SEMI-HERMETIC WATER-COOLED & REMOTE-COOLED PRDODUCTS

Installation, Operation, and Maintenance Instructions

First Edition

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SAFETY CONSIDERATIONS

Installation, start-up, and servicing of this equipment can be hazardous due to system pressures, electrical components, and equipment locations. Only trained, qualified installation and service personnel should install, start, and service this equipment.

When working on this equipment, observe precautions in the documentation, tags, stickers, and labels attached to the equipment. Follow all safety codes and any other safety precautions that apply. Wear safety glasses and work gloves. Use care when handling, rigging, and setting bulky equipment.

The installer and operator should read completely through all documentation before operating the chiller.

WARNING! Before performing service or maintenance operations on this equipment, shut off and tag main power supply. Electrical shock can cause serious personal injury or death.

RECEIVING AND INSPECTION

Immediately upon receiving shipment, the equipment should be inspected, in the presence of the of the carrier's representative, for evidence of any damage received in transit. If shipping damage has occurred, a claim should be made with the transportation company. Also, advise Ketema LP of the nature of the damages.

Equipment should be inspected for compliance with original order acknowledgment (equipment model numbers, voltages, etc.)

Acme chillers are often built to order for a specific application. The components referenced herein are representative of the catalogued product. Your product may use different components, wiring, and piping diagrams. Your product may also be designed for application conditions different from those mentioned in this document.

RIGGING

Each packaged chiller is carefully tested and crated at the factory, where every precaution is taken to assure that the unit reaches its destination in perfect condition. It is very important that the installer use the same care in handling the chiller. The riggers and movers should use every precaution when moving the equipment into place. Make sure that chains, cables, and other moving equipment are placed to avoid damaging the chiller. The refrigerant piping and process piping must not be used as a lifting point, ladder, or hand hold. The skids on which the unit is mounted should not be removed until the unit is at its final resting place.

Do not attach a chain hoist sling to the piping or equipment. Move the unit in an upright position and let it down gently from trucks or rollers. If a forklift is to be used, lift from skid only with special care so that forks do not contact refrigerant piping or frame mounted components. Equipment should be lifted in near level conditions to prevent undue stress on structural members.

MOUNTING

The chiller should be mounted on a smooth, hard level surface. The mounting surface should be rigid, and provisions should be made to prevent noise transmission (structural) to surrounding areas. The chiller should be mounted away from noise-sensitive areas. If mounting the chiller on a surface that is not on the ground, be sure to perform a structural analysis to be sure that the surface can support the weight of the chiller.

In most applications, it is recommended that vibration isolators be installed under the base. The isolators must be designed for the operating weight of the chiller. Rubber-in-shear or spring-type isolators are normally used. To further reduce the transmission of vibration, appropriate flexible connectors should be installed in the water piping.

LOCATION AND CLEARANCE

Make sure that the route by which the chiller will be moved to its final location has adequate floor strength to support the weight of the chiller. Make sure that doors and passageways have adequate clearance to maneuver the chiller. There should be adequate clearance around the final chiller location to permit maintenance, cleaning, repair, and component replacement.

The maximum process fluid pressure should not exceed 150 PSIG. For water-cooled chillers, the final location must have adequate water supply, and drainage facilities. Make sure that the cooling tower or city water connections can supply the necessary flow rate for the condensers. The maximum condenser water pressure should not exceed 100 PSIG.

If the unit is installed where it may be subject to freezing temperatures, provisions must be made to keep the condenser and process fluids above their freezing points. During operation, the Saturated Suction Temperature (SST) must be above the freezing point of the process fluid.

WIRING

All wiring must be in accordance with state and local codes and follow good wiring practice.

Power wiring to equipment must be adequately sized for the minimum ampacity shown on the unit nameplate. A disconnect should be located adjacent to the unit for both safety and servicing purposes.

The equipment wiring diagram should be examined and thoroughly understood before field wiring connections are made.

The supply power should be checked to be certain that the supply voltage agrees with the equipment nameplate. Serious damage to the compressor and motor(s) can occur if improper voltage is applied. The line voltage may not vary more than the voltage tolerances listed for the unit.

When wiring is complete, any pump motor(s) (if the unit is so equipped) and direct drive compressors should be checked for proper rotation. If the rotation is found to be incorrect, reverse two of three leads on the main incoming power.

PIPING CONSIDERATIONS

Due to the wide variation in local codes, Ketema LP cannot make specific recommendations for process and refrigerant piping. All piping must comply with generally accepted good piping practice, and must adhere to all local codes. The ASHRAE handbooks, particularly the *Refrigeration* and *HVAC Systems and Equipment* volumes, provide excellent guidelines for refrigerant and process piping.

<u>CHILLED WATER PIPING.</u> For proper operation, the process fluid return line should be connected to the evaporator nozzle adjacent to the refrigerant piping connections. The process fluid should leave the evaporator on the end opposite the refrigerant piping connections. A flow switch should be installed in a straight horizontal section of the chilled water piping. Pressure gauges should be installed in the chilled water piping to and from the evaporator to measure the pressure drop. The process fluid pressure drop through the evaporator can be used to determine the process fluid flow rate.

A strainer should be installed in the piping on the inlet side of the evaporator, and vibration eliminators should be employed on both the inlet and outlet pipes. Air vents should be located at all high points in the piping system. Vents should be located so that they are accessible for servicing. Drain connections should be provided at all low points to allow complete drainage of the evaporator and piping system. The process fluid piping should be insulated to reduce heat pickup and to prevent condensation.

The chiller is designed for the process fluid to flow through the evaporator at a constant flow rate. The process fluid flow rate must be held constant. If the process system utilizes variable speed pumps or control valves to vary the flow through the process heat transfer equipment, provisions must be made to assure that the process fluid flow rate through the chiller's evaporator remains constant.

If the process fluid system is used for dual-mode operation (heating during the winter and cooling during the summer), the evaporator must be isolated during the heating season so that hot water does not pass through the evaporator.

CONDENSER WATER PIPING. Condenser water regulating valves should always be used. When designing the condenser piping circuit, the piping must be sized so that the total resistance of the circuit, when supplying the maximum flow rate required by the condenser, does not exceed the minimum water pressure available in the main supply line. When calculating the pressure drop in the condenser water line, be sure to account for fittings and service valves, the strainer, the water regulating valve, the condenser, and vertical lift or static head.

Be sure that the maximum water pressure at the condenser does not exceed the design working pressure for the condenser. If the water pressure exceeds the design working pressure, a water pressure reducing valve should be installed ahead of the water regulating valve.

COOLING TOWER CONSIDERATIONS. A cooling tower can be used with all water-cooled chillers. Good strainers are required and should be located in the tower sump. The piping should contain a certain amount of flexibility between the component parts to allow for expansion and contraction. Never install the piping so that it is completely rigid. When more than one condenser is used with a cooling tower, the warm water leaving each condenser should discharge into a common manifold, and one common return line should carry the water to the tower.

