

dicating whether or not a system has excessive moisture in it. They are valuable additions to the system as a positive indication of when the drier cartridge should be replaced.

Strainers

Strainers must be used in all refrigerant systems, in both the liquid and suction lines. Their function is to protect all automatic valves and the compressor from foreign material in the system, such as pipe and welding scale, rust, metal chips, etc.

The strainer should always be mounted in a horizontal line with the flanged end down so that the screen can be replaced without loose particles falling into the system.

The installation of a liquid line strainer before each automatic valve is recommended to prevent particles from lodging

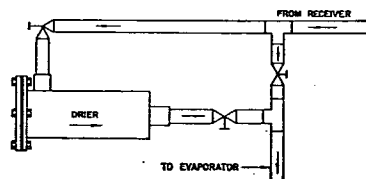


Fig. 42 Drier with Piping Connections

on the valve seats. Where multiple expansion valves with internal strainers are used at one location, a single main liquid line strainer will be sufficient to protect all of these. The liquid line strainer can be located anywhere in the line between the condenser (or receiver) and the automatic valves, preferably near the valves for maximum protection.

Refrigeration compressors are usually equipped with a built-in suction strainer which is adequate for the usual system with copper piping. Very often the compressor is shipped with a felt sock, or other temporary liner, in the suction strainer. This sock is effective in straining out finer particles than is possible with the standard suction screen and is left in for the first 50 hr of operation. At the end of that time it should be removed and inspected. If it has collected foreign material it should be cleaned and replaced for another 50 hr operation. This procedure should be repeated until it shows clean, at which time it should be removed permanently. The sock should not be forgotten and left in permanently because it causes a substantial pressure drop.

Care should be taken to pipe the suction line at the compressor so that the built-in strainer is accessible for servicing.

Both the liquid and suction line strainers should be adequately sized to insure adequate foreign material storage capacity without excessive pressure drop.

In steel piping systems an external suction line strainer is recommended in addition to the compressor strainer.

Liquid Indicators

Every refrigeration system should have a means of checking for sufficient refrigerant charge. The common devices used are liquid line sight glass, liquid level test cock on condenser or receiver and an external gage glass with equalizing connections and shut-off valves.

The liquid line sight glass is one of the most convenient to install and use. A properly installed sight glass will show bubbling when there is insufficient charge and a solid clear glass when there is sufficient charge.

The preferred location for checking sufficient refrigerant charge in the system is in the liquid line as close as possible to the receiver outlet, or condenser outlet if no receiver is used. The sight glass is best installed in a vertical section of the line a sufficient distance downstream from any valve so that the resulting disturbance does not appear in the glass. If it is installed too far away from the receiver, there may be sufficient pressure drop in the line to cause flashing and bubbles in the glass even though there is sufficient charge for a liquid seal at the receiver outlet. It often happens, with sight glasses installed near the evaporator, that no amount of overcharging of the system will give a solid liquid condition at the sight glass, because of pressure drop in the liquid line or lift. Subcooling is required here.

It may also be desirable to have an additional sight glass just before the solenoid valve near the evaporator, to check on the condition of the refrigerant at this point.

Sight glasses should be installed full size in the main liquid line, not in a bypass line that parallels the main line.

A sight glass with double ports and seal caps is preferable. The double ports allow a light to be put behind one port so that the state of the refrigerant is easily seen. The seal caps serve as an added protection against leakage since they are removed only when checking the refrigerant.

Moisture indicators are now appearing on the market large enough to be installed directly in the liquid line, in most cases, thus serving the dual purpose of liquid line sight glass and moisture indicator.

Many condensers and receivers are equipped with liquid level test cocks or connections for these devices, right on the shell as indicated in Fig. 43. The test cock is located at a height in the shell just below where the minimum operating liquid level should be. Opening of this cock while the system is

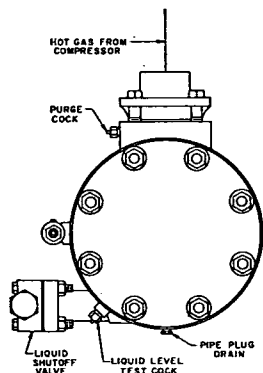


Fig. 43 Condenser with Liquid Level Test and Purge Cocks

in operation will show a jet of liquid refrigerant if the system has sufficient charge, but only gas if there is an insufficient charge. If a liquid level test cock is used, a sight glass in the liquid line leaving the condenser or receiver is unnecessary although it may be installed for convenience.

