Unit 14 Refrigeration System Accessories

Unit Contents

Student Components

Student Guide

Student Workbook

* Assignment Sheets and Job Sheet are located in the Student Workbook.

Prerequisites:
Unit 13—Basic Mechanical Refrigeration

Learning Activities Sheet

Student Name _____

Place a checkmark in the appropriate box as you complete each of the steps below.

❑ 1. **Take** Pretest provided by instructor. After test has been evaluated, follow instructor's recommendations.

Instructor's initials _____ Date _____

❑ 2. **Read** Objective Sheet.

Optional 

❑ 3. **Read** Reference text sections as designated by instructor.

Optional

❑ 4. **Answer** Review questions from reference text as designated by instructor.

Optional

❑ 5. **Stop** Ask instructor to evaluate the completed review questions. After work has been evaluated, follow instructor's recommendations.

❑ 6. **View** Videotape entitled "Refrigeration Accessories" as designated by instructor.

❑ 7. **Study** Information Sheet, Objectives 1 through 13.

❑ 8. **Do** Assignment Sheet 1, "Identify Components of a Mechanical Refrigeration System With Accessories."

❑ 9. **Stop** Have instructor evaluate the completed assignment sheet and if the evaluation is satisfactory, continue to Step 10. If the evaluation is not satisfactory, repeat Steps 7 and 8.

Instructor's initials _____ Date _____

❑ 10. **Do** Assignment Sheet 2, "Select Functions for Refrigeration System Accessories."

❑ 11.	**Stop**	Have instructor evaluate the completed assignment sheet and if the evaluation is satisfactory, continue to Step 12. If the evaluation is not satisfactory, repeat Steps 7 through 10. Instructor's initials _____ Date _____
❑ 12.	**Do**	Assignment Sheet 3, "Select Operating Positions for Service Valves."
❑ 13.	**Stop**	Have instructor evaluate the completed assignment sheet and if the evaluation is satisfactory, continue to Step 14. If the evaluation is not satisfactory, repeat Steps 7 and 12. Instructor's initials _____ Date _____
❑ 14.	**Practice**	Job Sheet 1, "Find and Identify Basic Refrigeration Components."
❑ 15.	**Do**	Job Sheet 1, "Find and Identify Basic Refrigeration Components."
❑ 16.	**Stop**	Have instructor evaluate your performance and if the evaluation is satisfactory, continue to Step 17. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 1 and repeat Steps 14 and 15. Instructor's initials _____ Date _____
❑ 17.	**Check**	With instructor for any additional assignments to be completed.
❑ 19.	**Take**	Posttest provided by instructor. After test has been evaluated, follow instructor's recommendations.
❑ 20.	**Stop**	Have instructor evaluate your unit performance. If the evaluation is satisfactory, proceed to next learning activities sheet. If evaluation is not satisfactory, ask instructor for further instructions. Instructor's initials _____ Date _____

Objective Sheet

Unit Objective

After completing this unit, the student should be able to identify components of a mechanical refrigeration system with accessories, select functions for refrigeration system accessories, select operating positions for service valves, and find and identify refrigeration system accessories. The student should demonstrate these competencies by completing the assignment sheets and job sheets and by scoring a minimum of 85 percent on the written test.

Specific Objectives

After completing this unit, the student should be able to:

1. Select the correct term that matches the definition.
2. Select the correct word(s) to complete statements concerning refrigeration system accessories and their locations.
3. Select the correct word(s) to complete statements concerning suction line accumulators and their functions.
4. Select the correct word(s) to complete statements concerning liquid receivers and their functions.
5. Select whether statements concerning oil separators and their functions are true or false.
6. Select the correct word(s) to complete statements concerning noise and vibration control with large compressors.
7. Select the correct word(s) to complete statements concerning filter-driers and their applications.
8. Select the correct answers to problems concerning monitoring moisture and liquid refrigerant in a system.
9. Select the correct service valve operating positions that match its definition.
10. Select the correct word(s) to complete statements concerning service valves and their applications.
11. Select whether statements concerning shut-off valves and their applications are true or false.
12. Select whether statements concerning access valves and ports and their applications are true or false.
13. Select whether statements concerning pressure controls and their applications are true or false.