If the chiller will experience large load variations, some method of cooling tower capacity control is necessary to insure that the condensing temperature remains within the prescribed limits. Cooling tower capacity control methods include automatic water regulating valves, variable speed fan motors, fan dampers, etc. Consult your tower manufacturer for suggestions on how to modulate the capacity of the cooling tower.

If the cooling tower is to be operated where the ambient temperature will fall below the freezing point, precautions must be taken to keep the tower from freezing. Typically, a tower will freeze when the ambient wet bulb temperature is below 32°F and the tower water flow rate is reduced, or when the tower is idle and the ambient dry bulb temperature drops below 32°F. Consult your tower manufacturer for suggestions on how to prevent freeze-up in low ambient conditions.

PRE-START-UP

REFRIGERANT PIPING. All water-cooled packaged chillers are leak tested, evacuated, and fully charged. Chillers that are used with remote condensers are leak tested, evacuated, and filled with a holding charge only. All units are performance tested at the factory. Rough handling during shipment and rigging may result in refrigerant leaks. Thoroughly check the refrigerant piping before starting the chiller

On chillers that contain a full charge, the refrigerant has been pumped down into the condenser(s). Open the condenser valve(s) and let a small amount of refrigerant into the rest of the system and check for leaks.

⚠**CAUTION: Never use air-refrigerant mixtures for leak testing.** Under certain conditions, some refrigerant-air mixtures become flammable.

ELECTIRCAL SYSTEM. All control wiring should be checked against the wiring diagram furnished with the unit. Check all electrical terminals and tighten any loose connections. If the chiller is equipped with mechanical safety switches, press the reset button on all switches to insure that they are in the operating position. Make sure that the supply power meets the requirements of the chiller, and make sure that all external wiring meets local electrical codes.

Most chillers have flow switch interlock terminals, which require that a flow switch be installed in the chilled fluid line. The chiller will not start until the flow switch indicates that fluid is flowing through the evaporator. Consult the electrical diagram for the location of these terminals.

Check the amperage draw of all motors and compressors. The actual amperage draw should not exceed the Run Load Amps (RLA) listed on the motor nameplate. On three-phase motors, the amperage draw should be uniform on all three phases.

⚠**CAUTION: Energize crankcase heaters and allow the heaters to operate for a minimum of 24 hours before starting the compressor.** This will allow any refrigerant that has migrated to the compressor crankcase during charging to boil out and insure proper compressor lubrication.

CONTROL SETTINGS. All safety and operating controls must be adjusted. The pressure and temperature controls have been set at the factory, however, it is still necessary to confirm that the settings are correct for your specific application, and that the controls function properly. Do not attempt to test the safety controls without some means of stopping the compressor in the event of extremely high or low-pressure conditions that could damage the equipment. If the control fails to function at set points, determine the cause and correct. Jumpering any safety control, other than for testing purposes, is dangerous to personnel and equipment, and voids the equipment warranty.

The controls described below are not found on all units. If your unit is equipped with a PLC, see the PLC operating manual for additional details on adjusting the setpoints.

High Pressure Control. Connect a gauge to the compressor discharge service valve. Restrict the condenser water flow. The control should open immediately when the discharge pressure reaches the control set point. This control is typically set at 270 PSIG.

Low Pressure Pumpdown Control. Using a gauge manifold set, connect the low-pressure gage to the compressor suction service valve, and the high-pressure gage to the compressor discharge service valve. Using the manifold, raise the suction pressure by admitting gas from the discharge valve into the suction valve. When the suction pressure has increased past the cut-in set point of the pumpdown control, the compressor should start, and should run until the suction pressure falls below the cut-out setting of the pumpdown control.

Oil Pressure Control. On compressors equipped with an electronic oil pressure switch, unplug the oil pressure sensor. The compressor should run approximately 120 seconds and cycle off. Check the operating oil pressure. This is the differential between the oil pump discharge pressure and the suction pressure, and should be a minimum of 12 PSID. After several hours of running time, check the compressor oil level. Proper level is approximately ¼ to ½ level on the oil sight glass.

Temperature Control. This control is the main operating thermostat. The sensing bulb is located in the return fluid nozzle on the evaporator. This control operates on entering (return) fluid temperature. The chiller is designed to cool the fluid flowing through the evaporator by a certain number of degrees (temperature range) at a fixed evaporator fluid flow rate. When the fluid returns to the chiller above the design leaving fluid temperature (the setpoint of the temperature control), this implies that there is a system load, and the chiller will start.

If your chiller is equipped with capacity control, the temperature control will have an additional stage for each step of capacity control. As the return fluid temperature approaches the temperature control set point, the cooling stages will be deactivated. Each compressor may be equipped with up to two stages of cylinder unloading. On multi-compressor chillers, there is typically one step of capacity control for each compressor, and the compressors may have cylinder unloading as well.

The temperature control is field adjustable. The setpoint of the control should be the chiller design leaving fluid temperature. In addition, if the chiller has more than one cooling stage, each stage will have it's own setpoint as well. The number of degrees per stage can be calculated by dividing the design temperature range by the number of stages. For example, if the design temperature range for a two-stage chiller is 10°F and the desired leaving fluid temperature is 45°F, there will be 5°F/stage. The setpoint for the first stage would be 45°F, and the setpoint for the second stage would be 50°F.

The chiller will be operating anytime the temperature control senses a load (i.e. anytime the return fluid temperature is above the control setpoint). If the actual load on the chiller is less than the operating capacity of the chiller, the chiller may overcool the process fluid. This overcooling can occur even if the chiller has capacity control, since the control steps are finite and cannot precisely match the exact load on the chiller. To avoid overcooling the fluid, it may be necessary to adjust the setpoint of the temperature control above the design leaving fluid temperature. If the chiller has more than one cooling stage, it may be necessary to adjust the stage setpoints as well.

Freeze Control. This control senses the evaporator refrigerant pressure, and is a manual - reset safety control with a fixed time delay circuit. This control responds to the suction pressure and will de-energize the compressor if the suction pressure is below the setpoint for longer than 120 seconds. The fixed time delay (120 seconds) allows the circuit to stabilize during start-up and normal pump-down operation. This control is adjustable but is factory set at 54 PSIG. On units where this control is factory-sealed, the seal is not to be broken without factory authorization, or the warranty will be voided.

Pumpdown switch. Each circuit is equipped with a pumpdown switch. When the pumpdown switch is in the pumped-down position, that circuit will not cool, and the control system will keep the suction pressure of that circuit below the cut-in setpoint of the pumpdown control. When the switch is in the ready or cooling position, that circuit will activate when the cooling load requires it.

Lead-lag switch. Dual circuit chillers are equipped with a manual lead-lag switch, which selects the lead circuit. The lead circuit should be regularly alternated to equalize wear on the compressors.

