



GP Series Portable Chillers

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Write Down Your Serial Numbers Here For Future Reference:

_____	_____
_____	_____
_____	_____

We are committed to a continuing program of product improvement.
Specifications, appearance, and dimensions described in this manual are subject to change without notice.

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Shipping Information

Unpacking and Inspection

You should inspect your equipment for possible shipping damage. Thoroughly check the equipment for any damage that might have occurred in transit, such as broken or loose wiring and components, loose hardware and mounting screws, etc.

In the Event of Shipping Damage

According to the contract terms and conditions of the Carrier, the responsibility of the Shipper ends at the time and place of shipment.

Notify the transportation company's local agent if you discover damage

Hold the damaged goods and packing material for the examining agent's inspection. **Do not return any goods before the transportation company's inspection and authorization.**

File a claim with the transportation company. Substantiate the claim by referring to the agent's report. A certified copy of our invoice is available upon request. The original Bill of Lading is attached to our original invoice. If the shipment was prepaid, write us for a receipted transportation bill.

Advise customer service regarding your wish for assistance and to obtain an RMA (return material authorization) number.

If the Shipment is Not Complete

Check the packing list as back-ordered items are noted on the packing list. In addition to the equipment itself, you should have:

- Bill of lading
- Packing list
- Operating and Installation packet
- Electrical schematic and panel layout drawings
- Component instruction manuals (if applicable)

Re-inspect the container and packing material to see if you missed any smaller items during unpacking.

If the Shipment is Not Correct

If the shipment is not what you ordered, **contact the parts and service department immediately** at (262) 641-8610. Have the order number and item number available. *Hold the items until you receive shipping instructions.*

Returns

Do not return any damaged or incorrect items until you receive shipping instructions from the shipping department.

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Chapter 1: Safety

1-1 How to Use This Manual

Use this manual as a guide and reference for installing, operating, and maintaining your equipment. The purpose is to assist you in applying efficient, proven techniques that enhance equipment productivity.

This manual covers only light corrective maintenance. No other maintenance should be undertaken without first contacting a service engineer.

The Functional Description section outlines models covered, standard features, and optional features. Additional sections within the manual provide instructions for installation, pre-operational procedures, operation, preventive maintenance, and corrective maintenance.

The Installation chapter includes required data for receiving, unpacking, inspecting, and setup of the equipment. We can also provide the assistance of a factory-trained technician to help train your operator(s) for a nominal charge. This section includes instructions, checks, and adjustments that should be followed before commencing with operation of the equipment. These instructions are intended to supplement standard shop procedures performed at shift, daily, and weekly intervals.

The Operation chapter includes a description of electrical and mechanical controls, in addition to information for operating the equipment safely and efficiently.

The Maintenance chapter is intended to serve as a source of detailed assembly and disassembly instructions for those areas of the equipment requiring service. Preventive maintenance sections are included to ensure that your equipment provides excellent, long service.

The Troubleshooting chapter serves as a guide for identification of most common problems. Potential problems are listed, along with possible causes and related solutions.

The Appendix contains technical specifications, drawings, schematics, and parts lists. A spare parts list with part numbers specific to your machine is provided with your shipping paperwork package. Refer to this section for a listing of spare parts for purchase. Have your serial number and model number ready when ordering.

Safety Symbols Used in this Manual

The following safety alert symbols are used to alert you to potential personal injury hazards. Obey all safety messages that follow these symbols to avoid possible injury or death.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a potentially hazardous situation or practice which, if not avoided, could result in death or serious injury.

CAUTION indicates a potentially hazardous situation or practice which, if not avoided, may result in minor or moderate injury or in property damage.

1-2 Warnings and Precautions

Our equipment is designed to provide safe and reliable operation when installed and operated within design specifications, following national and local safety codes.

To avoid possible personal injury or equipment damage when installing, operating, or maintaining this equipment, use good judgment and follow these safe practices:

- ✓ Follow all **SAFETY CODES**.
- ✓ Wear **SAFETY GLASSES** and **WORK GLOVES**.
- ✓ Disconnect and/or lock out power before servicing or maintaining the equipment.
- ✓ Use care when **LOADING, UNLOADING, RIGGING, or MOVING** this equipment.
- ✓ Operate this equipment within design specifications.
- ✓ **OPEN, TAG, and LOCK ALL DISCONNECTS** before working on equipment. You should remove the fuses and carry them with you.
- ✓ Make sure the equipment and components are properly **GROUND** before you switch on power.
- ✓ When welding or brazing in or around this equipment, make sure **VENTILATION** is **ADEQUATE**. **PROTECT** adjacent materials from flame or sparks by shielding with sheet metal. An approved **FIRE EXTINGUISHER** should be close at hand and ready for use if needed.
- ✓ Refrigeration systems can develop refrigerant pressures in excess of 500 psi (3,447.5 kPa/ 34.47 bars). **DO NOT CUT INTO THE REFRIGERATION SYSTEM. This must be performed by a qualified service technician only.**
- ✓ Do not restore power until you remove all tools, test equipment, etc., and the equipment and related components are fully reassembled.
- ✓ Only **PROPERLY TRAINED** personnel familiar with the information in this manual should work on this equipment.

We have long recognized the importance of safety and have designed and manufactured our equipment with operator safety as a prime consideration. We expect you, as a user, to abide by the foregoing recommendations in order to make operator safety a reality.

1-3 Responsibility

These machines are constructed for maximum operator safety when used under standard operating conditions and when recommended instructions are followed in the maintenance and operation of the machine.

All personnel engaged in the use of the machine should become familiar with its operation as described in this manual.

Proper operation of the machine promotes safety for the operator and all workers in its vicinity.

Each individual must take responsibility for observing the prescribed safety rules as outlined. All warning and danger signs must be observed and obeyed. All actual or potential danger areas must be reported to your immediate supervisor.

Chapter 2: Functional Description

2-1 Models Covered in This Manual

This manual provides operation, installation, and maintenance instructions for air-, water- and remote air-cooled portable chillers. Model numbers are listed on the serial tag. Make sure you know the model and serial number of your equipment before contacting the manufacturer for parts or service.

Our portable chiller models are designated by approximate compressor horsepower (5, 7 1/2, 10, 13 and 15 etc) and the cooling method used: -A for air-cooled, -W for water-cooled, and -R for remote-air cooled.

2-2 General Description

Our portable chillers are reliable, accurate, and easy to use process cooling units. They are available in air-, water-, and remote air-cooled designs in a range of sizes from 5 to 15 tons. All are self-contained, fully portable and shipped ready to use. (Remote air-cooled chillers require field installation by qualified technicians.)

Standard range of operation is 20°F to 80°F (-7°C to 27°C) for applications using a water/glycol mix and 45°F to 80°F (7° to 27°C) for water only applications.

A factory installed crankcase pressure regulating valve option is available for processes requiring a leaving water temperature over 80°F (27°C).

Chilled Water Circuit

Cooling water “To Process” and “From Process” connections are made at the female NPT couplings provided outside the unit. Warm coolant (water and glycol mixture) returns from the process and goes into the reservoir tank. The coolant is then pumped through the evaporator where it is cooled. The coolant flows to the process and returns to repeat the cycle.

A (manual) pressure actuated process water bypass valve located between the supply line and reservoir tank (single pump models only) allows minimal flow through the unit during the intermittent fluctuating flow conditions. It is not intended to provide continuous full bypass flow.

This minimal flow allows the temperature sensor to signal the controller to shut down the compressor because of the drop in process water temperature. Typically the flow switch shuts down the chiller in this low flow condition. This valve allows enough flow for the chiller to function when the flow is shut off to process.

Refrigeration Circuit

Air-, water-, and remote air-cooled refrigerant condensing differ only in the way the compressed gas is condensed to a liquid.

Liquid refrigerant from the condenser heat exchanger flowing in the liquid line passes through a shut-off valve into a filter/dryer that removes moisture and other contaminants. A refrigerant sight glass is provided. The refrigerant then passes through the thermal expansion valve, which allows the refrigerant to expand (boil off) and cool (remove the heat from) the fluid inside of the evaporator. The refrigerant gas flows through the suction line back into the compressor.

The refrigerant is compressed in the compressor and flows through the discharge line as a gas to the condenser. There it gives up its heat as it condenses to a liquid in the condenser.

An electronic hot gas bypass valve is used to control cooling capacity during intermittent or partial load conditions. This feature contributes substantially to chiller longevity by eliminating excessive cycling of the compressor and providing close temperature control.

2-3 Standard Features

Mechanical Features

Compressor. Hermetic scroll compressors.

Evaporator. Stainless steel copper brazed plate evaporators.

Air-Cooled Condenser. Aluminum fin/ tube with washable filters, *package unit only (option on remotes)*.

Water-Cooled Condenser. Tube-in-tube condensers. All come with electronic cooling water regulating valves. 1 in. NPT valves for GPWC20 & 30; 1.25 in. NPT valves for GPWC40; and 1.50 in. NPT valves for GPWC50.