Objective Sheet

14. Identify components of a mechanical refrigeration system with accessories and identify conditions in different parts of the system. (Assignment Sheet 1)

15. Select functions for refrigeration system accessories. (Assignment Sheet 2)

16. Select operating positions for service valves. (Assignment Sheet 3)

17. Find and identify refrigeration system accessories. (Job Sheet 1)

Information Sheet

Objective 1

Terms and definitions

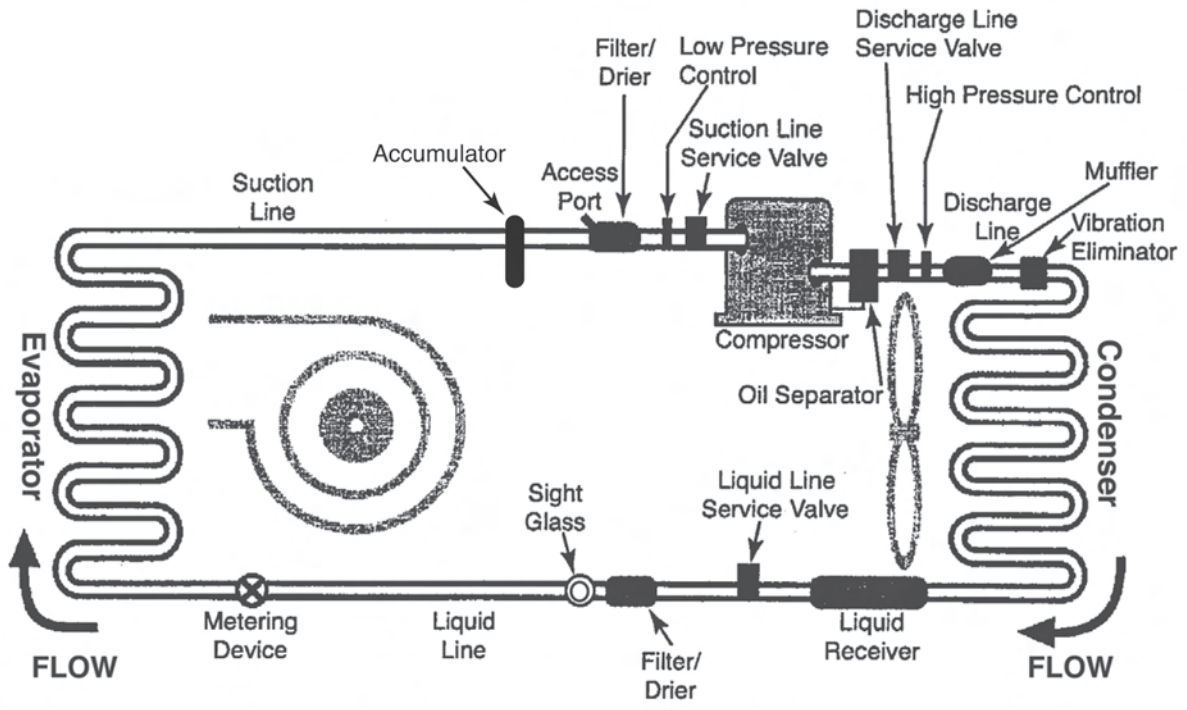
✔ **Note:** Please refer to "Key terms" for definitions.

a. Absorption
b. Adsorption
c. Chemical breakdown
d. Desiccant
e. Moisture
f. Particulate matter
g. ppm (parts per million)
h. Sludge

Objective 2

Refrigeration system accessories and their locations

Figure 1



a. **Accumulator**—A storage tank placed in the suction line to collect any liquid refrigerant that may remain in the evaporator discharge and prevent it from flowing on to the compressor until it has been turned into vapor

b. **Liquid receiver**—A storage tank placed in the liquid line at the outlet of the condenser to collect and store refrigerant when the total charge is not needed; normally allows only liquid to proceed to the metering device

c. **Oil separator**—Placed in the discharge line right after the compressor to catch oil traveling with the refrigerant and return it to the compressor

d. **Muffler**—A device that resembles a filter-drier placed in the discharge line to muffle the noise being transmitted by the compressor

e. **Vibration eliminators**—Shock absorbers installed in the discharge line, suction line or occasionally in the liquid line to prevent transmission of vibration which can cause lines to break or make irritating sounds

f. **Filter-drier**—Devices to trap moisture and other contaminants in a refrigeration system; placed in either the liquid line or suction line

g. **Sight Glass**—Located in the liquid line to indicate the presence of liquid refrigerant and sometimes also the presence of moisture (water or water vapor) in the refrigerant

h. **Service valves**—Located at various points in the system, including the liquid line, suction line and liquid line, to provide servicing of the system, may or may not include an access port; can be used to affect the operation of the system

i. **Access ports**—Located at various points in the system to allow access for monitoring pressures and addition or removal of refrigerant; can not be used to affect the operation of the system

j. **Shut-off valves**—Located at strategic places in the system to permit isolation of single components or selected sections of the system for service or repair

k. **Pressure controls**—Valves or switches that react to pressure are placed at various points in the system to monitor the pressure and control the operation of the system or to react to unsafe operation by shutting the system down

