expansion valve for passing enough extra liquid refrigerant to accomplish the desuperheating of the bypassed hot gas. The expansion valve bulb should be placed at least 5 ft downstream from the point of entrance of the bypass, and preferably further, to insure good mixing and best control.

Another variation of this figure would be the entrance of the hot gas bypass after the evaporator thermostatic expansion valve bulb, and adding another thermostatic expansion valve to supply liquid directly to the bypass line for desuperheating purposes (Diagram *D* of Fig. 49).

It is always important to install the hot gas bypass far enough back in the system to maintain sufficient gas velocities in suction risers, etc., to insure oil return at any evaporator loading.

Diagram *C* shows the most satisfactory of all hot gas bypass arrangements, although not the easiest to apply. Here the bypass is connected into the low side between the expansion valve and the entrance to the evaporator. This becomes difficult when using multiport distributors.

Solenoid valves should be used before the constant pressure bypass valve and before the thermal expansion valve used for liquid injection desuperheating, so that these devices cannot function until wanted.

The size of the hot gas bypass line is unimportant, since the pressure drop in the line can only be a small percentage of the pressure drop across the valve, no matter how small the line. For convenience, it may be the same size as the connections to the valve.

The size of the valve is very important. A control valve manufacturer should be contacted for sizing this valve, giving him the minimum compressor capacity which must be offset, refrigerant used, condensing pressure and suction pressure.

REFERENCES

[1] Sections 1 and 2, Refrigerant Piping (*Application Engineering Manual*, General Electric Co., July 1949).

[2] Section 25 (*Piping Application Data*, Carrier Air Conditioning Co.).

[3] Section B-10 (*Equipment Manual*, York Corp.—Subsidiary of Borg-Warner Corp., May 1, 1955).

[4] *Design and Installation Instructions*, Refrigerant Piping (I. B. 105-620-1, Westinghouse Electric Corp., September 1950).

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CHAPTER 71

REFRIGERANT PIPING SYSTEMS FOR AMMONIA

Piping Requirements; Pipe Joints; Pipe Location; Valves; Oil in Ammonia Systems; Compressor Piping; Piping Condenser; Evaporator Piping; Pipe Coils; Air Blower—Flooded Operation; Float Control; Suction Traps: Vertical Suction, Horizontal Suction; Pressurized Return; Liquid Ammonia Recirculation Systems; Compound Compression Systems; Cascade Systems

AMMONIA (Refrigerant 717) provides an economical medium for handling the refrigeration requirements in locations where a refrigerant leak will not cause discomfort to the occupants. Ammonia is a poisonous gas if inhaled in sufficient quantities and in lesser quantities is irritating to the eyes, nose and throat. In certain proportions ammonia and air form an explosive mixture. Therefore, it is extremely important that the ammonia equipment be installed with the interconnecting piping in such a way that parts of the system can be isolated for repair of leaks and component overhaul.

The importance of ammonia piping is sometimes overlooked due to stress on selection of major pieces of equipment and the fact that the mains represent a relatively small part of the total plant investment. Care should be exercised in the sizing of mains so that liberal flow is assured and that there will be no undue penalty either in capacity or horsepower caused by inadequate piping.

A great majority of service troubles are caused by lack of adequate precautions during erection and installation. It is of extreme importance that the installers should know the necessity of keeping the system internally clean.

Ammonia is a powerful solvent which readily removes from the inside of pipes, valves, fittings, etc., any dirt, scale, sand, or moisture which has remained in them during installation. These foreign substances are soon swept along with the suction gas to the compressor and are a distinct menace to the bearings, pistons, cylinder walls, valves, and the lubricating oil.

Moving parts are frequently scored when a compressor is run for the first time. Damage starts with minor scratches which increase progressively until they seriously affect the operation of the compressor, or render it unfit for further use.

If the system has been carefully and properly installed by excluding any and all foreign matter, the compressor will operate satisfactorily and give many years of trouble-free service.

In the fabrication of piping, it is well to provide a means for blowing out the piping before it is placed in service. This will aid in removal of the residual foreign material.

Discharge and liquid piping should be tested to 300 psig air pressure and suction and low side piping to 150 psig.

PIPING REQUIREMENTS

The following recommendations are offered as a guide to good practices in ammonia piping. Frequently there are codes or local ordinances governing ammonia mains; if so, they must be followed.

Recommended Material

Copper and copper bearing materials are normally attacked by ammonia and, therefore, are not used in ammonia piping systems. Iron and steel are suitable for ammonia gas and liquid. Therefore, the piping, fittings, and valves usually are manufactured from these materials.

The suggested pipe weight for ammonia work is as follows:

1. Any line 1 in. and smaller, to be extra heavy butt welded steel pipe (Schedule 80).
2. Liquid and discharge lines, 1¼ through 2 in., to be extra heavy butt welded steel pipe (Schedule 80).
3. Suction lines 1¼ through 2 in., may be full weight butt welded steel pipe (Schedule 40).
4. Lines 2½ in. and larger, may be full weight seamless steel pipe (Schedule 40).

Fittings

Couplings, elbows, and tees for threaded pipe should be for 2000 psig design pressure and be constructed of forged steel. Fittings for welded pipe should match the type of pipe used; i.e., full weight fittings for full weight pipe and extra heavy fittings for extra heavy pipe. For welded 1 in. and smaller pipe, socket-weld fittings should be used.

Flanges used in ammonia piping should be of tongue-and-groove design. Threaded flanges up through 1¼ in. may be oval 2-bolt type. Four-bolt square flanges should be used for sizes larger than 1¼ in. but they are available from ½ in. Threaded flanges should be round in lines above 4 in.

Welding flanges for low side piping may be 150 psig design pressure rating and for high side may be 300 psig.

PIPE JOINTS

Joints between lengths of pipe or between pipe and fittings should be threaded if the pipe size is 1¼ in. and smaller. Sizes of 1½ in. and larger should be welded. Sizes smaller than 1¼ in. may be welded where practicable.

Threaded Joints

For threaded joints the recommendation is as follows:

For ammonia piping use fresh smooth litharge and glycerine mixed to a thin paste. Use a fresh mixture for each joint or group of joints which are to be assembled simultaneously. The paste should be applied to the male thread. Enter the pipe 1½ to 2 threads and then apply the paste to the remaining threads before the joint is pulled tight. Do not apply a paste to the fitting threads because any excess will be rolled up ahead of the pipe end, and may subsequently break off and become loose pieces in the system.

When turning a fitting on by hand, turn it back and forth several times to work the paste well into the interstices of the threads. When the joint has been made tight, wipe off any excess paste on the inside where possible.

Welded Joints

Pipe should be cut and beveled prior to welding. Backup rings (chill rings) are recommended to keep slag and metallic particles from entering the pipe. Welding clamps are used to align the pipe and obtain a proper gap between pipe ends so a