PIPING. Before filling the condenser and evaporator system piping, be sure that all drain plugs are installed. Before the unit is electrically energized, evaporator and condenser flow should be established and adjusted for application requirements. Check all pumps for proper rotation. If necessary, change the pump rotation by reversing any two of the three power leads. In closed systems, be sure to bleed off any air at the highest point in the piping system. The evaporator and condenser flow can be determined by measuring the pressure differential through the component. Consult the pump flow/pressure curve and the condenser/evaporator pressure drop tables in this manual for information on flow rates and pressure drops.

REMOTE CONDENSERS. If the chiller uses a remote condensing unit, make sure that the condenser fans rotate freely and that they are rotating in the proper direction. Make sure that the unit is properly evacuated before charging the system.

COMPRESSORS. On most chillers, the compressors are solid mounted. Do not loosen the compressor bolts on solid mounted compressors. Check these bolts for tightness. If your chiller was ordered with optional spring-mounted compressors, you will need to release the compressor mounts from the shipping position.

START-UP

Fully open the compressor discharge valve(s), compressor suction valve(s), and condenser or receiver shut-off valve(s). These valves may be closed no more than two turns to give access to the pressure ports.

Start the evaporator and condenser pumps to establish flow. Apply power to the chiller. Turn the main switch to the ON position, and then move the pumpdown switch to the READY or ON position. The chiller should start if the process fluid requires cooling.

After the unit is operating, check the condenser, evaporator, and oil pressures for proper operation. Check the superheat setting and adjust the thermal expansion valve if necessary. Normal superheat at the compressor should be 8°F to 12°F at full load condition. The superheat is the actual suction gas temperature minus the saturated suction temperature corresponding to the suction pressure at compressor.

If your chiller is equipped with a PLC, see the PLC operating manual for additional details on how to start the chiller.

SHUT DOWN

Chillers that will not be required to operate for a period of time should be secured by storing the refrigerant charge in the receiver or condenser.

Front seat the receiver or condenser outlet valve. Set the thermostat at a setting below system temperature to insure that the liquid line solenoid is energized. Defeat the low-pressure control and allow the unit to pump down to a suction pressure of approximately 5 PSIG. It may be necessary to repeat the pump-down procedure as some refrigerant will remain in the compressor oil and will slowly boil off. When suction pressure holds at 5 PSIG, front seat the suction service valve. Lock the electrical disconnect in the off position. The evaporator water flow must be maintained during the pumpdown procedure.

If the chiller is to be out of service for a prolonged period of time, it should be completely drained of water. This will prevent accidental freezing and prevent mineral precipitation and biological growth in the stagnant water.

SYSTEM RESTART AFTER SHUT-DOWN

Inspect the chiller for possible worn or faulty components and repair if required. Thoroughly leak-test the chiller refrigerant piping. The condensers should be checked for fouling and cleaned if necessary. Refill water system and purge all the air from system. Energize crankcase heaters and allow the heaters to operate for a minimum of 24 hours before compressor restart. Install gauges, start the system and check for correct refrigerant charge and proper system operation and balance.

MAINTENANCE

The system should be checked periodically. Use only the services of a qualified refrigeration mechanic for inspection and maintenance checks of service operation.

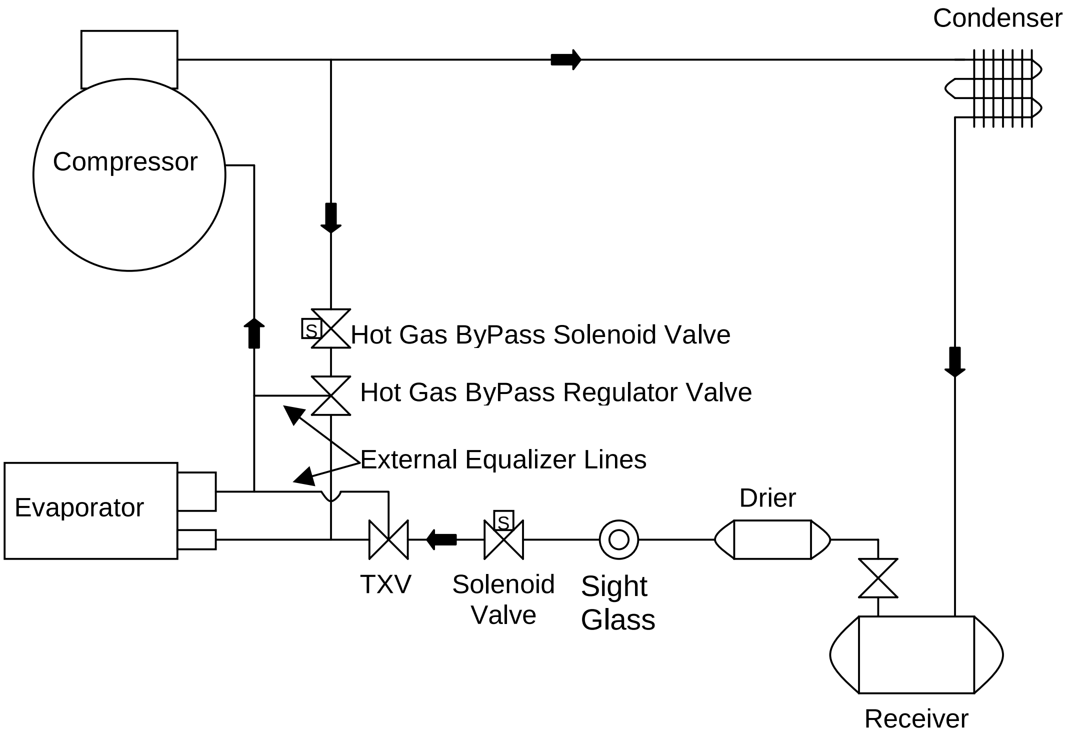
Water Treatment. The condenser and evaporator fluids should be tested by a local testing agency. Strictly follow their recommendations for mineral and biological treatment. The water conditions dictate how often the condenser(s) need to be cleaned.

Cooling Towers. The condition of the water and the air in the locality of the installation dictate the amount of service necessary to maintain the equipment in good operating condition. Besides the concentration of impurities caused by the evaporation of the water, harmful atmospheric conditions such as industrial smoke, chemical fumes, salt air, and heavy dust can form corrosive solutions with water as it is sprayed in the cooling tower. If these conditions exist, water treatment must be used to prevent fouling of the condenser(s).

Compressor Oil Level. The compressor oil level should be checked periodically. If oil is needed, allow the equipment to pump-down to approximately 5 PSIG crankcase pressure. Place the electrical disconnect in the off position and close the suction and discharge service valves. Slowly remove the oil fill plug from the compressor crankcase. Slight pressure is still in crankcase and care must be taken to prevent “blow out” of plug. Add clean, dry refrigerant oil appropriate for the refrigerant in the chiller until the oil level is approximately mid-point in the oil sight glass. Replace the oil fill plug and open the discharge and suction service valves. Restart the compressor and check the oil level after two hours of operation. Oil loss suggests that the system may have a leak. Carefully inspect the entire system for evidence of oil and repair as necessary.