Objective 3

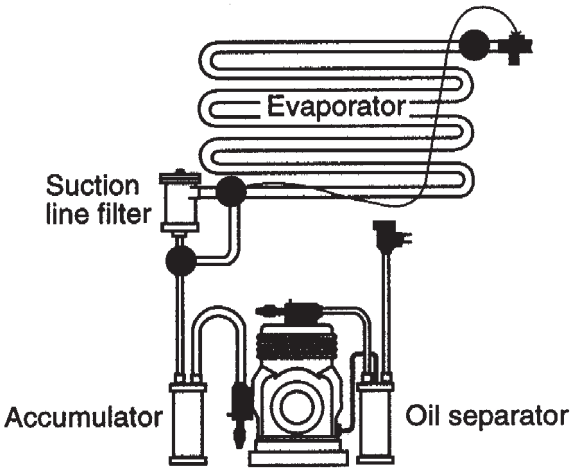
Suction line accumulators and their functions

a. In ideal situations, no liquid comes out of the evaporator, but in reality, there are times when all of the refrigerant is not vaporized and liquid refrigerant is ejected from the evaporator.

b. Since a compressor is designed to compress only vapor, liquid refrigerant can damage compressor reed valves, pistons, rods, and crank shafts.

c. An accumulator is installed in the suction line so that it can accumulate any liquid in the suction line, vaporize it, and send it on to the compressor.

Figure 2



Courtesy Henry Valve Company

d. The accumulator may also store any refrigerant not in use in the system and meter it back in appropriate quantities to the compressor.

e. Although horizontal accumulators are in use, vertical accumulators are the most common, and they are usually sized with a holding capacity up to 50 percent of the system charge, but small enough not to add excessive pressure drop to the system.

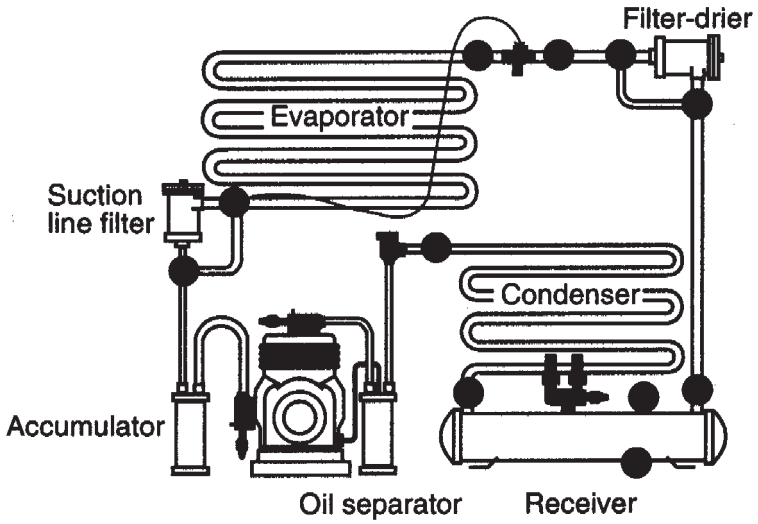
Objective 4

Liquid receivers and their functions

a. The amount of refrigerant charge is critical to many refrigeration systems; especially in smaller systems like domestic refrigerators or air conditioning systems where the load does not vary dramatically, the amount of refrigerant charge needs to be exact or very close to it.

b. In some systems, total refrigerant demand may vary considerably with load conditions and a liquid receiver is used to store refrigerant which is not needed under light load conditions.

Figure 3



Courtesy Henry Valve Company

c. The liquid refrigerant in the receiver traps any vapor leaving the condenser and therefore allows only subcooled liquid to feed the metering device making the system more efficient.

d. The liquid receiver is also used as a place to receive or store the bulk of the refrigerant during a “pump down” for servicing; when refrigerant is pumped out of other parts of the system into the condenser and receiver

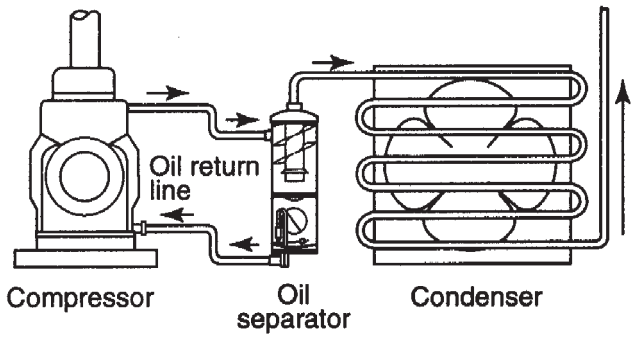
Objective 5

Oil separators and their functions

a. Some oil will almost always leave the compressor crank case and be discharged out of the compressor along with refrigerant.

b. The main function of an oil separator is to separate the oil from the refrigerant and return it to the compressor crankcase before it can enter other components of the system.