Remote Air-Cooled Condenser. Aluminum fin/tube with low ambient control down to – 20°F (-29°C) via a variable-speed primary fan.

Reservoir. 5 hp and 7.5 hp models use a 20 gallon polyethylene tank. 10 hp and 15 hp models use a 40 gallon polyethylene tank.

Piping. Non-ferrous piping

Pump. TEFC motors (Optional 10 HP is ODP only)—horizontally mounted stamped stainless steel construction.

Other Mechanical Features

- Low process water thermal flow switch
- NEMA-rated fan motor(s) on air-cooled models
- Galvanized structural steel frame, painted cabinetry, with 4” (locking) swivel casters
- Internal process water bypass valve for system protection only
- Fully insulated refrigeration and process water piping
- 20 mesh Y strainer on process water piping into the evaporator
- Tank level indication
- Pump pressure indication

Electrical Features

- Fully accessible NEMA 12-style electrical control enclosure
- Single-point power and ground connection
- Non-fused disconnect switch, lockable
- Branch circuit fusing
- 208-230/3/60, 460/3/60, 575/3/60 volt; 400/3/50 volt

Refrigeration Features

- HFC-410a refrigerant
- Electronic hot gas bypass capacity control
- High refrigerant pressure cutout switches
- Suction and discharge pressure transducers.
- High pressure spring actuated relief valve
- Multiple refrigeration access ports
- Liquid line shut-off ball valves
- Filter-dryer
- Sight glass
- Externally equalized thermal expansion valve
- Liquid line solenoid
- Compressor crankcase heater

Controller Features

- Off-the-shelf microprocessor-based PID controller with To Process, From Process and Set Point readout
- Time delay for proof of water flow/pressure (models w/pump only)
- Low refrigerant pressure time delay for low ambient start-up on remote air-cooled and air-cooled chillers with the variable-speed fan option.
- 8 line x 20 character display with status, alarm, and service screens

Other Features

- One year labor warranty and one year compressor warranty
- Two year parts warranty
- Two year limited controller warranty

2-4 Safety Devices and Interlocks

Caution! *Protect the system from freezing with glycol 20°F below the leaving water temperature set point. Condensation may form inside the pump tank and dilute the mixture, therefore the freezing point should be verified periodically. See Figure 6 on page 18 for the correct mixture.*

Crankcase Heater

5 hp through 15 hp portable chillers have a crankcase heater. It is wired through the control transformer that operates continuously whenever power is applied to the chiller.

Caution! *Energize the crankcase heater for at least 24 hours before initial startup to drive dissolved refrigerant from the compressor oil. Failure to do so will damage the compressor.*

High Pressure Cutout

This electro-mechanical cutout device opens the compressor control circuit if the refrigeration system compressor discharge pressure exceeds 575 psi..

Note: *The high-pressure cutout is a manual reset device typically mounted on the compressor discharge line inside the mechanical cabinet. Call a refrigeration service technician to analyze the problem and reset the control.*

Low Pressure Cutout (no switch but done through the transducer)

There are two pressure transducers in the refrigeration piping – one on the suction line before the compressor and one on the discharge line after the compressor. Within the program there are four settings that warn and fault based on these two pressure transducers. The low suction warning is set for 110 psig (758 kPa), and the compressor will fault at 100 psig (689 kPa). The low discharge warning is set for 200 psig (1,379 kPa), and the compressor will fault at 180 psig (1,241 kPa). To prevent nuisance tripping there are delays built in to the program.

Note: *Call a refrigeration service technician to analyze the problem to prevent recurring low pressure faults.*

Flow Switch

The thermal dispersion flow switch cutout device, mounted in the process piping, shuts down the chiller if it senses that the water/glycol flow rate through the evaporator has dropped below an acceptable level. The flow switch opens the control circuit and shuts down the pumps and the chiller.

Remote Start/Stop Interlock

An additional contact is provided to allow the remote starting or stopping of the chiller. To use this feature, remove the jumper between terminals 1 and 23, and supply a switch or dry contact interlock connected in series between these two terminals. Refer to the schematic inside the control enclosure door.

2-5 Optional Features

Options marked with “*” indicate options that can be factory installed or retrofitted in the field.

Automatic Water Make-Up*. Not available on chillers less reservoir tank. Includes an electric water solenoid valve, a level sensing pressure switch mounted in the reservoir tank, and the necessary internal piping to connect the chiller to a make-up water source. See Appendix for typical piping diagrams.

Caution! *Customer piping must provide backflow protection and venting of tank to atmosphere to prevent over-pressurization of the reservoir tank (not needed for open tank). See Error! Reference source not found. on page Error! Bookmark not defined..*

Process Water Side-stream Filter*. Not available on chillers less pump and reservoir tank. This option includes a 50 micron filter, flow meter, ball valve for throttling water flow, and the necessary piping to provide constant filtering of the process water at about one gallon per minute (1 gpm/3.8lpm).

General Fault Indicator Audible/Visual Alarm*. This option includes a 100 dB audible alarm horn/ visual alarm strobe and silence button with provisions for customer wiring indication interlock. The alarm signals anytime that a fault is recognized during the operation of the chiller.

Communications Options. RS-485 serial Modbus communications.

High Pressure Fans. Provides for an additional 1.0"WC (250 Pa) of static pressure on fan discharge. High-pressure fans are necessary and must be included in chiller installations where exiting air exhausts through ductwork.

They can be retrofitted without sheet metal modification, but will require changing out fan blades, and in some cases, fan motors and electrical components.

Variable Speed Fan. Reduces the speed of the fan based on entering air temperature and system load, allowing the chiller to operate in ambient temperatures below 60°F (15.5°C). This option will also reduce fan noise in ambient temperatures below 95°F (35°C).

Stainless Steel Reservoir. Manufactured from 304 stainless steel.

Mounting Features.

- Mounting rails with feet

Optional Operating Voltages. 208-230/3/60, 460/3/60, 575/3/60, and 400/3/50 volt available

UL Labeled Electrical Subpanel. This option provides for the subpanel to be listed with Underwriters Laboratory, with UL-related benefits and features.

Optional Pumps. Pump options are available for greater pressure and flow rates. A recirculation pump is required whenever process water flow is less than 1.2 gpm per ton or greater than 4.8 gpm per ton. See Figure 1 on page 12 for optional pump amperages.

NEMA 4 Electrical Enclosure. Provides for NEMA 4-level electrical enclosure protection.

Figure 1: Optional Pump Amperages

Voltage	Construction	HP	Full Load Amps
460/3/60	SS	1	1.7
		1.5	2.3
		2	4.0
		3	4.2
		5	8.2
		10	12.0

Chapter 3: Installation

3-1 Uncrating

All models are shipped mounted on a skid, enclosed in a plastic wrapper, and open-crated on all four sides and top.

1. Pry the crating away from the skid.
2. Use a pry bar to remove the blocks securing the unit to the skid.
3. Lift unit from sides, inserting forklift under the base. The forks must be equidistant from the centerline of the unit and the unit must be balanced on the forks. Lift slowly and only high enough to clear the skid. Use a pry bar if necessary to carefully remove the skid from the unit.
4. Lower slowly. The unit should land on its casters or rails and can then be moved into position.
5. Retain the crating material for reshipping the chiller in case hidden shipping damage is found.

3-2 Electrical Connections

Supply electricity of the voltage, phase, and cycle listed on the serial tag. Total running amps are also found in the specification tables on pages in the Appendix.

Bring properly sized power leads and ground from a fused disconnect (installed by your electrician) to the unit. Use dual-element fuses in the disconnect switch, sized according to the National Electrical Code recommendations. Note the outline drawings for egress into the cabinet. Make sure all electrical connections are tight.

Important!

Refer to your local electrical requirements for proper feeder conductor and supply disconnecting sizing. For instance, in the United States refer to National Electric Code (NEC) Article 430-24 through 430-26, Table 310.15(B)(2)(a)

3-3 Process Water Connections

All of our portable chillers have two chilled water connections. The chilled water supply, labeled “To Process” is the outlet for the chilled water leading to the process being cooled. The chilled water return, labeled “From Process” is the inlet leading from the process back into the chiller to be cooled and re-circulated.

All external chilled water connections should be run full size to the process. Flow and pressure information is available in the Appendix. The largest possible openings and passages should be provided for the flow of chilled water through platens, dies, molds, or other pieces of equipment.

Note: *Be sure to reduce external pressure drop as much as possible by generously sizing piping and tooling water passageways.*

3-4 Bypass Valve Considerations

Our portable chillers have an internal manual bypass valve. If the flow is stopped to the process while the chiller is running, the factory-set bypass valve allows a small amount of water to flow through the chiller. This action allows the chiller to keep functioning while the flow is stopped to process. The bypass valve is not intended to provide continuous full bypass flow.

Caution! *Do not attempt to adjust or otherwise tamper with the internal bypass. Your warranty will be voided.*

3-5 Galvanic Corrosion Considerations

The materials used in the water circuit piping of these chillers are non-ferrous and react electro-chemically with ferrous metallic materials. Some water has dissolved minerals that greatly accelerate the reaction between dissimilar metals.

