

## Chapter – 17      Liquid Carry Over and Gas/Liquid Disengagement

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Refrigeration compressors are designed and constructed for gas compression duty only. It is detrimental to the compressor if refrigerant liquid is slug over to the compressor suction. Therefore, it is vital important that the refrigeration system is to be designed in such way to prevent the liquid carry over from the low side.

Liquid slug over to compressor suction might be due to poor design of the evaporator; or malfunction of control; or liquid trapped in the suction line.

Liquid carry over is not allowed for centrifugal and reciprocating compressors. Screw compressor is able to take very small flow of the liquid, as long as only if the flow is small and the flow is steady such as the oil/refrigerant liquid from oil return. To ensure the safe operation of the system, it is preferred that no liquid is presented in the suction even it is screw compressor.

The most effective way to prevent the liquid slug over to the compressor suction is to place a suction trap right before the compressor suction as shown in Figure 17-1.

The Suction Trap is also referred to as:

- Suction Drum.
- Suction Surge Drum.
- Suction Scrubber.
- Knockout Drum.
- Dead-end Trap.
- Suction Accumulator.

The suction scrubber, if used, it should be placed as close as possible to the compressor suction, to strip the liquid and oil out from the suction stream before it is entering into the compressor. Therefore, suction trap provided shall be large enough to accumulate the excess liquid from the low side.

Usually a suction trap should be installed if the evaporator is remote mounted or if no assurance that the evaporator is properly designed. No suction trap is required if the evaporator and the compressor are close coupled within the same engine room and the evaporator design is properly designed. Other conditions or applications that might require the use of suction trap are as the following:

- Multiple evaporators are used for the installation.
- Rapid changing refrigeration load condition.