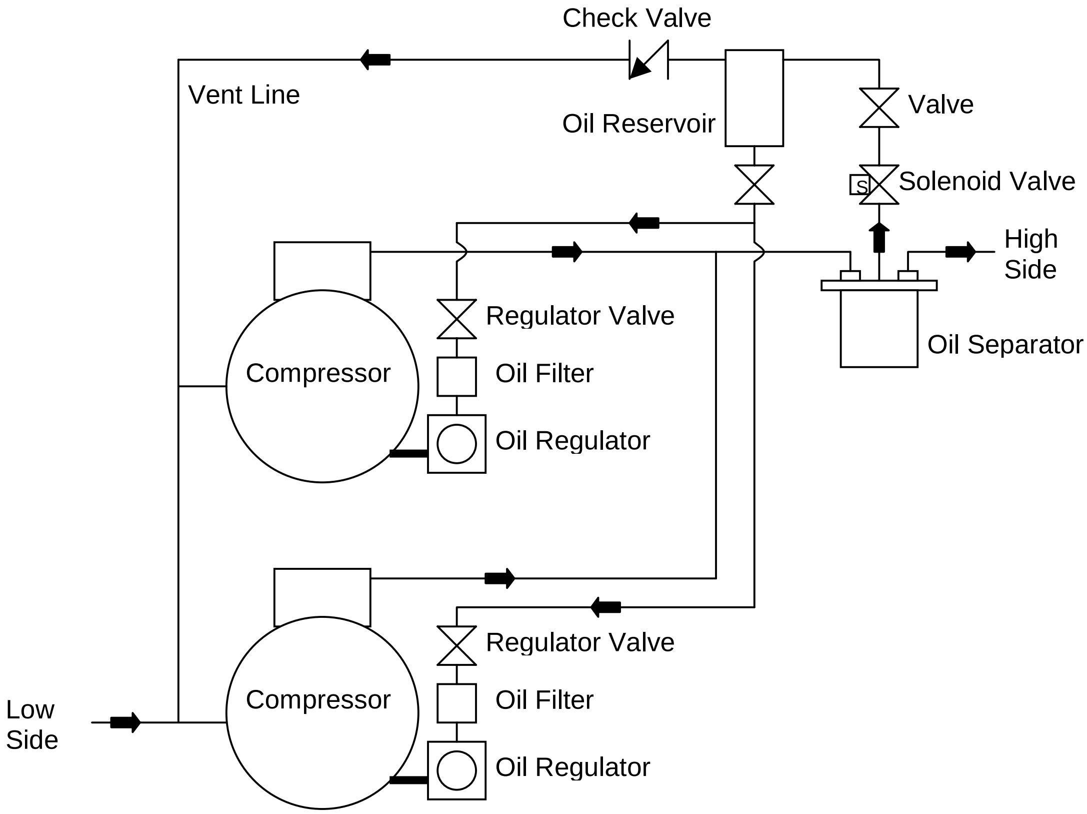
Electrical System. Periodically check all electrical connections for possible loose or corroded terminals. Repair as necessary.

HOT-GAS BYPASS SYSTEM



This figure shows a typical hot-gas bypass piping arrangement. This method of hot-gas bypass provides distinct advantages over other methods. The primary advantage of this method is that the system thermostatic expansion valve will respond to the increased superheat of the vapor leaving the evaporator and will provide the liquid required for desuperheating. Also the evaporator serves as an excellent mixing chamber for the bypassed hot gas and the liquid-vapor mixture from the expansion valve. This insures a dry vapor reaching the compressor suction. Oil return from the evaporator is also improved since the velocity in the evaporator is kept high by the hot gas.

OIL CONTROL SYSTEM



Some chillers are designed with multiple compressors sharing a common refrigeration circuit. On such chillers, it is necessary to maintain oil equalization between each compressor in order to prevent loss of oil from a particular compressor.

The method of crankcase oil equalization used by ACME is the AC&R System consisting of an oil separator mounted in the common discharge line, an oil reservoir, and an oil regulating valve mounted on each compressor crankcase. In addition, a check valve having a 20 pound differential is installed in the vent line from the reservoir to the suction line.

With either or both compressors running, the oil separator will collect the oil vapor leaving the compressor(s) and return this oil to the reservoir. The reservoir will be at a pressure approximately 20 pounds above the compressor crankcase pressure. Oil from the reservoir is piped to the oil regulators that are mounted on the compressor crankcase. As the crankcase oil level drops, the regulator will admit oil to the crankcase to maintain the proper operating level.

How It Works. A reserve of oil is necessary for the operation of the OIL CONTROL SYSTEM. The OIL RSERVOIR is the holding vessel for this stand-by oil. It has two sight glass ports on the shell to observe the oil level inside the vessel. Oil is fed into the OIL RESERVOIR by the OIL SEPARATOR.

High pressure from the high side returns with the oil from the OIL SEPARATOR to the RESERVOIR. In a period of time, enough pressure could build up to adversely affect the float and needle assembly in the OIL LEVEL REGULATOR. For protection, a vent line is installed from the top of the OIL RESERVOIR back to the low-pressure suction line. This line permits the pressure in the OIL RESERVOIR to be approximately the same as the pressure in the suction line and the crankcases of the compressors. Oil in the OIL RESERVOIR feeds down through 3/8” and ¼” OD tubing and keeps the OIL LEVEL REGULATORS supplied with oil.

A REGULATING VALVE is mounted on the suction line vent connection on top of the OIL RESERVOIR and will maintain 20 PSID pressure differential over the crankcase. This positive pressure will keep the oil line to the OIL LEVEL REGULATORS filled and ready.

The valve on the top of the OIL RESERVOIR automatically receives oil from the OIL SEPARATOR (open position). To add oil to the OIL RESERVOIR manually, close the valve and fill the OIL RESERVOIR through the ¼” flare connection the side of the valve. Open valve after filling.