PVC or non-ferrous piping is recommended to reduce galvanic action. If iron piping must be used, use dielectric unions at the chiller, and water treatment is required.

3-6 Water Treatment Considerations

Water treatment is an integral part of the system. In some locations, water may cause large deposits of scale, erosion, algae, and/or corrosion.

Note: *The use of poor quality water may result in inefficient operation, heat exchanger damage, and pump seal damage. Consult a qualified water treatment specialist to determine whether treatment is needed.*

3-7 Condenser Considerations

Water-Cooled Chiller Condensers

Water-cooled portable chillers can use city water or tower water as a cooling medium. Make sure that all external piping and connections supplying and discharging water to and from the condenser are full size.

You'll make two connections to the water-cooled condenser:

Condenser Water In. The condenser water supply, labeled "Condenser Water In", is located at the rear of the chiller. It is the inlet for city or tower water.

Make sure that water is supplied at a maximum temperature of 85°F (29°C) and a minimum pressure of 25 psi.

Caution! *The electronic water-regulating valves pressure setpoint is set at the factory. Only a qualified refrigeration technician should adjust the pressure setting. Please contact our service group at 800-423-3183 to schedule an appointment.*

Normal HFC-410a refrigerant condensing pressure is 342 psi (2,360 kPa), with 85°F (27°C) water at 25 psi entering condenser water pressure

Condenser Water Out. Condenser water return, labeled "Condenser Water Out", is located at the rear of the chiller. It is the outlet for water after it has passed through the condenser.

It is connected to the tower water return line or to a sewer or other approved discharge receiver. A water-regulating valve is a standard feature in the condenser water out line.

Air-Cooled Chiller Condensers

Air-cooled chillers use the surrounding air to cool the condenser. Install the chiller in an area where there is free passage of air for condensing and provisions for removal of heated air from the area. Do not locate air-cooled chillers in locations where steam, hot air, or fume exhausts can be drawn into the chiller.

Caution! *Clean air-cooled condensers and filters frequently. Failure to do so results in reduced capacity, increased operating costs, and possible failure of the equipment. Cleaning instructions can be found in the Maintenance chapter of this manual*

Normal maximum refrigerant condensing pressure with 95°F (35°C) air entering the condenser is 420 psi (2896 kPa).

Condensing Air Temperature. Our air-cooled portable chillers are designed to operate at a minimum condenser entering air temperature of approximately 60°F (15.5°C). Operation of the equipment at a lower condenser entering air temperature can cause the chiller to malfunction. For entering air temperatures below 60°F (15.5°C), an optional fan motor speed control is available. We recommend maintaining a minimum 60°F (15.5°C) ambient temperature.

Remote Air-Cooled Chiller Condensers

Remote air-cooled portable chillers are shipped with nitrogen holding charge and a full charge of oil (excluding the amount needed for field piping). The remote air condenser is shipped with a dry nitrogen charge. Verify that the holding charge has not been lost prior to installation. If there is no pressure, leak test the unit and repair before installing the interconnecting refrigerant piping. Read this entire section before installation.

Note: *Piping should be type “L” or type “K” refrigerant grade copper tubing only. Proper sizing and installation has a significant effect on system performance, reliability, and safety.*

Interconnecting Refrigerant Piping. The chiller and condenser refrigerant lines are terminated with a cap and brazed closed. Use a tube cutter to remove caps.

Caution! *Do not use a saw to remove the end caps because this will allow copper chips to contaminate the system.*

A certified refrigeration contractor need only to install the interconnecting refrigerant piping between the chiller and the outdoor air-cooled condenser. This piping must be properly sized, type “L” or type “K” refrigerant grade tubing, high temperature brazed, Install a customer supplied 650 psi approved refrigerant relief valve in the discharge line at the condenser, following all codes.

When brazing copper joints, flow dry nitrogen through the system to prevent carbon/scale formation, which causes contamination. Isolate the refrigerant lines from the building, preventing transfer of line vibration to the structure. Do not secure the lines rigidly.

Leak check and evacuate the system down to 400 microns. A decay of 50 microns after one hour is acceptable.

Warning! *To prevent injury or death due to explosion and/or inhalation of phosgene gas, purge system thoroughly while brazing refrigerant piping connections. Use a pressure regulator in the line between the unit and the high-pressure nitrogen cylinder to avoid over-pressurization and possible explosion.*

System Configuration. The system can be configured in any of the arrangements shown on page 49 of the Appendix. The configuration and distance between the chiller and the condenser affects pipe size, refrigerant charge, oil return, and oil charge. Therefore there are limitations that must be adhered to for reliable and optimal operation.

- Leaving water temperature affects discharge line size. Be sure to inform the installing contractor of the leaving water temperature range in which the chiller will be operating
- The total distance between the chiller and condenser must not exceed 200 feet or 300 equivalent pipe feet
- Discharge line risers cannot exceed an elevation difference greater than 100 feet without a 2% efficiency decrease.
- Refer to page 49 of the Appendix for the location of traps.
- Refrigeration lines must not be crossed, i.e., chiller liquid lines are to be piped to condenser liquid lines.

Sizing Refrigerant Lines. To determine field installed liquid and discharge line sizes, first establish the equivalent length of pipe for each line, valve, and elbow. Chiller capacity and

leaving water temperature range is also required. See Figure 2 on page 17 for lengths of refrigerant valves and fittings.

Liquid Line Sizing. The liquid line should be sized as small as possible while maintaining acceptable pressure drop to minimize the refrigerant charge. Liquid line risers must not exceed 15 feet from the base of the air-cooled condenser. Horizontal runs do not require a pitch. Insulation is not required unless the line is installed in a high ambient area, i.e., boiler room. Install a liquid line-charging valve to facilitate refrigerant charging. See Figure 3 on page 17 for sizing information. See Figure 5 on page 19 for charge determination.

Discharge Line Sizing. For horizontal runs, the discharge line should be pitched downward, in the direction of flow, at a rate of 1/2" for every 10 feet. This will allow oil to flow towards the condenser. Discharge line sizing is based on the velocity required for sufficient oil return back to the compressor. See Figure 4 on page 18 for discharge line sizing.

Figure 2: Equivalent Length in Feet for Valves and Fittings

Line Size OD (inches)	Angle Valve	Short Radius EL	Long Radius EL
3/8	24	4	2.8
1/2	24	4.7	3.2
5/8	25	5.7	3.9
3/4	25	6.5	4.5
7/8	28	7.8	5.3
1-1/8	29	2.7	1.9
1-3/8	33	3.2	2.2
1-5/8	34	3.8	2.6
2-1/8	39	5.2	3.4
2-5/8	44	6.5	4.2

Figure 3: Liquid Line Sizing

5 TON CIRCUIT				
Total Equiv. Length (Ft)	Liquid Line Size (OD")			
	Horizontal or Downflow	Upflow 1-5 Ft	Upflow 6-10 Ft	Upflow 11-15 Ft
25	1/2	1/2	1/2	1/2
50	1/2	1/2	1/2	1/2
75	1/2	1/2	1/2	1/2
100	1/2	1/2	1/2	5/8
125	1/2	1/2	1/2	5/8
150	1/2	1/2	5/8	5/8
175	1/2	5/8	5/8	5/8
200	1/2	5/8	5/8	5/8
225	1/2	5/8	5/8	5/8
250	5/8	5/8	5/8	5/8
275	5/8	5/8	5/8	5/8
300	5/8	5/8	5/8	5/8

7.5 TON CIRCUIT				
Total Equiv. Length (Ft)	Liquid Line Size (OD")			
	Horizontal or Downflow	Upflow 1-5 Ft	Upflow 6-10 Ft	Upflow 11-15 Ft
25	5/8	5/8	5/8	5/8
50	5/8	5/8	5/8	5/8
75	5/8	5/8	5/8	5/8
100	5/8	5/8	5/8	5/8
125	5/8	5/8	5/8	5/8
150	5/8	5/8	5/8	5/8
175	5/8	5/8	5/8	3/4
200	5/8	5/8	5/8	3/4
225	5/8	5/8	5/8	3/4
250	5/8	5/8	3/4	3/4
275	5/8	5/8	3/4	3/4
300	5/8	5/8	3/4	3/4

10 TON CIRCUIT				
Total Equiv. Length (Ft)	Liquid Line Size (OD")			
	Horizontal or Downflow	Upflow 1-5 Ft	Upflow 6-10 Ft	Upflow 11-15 Ft
25	5/8	5/8	5/8	3/4
50	5/8	5/8	3/4	3/4
75	5/8	5/8	3/4	3/4
100	5/8	3/4	3/4	3/4
125	3/4	3/4	3/4	7/8
150	3/4	3/4	3/4	7/8
175	3/4	3/4	3/4	7/8
200	3/4	3/4	3/4	7/8
225	3/4	3/4	7/8	7/8
250	3/4	3/4	7/8	7/8
275	3/4	3/4	7/8	7/8
300	3/4	3/4	7/8	7/8