Figure 4

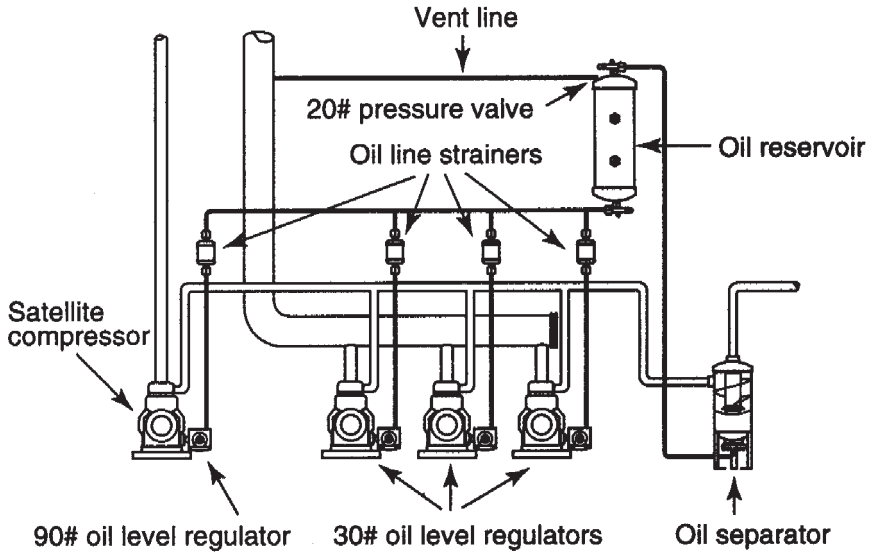


Courtesy Henry Valve Company

c. Oil separators are not in common use on small systems, but they are frequent components of low temperature refrigeration units and larger air conditioning systems.

d. On systems large enough to demand sophisticated oil control systems, an oil separator may be used in conjunction with an oil reservoir and oil level regulators.

Figure 5



Courtesy Henry Valve Company

Objective 6

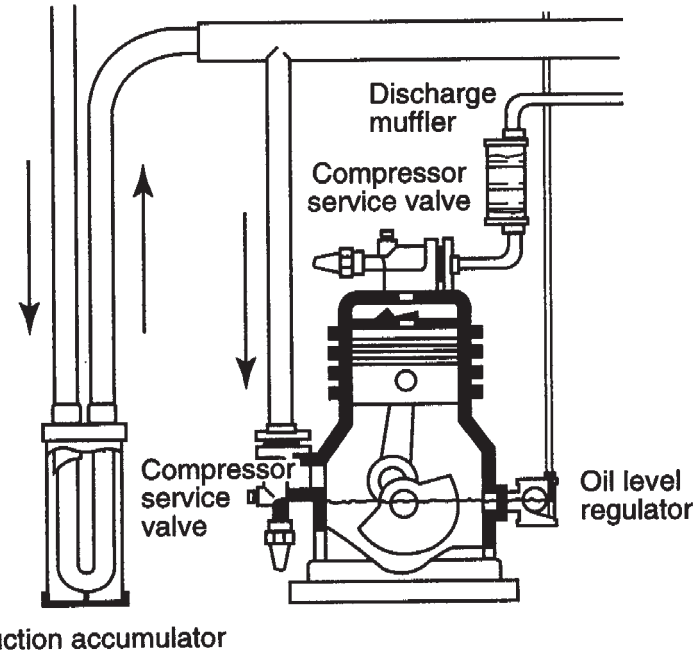
Noise and vibration control with large compressors

a. The larger compressors in larger refrigeration systems pose special problems with noise which can be loud enough to discomfort people, and vibration which can be strong enough to threaten system components.

b. To “dampen” or control noise, larger systems have mufflers installed right after the compressor in the discharge line.

c. Most mufflers route compressor discharge into lines that change it directionally as it passes through sound-deadening baffles.

Figure 6

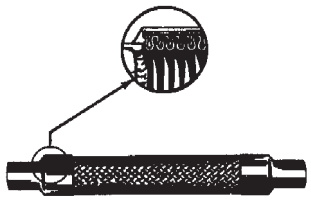


Courtesy Henry Valve Company

d. To minimize vibration, larger systems have a vibration eliminator installed in the discharge line parallel to the crankshaft of the compressor and sometimes in the suction line.

e. A vibration eliminator is designed to absorb and distribute vibration shock along a length of wafer-like baffles; the vibration eliminator also helps muffle sound from a compressor.