COMPRESSOR WILL NOT RUN	a) Main Switch open or circuit breakers open b) Fuse blown c) Thermal overloads tripped or fuses blown d) Defective contactor or coil e) System shut down by safety device f) No cooling required g) Liquid line solenoid will not open h) Motor electrical trouble i) Loose wiring	a) Close switch. b) Check electrical circuits and motor windings for shorts or grounds. Investigate for possible overloading. Replace fuse or reset breakers after fault is corrected. c) Overloads are auto reset. Check unit closely when unit comes back on line. d) Repair or replace. e) Determine type and cause of fault and correct it before resetting switch. f) None. Wait until unit calls for cooling. g) Repair or replace coil. h) Check motor for opens, short circuit, or burnout. i) Check all wire junctions. Tighten all terminal screws.
COMPRESSOR NOISY OR VIBRATING	a) Flooding of refrigerant into crankcase b) Improper piping support on discharge or liquid line c) Worn compressor	a) Check setting of expansion valve. b) Relocate, add, or remove hangers. c) Replace.
HIGH DISCHARGE PRESSURE	a) Fouled condenser tubes b) Condenser water flow rate too low or water too warm c) Non-condensibles in system d) Discharge shut-off valve partially closed e) System is overcharged with refrigerant	a) Clean condenser tubes. b) Adjust water flow rate and temperature to design conditions. c) Purge the non-condensibles. d) Open valve. e) Remove excess refrigerant.
LOW DISCHARGE PRESSURE	a) Condenser water flow rate too high or water too cold. b) Suction shut-off valve partially closed c) Insufficient refrigerant in system d) Low suction pressure	a) Adjust water to design temperature and rate. b) Open valve. c) Check for leaks. Repair and add charge. d) See correction steps for low suction pressure below.
HIGH SUCTION PRESSURE	a) Excessive load b) Expansion valve overfeeding	a) Reduce load or add additional equipment. b) Check remote bulb. Regulate superheat.
LOW SUCTION PRESSURE	a) Lack of refrigerant b) Evaporator dirty c) Clogged liquid line filter-drier d) Liquid line solenoid is blocked or stuck e) Expansion valve malfunctioning f) Insufficient evaporator water flow g) The compressor has been started too quickly after a previous pumpdown	a) Check for leaks. Repair and add charge. b) Clean chemically. c) Replace cartridge(s). d) Repair or replace valve. e) Check and reset for proper superheat, replace if necessary. f) Adjust evaporator flow rate. g) The cold TXV bulb is causing the TXV to underfeed the evaporator. Increase anti-cycling timer setting (if unit is so equipped).

PROBLEM	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
LITTLE OR NO OIL PRESSURE	a) Clogged suction oil strainer b) Excessive liquid in crankcase c) Oil pressure gauge/trandsucer defective d) Defective oil pressure safety switch e) Worn oil pump f) Oil pump reversing gear stuck in wrong position g) Worn bearings h) Low oil level i) Loose fitting on oil lines j) Flooding of refrigerant into crankcase	a) Clean. b) Check crankcase heater. Reset expansion valve for higher superheat. Check liquid line solenoid valve operation. c) Repair or replace. d) Replace. e) Replace. f) Reverse direction of compressor rotation. g) Replace compressor. h) Add oil. i) Check and tighten system. j) Adjust thermal expansion valve.
COMPRESSOR LOSES OIL	a) Lack of refrigerant b) Excessive compression ring blow-by c) Insufficient evaporator water flow	a) Check for leaks and repair. Add refrigerant. b) Replace compressor. c) Oil is logging in evaporator. Adjust evaporator flow rate.
MOTOR OVERLOAD RELAYS OR CIRCUIT BREAKERS OPEN	a) Low voltage during high load conditions b) Defective or grounded wiring in motor or power circuits c) Loose power wiring d) High condensing temperature e) Power line fault causing unbalanced voltage	a) Check supply voltage for excessive line drop. b) Replace compressor motor. c) Check all connections and tighten. d) See corrective steps for high discharge pressure. e) Check supply voltage. Notify power company. Do not start until fault is corrected.
COMPRESSOR THERMAL PROTECTOR OPEN	a) Operating beyond design conditions b) Discharge valve partially shut c) Blown valve plate gasket	a) Check operating condition for mis-application of chiller. b) Open valve. c) Replace gasket.
FREEZE PROTECTION OPENS	a) Thermostat set too low b) Low pressure freeze control set too high c) Low suction temperature	a) Reset the thermostat. b) Reset the control. c) See " Low Suction Pressure".

KETEMA LP

EVAPORATOR SPECIFICATIONS

water @ 50°F

Model	Fluid Connections			Max Flow	Shellside Pressure Drop in PSID at % Max Flow									
	Inlet in	Outlet in	Drain in	GPM	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
DXC-606-RS	3 MPT	3 MPT	3/8 FPT	70	0.12	0.48	1.06	1.88	2.92	4.18	5.68	7.40	9.34	11.52
DXC-804-S	4 MPT	4 MPT	3/8 FPT	180	0.13	0.50	1.09	1.90	2.93	4.16	5.61	7.27	9.15	11.23
DXC-805-RS	4 MPT	4 MPT	3/8 FPT	120	0.15	0.56	1.22	2.12	3.26	4.63	6.24	8.09	10.18	12.49
DXC-806-S	4 MPT	4 MPT	3/8 FPT	180	0.18	0.69	1.52	2.65	4.08	5.81	7.85	10.19	12.83	15.76
DXT-504-Q	2 MPT	2 MPT	3/4 FPT	30	0.55	0.68	0.89	1.18	1.85	2.67	3.64	4.75	5.96	7.30
DXT-505-Q	2 MPT	2 MPT	3/4 FPT	30	0.56	0.73	1.00	1.51	2.36	3.40	4.63	6.06	7.60	9.31
DXT-605-Q	2.5 MPT	2.5 MPT	3/4 FPT	50	0.57	0.76	1.08	1.77	2.77	3.99	5.44	7.06	8.86	10.85
DXT-804-Q	3 MPT	3 MPT	3/4 FPT	80	0.55	0.68	0.90	1.20	1.88	2.71	3.69	4.76	5.96	7.28
DXT-805-Q	3 MPT	3 MPT	3/4 FPT	80	0.56	0.73	1.00	1.50	2.35	3.40	4.63	5.97	7.47	9.13
DXT-806-R	3 MPT	3 MPT	3/4 FPT	100	0.56	0.72	0.99	1.47	2.30	3.32	4.52	5.84	7.33	8.96
DXT-807-R	3 MPT	3 MPT	3/4 FPT	100	0.57	0.75	1.06	1.69	2.65	3.82	5.20	6.74	8.44	10.33
DXT-1007-S	4 FLG	4 FLG	3/4 FPT	180	0.54	0.66	0.85	1.11	1.61	2.30	3.12	4.06	5.13	6.27
DXT-1008-S	4 FLG	4 FLG	3/4 FPT	180	0.68	0.68	0.90	1.19	1.83	2.62	3.56	4.63	5.84	7.14
DXT-1009-S	5 FLG	5 FLG	3/4 FPT	250	0.61	0.92	1.56	2.73	4.25	6.09	8.21	10.59	13.25	16.20
DXT-1206-S	5 FLG	5 FLG	3/4 FPT	250	0.54	0.65	0.83	1.07	1.51	2.15	2.91	3.78	4.76	5.81
DXT-1208-S	5 FLG	5 FLG	3/4 FPT	250	0.56	0.71	0.96	1.38	2.12	3.03	4.09	5.31	6.69	8.18
DXT-1209-ST	5 FLG	5 FLG	3/4 FPT	250	0.55	0.69	0.91	1.20	1.82	2.56	3.44	4.43	5.55	6.79
DXT-1410-S	6 FLG	6 FLG	3/4 FPT	450	0.18	0.65	1.40	2.44	3.77	5.38	7.27	9.43	11.86	14.55
DXT-1610-S	8 FLG	8 FLG	3/4 FPT	600	0.19	0.68	1.47	2.57	3.97	5.67	7.64	9.92	12.47	15.29
DXT-1810-S	8 FLG	8 FLG	3/4 FPT	750	0.16	0.57	1.23	2.15	3.32	4.74	6.40	8.30	10.44	12.80
DXT-1811-S	8 FLG	8 FLG	3/4 FPT	750	0.19	1.47	1.47	2.56	3.96	5.65	7.63	9.89	12.44	15.26