15 TON CIRCUIT				
Total Equiv. Length (Ft)	Liquid Line Size (OD")			
	Horizontal or Downflow	Upflow 1-5 Ft	Upflow 6-10 Ft	Upflow 11-15 Ft
25	7/8	7/8	7/8	7/8
50	7/8	7/8	7/8	7/8
75	7/8	7/8	7/8	7/8
100	7/8	7/8	7/8	7/8
125	7/8	7/8	7/8	7/8
150	7/8	7/8	7/8	7/8
175	7/8	7/8	7/8	7/8
200	7/8	7/8	7/8	7/8
225	7/8	7/8	7/8	7/8
250	7/8	7/8	7/8	7/8
275	7/8	7/8	7/8	1-1/8
300	7/8	7/8	7/8	1-1/8

Figure 4: Discharge Line Sizing

Circuit Tons	Horizontal or Downflow Discharge Line Sizes (OD")											
	Total Equivalent Length (Ft)											
	25	50	75	100	125	150	175	200	225	250	275	300
5	5/8	5/8	5/8	5/8	3/4	3/4	3/4	3/4	3/4	3/4	3/4	7/8
7.5	7/8	7/8	7/8	7/8	7/8	7/8	7/8	7/8	7/8	7/8	7/8	7/8
10	7/8	7/8	7/8	7/8	7/8	7/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8
15	7/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8

Circuit Tons	Upflow Discharge Line Sizes (OD")											
	Total Equivalent Length (Ft)											
	25	50	75	100	125	150	175	200	225	250	275	300
5	5/8	5/8	5/8	5/8	A-3/8 B-5/8	A-3/8 B-5/8	A-3/8 B-5/8	A-3/8 B-5/8	A-3/8 B-5/8	A-3/8 B-5/8	A-3/8 B-5/8	A-3/8 B-3/4
7.5	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4
10	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4	A-3/8 B-3/4	A-1/2 B-7/8	A-1/2 B-7/8	A-1/2 B-7/8	A-1/2 B-7/8	A-1/2 B-7/8
15	7/8	7/8	A-1/2 B-7/8	A-1/2 B-7/8	A-1/2 B-7/8	A-1/2 B-7/8	A-1/2 B-7/8	A-1/2 B-7/8	A-1/2 B-7/8	A-1/2 B-7/8	A-1/2 B-1-1/8	A-1/2 B-1-1/8

Refrigerant Charge Determination. The approximate amount of refrigerant charge required by the system varies based on the total length of the refrigerant lines and the size of the chiller. Referring to Figure 5, determine the amount of charge based on the horsepower of the chiller and the amount of charge based on discharge and liquid line sizes and lengths. Add these three numbers together to find the final operating charge. The final operating charge must be verified by running the system and checking the liquid line sight glass.

Figure 5: Refrigerant Charge Determination

Chiller Model	Condenser and Chiller Charge (per circuit)									
	Minimum Design Ambient - °F									
	60	50	40	30	20	10	0	-10	-20	
GPRC5	9	9	10	11	12	13	13	13	14	
GPRC7.5	10	10	12	14	15	16	16	17	17	
GPRC10	13	13	15	17	19	20	21	21	22	
GPRC15	18	19	22	25	27	29	30	31	32	

Line Size OD (inches)	Discharge Line LBS of R-410a	Liquid Line LBS of R-410a
3/8	0.3	3.2
1/2	0.6	6.0
5/8	1.0	9.6
3/4	1.5	14.4
7/8	2.1	20.0
1-1/8	3.7	34.1

Oil Charge Determination. The remote air-cooled portable chillers are factory charged with the amount of oil required without field-installed piping. Additional oil required is dependent on the amount of additional refrigerant added.

Calculate the amount of additional oil required by using the following formula:

$$\text{Pints of oil (Copeland Ultra 22cc)} = \text{lbs of R-410a added for field installed piping} / 100.$$

3-8 Checking Motor Direction

All of our portable chillers have their motor rotations properly phased at the factory. If compressors, pumps, or fans are running in reverse rotation, disconnect and lock out the power source and reverse any two power leads into the chiller disconnect switch.

Caution! *Do not switch leads at the motors, motor starters, or contactors.*

Three-Phase Compressors

Scroll compressors are directionally-dependent and compress in one rotational direction. Reversing rotation direction results in an elevated sound level and a substantially-reduced current draw.

Water Pumps

Correct pump rotation is indicated by a positive pressure of 20 to 40 psi on the pump pressure gauge. Pump rotation should be clockwise when viewed from the motor end. For chillers with optional pumps, check the appropriate pump curve in the Appendix.

Caution! *Do not run pump dry. Doing so will result in seal damage.*

Condenser Fan

Air should be drawn through the condenser and discharged vertically from the chiller.

3-9 Water Reservoir

All portable chillers shipped during the fall, winter, or spring, or those units that are shipped from stock are flushed at the factory with a water/ethylene glycol solution to prevent piping components prone to retaining water from freezing. During startup and when additional solution is required, refer to the ethylene glycol and propylene glycol curves in Figure 6 on page 20. Add a pre-mixed solution of industrial quality (not automotive) ethylene glycol or propylene glycol and water to provide freeze protection to a temperature 20°F (11°C) below the normal chiller operating temperature set point.

Glycol and/or water, with an inhibitor, should be used to protect the materials (copper, steel, stainless steel, and bronze) in the system from corrosion. If you intend to use straight water, we strongly advise a minimum leaving water temperature of 45°F (7°C) or contact the service department.

The following glycol products are available:

Part Number	Description
A0541358	Ethylene glycol, 5 gallons (18.9 liters)
A0539637	Ethylene glycol, 55 gallons (208.2 liters)
A0542990	Propylene glycol, 5 gallons (18.9 liters)
A0542991	Propylene glycol, 55 gallons (208.2 liters)

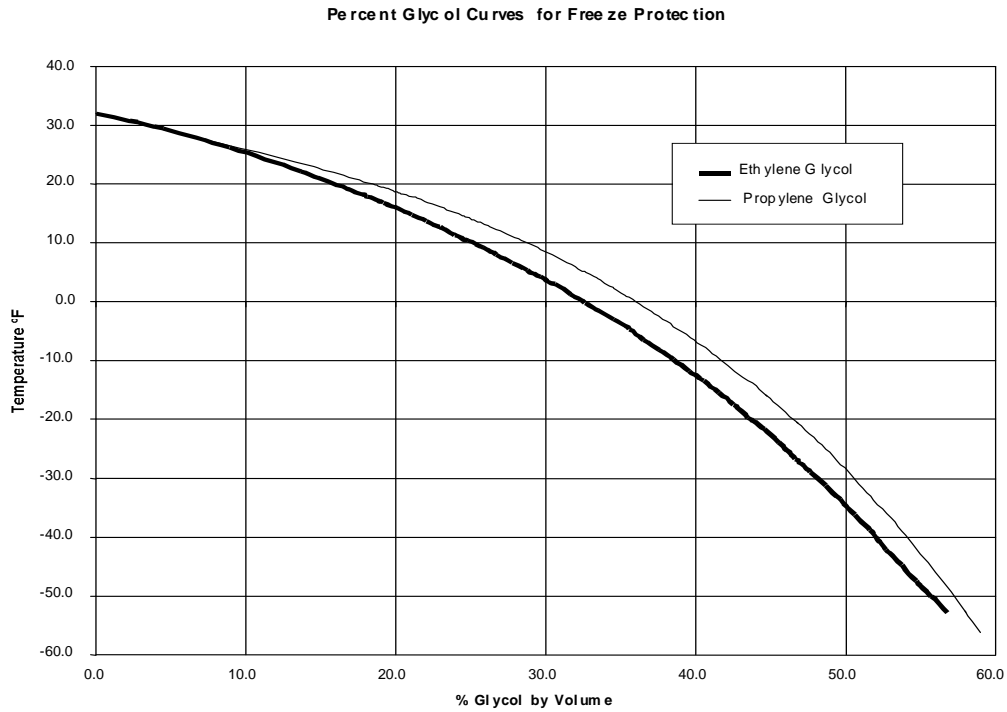
Caution! *Do not connect make-up water directly to the chilled water reservoir unless you have an approved automatic water make-up system installed.*

Caution! *Do not pressurize tank. Supply and return connections must be trapped and vented to allow vertical risers to drain into tank. Do not overfill system. Allow enough free space in tank for vertical piping to drain.*

If your application has chilled water or process piping above the chiller, trap and vent the supply and return lines to allow vertical piping to drain into tank.

Note: *In applications where the process or process piping is above the reservoir, take steps to prevent over pressurization of the reservoir. This condition can occur on system shutdown when the water in the system drains into the reservoir. To prevent this, a vacuum breaker should be installed at the high point of the “To Process” and “From Process” lines.*

Figure 6: Ethylene Glycol and Propylene Glycol Curves



Example: 45°F set point minus 20°F = 25°F.

From Figure 28, 25°F equates to 10% by volume of glycol required.

