

(2) 325 tpd York Chlorine Liquefier Systems

The liquefier is a split bundle and serves as both the primary liquefier and the secondary liquefier. The total for each York system is 325 tons liquid Cl₂, with 272 tons liquid on the primary side and 53 tons of liquid chlorine on the secondary side of the heat exchanger. New in 1998 and installed in 2000. The information is listed below.

One Mycom R-23 liquefier system that serves our tertiary chiller. This unit is rated for 24 tons of liquid chlorine. Installed in 1994. The information is listed below.

A. Primary Liquefaction Units

The primaries consist of various individual subcomponents. These are: 1) the Evaporator uses Freon evaporation to condense the chlorine; 2) the compressor compresses the Freon gas generated in the evaporator; 3) the condenser uses river water to condense the Freon from the compressor; 4) the economizer flashes off Freon and returns vapor to the compressor in order to sub-cool the liquid Freon; 5) the purge units pulls non-condensables out of the Freon system and discharges to the atmosphere; 6) the chilled water chiller/economizer – uses Freon evaporation to chill the water for the chilled water system and it acts as a surge drum/economizer.

1. Evaporator (Chlorine Condenser)

The evaporator is a horizontal, double-pass, shell-and-tube heat exchanger. Chlorine is on the tube side and liquid Freon R-134A on the shell side. The primary liquefier is a shared bundle heat exchanger with the secondary liquefier. The primary side bundle consists of 958 seamless carbon steel (SA-179) tubes. The secondary side bundle consists of 210 tubes. The tubes are ¾” 12 BWG tubes with a length of 12’. The shell is carbon steel (SA-516 70). The unit is rated at 300 psig.

The total heat exchanger duty of the primary/secondary liquefier is 3,564,000 BTU/Hr. The primary side of the bundle is designed for 25,468 lb/h of inlet chlorine gas and 22,681 lb/h of liquid chlorine discharging.

The shell-side of the evaporator includes a Freon accumulator which acts as a surge drum for the Freon gas that is evaporated on the shell-side of

the chlorine condenser. The accumulator size is 36" x 120" with three 20" risers and two 6" outlets. The shell-side/accumulator is protected by a relief valve set at 300 psig.

2. Compressor

The Freon compressor is a five-stage York centrifugal compressor model number M526A. The casing size is 26" which is constructed of cast iron. The five impellers are constructed of aluminum 6061TC. The maximum rating of the compressor is 300 psig. The oil type is York "J" and requires 40 gal for an oil charge. It has a single gas seal filter arrangement with an A-4 type of gas seal. The speed of the compressor is 7448 RPM with a shaft horsepower of 866. The compressor consists of a suction loading and two side loading ports.

The compressor is driven by a 900 HP, 2300 volt motor, 3 phase, 60 Hz, operating at 1785 RPM. The motor is a Louis Allis with full load current of 202 amps with locked rotor current of 1235 amps. Shaft size is 3.375 with a keyway of 0.875" square. Frame size is 7111 DS. The space heaters are 650 watts, 120/1/60. When the compressor is shut down, the oil heater inside the compressor housing keeps the oil from cooling, thus reducing the amount of Freon that can be absorbed by the oil.

The gear box is a Lufkin model N1200C with 1035 HP. The inlet speed is 1780 RPM and the output speed is 7448 RPM. It requires 15 gpm of oil with oil type of 150 SSU @ 100 F. The auxiliary oil pump is a Viking model HJ-495M constructed of cast iron with Neoprene seals. The maximum design flow rate is 23 gpm. It is driven by a 2 Hp motor at 1750 RPM.

The low speed gear/motor coupling is a Thomas/Rexnord series 71 size 512. Bored for a 5" shaft to 3.375" shaft. Design speed of 1780 RPM with design horse power of 1035.

3. Freon Condenser

The Freon condenser is a four-pass, shell and tube heat exchanger with water on the tube side and Freon R-134A on the shell side. The condenser is 48" diameter x 156" long. The shell is constructed of carbon steel (SA-516-70). There are 1764 tubes constructed of 3/4" carbon steel (90/10 Cu-Ni SB-359 C70600), 18 BWG, with overall length of 13 ft. The heat exchanger duty is 7,140,000 BTU/Hr. The compressed Freon is distributed along the condenser with baffles.