EVAPORATOR SPECIFICATIONS-continued

20% ethylene glycol/water solution @ 30°F

Model	Fluid Connections			Max Flow	Shellside Pressure Drop in PSID at % Max Flow									
	Inlet	Outlet	Drain											
	in	in	in	GPM	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
DXC-606-RS	3 MPT	3 MPT	3/8 FPT	70	0.14	0.52	1.14	2.00	3.10	4.44	6.02	7.83	9.87	12.16
DXC-804-S	4 MPT	4 MPT	3/8 FPT	180	0.17	0.57	1.23	2.13	3.25	4.61	6.20	8.01	10.05	12.31
DXC-805-RS	4 MPT	4 MPT	3/8 FPT	120	0.19	0.63	1.37	2.36	3.62	5.13	6.90	8.92	11.18	13.70
DXC-806-S	4 MPT	4 MPT	3/8 FPT	180	0.22	0.78	1.69	2.93	4.49	6.38	8.59	11.12	13.97	17.13
DXT-504-Q	2 MPT	2 MPT	3/4 FPT	30	0.56	0.69	0.93	1.28	1.97	2.81	3.80	4.93	6.21	7.64
DXT-505-Q	2 MPT	2 MPT	3/4 FPT	30	0.58	0.75	1.04	1.62	2.51	3.58	4.84	6.28	7.91	9.73
DXT-605-Q	2.5 MPT	2.5 MPT	3/4 FPT	50	0.59	0.78	1.13	1.88	2.91	4.17	5.63	7.32	9.23	11.41
DXT-804-Q	3 MPT	3 MPT	3/4 FPT	80	0.57	0.70	0.93	1.29	1.98	2.83	3.82	4.95	6.27	7.75
DXT-805-Q	3 MPT	3 MPT	3/4 FPT	80	0.58	0.74	1.04	1.61	2.49	3.55	4.79	6.21	7.85	9.71
DXT-806-R	3 MPT	3 MPT	3/4 FPT	100	0.58	0.74	1.03	1.57	2.43	3.47	4.68	6.07	7.66	9.46
DXT-807-R	3 MPT	3 MPT	3/4 FPT	100	0.59	0.78	1.10	1.81	2.80	3.99	5.39	6.99	8.81	10.89
DXT-1007-S	4 FLG	4 FLG	3/4 FPT	180	0.55	0.67	0.87	1.11	1.70	2.42	3.26	4.22	5.30	6.50
DXT-1008-S	4 FLG	4 FLG	3/4 FPT	180	0.56	0.70	0.92	1.26	1.94	2.76	3.71	4.81	6.04	7.40
DXT-1009-S	5 FLG	5 FLG	3/4 FPT	250	0.63	0.94	1.66	2.88	4.44	6.31	8.50	11.01	13.89	17.12
DXT-1206-S	5 FLG	5 FLG	3/4 FPT	250	0.55	0.67	0.85	1.11	1.59	2.26	3.03	3.92	4.91	6.02
DXT-1208-S	5 FLG	5 FLG	3/4 FPT	250	0.57	0.73	0.99	1.46	2.24	3.18	4.27	5.52	6.91	8.47
DXT-1209-ST	5 FLG	5 FLG	3/4 FPT	250	0.56	0.71	0.93	1.26	1.91	2.69	3.59	4.62	5.76	7.03
DXT-1410-S	6 FLG	6 FLG	3/4 FPT	450	0.24	0.78	1.61	2.73	4.16	5.89	7.91	10.24	12.86	15.78
DXT-1610-S	8 FLG	8 FLG	3/4 FPT	600	0.24	0.80	1.67	2.86	4.36	6.18	8.32	10.77	13.54	16.62
DXT-1810-S	8 FLG	8 FLG	3/4 FPT	750	0.20	0.67	1.40	2.39	3.64	5.16	6.95	9.00	11.31	13.89
DXT-1811-S	8 FLG	8 FLG	3/4 FPT	750	0.24	0.80	1.67	2.85	4.35	6.16	8.29	10.74	13.49	16.56

40% ethylene glycol/water solution @ 10°F

Model	Fluid Connections			Max Flow	Shellside Pressure Drop in PSID at % Max Flow									
	Inlet	Outlet	Drain											
	in	in	in	GPM	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
DXC-606-RS	3 MPT	3 MPT	3/8 FPT	70	0.16	0.59	1.27	2.20	3.38	4.82	6.50	8.44	10.63	13.07
DXC-804-S	4 MPT	4 MPT	3/8 FPT	180	0.24	0.78	1.55	2.56	3.80	5.35	7.16	9.22	11.52	14.07
DXC-805-RS	4 MPT	4 MPT	3/8 FPT	120	0.28	0.87	1.74	2.85	4.21	5.94	7.96	10.25	12.82	15.67
DXC-806-S	4 MPT	4 MPT	3/8 FPT	180	0.32	1.03	2.08	3.46	5.16	7.30	9.79	12.62	15.81	19.34
DXT-504-Q	2 MPT	2 MPT	3/4 FPT	30	0.60	0.81	1.11	1.64	2.33	3.14	4.22	5.47	6.87	8.43
DXT-505-Q	2 MPT	2 MPT	3/4 FPT	30	0.62	0.89	1.32	2.09	2.97	3.98	5.36	6.95	8.73	10.71
DXT-605-Q	2.5 MPT	2.5 MPT	3/4 FPT	50	0.63	0.92	1.44	2.27	3.25	4.55	6.15	7.99	10.05	12.36
DXT-804-Q	3 MPT	3 MPT	3/4 FPT	80	0.61	0.83	1.12	1.60	2.23	3.16	4.26	5.52	6.94	8.51
DXT-805-Q	3 MPT	3 MPT	3/4 FPT	80	0.64	0.91	1.34	2.02	2.82	3.96	5.34	6.92	8.69	10.67
DXT-806-R	3 MPT	3 MPT	3/4 FPT	100	0.63	0.88	1.24	1.95	2.76	3.84	5.18	6.71	8.43	10.35
DXT-807-R	3 MPT	3 MPT	3/4 FPT	100	0.65	0.94	1.44	2.26	3.20	4.42	5.96	7.72	9.71	11.92
DXT-1007-S	4 FLG	4 FLG	3/4 FPT	180	0.59	0.76	1.00	1.38	2.00	2.70	3.54	4.58	5.75	7.05
DXT-1008-S	4 FLG	4 FLG	3/4 FPT	180	0.60	0.80	1.07	1.58	2.29	3.09	4.03	5.22	6.55	8.03
DXT-1009-S	5 FLG	5 FLG	3/4 FPT	250	0.70	1.12	2.05	3.32	4.82	6.85	9.22	11.94	14.99	18.37
DXT-1206-S	5 FLG	5 FLG	3/4 FPT	250	0.58	0.74	0.96	1.29	1.86	2.51	3.28	4.24	5.31	6.50
DXT-1208-S	5 FLG	5 FLG	3/4 FPT	250	0.61	0.84	1.12	1.82	2.63	3.55	4.62	5.96	7.47	9.14
DXT-1209-ST	5 FLG	5 FLG	3/4 FPT	250	0.59	0.78	1.05	1.53	2.24	3.05	3.97	4.96	6.16	7.51
DXT-1410-S	6 FLG	6 FLG	3/4 FPT	450	0.44	1.16	2.23	3.61	5.27	7.23	9.49	12.07	14.95	18.13
DXT-1610-S	8 FLG	8 FLG	3/4 FPT	600	0.42	1.17	2.29	3.68	5.41	7.45	9.82	12.52	15.55	18.90
DXT-1810-S	8 FLG	8 FLG	3/4 FPT	750	0.36	0.98	1.92	3.09	4.53	6.24	8.22	10.48	13.01	15.81
DXT-1811-S	8 FLG	8 FLG	3/4 FPT	750	0.43	1.18	2.30	3.70	5.42	7.46	9.83	12.52	15.53	18.87