Note: *The standard pumps used in the GPAC Series chillers are not recommended to be used with fluid below 0°F (-18°C). Please consult factory for the proper pump.*

3-10 Automatic Water Make-Up Option

The chiller may be connected to an automatic make-up system if the optional package (pipe fittings, solenoid valve and 1/2" NPT city water make-up connection) is factory installed.

If the automatic make-up system is connected to a city water system, make provisions to prevent backflow contamination. Install an approved backflow preventer in accordance with local codes.

Caution! *Adding straight city water into a glycol/water mixture dilutes the solution and eventually leads to system freeze-up. Damage from freeze-up is not covered by the warranty.*

To prevent system freeze-up in automatic make-up applications, we recommend using either a chemical feeder or make-up reservoir to replenish glycol. Contact the sales department for more information about these configurations.

3-11 Initial Start-Up

- Check the shipping papers against the serial tag to be sure chiller size, type and voltage is correct for the process that will be controlled. Portable chillers are built with a voltage specific compressor and cannot be re-wired for an alternate voltage.
- Check the transformer primary voltage connections to be sure they are configured for the electrical power you are using. The voltage at the main power connection must read within plus or minus ten percent ($\pm 10\%$) of the voltage listed on the serial tag. Electrical connections must conform to all applicable codes.
- Complete chilled water To Process and From Process connections.
- Be sure the reservoir tank and chilled water circuit piping are filled a water/glycol mixture. The water/glycol mixture should provide for freeze protection to at least 20°F (11°C) below the leaving water temperature you want. Should the display show a tank level less than 0 after the tank is filled, check the clear tube leading from the tank to the tank level pressure switch for a blockage.
- The air-cooled condenser should have an adequate supply of 60° to 115°F (16° to 46°C) air for proper operation.
- The tower or city water condenser cooling in and out connections should be completed and an adequate supply of 85°F (30°C) tower or 70°F (21°C) city water, at 25 psi pressure, for proper operation.
- Connect the main 3 phase incoming power to the unit making certain that line one (1) L1 is connected to the A phase, line two (2) L2 is connected to the B phase, and line three (3) L3 is connected to the C phase. Check for proper rotation direction of fan(s) and pump(s).

The crankcase heater is automatically energized when the main power is applied. It should be on for at least 24 hours before startup to force dissolved refrigerant from the compressor oil.







3-12 Finishing Setup: Setting Up Passwords

You can establish passwords for two levels of security: operators and supervisors. The controller comes from the factory with neither password set. This allows every user access to all functions.

Operator Password. If you define a password for operators, then a password will be required to carry out any function (other than reviewing the status screens). Entering the operator's password will give the user access to the setpoints for leaving temperature, high temperature warning, high temperature fault.

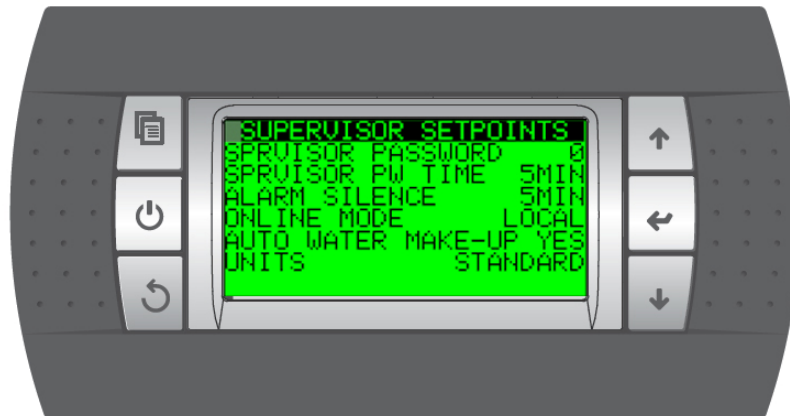
Supervisor Password. If you define a password for supervisors (or setup personnel) then most settings can be changed only after entering the password. The password will be required to display the extended setpoints for operating parameters and alarms. Section 4-6 shows a table of setpoints and the restrictions between Operator and Supervisor.





To set password protections:




1. Press the  button to access the menu screen.
2. Press the  or  to highlight SETPOINTS, and press .
3. Press the  or  until the following screen appears for the Operator Password



or the following screen for the Supervisor Password



4. Press  to accept the screen, and then press  until the Operator or Supervisor Password line is highlighted.
5. Press  or  to increment or decrement the number. The password can be between 0 and 9999.

6. Press  to accept the Password and move to the next line.
7. For either Operator or Supervisor password the time that the password will allow the controller to be active can be set by the Operator or Supervisor Password Time. With the PW Time value highlighted, press  or  to increment or decrement the time. The password time for either setup can be from 0 to 99 minutes.

Chapter 4: Operation

4-1 Panel Buttons, Indicator Lights, and Switches

Microprocessor Controller

The standard chillers use a microprocessor-based PID controller. The Carel PCO controller along with the Carel PGD1 Interface is a modular, self-contained unit that can slide from its mounting housing. It is factory set and adjusted; no field adjustment to the internal controls is necessary. The standard operation range is 20°F to 80°F (-7°C to 27°C).

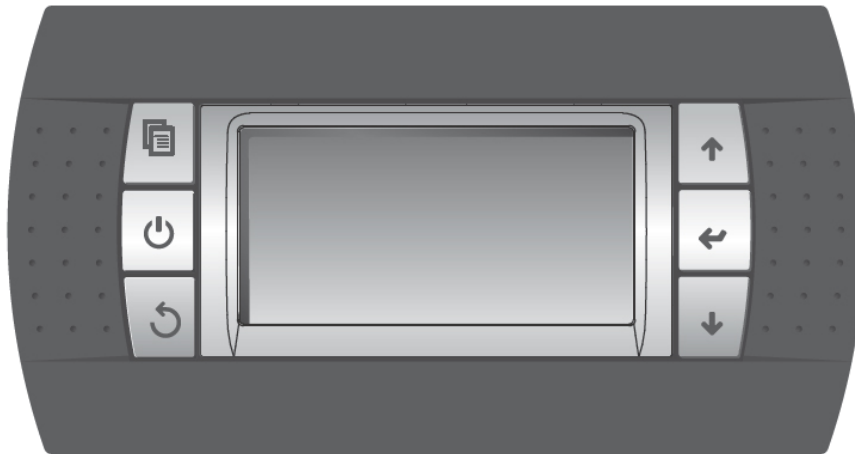








Figure 7 - Controller Display

Button	Button Description	Detailed description
	Menu Button	Used to access the menus structure of the PGD interface
	On/Off Button	Used to turn the entire chiller On or Off. The button is backlit and will turn amber when the chiller is On.
	Back Button	Used to back up from a menu and return to the main status screen
	Up Arrow Button	Used to increment a data field or scroll up within a menu structure.
	Enter Button	Used to accept a data field value or to select a menu item.
	Down Arrow Button	Used to decrement a data field or scroll down within a menu structure.

4-2 Initial Start-up

1. Verify the initial start-up checklist from Chapter 3, Section 3-11.
2. With the main supply power switch in the ON position, the screen will display the version of the software for a period of 5 seconds, and then display the main status screen.

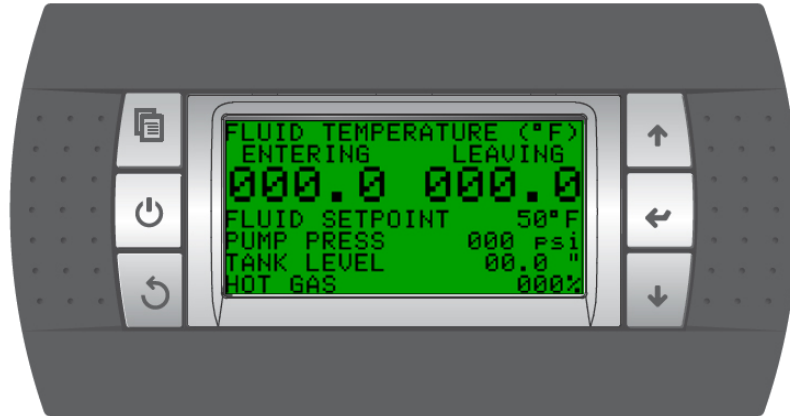


Figure 8 - Main Status Screen









3. Set the Leaving Fluid temperature by depressing the  button to display the menu.



Figure 9 - Menu Screen

4. Depress the  or  button to highlight SETPOINTS and press . If passwords were setup (See Section 3-12 for information on the controller passwords) the password screen will appear.



Enter the established Operator Password by depressing the  to move the position of the cursor, and then depressing the  or  button to increment or decrement the number. Once all of the numbers have been entered depress the  to accept the password. The following screen will appear.