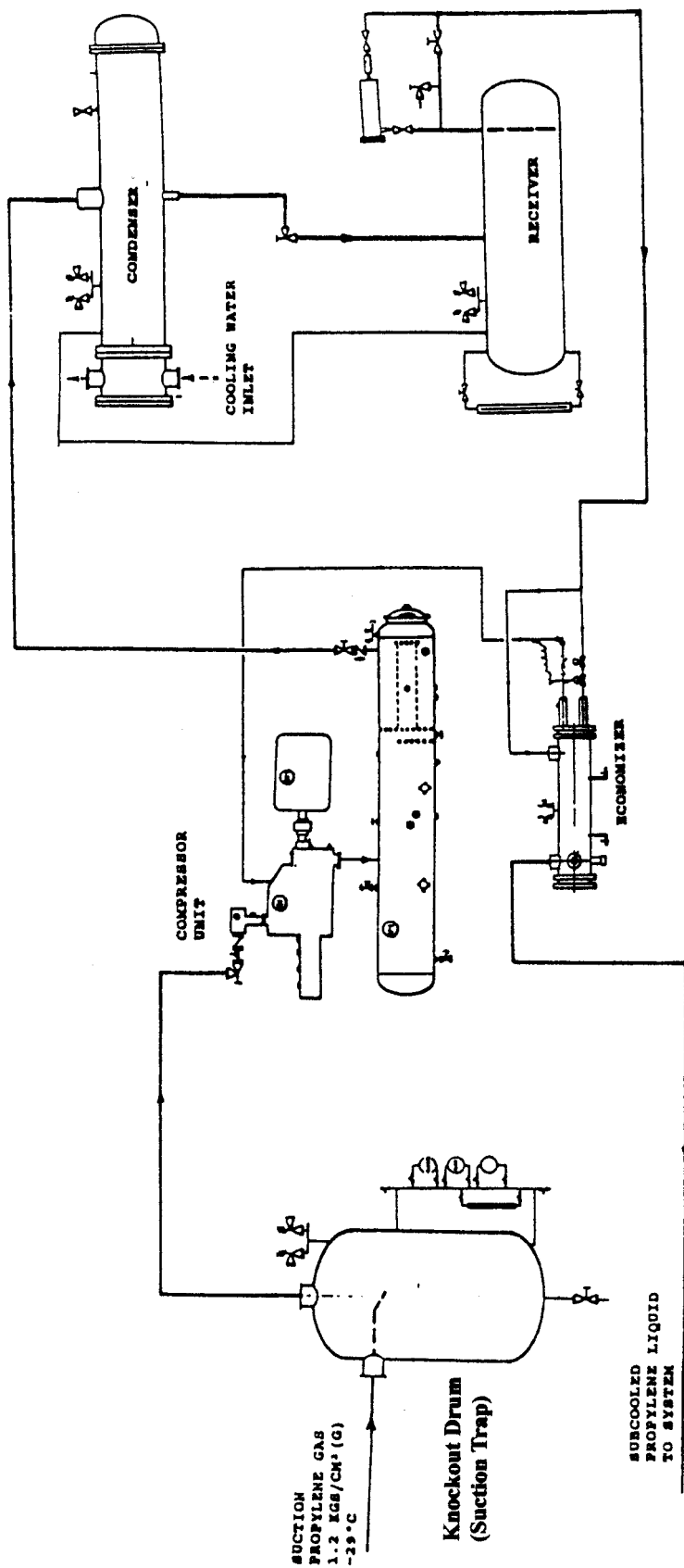


Figure 17-1 Suction Trap (Knockout Drum) Arrangement

- High range of cooling fluid.
- For central collection of liquid and oil.
- Quench or to desuperheating the high superheated suction gas.

The size of a suction trap is expressed in diameter by height of the vessel. It can be either vertical or horizontal design. In any cases, it must be sized large enough to provide the separation space for gas and liquid disengagement in the trap. The criteria of sizing the suction trap are as the following:

- 1.0 The cross section area of the suction trap should be large enough that the vertical refrigeration vapor travel velocity does not exceed the maximum allowable gravity separation velocity for the refrigerant used.
- 2.0 The height between the liquid level and the suction nozzle in the suction trap shall provide enough distance for vertical separation.
- 3.0 It shall be large enough to hold the accumulated liquid during operation.

The Figure 17-2 is the maximum allowable gravity separation vapor velocity for various commonly used refrigerants to prevent liquid carryover.

The separation velocity and travel distance are also applicable for the design of intermediate intercooler and flooded evaporator; enough separation space is to be provided to prevent liquid carryover from the intercooler or from the evaporator.

Some suction traps are equipped with moisture eliminator or demister to increase the separation efficiency. The suction trap size could be smaller if effective moisture eliminator is used.

Figure 17-3 is the typical suction trap for gravity separation. Normally, the suction connection is at the top of the suction trap. The alternate suction connection can be at the side of the suction trap if the engine room ceiling height is limited.

Figure 17-4 is the typical intermediate intercooler with a subcooling coil. The intercooler is with a demister (moisture eliminator); the inlet gas connection for the low stage compressor is at the upper portion of the intercooler, the perforated pipe is extended below the liquid level in the intercooler with a perforated plate to hold down the boiling and foaming of the refrigerant.

The common used accessories for the suction trap are as the following:

- Pressure safety relief valve.
- High liquid level alarm switch.
- High liquid level cutout switch.
- Liquid transfer switches.
- Liquid level sight glass and indicator.
- Liquid subcooling coil.
- Vaporize heater.
- Liquid drain valve or liquid transfer arrangement.
- Oil drain valve.