4. Receiver/Economizer

The economizer is a horizontal tank constructed of carbon steel (SA-516-70) with dimensions of 14' length and 4' diameter. It is rated for 300 psig and – 20 F. The R-134A liquid level is maintained in the receiver by a level control valve in the liquid Freon discharge line. The pressure on the economizer is equalized with the inlet pressure to the 5th stage of the Freon compressor. The operating pressure of the economizer is 97.2 psia (82.5

psig). The economizer is designed to improve the efficiency of the Primaries, and cool the Freon from the condenser. The decrease in pressure across the Freon condenser level control valve decreases the temperature of the Freon. The liquid Freon from the Freon condenser flows into the economizer.

5. Purge Units

The purge unit is a "thermal" unit; that is, it uses the cooling from liquid Freon flashing to liquefy the Freon in the purge gas. The double drum purge unit is a two stage unit consisting of a concentrator and a purge drum. The concentrator and the purge drum each consists of a drum containing a direct expansion coil controlled by a thermal expansion valve. High pressure liquid R-134A passes through a filter, the expansion valves, and enters the drums. Non-condensable gas from the top of the condenser is fed through a flow orifice and into the concentrator drum. Refrigerant gas is condensed by contact with the cold coils in the drum which leaves concentrated foul gas. The liquid Freon collects in the bottom of the drum. An automatic float located in the bottom of the drum maintains a liquid seal and prevents non-condensable gas from re-entering the system. The liquid which passes through the expansion valve adsorbs heat from condensing Freon gas, and passes back as a gas through the economizer to the suction of the compressor. The condensed R-134A liquid passes through the float valve and is expanded into the coil of the purger which reclaims the refrigerant.

The foul gas is removed from the top of the concentrator and enters the purge drum through a flow orifice. The purge drum is utilized to condense any remaining refrigerant in the foul gas. The foul gas accumulates in the top of the purge drum. When the differential pressure between the top of the purge drum and the condenser pressure falls to 10 PSI the differential pressure switch actuates a solenoid valve which exhausts the foul gas to the atmosphere.

Due to the relative densities, water rises to the top of the refrigerant. The refrigerant a float chamber while the water remains on the refrigerant surface. Drain valves are available for draining the water.

6. Water Chiller/Economizer

The water chiller/economizer is 2 pass shell & tube heat exchanger with R-134A on the shell-side and water from the chilled water system on the tube-side. The shell is constructed of carbon steel (SA—53 E/B) with an I.D. of 13.25". The tubes are 3/4" constructed of 18 BWG 90/10SB-359 C70600. There are 116 tubes in the bundle with an overall length of 12'. The heat exchanger duty is 900,000 BTU/Hr. The unit includes a Freon gas accumulator on top of the heat exchanger. The overall size of the unit with accumulator is 24" x 144".

B. Pump Down Unit

The pump down unit is used to remove/add Freon from/to the primary/secondary liquefier, Freon condenser, and chilled water chiller/economizer. Transfers between pieces of equipment can be made. Freon is stored in the receiver when removed from the other pieces of equipment. This unit consists of a compressor; condenser, and oil separator with an oil return system to the compressor.

The pumpout compressor is a Blu-Cold model 1 6799 reciprocating compressor, 4-cylinder, 5 hp, 12.4 CFM capacity at 300 RPM. The oil is CP-Solest 68.

The water cooled condenser is a standard model SST-500, 6-5/8" x 44" overall, 11.4 ft² surface area, 5/8" OD plain copper steel wire wrapped tubes.

The discharge oil separator is a Temprite model 504, with internal float for oil return to compressor.

The motor for the compressor is a Siemens squirrel cage induction type 5 hp, 1800 RPM, F-1, 184T Frame, TEFC, 460V/3/60.

Freon R23 System

A. R23 Compressor

The R23 compressor is a rotary screw type with 23.6 tons of refrigeration (283,200 BTU/hr) capacity. The material of construction is cast iron. It includes 120V space heaters and a control power panel. The motor is 125 hp, 3550 rpm, and 460V. The weight is 8500 lb. The manufacturer is Mycom.