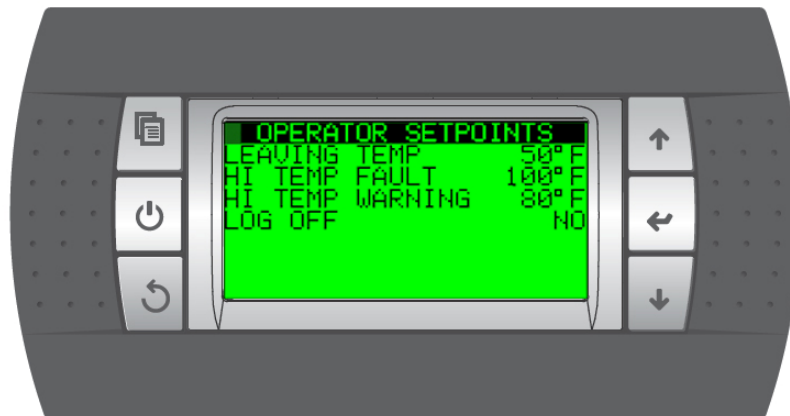








Figure 10 - Operator Setpoints Screen

5. Depress  to move the cursor to the Leaving Temp line. Use the  or  button to increment or decrement the value. Depress  to accept the value and move the cursor down one line.
6. Depress the  button twice to return to the main status screen.
7. Depress the  to start the chiller.
8. Check pump rotation
9. Check the pump amp draw and pump pressure. Make sure that the amp draw reading is within the running load and service factor amps.
10. Operate the chiller, looking for any leaks and listening for unusual noises or vibrations that could indicate improper operation.

Elevated sound level and substantially reduced current draw indicate reverse rotation. After several minutes of operation, the compressor internal protector trips.

4-3 Status Screens

The controller has eight (8) preconfigured status screens. The main status screen (shown in Figure 11) shows the main operating points of the chiller: Entering and Leaving fluid temperatures; Leaving fluid setpoint, pump discharge pressure, tank fluid level (depth), and percentage of hot-gas bypass output.

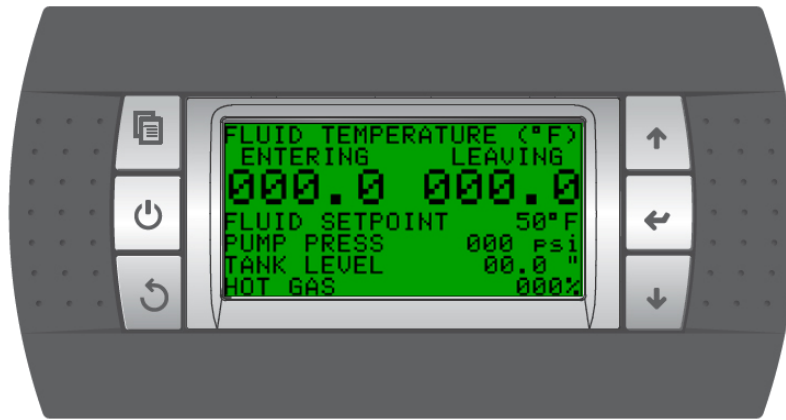

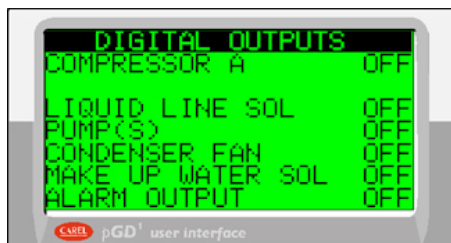
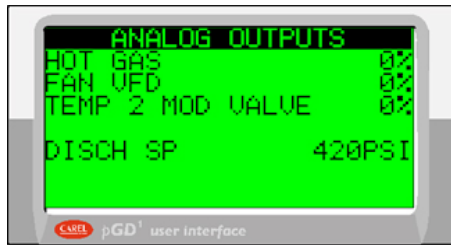
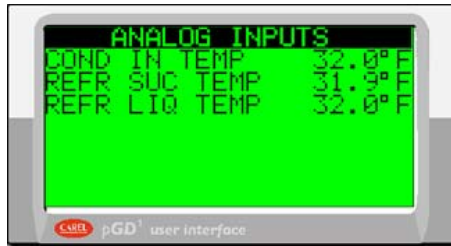
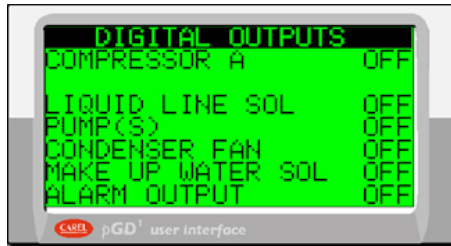


Figure 11 - Main Status Screen

Depressing  cycles through the following screens (shown below) – Analog I/O, Digital I/O, and Test. The Analog and Digital I/O screens provide status of all of the inputs and outputs for the controller. The Test aides in troubleshooting the chiller when it is not functioning properly by displaying the basic information that a service person will need to know to determine the problem.







4-4 Access Levels

The controller is setup to allow access to three distinct password groups: operator, supervisor, and service. Operator access allows the user to modify the Leaving Water Temp, Hi Temp Warning, and Hi Temp Fault setpoints. Supervisor access allows the supervisor to modify the above plus

Selecting any of the menus in the Menu Screen will display the Password Screen.

4-5 Controller Setpoints

Variable	Description	Access Level	
		Operator	Supervisor
Leaving Temp	Temperature of fluid out to process	x	x
Hi Temp Warning	Setpoint for alarm to warn when leaving fluid temperature is too high	x	x
Hi Temp Fault	Setpoint to shut down pump and compressor based on leaving fluid temperature	x	x
Compressor On Differential	Temperature Difference between Leaving Fluid Temperature and Setpoint to turn on the compressor		x
Compressor Off Differential	Temperature Difference between Leaving Fluid Temperature and Setpoint to turn off the compressor		x
Pump Stop Delay	Delay time in seconds between fault and stopping the pump		x
Low Temperature Warning	Temperature to activate Low Temperature Warning alarm		x
Low Temperature Fault	Temperature to activate Low Temperature Fault alarm		x
Water Make-up On	The tank level to turn on optional water make-up valve; based on size of tank		x
Water Make-up Off	The tank level to turn off optional water make-up valve; based on size of tank.		x
Water Make-up Time	The time in seconds that controller will allow for filling the tank		x
Low Level Warning	Tank level that will activate Low Level Warning alarm		x
Low Level Fault	Tank level that will activate Low Level Warning fault		x
High Level Warning	Tank level that will activate High Level Warning alarm		x
High Level Fault	Tank level that will activate High Level Warning fault		x
High Temperature Delay	Delay time in minutes between fault and stopping the compressor and pump		x
Alarm Silence Time	Time in minutes to silence alarm (with optional audible alarm). After time alarm will reactivate.		x
Operator Password Time	Time in minutes for operator password to be active		x
Supervisor Password Time	Time in minutes for supervisor password to be active		x








1. Set the Leaving Fluid temperature by depressing the  button to display the menu.




Figure 12 - Menu Screen

2. Depress the  or  button to highlight SETPOINTS and press . If passwords were setup (See Section 3-12 for information on the controller passwords) the password screen will appear.



Enter the Operator Password by depressing the  to move the position of the cursor, and then depressing the  or  button to increment or decrement the number. Once all of the numbers have been entered depress

the  to accept the password. The following screen will appear.

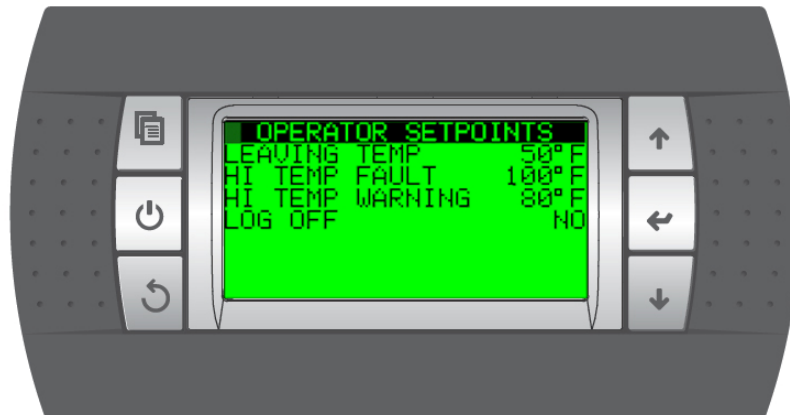







Figure 13 - Operator Setpoints Screen

3. Depress  to move the cursor to the Leaving Temp line. Use the  or  button to increment or decrement the value. Depress  to accept the value and move the cursor down one line.
4. Adjust the Hi Temp Warning and Hi Temp Fault in the same manner.
5. Depress the  button twice to return to the main status screen.

4-6 Alarms

The controller is setup with multiple alarms, most of them configurable using the Supervisor password. Section 4-5 Controller Setpoints gives a list of alarms that the controller is setup to display. The alarms are broken up into two categories – warnings and faults. The warning notifies the user that the parameter has been exceeded and the chiller is allowed to keep operating, but should be monitored to determine the cause of the warning. The fault notifies the user that the parameter has been exceeded and the chiller and pump has been shut down to protect the system.

4-7 Optional Communications

The communications function allows you to monitor and set the parameters by a program prepared and running on a host computer connected to the controller.

When using the communications function, you must add on the unit for RS-485 Modbus communications. The communications function allows you to read/write parameters, do operating instructions, and select the setting level.