Figure 7



Objective 7

Filter-driers and their applications

Key terms:

- **Absorption**—The capacity of one substance to draw another substance into it like a sponge sucks up water
- **Adsorption**—The tendency of gases or liquids to adhere in thin layers to solids with which they come in contact
- **Chemical breakdown**—The general disintegration of oil and refrigerant in a system brought on by moisture, dirt, and air usually in the presence of high operating temperatures; when the oil breaks down it forms sludge and acid
- **Desiccant**—A drying agent used to absorb water and moisture
- **Moisture**—Water in liquid or vapor form
- **Particulate matter**—The very fine particles of scale, rust, metal, and solids in sludge that develop from extended system operation and especially from overheating
- **Sludge**—The dark, heavy, viscous matter that forms when oil breaks down into organic acid and combines with carbons, metals, and other particulates in the system

a. New refrigerant should always be clean and dry but when systems are not kept clean or when compressors fail, chemical breakdown occurs and extra clean up measures must be taken.

b. Filters and filter-driers are used to insure that only clean, dry refrigerant is circulated through a refrigeration system.

c. Filters contain only a screen to catch particulate contaminants in liquid or vapor refrigerant as it passes through it.

d. Filter-driers, as the name implies, perform the dual roles of filtering contaminants and drying out moisture from a system.

e. To accomplish their purposes, filter-driers contain a desiccant which absorbs moisture that passes through it, and other material that acts as a magnet to adsorb particulate contaminants that pass over it.

f. A filter-drier is usually placed in the liquid line and can be installed with flare nuts or sweated in.

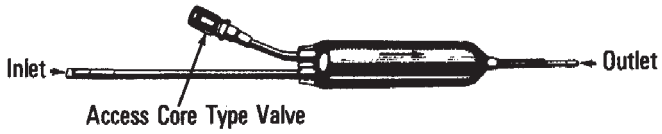
Figure 8

Flare

Sweat

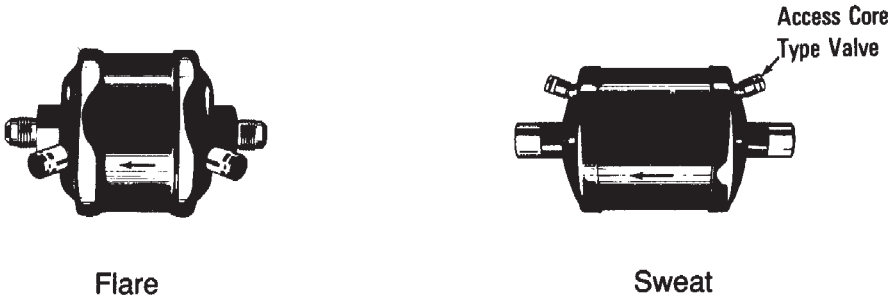
g. Filter-driers designed especially for capillary tube metering devices are sweated or brazed into the liquid line where it attaches to the capillary tube.

Figure 9



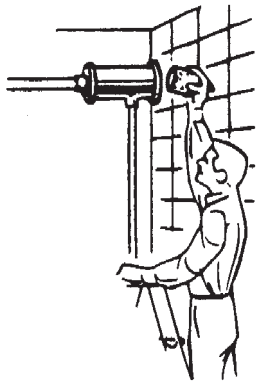
h. Filter-driers are directionally oriented and should be installed so that the marking arrow on the case points in the direction of flow, or the “in” “out” ends of the filter-drier are properly oriented.

Figure 10



i. Some filter-driers have replaceable cores so that the filtering element can be changed as specified by the manufacturer or as system operation demands.

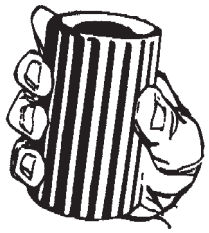
Figure 11



j. Filters are recommended to be permanently installed on the suction line just before the compressor or prior to system start-up and on the suction line of a system that has been cleaned up after a compressor burnout.

k. Replaceable filters for recycling machines require cores with high moisture absorption and acid removal capacities; this increased capacity is achieved with special desiccant materials.

Figure 12



Courtesy Henry Valve Company

Objective 8

Monitoring moisture and liquid refrigerant in a system

Key term:

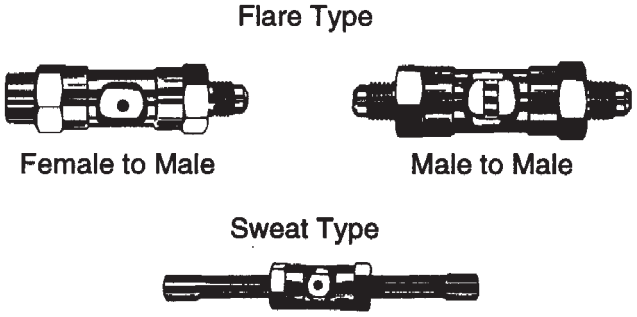
- **ppm (parts per million)**—The addition of 1 pound of a substance to 999,999 pounds of water so that the dissolved substance and water together weigh : a million pounds

a. Since efficient continuing operation of a refrigeration system depends upon only clean, dry refrigerant and oil circulating through the system the condition of the refrigerant must be monitored.

b. Since we can not see through the walls of the components or into the copper tubing, sight glasses are used to take a peek at the refrigerant.

c. Sight glasses act as liquid indicators which monitor the state of the refrigerant; telling the technician if there is liquid only, vapor only or a liquid vapor mix.

