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EVAPORATOR FLOODED WITH REFRIGERANT



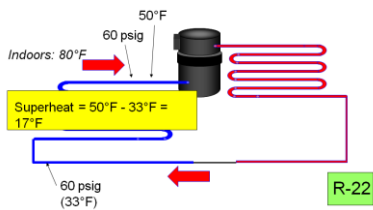
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STARVED EVAPORATOR



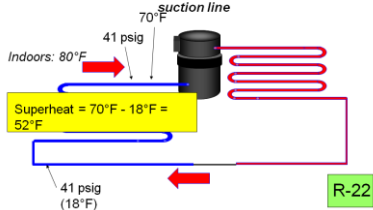
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STARVED EVAPORATOR: Low suction pressure, warm suction line

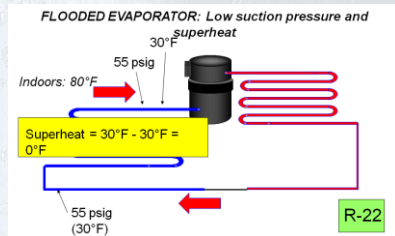


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CHARGING SYSTEMS IN THE FIELD

- When the system is operating correctly under design conditions, there should be a prescribed amount of refrigerant in the condenser, the evaporator, and the liquid line
- The amount of refrigerant in the evaporator can be measured by superheat
- The amount of refrigerant in the condenser can be measured by subcooling

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FIELD CHARGING THE TXV SYSTEM

- Reduce the airflow across the condenser to simulate a 95° F outside air temperature
- The superheat check will not work for the TXV because it is designed to maintain a constant superheat of 8° to 12° under any load condition
- A subcooling check of the condenser can be used to check the system charge
- Typical subcooling circuit will subcool the liquid refrigerant from 10° to 20° cooler than the condensing temperature
- Excessive subcooling indicates an overcharge

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ELECTRICAL TROUBLESHOOTING

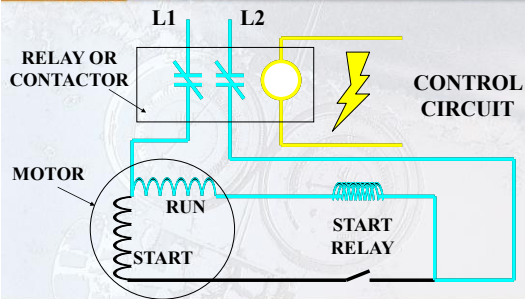
- You need to know what the readings should be to know whether the actual readings are correct or not
- Begin any electrical troubleshooting by verifying that the power supply is energized and that the voltage is correct
- If the power supply voltage is correct, move on to the various components

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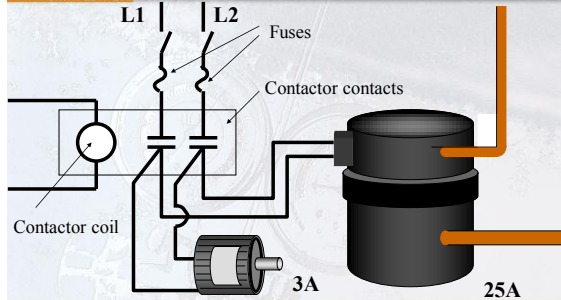


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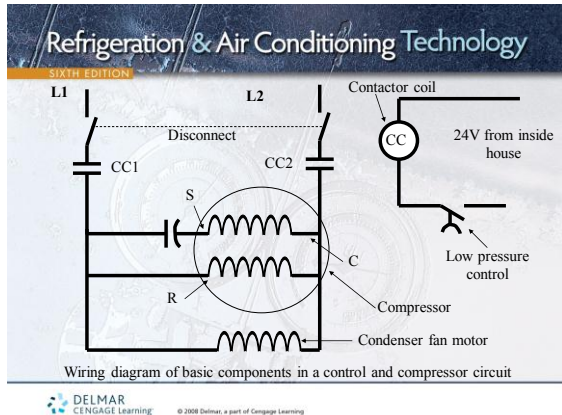
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COMPRESSOR ELECTRICAL CHECKUP

- Technicians need to be careful when condemning a compressor
 - Many condemned compressors are not bad
 - Unnecessary labor and material costs
- Compressor problems can be mechanical or electrical

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ELECTRICALLY CHECK A SINGLE-PHASE COMPRESSOR

- Make certain wires are disconnected from the compressor
- Make certain all compressor terminals are clean
- Check resistance from windings to ground (ohmmeter or megohmmeter)
- Check resistance of the start and run windings

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ELECTRICALLY CHECK A SINGLE-PHASE COMPRESSOR (cont'd.)

- Check continuity between run and start terminals
- Check voltage between common and run terminals and between common and start terminals
- Voltage readings should be within 10% of the rated voltage

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ELECTRICALLY CHECK A THREE-PHASE COMPRESSOR

- Check resistance from windings to ground
- Make certain wires are disconnected from the compressor
- Make certain all compressor terminals are clean
- Check each winding from terminal to terminal
- The resistance readings should be the same in all windings

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MECHANICALLY CHECKING A COMPRESSOR

- If the supply voltage is correct, the compressor should start
- If the compressor does not start, the compressor may be stuck
- Reversing the direction of the motor may free the motor

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COMPRESSOR CAPACITY

- One or more cylinders may not be functioning properly
- Simulate design conditions as closely as possible
- If voltage is correct and amperage is very low, the compressor is not pumping to capacity
- Indicated by a high suction pressure and a low head pressure

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TROUBLESHOOTING THE CIRCUIT ELECTRICAL PROTECTORS – FUSES AND BREAKERS

- Open circuit breakers or blown fuses should be treated with caution
- Do not reset or replace a tripped breaker or fuse without trying to determine what caused the fuse to blow or the breaker to trip

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SUMMARY - 1

- Troubleshooting air-conditioning equipment involves both the mechanical and electrical systems
- Mechanical problems may appear to be electrical and vice versa
- Gages and temperature-testing equipment are used when performing mechanical troubleshooting
- Gage manifolds are used whenever the pressures need to be known for the system
- Gages are used to calculate superheat and subcooling

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SUMMARY - 2

- Gage manifolds should not be connected every time a system is serviced
- Short gage hoses will limit refrigerant loss
- Standard-efficiency systems usually have a refrigerant boiling temperature of about 35° F cooler than the entering air temperature
- Standard efficiency air-cooled condensers condense the refrigerant at no more than 30° F higher than the ambient temperature

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SUMMARY - 3

- Temperature readings are needed to calculate evaporator superheat and condenser subcooling
- The amount of refrigerant in the evaporator can be measured by superheat
- The amount of refrigerant in the condenser can be measured by subcooling
- Typical subcooling circuit will subcool the liquid refrigerant from 10° to 20° cooler than the condensing temperature

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SUMMARY - 4

- Begin any electrical troubleshooting by verifying that the power supply is energized and that the voltage is correct
- Use an ohmmeter to check compressor windings for grounds, shorts and open circuits
- Compressor voltage readings should be within 10% of the rated voltage
- If the supply voltage to the compressor is correct, the compressor should start

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