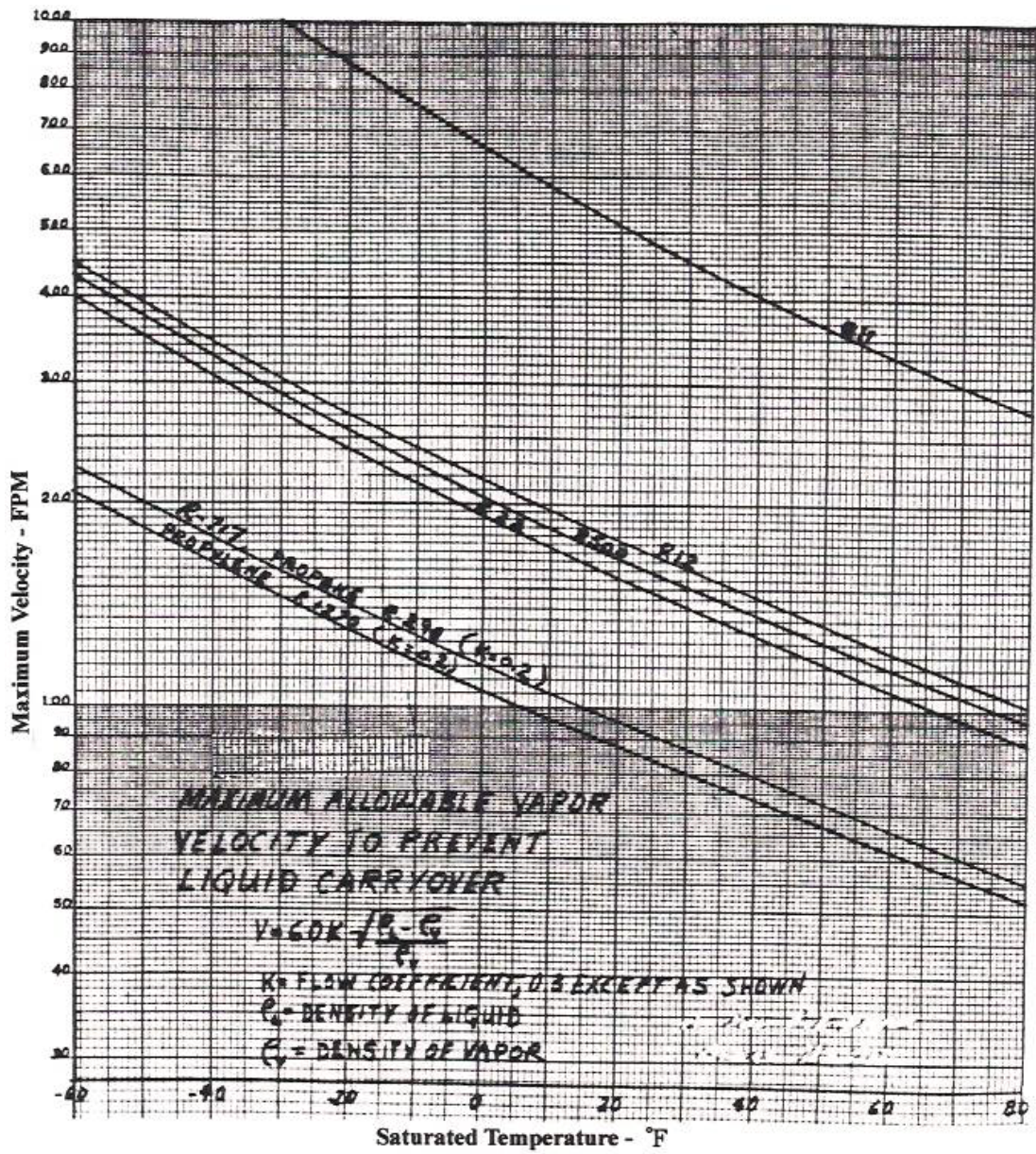


Figure 17-2 Maximum Gas & Liquid Separation Velocity

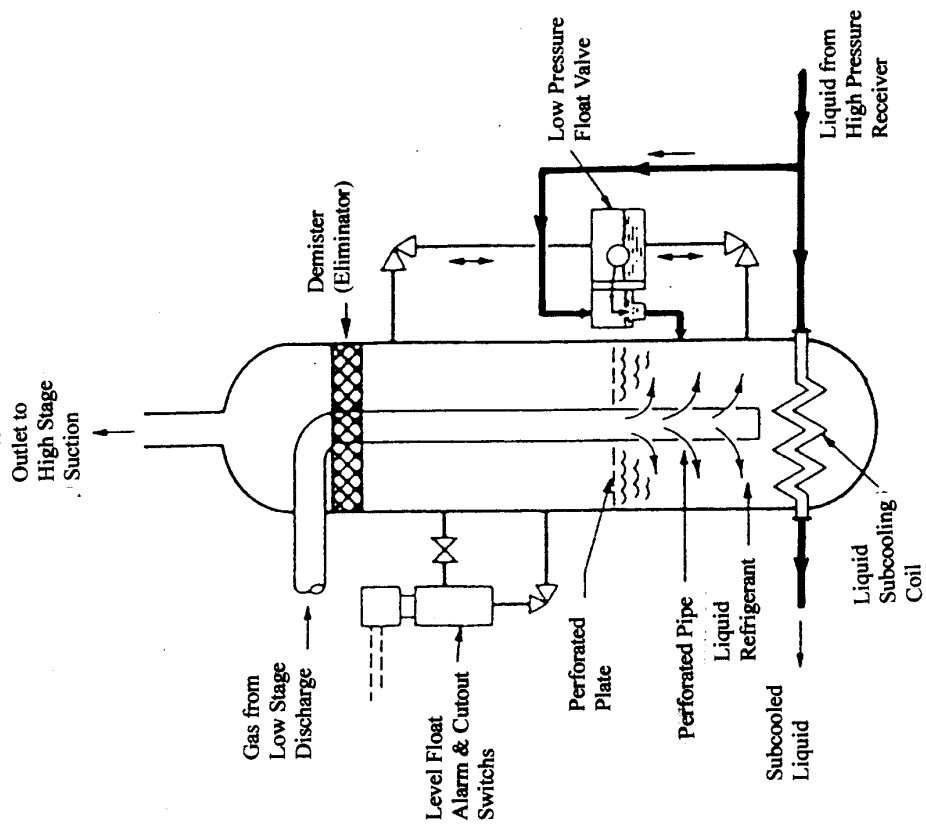


