

full penetration weld is obtained. The weld should be made by a competent welder, using proper procedures such as the *Standard Procedure Specifications for Welding of Pipe, Fittings and Flanges*, prepared by the Mechanical Contractors Association of America.

Gasketed Joints

When using flanges, a $\frac{1}{16}$ in. fiber gasket should be used. Prior to tightening flange bolts to valves, controls, or to flange unions, the pipe to be connected should be in parallel alignment and the bolt holes should be in line. If flanges are used as a means of straightening pipe, they may put stress into adjacent valves, compressors, and controls and cause binding of the operating mechanism.

Flange bolts should be drawn up evenly when connecting flanges to prevent flange breakage.

Union Joints

For gage and pressure control lines and also for joints up to $\frac{3}{4}$ in., it is economical to use a steel ground joint union. When tightening this type of joint, the two pipes must be in parallel alignment. To be effective, the two parts of the union must match almost perfectly because sealing of the joint is due to a metal to metal contact.

PIPE LOCATION

Piping should be at least $7\frac{1}{2}$ ft above the floors if possible. Care must be exercised in the location of pipes in relation to other piping and structural members, especially when the lines are to be insulated. The distance between insulated pipe lines should be at least three times the thickness of the insulation for screwed fittings, and four times for flange fittings. Space between pipe and adjacent surfaces should be three-fourths these amounts.

Hangers should be provided close to the vertical risers to and from compressors to keep the piping weight off the compressor. Pipe hangers should be placed not more than 8 to 10 ft apart. Hangers should be placed within 2 ft of a change in direction of the piping. Hangers should be designed to bear on the outside of insulated lines. Usually sheet metal sleeves on the lower half of the insulation are sufficient to prevent deformation.

Piping to and from compressors and also to other plant components should be designed for flexibility so as to provide for expansion and contraction without stressing the equipment. Sufficient flange or union joints should be located in the piping so that components can be easily assembled at time of initial installation and also disassembled for servicing.

VALVES

Stop Valves

The location of stop valves is an important consideration in the plant design. It is considered good practice to locate stop valves in the inlet and outlet lines to all condensers, receivers, evaporators and long lengths of pipe to permit them to be isolated in case of leaks and to facilitate pumping out for repairs.

Stop valves should be installed with the valve stems horizontal or as nearly so as possible. When the valve stem is horizontal, there is less chance for dirt or scale to lodge on the valve seat or disk and cause it to leak, or for liquid or oil to pocket in the area below the seat. When opening a back seating valve, it should be kept one-half turn from the full open position to keep liquid from being trapped behind the seat.

Valves of $1\frac{1}{2}$ in. and smaller may have threaded connections. Valves $1\frac{1}{2}$ in. and larger should be flanged and supplied with welding type companion flanges.

Ammonia stop valves should have the following features:

1. Soft seating surfaces for positive shutoff.
2. Back seating to permit repacking the valve stem while in service.
3. Arranged so packing can be tightened easily.
4. Body to be a close-grained semi-steel casting.
5. Either globe or angle style.
6. Bolted bonnets above size 1 in., threaded bonnets for 1 in. and smaller.

Control Valves

Suction pressure regulators, solenoid valves, and thermal expansion valves should be flanged for easy assembling and removal. Valves $1\frac{1}{2}$ in. and larger should have welding companion flanges and valves $1\frac{1}{2}$ in. and smaller may have threaded companion flanges.

A strainer should be used in front of control valves to protect them from dirt.

Solenoid Valves

Solenoid valves should be located upright, protected from moisture, have flexible conduit connections, and have an electric light, wired in parallel, to indicate when the coil is energized. A manual opening stem is useful for emergencies.

Solenoid valves for high pressure liquid feed to evaporators should have soft seats for positive shutoff and have a properly adjusted valve downstream where expansion takes place, rather than in the solenoid port.

Solenoid valves for other applications, such as in suction lines, hot gas lines or gravity feed lines, should be designed for the pressure and temperature of the fluid flowing and allow for the pressure drop available.

Suction Pressure Regulators

Suction pressure regulators are used at temperature levels where a 2 psi drop through them will not hinder the performance of the system. They should be selected with a modulating port which has a good range from 10 to 100 percent of their design load.

A small solenoid valve used in conjunction with the back pressure regulator can adapt it to a suction stop valve for either temperature control or for use on automatic defrosting evaporators.

Manual opening stems are a necessity on suction pressure regulators.

Where an even product temperature is necessary, a compensated suction pressure regulator that senses product temperature is very useful. If air is used in the control of the regulator, it should be kept out of cold spaces to prevent freezing of entrained moisture.

OIL IN AMMONIA SYSTEMS

Oil does not mix with ammonia and being heavier than ammonia, will exist in liquid form underneath the ammonia in equipment from the condenser to the evaporators. Ammonia systems are not designed to return oil from the evaporators to the compressor as is the case with Refrigerants 12 and 22. Oil is best removed at the higher temperature locations. It can be removed easily at evaporator temperatures above 0 F. Below this temperature the combination of high oil viscosity and low pressure in the system makes the removal of oil somewhat difficult. Locating the oil receiver on this type of evaporator in a warm space may be beneficial.