Figure 13



d. If the technician observes bubbles in the sight glass installed in the liquid line this indicates that both liquid and vapor are present.

e. A technician can use the presence or absence of bubbles to determine how a system with an expansion valve is operating since pure liquid is desirable in the liquid line.

f. When a moisture-indicating chemical is built into the sight glass it can also alert the technician if moisture is present.

g. The safe moisture level varies with the refrigerant, and is expressed in parts per million and varies with the temperature.

h. Sight glasses which monitor both liquid charge and moisture content provide a color-coded scale for visual evaluation.

i. Follow manufacturer's guidelines for installing and reading a sight glass; a typical color-coded scale is presented in the following graphic.

Figure 14

MOISTURE CONTENT PPM

See All Shows	Liquid Line Temp.	Refrigerants 11 & 12			Refrigerant 22			Refrigerants 502, 113 & 114			Refrigerant 500		
		75°	100°	125°	75°	100°	125°	75°	100°	125°	75°	100°	125°
Green DRY		Below 5	Below **10**	Below 20	Below 30	Below **45**	Below 60	Below 10	Below **20**	Below 30	Below 40	Below **60**	Below 100
Chartreuse CAUTION		5-15	**10-30**	20-50	30-90	**45-130**	60-180	10-45	**20-65**	30-110	40-90	**60-150**	100-230
Yellow WET		Above 15	Above **30**	Above 50	Above 90	Above **130**	Above 180	Above 45	Above **65**	Above 110	Above 90	Above **150**	Above 230

BOLD figures are for the average design conditions of refrigerant liquid lines operating at 100°F. Since the actual temperature is not critical, a satisfactory estimate can be made by comparing it to body temperature. If it feels cool to the touch, use 75°F., whereas if it feels warm, use 125°F. column figures.
The See-All calibration information given above is based on detailed experimental data for Refrigerants 12, 22, 500, 502, and 113. The calibration information on other refrigerants and solvents was obtained from a comparison of their properties with 12, 22, 500, 502, and 113. For the less common liquids the following moisture calibration is suggested.

Refrigerant 21 ..... use ..... "22" calibration
Refrigerant 30 ..... use ..... "22" calibration
Trichloroethylene ..... use ..... "22" calibration
Perchloroethylene ..... use ..... "113" calibration
Ammonia ..... See-All Not Suitable

FOR AIR — Tests on air show that the See-All changes color in the range of **0.5% to 2.0% R.H.** In ordinary air lines this means that the See-All will change color at dew points in the range of minus 40° to minus 60°F.

j. The moisture-detecting element in a sight glass may fail because of exposure to excess moisture or acid and must be replaced or disregarded.

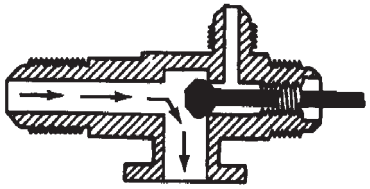
Objective 9

Service valves, their operating positions and functions

a. Service valves are usually three way stem type valves and thus have no off or on position but have three possible positions; backseated, cracked and frontseated.

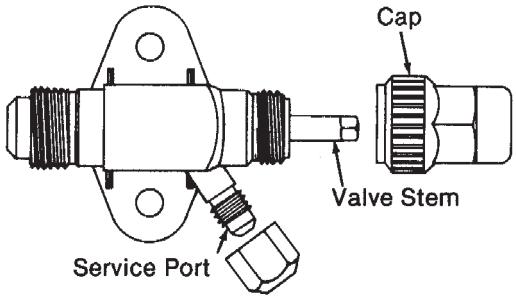
b. **Backseated**—A service valve position with the stem turned counterclockwise all the way out, the normal operating position of a service valve so that liquid or vapor refrigerant will continue to pass through the valve but the access port is blocked

Figure 15



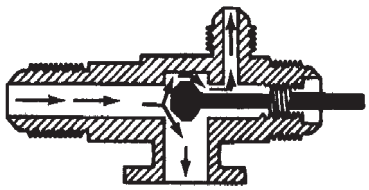
c. When a service valve is backseated and the system is operating normally, the cap nut on the service port can be safely removed so the center hose from the manifold gauge set can be connected to the access port.