Chapter 5: Maintenance

5-1 Lubrication

Grease all fan motors, and pump motors that do not have permanently sealed bearings. Be sure to use an all-purpose industrial grease with a temperature reference of 185° F (85° C). Remove the grease relief plug (motors only) before adding grease, add grease until a small amount pours out, and replace the plug when finished.

Caution! *Failure to remove the grease relief plug will result in dislodging the bearing grease seal, eventually causing bearing failure.*

Refrigeration compressors are hermetically sealed and no lubrication is required.

5-2 Filter Cleaning

Air filter cleaning is important to keep your air-cooled portable chiller operating at peak efficiency and capacity. Clean the filters whenever they appear dirty, or at regularly scheduled intervals.

1. Turn the chiller off.
2. Slide the filter rod to release it from the frame at the top and bottom.
3. Wash down the filter with clean water (preferably with a garden hose), directing the flow of water opposite the direction of airflow. If dirt is heavy, use a mild detergent and rinse well. Allow the filter to dry completely before replacing it on the chiller.

Note: *Keep a spare air filter set on hand. Install and use it while cleaning).*

Caution! *Do not use compressed air to blow off a dirty filter. It will not clean very well, and the filter could be damaged. Never run the chiller without properly installed filters.*

5-3 Maintaining the Condenser

Dirty condenser heat exchange surfaces reduce system capacity and efficiency.

Air- and Remote Air-Cooled Chillers

Brush or vacuum light dirt accumulations off the aluminum condenser fins. Avoid bending or damaging them. Heavy dirt accumulations on the fins may require professional cleaning.

Water-Cooled Chillers

Proper water treatment will greatly reduce cleaning intervals.

Coaxial Condensers (Standard). Remove dirt and slime in the condenser tube water side by reverse-circulating with a mild detergent and water solution. Remove mineral deposits by reverse circulating Liquid Inhibited Acid De-Scaling Solution (Part No. A0502600) through the water side of the condenser. Follow the directions on the container.

Shell & Tube Condensers (Optional). Remove dirt and slime in the condenser tube water side by cleaning with a nylon tube brush. Remove mineral deposits by reverse circulating Liquid Inhibited Acid De-Scaling Solution (Part No. A0502600) through the tube water side of the condenser. Follow the directions on the container.

The refrigerant side is sealed and requires no routine maintenance.

Caution! *Do not use steam or water over 140°F (60°C) to clean a condenser unless you are monitoring the refrigeration circuit for excessive pressure with gauges. Only a trained technician should use this method.*

5-4 Maintaining the Evaporator

Dirty evaporator heat exchange surfaces reduce system capacity and efficiency. Remove dirt and slime in the evaporator by reverse-circulating with a mild detergent and water solution.

Remove mineral deposits by reverse-circulating Liquid Citric Acid De-Scaling Solution (Part No. A0536607). Follow the directions on the container.

5-5 Evaporator Process Piping Y-Strainer

The process piping Y-strainer requires periodic cleaning of its screen to insure the proper flow through the evaporator. To clean the strainer screen, remove the access plug and retaining cap, and pull out the screen.

Wipe, brush, or vacuum out any dirt left in the strainer body. Clean the screen and replace it in the strainer taking care to fit it squarely into the machined seat provided.

Caution! *Do not forget to re-install the screen after cleaning it. Operating the chiller with no strainer screen can potentially plug the evaporator with dirt. The warranty does not cover chiller failures from a dirty evaporator.*

5-6 Preventative Maintenance Service

Follow a systematic preventive maintenance program to help avoid costly down time. Call the Service Department to arrange a schedule of inspections. This service can be tailored to fit your maintenance requirements. These inspections include, but are not limited to:

- Checking refrigerant suction and discharge pressures
- Checking safety and operating conditions
- Checking voltage and amperage of all motors
- Checking all electrical connections
- Checking quantity of refrigerant
- Checking compressor oil level on units with tandem compressors
- Checking lubrication of motor and pump bearings
- Checking circulating pump operation
- Checking flow through heat exchangers
- Checking compressor efficiency
- Checking noise levels

Chapter 6: Troubleshooting

Problem	Possible cause	Solution
Unit does not run.	No power.	Check main disconnect, fuses, wiring, and power lead to unit.
	Wrong voltage supplied to unit.	Voltage must be within plus or minus 10% of nameplate rating.
	Defective display.	Replace.
	Control circuit fuse blown.	Replace control circuit fuse.
		Check transformer.
		Check for a short circuit.
	Defective control transformer.	Replace.
Piping flow switch circuit open.	Add water or water/glycol solution as required.	
Pump motor off on overload.	Reset and test.	
Pump runs; compressor does not.	Leaving fluid setpoint set higher than temperature of liquid in system.	Lower the leaving fluid temperature below the leaving temperature you desire.
	Compressor internal overload or fuses are open.	Allow time to cool and reset, then check for high/low volt-age. It must be within plus or minus 10% of the nameplate rating.
		Check for open fuses and loose compressor electrical connections.
	Compressor contactor holding coil open.	Repair or replace.
	Defective compressor auxiliary contact.	Repair or replace.
Broken wire in the compressor control circuit.	Locate and repair.	
Pump runs, compressor cycles at short intervals.	Plugged Y-strainer	Clean
	Hot gas not coming on	Check hot gas analog output value through status screen. Contact Service if output value remains at 0% throughout compressor cycle.
	Low water flow	Install bypass between to-and-from process line
Water temperature is too high.	Water/glycol mixture inadequate for process.	Make sure that the water/glycol mixture protection is right for the process.
	Improperly set leaving fluid temperature, warning, or fault set point	Adjust.
	Refrigerant charge is low.	Call service to find and repair the leak, then have refrigerant added.

Problem	Possible cause	Solution
Pump process pressure low (refer to curves for normal pressure for various pumps).	Pump running in reverse.	Verify rotation; if running in reverse rotation, reverse any two main power leads. Re-verify for correct pump rotation.
	Check for foreign matter.	Clean the system strainer.
Pump process pressure is too high.	Restricted water flow.	Check for partially closed valves etc. Make sure that all lines are properly sized.
Unit runs continuously, but not enough cooling power.	Restricted condenser air flow.	Clean filters.
		Clean condenser.
	Unit low on refrigerant.	Check the refrigerant charge by viewing sight glass on liquid line upstream of the expansion valve.
	Compressor not operating efficiently.	Call service.
Unit under-sized for application.	Call sales rep.	

Chapter 7: Appendix

7-1 Returned Material Policy

Credit Returns

Prior to the return of any material, **authorization** must be given by **the manufacturer**. A RMA number will be assigned for the equipment to be returned.

Reason for requesting the return must be given.

All returned Material purchased from the manufacturer is subject to 15% (\$75.00 minimum) restocking charge.

All returns are to be shipped prepaid.

The invoice number and date or purchase order number and date must be supplied.

No credit will be issued for material that is not within the manufacturer's warranty period and/or in new and unused condition, suitable for resale.

Warranty Returns

Prior to the return of any material, **authorization** must be given by **the manufacturer**. A RMA number will be assigned for the equipment to be returned.

Reason for requesting the return must be given.

All returns are to be shipped prepaid.

The invoice number and date or purchase number and date must be supplied.

After inspecting the material, a replacement or credit will be given, at the **manufacturer's** discretion, if the item is found to be defective in materials or workmanship. Purchased components are covered under their specific warranty terms.

7-2 Technical Assistance

Parts Department

Call toll-free 7am–5pm CST [800] 423-3183 or call [262] 641-8610, Fax [262] 641-8653

The ACS Customer Service Group will provide your company with genuine OEM quality parts manufactured to engineering design specifications, which will maximize your equipment's performance and efficiency. To assist in expediting your phone or fax order, please have the model and serial number of your unit when you contact us. A customer replacement parts list is included in this manual for your convenience. ACS welcomes inquiries on all your parts needs and is dedicated to providing excellent customer service.

Service Department

Call toll-free 8am–5pm CST [800] 423-3183 or call [262] 641-8610

Emergencies after 5pm CST, call [847] 439-5655

We have a qualified service department ready to help. Service contracts are available for most products.

Sales Department

Call [262] 641-8610 Monday–Friday, 8am–5pm CST

Our products are sold by a world-wide network of independent sales representatives. Contact our Sales Department for the name of the sales representative nearest you.

Contract Department

Call [262] 641-8610 Monday–Friday, 8am–5pm CST

Let us install your system. The Contract Department offers any or all of these services: project planning; system packages including drawings; equipment, labor, and construction materials; and union or non-union installations.