Figure 17-4 Typical Intercooler with Subcooling Coil

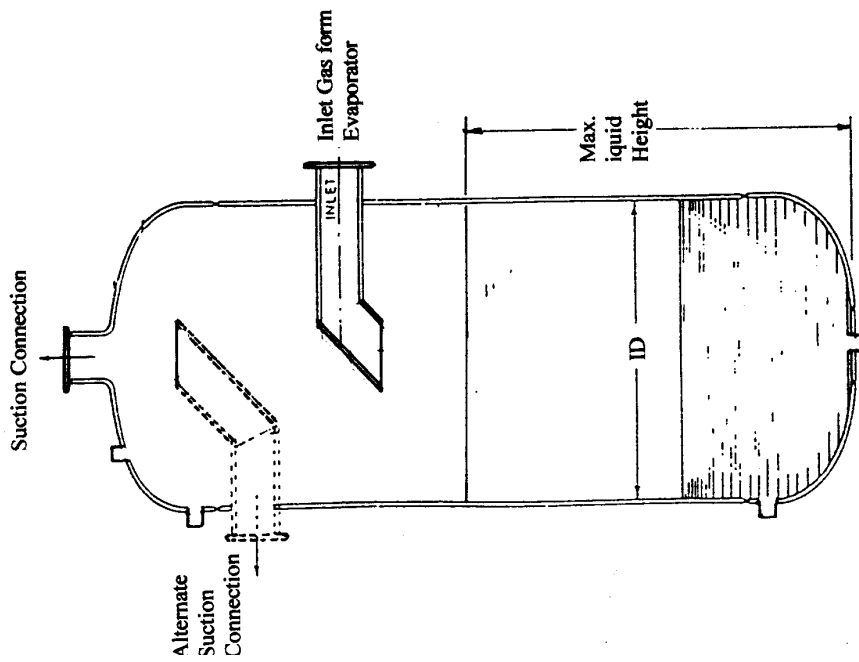


Figure 17-3 Typical Suction Scrubber