KETEMA LP

EVAPORATOR SPECIFICATIONS-continued

20% propylene glycol/water solution @ 30°F

Model	Fluid Connections			Max Flow	Shellside Pressure Drop in PSID at % Max Flow									
	Inlet	Outlet	Drain											
	in	in	in	GPM	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
DXC-606-RS	3 MPT	3 MPT	3/8 FPT	70	0.14	0.52	1.15	2.01	3.12	4.46	6.03	7.85	9.90	12.18
DXC-804-S	4 MPT	4 MPT	3/8 FPT	180	0.18	0.60	1.26	2.18	3.33	4.71	6.32	8.16	10.23	12.52
DXC-805-RS	4 MPT	4 MPT	3/8 FPT	120	0.20	0.66	1.40	2.42	3.70	5.24	7.04	9.09	11.39	13.94
DXC-806-S	4 MPT	4 MPT	3/8 FPT	180	0.24	0.81	1.72	2.99	4.58	6.49	8.73	11.29	14.17	17.37
DXT-504-Q	2 MPT	2 MPT	3/4 FPT	30	0.57	0.72	0.93	1.29	1.99	2.84	3.84	4.98	6.26	7.69
DXT-505-Q	2 MPT	2 MPT	3/4 FPT	30	0.59	0.78	1.05	1.64	2.53	3.61	4.88	6.33	7.97	9.79
DXT-605-Q	2.5 MPT	2.5 MPT	3/4 FPT	50	0.60	0.80	1.13	1.89	2.93	4.19	5.67	7.36	9.27	11.40
DXT-804-Q	3 MPT	3 MPT	3/4 FPT	80	0.57	0.71	0.93	1.30	2.01	2.86	3.86	5.01	6.30	7.73
DXT-805-Q	3 MPT	3 MPT	3/4 FPT	80	0.59	0.76	1.04	1.63	2.52	3.59	4.84	6.28	7.89	9.69
DXT-806-R	3 MPT	3 MPT	3/4 FPT	100	0.59	0.76	1.03	1.59	2.45	3.50	4.72	6.12	7.70	9.46
DXT-807-R	3 MPT	3 MPT	3/4 FPT	100	0.60	0.80	1.11	1.83	2.82	4.03	5.44	7.05	8.87	10.89
DXT-1007-S	4 FLG	4 FLG	3/4 FPT	180	0.56	0.69	0.87	1.11	1.71	2.43	3.27	4.24	5.32	6.53
DXT-1008-S	4 FLG	4 FLG	3/4 FPT	180	0.57	0.72	0.93	1.27	1.95	2.77	3.73	4.83	6.07	7.44
DXT-1009-S	5 FLG	5 FLG	3/4 FPT	250	0.64	0.96	1.67	2.90	4.46	6.34	8.54	11.05	13.88	17.02
DXT-1206-S	5 FLG	5 FLG	3/4 FPT	250	0.56	0.68	0.85	1.11	1.60	2.27	3.05	3.93	4.93	6.04
DXT-1208-S	5 FLG	5 FLG	3/4 FPT	250	0.58	0.75	1.00	1.47	2.25	3.19	4.29	5.54	6.94	8.50
DXT-1209-ST	5 FLG	5 FLG	3/4 FPT	250	0.57	0.72	0.95	1.26	1.91	2.69	3.60	4.63	5.77	7.04
DXT-1410-S	6 FLG	6 FLG	3/4 FPT	450	0.26	0.84	1.69	2.84	4.29	6.03	8.07	10.41	13.04	15.97
DXT-1610-S	8 FLG	8 FLG	3/4 FPT	600	0.27	0.86	1.75	2.95	4.47	6.31	8.46	10.92	13.70	16.80
DXT-1810-S	8 FLG	8 FLG	3/4 FPT	750	0.22	0.72	1.46	2.47	3.74	5.27	7.07	9.13	11.45	14.04
DXT-1811-S	8 FLG	8 FLG	3/4 FPT	750	0.27	0.86	1.75	2.95	4.47	6.30	8.44	10.89	13.66	16.75