Figure 16



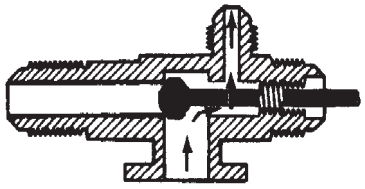
d. **Cracked**—A service valve with the stem turned clockwise a couple of turns to permit vapor or liquid refrigerant to continue to pass through the valve but also is open to the access port so pressures can be monitored or refrigerant added or removed.

Figure 17



e. **Frontseated**—A service valve position with the stem turned clockwise all the way in so that it shuts off the flow of refrigerant through the valve, but the access port is open to the component so that refrigerant can be monitored, added or removed.

Figure 18



Objective 10

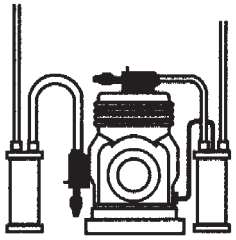
Service valves and their applications

a. A suction line service valve is usually permanently installed on the compressor and the suction line is connected to it.

b. A discharge line service valve is usually permanently installed on the compressor and the discharge line is connected to it.

Figure 19

Discharge line service valve



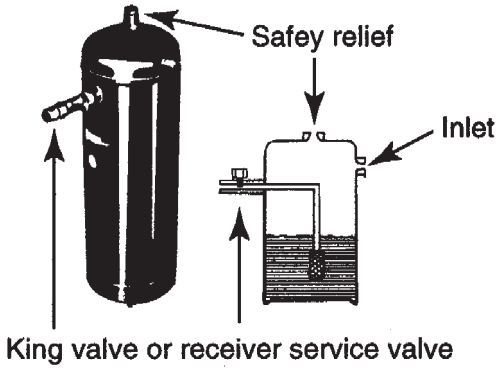
Suction line service valve

Courtesy Henry Valve Company

c. A service valve is usually permanently installed on the liquid receiver on the outlet side of the receiver and the liquid line is connected to it.

d. The service valve after the receiver is commonly called a “king valve” because it can be closed to permit pump down of the system and trap the refrigerant in the receiver and condenser, and in that sense, it can rule the system.

Figure 20



e. Service valves without an access port are only two way valves and are called shut-off valves.

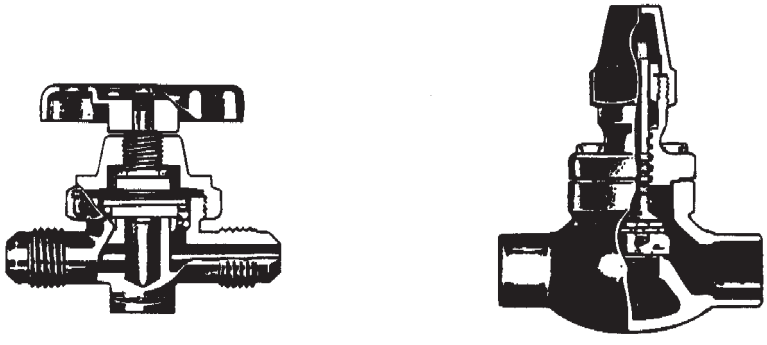
f. A shut-off valve is sometimes installed on the liquid receiver on the inlet side of the receiver so it can be used with the liquid receiver service valve or king valve to isolate the refrigerant in a system.

Objective 11

Shut-off valves and their applications

a. Shut-off valves are stem-type valves that may be controlled with a ratchet wrench or hand operated.

Figure 21



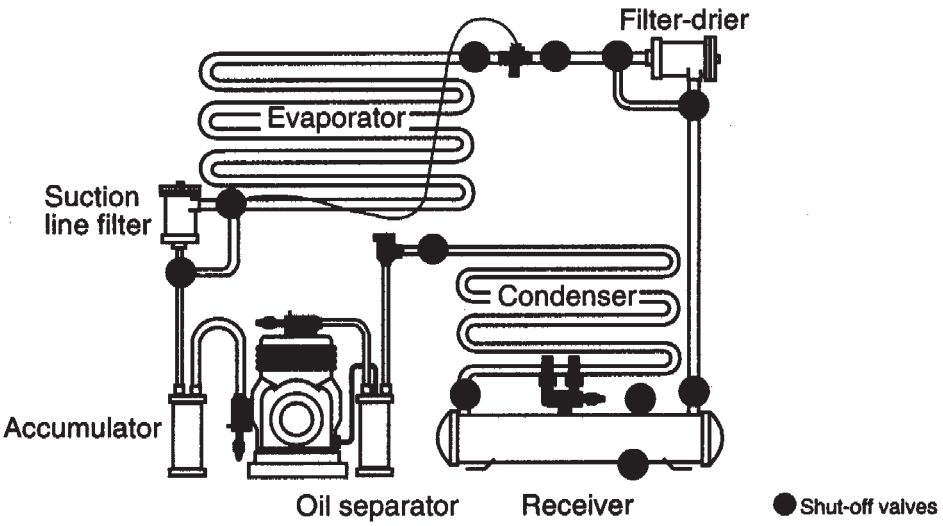
Courtesy Henry Valve Company

b. Shut-off valves are located at strategic places in a refrigeration system to permit the isolation of single components or selected sections of the system for monitoring, service, or repair.

c. Shut-off valves help eliminate the need for accessing a system at a point that might permit refrigerant to be expelled into the atmosphere or where air might enter into a system.