B. Tertiary Oil Separator Pot (Oil Skimmer)

The tertiary oil skimmer is a 10" diameter x 36" long vessel constructed of stainless steel and rated at 300 psig. The skimmer includes a single phase heater, 2kw and 120V. The empty weight is 150 lb. The manufacturer is FES.

C. R23 Condenser

The R23 condenser is a shell-and-tube heat exchanger. It is 19" diameter and 16' long. The tubes are 0.75" diameter, 14BWG thickness, 16' long and constructed of 333GR3 carbon steel. The capacity of 334 tubes is 36.6 tons of refrigeration (439,200 BTU/hr) over 591 square feet. It is rated for 250 psig and 150 °F. It includes 1.5" of insulation. The weight is 4118 lb. The manufacturer is Old Dominion.

D. R23 Condenser Filter Dryer

The R23 condenser filter dryer in connection to the R23 condenser. It is constructed of carbon steel. It is rated for 500 psig. It includes 1.5" of insulation. The weight is 80 lb. The manufacturer is Henry.

E. R23 Expansion Tank

The R23 expansion tank is a 60" diameter x 24' long vessel constructed of carbon steel and rated at 300 psig. The empty weight is 12350 lb. The manufacturer is FES.

F. R23 Compressor Oil Separator

The R23 Compressor Oil Separator is a 20" diameter x 118" long vessel constructed of carbon steel and rated at 300 psig. The oil separator includes three single phase heaters, 1.2kw and 120V each. It includes 1.5" of insulation. The empty weight is 1200 lb. The manufacturer is FES.

G. R23 Compressor Oil Strainer (2)

The R23 compressor oil strainers are carbon steel rated at 300 psig. The weight is 25 lb. The manufacturer is FES.

H. R23 Compressor Oil Pump (2)

The R23 compressor oil pumps are gear type pumps constructed of cast iron. The motors are 3 hp, 1200 rpm, and 460V. It includes 1.5" of insulation. The weight is 85 lb. The manufacturer is Viking.

I. R23 Compressor Oil Cooler (2)

The R23 compressor oil coolers are 6" diameter x 84" long shell and tube heat exchangers. It is constructed of carbon steel shell and copper tubes, and rated at 400 psig shell and 150 psig tube. The coolers include 1.5" insulation. The empty weight is 400 lb. The manufacturer is Ketema.

J. R23 Compressor Oil Filter (2)

The R23 compressor oil filter is constructed of carbon steel. It includes 1.5" of insulation. The weight is 60 lb. The manufacturer is FES.

K. R23 Compressor Suction Heater

The R23 compressor suction heater is an 8" diameter x 36" long shell and tube heat exchanger. The tubes are 0.75" diameter, 0.083" thick and constructed of

334GR3 carbon steel rated at 300 psig and 150 F. It includes 32 square feet of heating and 3" of insulation. The empty weight is 503 lb. The manufacturer is Old Dominion.

L. R23 Compressor Secondary Oil Separator

The R23 compressor secondary oil separator is located downstream of the main oil separator. The material of construction is carbon steel rated at 300 psig. The empty weight is 210 lb. The manufacturer is Balston.

M. R23 Condenser Oil Separation Pot

The R23 condenser oil separation pot is a 10" diameter x 36" long vessel constructed of carbon steel and rated at 300 psig. The skimmer includes a single-phase, 2kw, 120V heater. The empty weight is 150 lb. The manufacturer is FES.

N. R23 PumpOut Unit

The R23 pumpout unit is a multipiston skid-mounted compressor constructed of carbon steel and cast iron. It is rated for 300 psig. The motor is a 15 hp, 1800 rpm, and 460V. The empty weight is 1530 lb. The manufacturer is Mycom.

O. R23 Compressor Sump Pump

The R23 compressor sump pump is a Goulds 1x11/26. The pump has a 5.25" impeller with river water flush. The vertical pit depth is 4'. The capacity is 25 gpm at 25' of head. The material of construction is cast iron. The motor is a 1.5 hp, 1750 rpm, and 460 volt. Empty weight is 443 lb. The manufacturer is Goulds.