40% propylene glycol/water solution @ 10°F

Model	Fluid Connections			Max Flow	Shellside Pressure Drop in PSID at % Max Flow									
	Inlet	Outlet	Drain											
	in	in	in	GPM	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
DXC-606-RS	3 MPT	3 MPT	3/8 FPT	70	0.53	0.66	1.38	2.36	3.60	5.07	6.79	8.76	10.97	13.42
DXC-804-S	4 MPT	4 MPT	3/8 FPT	180	0.58	1.04	2.02	3.26	4.75	6.48	8.44	10.62	13.03	15.67
DXC-805-RS	4 MPT	4 MPT	3/8 FPT	120	0.62	1.19	2.30	3.69	5.35	7.27	9.44	11.86	14.52	17.43
DXC-806-S	4 MPT	4 MPT	3/8 FPT	180	0.82	1.35	2.65	4.31	6.31	8.64	11.30	14.28	17.57	21.17
DXT-504-Q	2 MPT	2 MPT	3/4 FPT	30	0.66	0.91	1.38	2.20	3.19	4.34	5.61	7.03	8.39	9.88
DXT-505-Q	2 MPT	2 MPT	3/4 FPT	30	0.70	1.01	1.74	2.79	4.04	5.49	7.12	8.96	10.69	12.59
DXT-605-Q	2.5 MPT	2.5 MPT	3/4 FPT	50	0.69	1.03	1.83	2.98	4.38	5.99	7.79	9.56	11.53	13.64
DXT-804-Q	3 MPT	3 MPT	3/4 FPT	80	0.68	0.97	1.53	2.39	3.39	4.48	5.74	6.91	8.22	9.61
DXT-805-Q	3 MPT	3 MPT	3/4 FPT	80	0.73	1.09	1.92	3.01	4.26	5.64	7.22	8.72	10.37	12.11
DXT-806-R	3 MPT	3 MPT	3/4 FPT	100	0.71	1.04	1.76	2.76	3.93	5.21	6.68	8.23	9.95	11.70
DXT-807-R	3 MPT	3 MPT	3/4 FPT	100	0.75	1.13	2.03	3.19	4.54	6.02	7.72	9.52	11.53	13.53
DXT-1007-S	4 FLG	4 FLG	3/4 FPT	180	0.64	0.85	1.16	1.83	2.63	3.54	4.50	5.62	6.85	8.08
DXT-1008-S	4 FLG	4 FLG	3/4 FPT	180	0.66	0.90	1.33	2.10	3.00	4.04	5.14	6.42	7.81	9.24
DXT-1009-S	5 FLG	5 FLG	3/4 FPT	250	0.81	1.44	2.74	4.35	6.26	8.39	10.85	13.50	16.47	19.52
DXT-1206-S	5 FLG	5 FLG	3/4 FPT	250	0.63	0.82	1.13	1.70	2.43	3.27	4.14	5.17	6.30	7.40
DXT-1208-S	5 FLG	5 FLG	3/4 FPT	250	0.69	0.96	1.52	2.39	3.42	4.60	5.92	7.29	8.88	10.60
DXT-1209-ST	5 FLG	5 FLG	3/4 FPT	250	0.65	0.87	1.20	1.92	2.75	3.71	4.79	5.99	7.23	8.63
DXT-1410-S	6 FLG	6 FLG	3/4 FPT	450	0.98	1.97	3.30	4.97	6.96	9.29	11.94	14.94	18.24	21.74
DXT-1610-S	8 FLG	8 FLG	3/4 FPT	600	0.89	1.87	3.23	4.94	7.01	9.45	12.27	15.26	18.59	22.21
DXT-1810-S	8 FLG	8 FLG	3/4 FPT	750	0.76	1.59	2.72	4.15	5.88	7.91	10.26	12.80	15.58	18.61
DXT-1811-S	8 FLG	8 FLG	3/4 FPT	750	1.92	1.92	3.28	4.99	7.06	9.48	12.28	15.33	18.65	22.28

KETEMA LP

CONDENSER SPECIFICATIONS

Model	Fluid Connections Inlet in	Outlet in	Drain in	Max Flow GPM	Tubeside Pressure Drop in PSID at % Max Flow (Note 1) 10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
AHX-605-C-2	2 FPT	2 FPT	3/8 FPT	90	Note 2	0.36	0.75	1.25	1.87	2.60	3.43	4.36	5.39	6.53
AHX-805-A-2	2.5 FPT	2.5 FPT	3/8 FPT	150	Note 2	0.37	0.76	1.28	1.91	2.65	3.49	4.45	5.51	6.67
AHX-806-A-2	2.5 FPT	2.5 FPT	3/8 FPT	150	Note 2	0.42	0.87	1.45	2.15	2.98	3.94	5.00	6.18	7.47
AHX-1005-A-2	3 FPT	3 FPT	3/8 FPT	220	Note 2	0.36	0.74	1.24	1.85	2.58	3.40	4.33	5.36	6.49
AHX-1006-A-2	3 FPT	3 FPT	3/8 FPT	220	Note 2	0.41	0.84	1.41	2.09	2.90	3.83	4.86	6.01	7.27
AHX-1205-A-2	4 FPT	4 FPT	3/8 FPT	300	Note 2	0.33	0.67	1.11	1.66	2.30	3.03	3.85	4.76	5.76
AHX-1206-A-2	4 FPT	4 FPT	3/8 FPT	300	Note 2	0.37	0.76	1.27	1.89	2.61	3.44	4.36	5.38	6.50
AHX-1208-A-1	6 FLG	6 FLG	3/8 FPT	600	Note 2	0.23	0.47	0.79	1.16	1.60	2.10	2.66	3.27	3.94

AHX Design Pressures
Shell (refrigerant) side: 350 PSIG @ 250°F
Tube (fluid) side: 150 PSIG @ 150°F

FPT - female pipe thread
FLG - 125 lb flat face flange

Note 1: Water at an average temperature of 90°F. For other fluids, consult the factory.
Note 2: This water flow rate is below the minimum acceptable limit.

COMPRESSOR SPECIFICATIONS

Compressor Model	Nom HP	Cyl	CCH Watts	460 V RLA	460 V LRA AL/PW	460 V Max Fuse	460 V Std Fuse	208/230 V RLA	208/230 V LRA AL/PW	208/230 V Max Fuse	208/230 V Std Fuse	oil type/quan oz
4H-25.2	25	4	140	42	218/NA	74	70	84	436/262	147	110	AB/158
6J-33.2	33	6	140	55	275/NA	96	70	110	550/330	193	150	AB/167
6H-35.2	35	6	140	58	275/NA	102	70	116	550/330	203	150	AB/167
6G-40.2	40	6	140	78	250/NA	137	110	156	700/420	273	225	AB/167
6F-50.2	50	6	140	80	425/NA	140	125	160	950/570	280	225	AB/167
8GC-60.2	60	8	140	110	488/332	193	150	240	1050/714	420	350	AB/175
8FC-70.2	70	8	140	132	545/371	231	200	290	1190/809	508	400	AB/175
4DH3-2500-TSK	25	4	100	41	214/NA	72	70	82	428/250	144	110	MO/135
6DB3-3000-TSK	30	6	100	53	283/NA	93	70	105	565/340	184	150	MO/140
6DH3-3500-TSK	35	6	100	54	283/NA	95	70	107	565/340	187	150	MO/140
6DJ3-4000-TSN	40	6	200	71	297/NA	124	110	142	594/340	249	225	MO/255
8DP1-5000-TSK	50	8	200	90	535/NA	158	125	180	1070/654	315	225	MO/260
8DS1-6000-TSK	60	8	200	112	535/NA	196	150	224	1070/654	392	300	MO/260

CCH - crankcase heater
RLA - rated load amps
LRA - locked rotor amps
AL - across-the-line start
PW - part-winding start
AB - alkylbenzene
MO - mineral oil
NA - not available

Notes:
1) 4-cylinder compressors can be equipped with 1 stage of unloading for 50% capacity reduction.
2) 6-cylinder compressors can be equipped with 1 stage of unloading for 33 % capacity reduction, or 2 stages of unloading for 67% capacity reduction.
3) 8-cylinder compressors can be equipped with 1 stage of unloading for 25 % capacity reduction, or 2 stages of unloading for 50% capacity reduction.