✔ **Note:** The following Henry Valve Company graphic demonstrates the many places a shut-off valve would benefit component and system service in a typical system.

Figure 22



Courtesy Henry Valve Company

Objective 12

Access valves and ports and their applications

a. Many small systems do not have full service valves but only some method of access, or entry to the system.

b. Access valves or ports cannot affect system operation but only allow monitoring of pressures and addition or removal of refrigerant.

c. A special valve adaptor kit is available for those refrigerators and other small appliances which have fittings for removable access valves which can be attached and then removed when the service is completed.

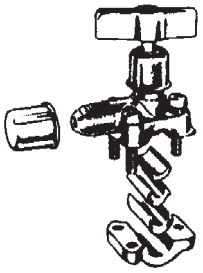
d. On equipment that has neither valves nor provision for valves; a valve must be attached.

e. A process tube adaptor kit can be used on equipment that has a process tube, a small tube left sticking out of a component which has been pinched off, but the refrigerant must first be removed by some other means.

f. Saddle valves or piercing valves can be mounted on a process tube or on one of the refrigerant lines to gain access to the system.

g. Saddle valves get their name from the way they saddle the refrigerant line and then are brazed or clamped into place so a sharp steel pin can be screwed into the line to puncture it.

Figure 23



h. Saddle valves have a service port with a cap nut to protect the port until the valve needs to be accessed.

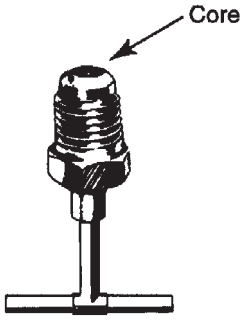
Figure 24

i. Clamp on saddle valves should always be considered temporary because, in time, they will leak, and that is why they should always be eliminated or replaced with a brazed in valve after service is complete.

j. Saddle valves may open and close with a small wrench like an allen wrench, or may be core type.

k. Core type valves or Schrader valves have a valve core just like the valve core on an automobile tube or tire; when the core is depressed, pressure can pass through the valve, and when the core is released, the valve is closed.

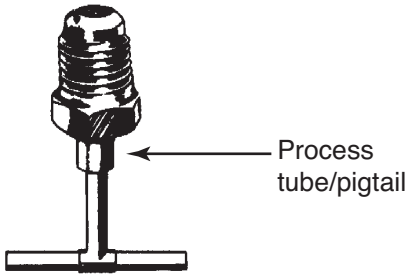
Figure 25



l. Access ports on service valves may be core type or the service valve may be a two way service valve with an auxiliary core type access port that cannot be shut off by the service valve operation.

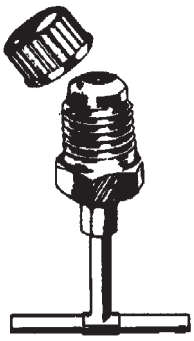
m. Schrader valves can be permanently brazed into a line to provide access at points where access valves were not installed by the manufacturer or installed in a process tube or pig tail on one of the components.

Figure 26



n. Schrader valves have cap nuts to protect them until the valve needs to be accessed.

Figure 27



Objective 13

Pressure controls and their applications

a. Maintaining desired pressures in the various sections of a refrigeration system is essential for proper operation of the system.

b. Pressure controls are electrical or mechanical controls that react to pressure changes and are used to monitor the pressure and control the operation of the system or to react to unsafe operation by shutting components or the system down.

c. High and low pressure motor control switches turn compressors or fan motors off and on to maintain desired pressures in the system.

d. Pressure motor control switches are used on larger air conditioning systems and many commercial refrigeration systems.

e. Motor safety controls monitor pressures and turn motors off when pressures get above or below safe operating limits.

f. Motor safety controls may react to high pressure, low pressure or oil pressure.

g. Motor safety controls are essential to almost all refrigeration systems.

h. Pressure control valves are designed to maintain desired pressure conditions in a component or portion of the system by restricting refrigerant flow or diverting refrigerant flow to a different part of the system.

i. Pressure control valves are frequently used on larger air conditioning systems and on commercial refrigeration systems.