Oil will tend to settle out in low spots of evaporator coils

Refrigerant Piping Systems for Ammonia

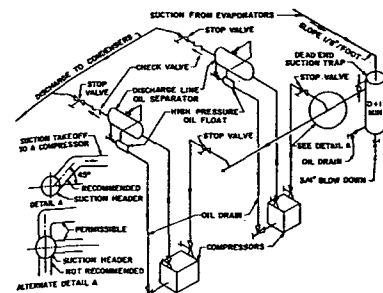


Fig. 1 Piping for Two Compressors in Parallel Operation

and will adversely affect the evaporator efficiency. Oil also has a tendency to settle in the liquid line strainers, valves, and controls, which sometimes upsets the performance of the evaporator and causes excessive liquid to be fed to the evaporator and subsequent liquid into the suction main.

Since the source of most of the oil in the system is the compressors, the best way to reduce the oil concentration in the system is to use oil separators in the discharge line and return oil directly to the compressor or into an oil receiver. (See Fig. 1.)

COMPRESSOR PIPING

Fig. 1 shows a typical piping arrangement of two compressors operating in parallel off the same suction main. Section mains should be laid out with the objective of returning only clean dry gas to the compressor. There is always the possibility of dirt and scale being carried along from the evaporators, especially where a new compressor is connected to an old system. This foreign material will collect on the bottom of a horizontal run of pipe and should be prevented from being drawn along with the suction gas to the compressor. If a suction trap or low-pressure receiver is used in the engine room, the suction main could be run directly from this piece of shell equipment and into the compressors. However, if the suction trap or low-pressure receiver is removed from the engine room, a dead end trap should be used in the compressor room. The dead end suction trap is constructed of pipe one size larger than the main suction line and eight pipe diameters in length. An oil drain and blowoff valve are provided to remove any scale or accumulated foreign material.

The suction takeoff to each individual compressor should be tangential to the side of the pipe and at a 45 deg angle as shown in the inset on Fig. 1. This type of arrangement has the advantage of preventing slugs of oil or liquid ammonia, that might be drawn through with the suction gas, from being taken directly into the compressor. Instead, they are trapped in the suction header where liquid is slowly boiled off and oil is periodically drained from the low point. Suction takeoffs can also be connected to the top of the header or to the side, as is shown in inset of Fig. 1, but should not be connected to the lower side.

The service valves on the compressor are opened and closed frequently and sometimes do not seat tight. Therefore, a stop valve is recommended in the suction takeoff to each compressor. This valve is used infrequently and will be a

positive shut-off in case it is necessary to open up the compressor.

The main suction line should slope toward the trap at $\frac{1}{4}$ in. per foot if possible.

Oil Separators

Oil separators are provided in the discharge line of each compressor. A high-pressure float valve drains all the oil from the back into the compressor crankcase. It is best to move the oil separator as far from the compressor as possible to take advantage of the cooling obtained by the extra length of pipe on the discharge gas before it enters the oil separator. This will reduce the specific volume of the ammonia vapor and make the oil separator more effective. The external float return valve, as shown, is highly preferable for automatic oil return.

The filled type of oil separator shown in Fig. 1 does not require any external cooling medium.

Fig. 2 shows a water-cooled oil separator and the necessary connections, both on the ammonia and water side. It is necessary to limit water flow through the separator, so that it does not condense any ammonia in the separator, from which it will be drained into the crankcase. A thermostatic type of water regulating valve is recommended with this discharge line oil separator.

Discharge Check Valves

Check valves are provided on the downstream side of each oil separator to minimize the flow of high pressure gas into a compressor not in operation.

If the engine room temperature is less than the condensing temperature, it is possible for gas to leak past the check valve and condense in the discharge line and oil separator. Liquid ammonia would drain into the compressor from the float under the oil separator when this occurs. Some positive method of equalizing between the discharge line and suction line is recommended for situations such as this and always when the compressors are located outside or in unheated spaces. The equalizing can be done automatically either by a $\frac{1}{4}$ in. normally open solenoid valve between the discharge line and suction line that is open when the compressor motor stops, or by a compressor oil pressure actuated valve that opens whenever the compressor stops. It can be accomplished manually by having a $\frac{1}{4}$ in. hand valve between the discharge and suction lines to be opened whenever the compressor stops.

The discharge line from each compressor should enter the discharge main at a 45 deg angle in the horizontal plane so that a smooth flow of gas is obtained.

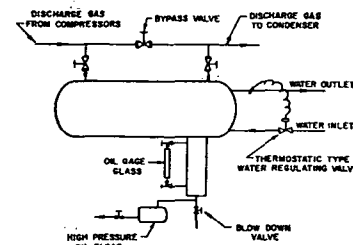


Fig. 2 Water-Cooled Oil Separator and Piping