Refrigerant Charging Connection

The two usual methods of charging the refrigeration system are:

1. Charging into the liquid line between the receiver shut-off valve and the expansion valve as shown in Fig. 44. The advantages of this method are: (a) dumping liquid into the compressor is prevented, (b) the system can be charged rapidly since the refrigerant is charged as a liquid and does not have to be evaporated from the drum, and (c) the charging connection is convenient to the liquid test cock or liquid line sight glass. To prevent the impurities and moisture in the drum being drawn into the system, the practice of charging through a filter and dehydrator should be adopted.
2. Charging into the suction line. Except for very small systems, this method is not practical because of the time required to evaporate the refrigerant from the drum and because of the danger of dumping raw liquid into the compressor.

HEAD PRESSURE CONTROL FOR REFRIGERANT CONDENSERS

In applying refrigerant condensers, it is well to take advantage of lower than design condensing temperatures whenever possible to obtain more refrigeration capacity from the system, lower brake hp requirements per ton of refrigeration, and lower compressor discharge temperatures.

At the same time, it is often necessary to take precautions that the condensing pressure does not drop too low during periods of low water or outside air temperatures. This is particularly true for applications that have high internal or process loads throughout the year, and also systems having compressor capacity control.

The principal problem arising from abnormally low condensing pressures is the reduction of the pressure difference available across the expansion valve to the point where it is unable to feed sufficient refrigerant to the evaporator to handle the cooling load.

Liquid feed devices are rated in accordance with the pressure difference across the port. A valve selected at a pressure difference of 60 lb, the standard rating point for Refrigerant 12 valves, would have substantially less capacity if the available pressure difference were only 20 lb.

Water-Cooled Condensers

With water-cooled condensers, head pressure controls are used for the dual purpose of maintaining the condensing pressure and conserving water. On cooling tower applications,

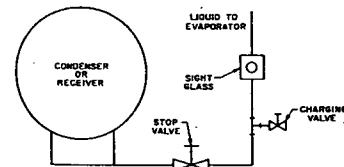


Fig. 44 Sight Glass and Charging Valve Locations

they are used only where it is necessary to maintain condensing temperatures.

Condenser Water Regulating Valves

The control commonly used with water-cooled condensers is the condenser water regulating valve. This valve is usually located in the supply water line to the condenser. It is a throttling type valve and responds to a difference between condensing pressure and a pre-determined shut-off pressure. The higher this difference, the more the valve opens up, and vice versa. A pilot connection to the top of the condenser transmits condensing pressure to the valve which assumes an opening position according to this pressure.

The shut-off pressure of the valve must be set slightly higher than the highest refrigerant pressure expected in the condenser when the system is not in operation. This is to make sure the valve will close and not pass water during off cycles. This pressure will be slightly higher than the saturation pressure of the refrigerant at the highest ambient temperature expected around the condenser.

Condenser water regulating valves are usually sized to pass the design quantity of water at about a 25 to 30 lb difference between design condensing pressure and valve shut-off pressure.

Water Bypass

In cooling tower applications a simple bypass can also be used to maintain condensing temperature, employing a manual valve or an automatic valve responsive to head pressure change. The valve can be either the two-way or three-way type.

Evaporative Condensers

With evaporative condensers, various methods are employed for condensing pressure control: (1) cycling spray pump motor, (2) cycling both fan and spray pump motors, (3) throttling spray water, (4) air bypassing duct and dampers, and (5) air throttling dampers, either on inlet or discharge.

The water pump cycling method employs a pressure control at the gas inlet which starts and stops the pump in response to changes in the head pressure. As the head pressure increases, the pump starts and sprays water over the condenser coils. As the head pressure drops, the pump stops and the unit becomes an air-cooled condenser.

The main disadvantage of this system is that it is difficult to maintain a constant head pressure for as soon as the pump stops the pressure goes up and the pump starts again. This short cycling occurs because the coil, not having an extended surface, has insufficient capacity when operating as an air-cooled condenser. Short cycling results in excessive deposits of mineral and scale on the water side of the tubes and also decreases the life of the water pump and its motor and starter. An additional disadvantage is that the sprayed water may freeze on the coil tubes when the inlet air temperature is below 20 F.

One method of regulating head pressure is to control the amount of air admitted by the damper (Fig. 45).

The modulating head pressure control located on the incoming hot gas line operates the damper motor at the inlet air duct. As the head pressure begins to rise, the damper opens and allows increased air flow over the condenser; as the head pressure falls, the pressure control causes the motor to close the damper restricting air flow over the condenser until the desired pressure is restored.