7-3 Specifications

Air-Cooled Portable Chillers

Nominal operating parameters for air-cooled models are 50°F (10°C) leaving water temperature at 2.4 gpm per ton (9.1 lpm per 3.517 kW) with 95°F (35°C) ambient air. **For 50 Hz applications**, multiply capacity by **0.83**. *Nominal 60 Hz capacity flow rate must be maintained.*

G-PAC-20

PERFORMANCE (NOMINAL DESIGN CONDITIONS)					
COOLING CAPACITY	4.65	TONS	ALTITUDE	SEA LEVEL	
COOLANT SUPPLY TEMPERATURE	50	°F	COMPRESSOR POWER	4936	WATTS
AMBIENT AIR TEMPERATURE	95	°F	EER	11.31	BTU/WATT
COOLANT	WATER		CONDENSER AIR FLOW	4230	CFM
COOLANT FLOW	11	GPM	SOUND POWER LEVEL	86	dBA
UNIT PRESSURE DROP	7	PSID	SOUND PRESSURE LEVEL @ 1 METER		dBA
OPERATING PARAMETERS					
COOLANT SUPPLY TEMPERATURE	20-80	°F	COOLANT FLOW		GPM
AMBIENT AIR TEMPERATURE	60-115	°F	MINIMUM LOAD	0.944	TONS
SPECIFICATIONS					
COMPRESSOR	SCROLL		EVAPORATOR FILTER	20 MESH	
COOLANT PUMP	STAINLESS STEEL CENTRIFUGAL		COOLANT CIRCUIT	NON-FERROUS	
EVAPORATOR	BRAZED PLATE		CAPACITY CONTROL	HOT GAS BYPASS	
CONDENSER	ALUMINUM		REFRIGERANT	3 LBS R-410A	
CONDENSER FANS	24 INCH AXIAL		FRAME	GALVANIZED STEEL	
CONDENSER FAN MOTOR	1/2 HP OAO, 1140 RPM		PANELS	POWDER COATED STEEL	
RESERVOIR	20 GALLON POLYETHYLENE		WEIGHT (OPERATING)	690	LBS
POWER	460V/3PH/60HZ		WEIGHT (SHIPPING)	520	LBS
CONTROL CIRCUIT	120	VDC	ELECTRICAL ENCLOSURE	NEMA 12	
COMPRESSOR FULL LOAD AMPS	10.7	AMPS	CONTROL	MICROPROCESSOR	

G-PAC-30

PERFORMANCE (NOMINAL DESIGN CONDITIONS)					
COOLING CAPACITY	7.30	TONS	ALTITUDE	SEA LEVEL	
COOLANT SUPPLY TEMPERATURE	50	°F	COMPRESSOR POWER	7579	WATTS
AMBIENT AIR TEMPERATURE	95	°F	EER	11.56	BTU/WATT
COOLANT	WATER		CONDENSER AIR FLOW	6343	CFM
COOLANT FLOW	18	GPM	SOUND POWER LEVEL	92	dBA
UNIT PRESSURE DROP	7	PSID	SOUND PRESSURE LEVEL @ 1 METER		dBA
OPERATING PARAMETERS					
COOLANT SUPPLY TEMPERATURE	20-80	°F	COOLANT FLOW		GPM
AMBIENT AIR TEMPERATURE	60-115	°F	MINIMUM LOAD	1.504	TONS
SPECIFICATIONS					
COMPRESSOR	SCROLL		EVAPORATOR FILTER	20 MESH	
COOLANT PUMP	STAINLESS STEEL CENTRIFUGAL		COOLANT CIRCUIT	NON-FERROUS	
EVAPORATOR	BRAZED PLATE		CAPACITY CONTROL	HOT GAS BYPASS	
CONDENSER	ALUMINUM		REFRIGERANT	4 LBS R-410A	
CONDENSER FANS	24 INCH AXIAL		FRAME	GALVANIZED STEEL	
CONDENSER FAN MOTOR	1 HP OAO, 1140 RPM		PANELS	POWDER COATED STEEL	
RESERVOIR	20 GALLON POLYETHYLENE		WEIGHT (OPERATING)	870	LBS
POWER	460V/3PH/60HZ		WEIGHT (SHIPPING)	700	LBS
CONTROL CIRCUIT	120	VDC	ELECTRICAL ENCLOSURE	NEMA 12	
COMPRESSOR FULL LOAD AMPS	16.4	AMPS	CONTROL	MICROPROCESSOR	

G-PAC-40

PERFORMANCE (NOMINAL DESIGN CONDITIONS)					
COOLING CAPACITY	9.91	TONS	ALTITUDE	SEA LEVEL	
COOLANT SUPPLY TEMPERATURE	50	°F	COMPRESSOR POWER	10070	WATTS
AMBIENT AIR TEMPERATURE	95	°F	EER	11.81	BTU/WATT
COOLANT	WATER		CONDENSER AIR FLOW	8458	CFM
COOLANT FLOW	24	GPM	SOUND POWER LEVEL	87	dBA
UNIT PRESSURE DROP	7	PSID	SOUND PRESSURE LEVEL @ 1 METER		dBA
OPERATING PARAMETERS					
COOLANT SUPPLY TEMPERATURE	20-80	°F	COOLANT FLOW		GPM
AMBIENT AIR TEMPERATURE	60-115	°F	MINIMUM LOAD	2.022	TONS
SPECIFICATIONS					
COMPRESSOR	SCROLL		EVAPORATOR FILTER	20 MESH	
COOLANT PUMP	STAINLESS STEEL CENTRIFUGAL		COOLANT CIRCUIT	NON-FERROUS	
EVAPORATOR	BRAZED PLATE		CAPACITY CONTROL	HOT GAS BYPASS	
CONDENSER	ALUMINUM		REFRIGERANT	6 LBS R-410A	
CONDENSER FANS	32 INCH AXIAL		FRAME	GALVANIZED STEEL	
CONDENSER FAN MOTOR	1 HP OAO, 1140 RPM		PANELS	POWDER COATED STEEL	
RESERVOIR	40 GALLON POLYETHYLENE		WEIGHT (OPERATING)	1090	LBS
POWER	460V/3PH/60HZ		WEIGHT (SHIPPING)	760	LBS
CONTROL CIRCUIT	120	VDC	ELECTRICAL ENCLOSURE	NEMA 12	
COMPRESSOR FULL LOAD AMPS	20	AMPS	CONTROL	MICROPROCESSOR	

G-PAC-50

PERFORMANCE (NOMINAL DESIGN CONDITIONS)					
COOLING CAPACITY	15.19	TONS	ALTITUDE	SEA LEVEL	
COOLANT SUPPLY TEMPERATURE	50	°F	COMPRESSOR POWER	14882	WATTS
AMBIENT AIR TEMPERATURE	95	°F	EER	12.25	BTU/WATT
COOLANT	WATER		CONDENSER AIR FLOW	12687	CFM
COOLANT FLOW	36	GPM	SOUND POWER LEVEL	93	dBA
UNIT PRESSURE DROP	7	PSID	SOUND PRESSURE LEVEL @ 1 METER		dBA
OPERATING PARAMETERS					
COOLANT SUPPLY TEMPERATURE	20-80	°F	COOLANT FLOW		GPM
AMBIENT AIR TEMPERATURE	60-115	°F	MINIMUM LOAD	3.016	TONS
SPECIFICATIONS					
COMPRESSOR	SCROLL		EVAPORATOR FILTER	20 MESH	
COOLANT PUMP	STAINLESS STEEL CENTRIFUGAL		COOLANT CIRCUIT	NON-FERROUS	
EVAPORATOR	BRAZED PLATE		CAPACITY CONTROL	HOT GAS BYPASS	
CONDENSER	ALUMINUM		REFRIGERANT	8 LBS R-410A	
CONDENSER FANS	32 INCH AXIAL		FRAME	GALVANIZED STEEL	
CONDENSER FAN MOTOR	2 HP OAO, 1140 RPM		PANELS	POWDER COATED STEEL	
RESERVOIR	40 GALLON POLYETHYLENE		WEIGHT (OPERATING)	1290	LBS
POWER	460V/3PH/60HZ		WEIGHT (SHIPPING)	950	LBS
CONTROL CIRCUIT	120	VDC	ELECTRICAL ENCLOSURE	NEMA 12	
COMPRESSOR FULL LOAD AMPS	30	AMPS	CONTROL	MICROPROCESSOR	

Water-Cooled Portable Chillers

Nominal operating parameters for water-cooled models are 50°F (10°C) leaving water temperature at 2.4 gpm per ton (9.1 lpm per 3.517 kW) with 85°F (29°C) tower water. **For 50 Hz applications**, multiply capacity by **0.83**. *Nominal 60 Hz capacity flow rate must be maintained.*

G-PWC-20

PERFORMANCE (NOMINAL DESIGN CONDITIONS, 60 HZ)					
COOLING CAPACITY	5.12	TONS	ALTITUDE	SEA LEVEL	
COOLANT SUPPLY TEMPERATURE	50	°F	COMPRESSOR POWER	4064	WATTS
CONDENSER INLET WATER TEMPERATURE	85	°F	EER	15.13	BTU/WATT
COOLANT	WATER		CONDENSER WATER FLOW	15.9	GPM
COOLANT FLOW	13	GPM	SOUND POWER LEVEL	dBA	
UNIT PRESSURE DROP	7	PSID	SOUND PRESSURE LEVEL @ 1 METER		
OPERATING PARAMETERS					
COOLANT SUPPLY TEMPERATURE	20-80	°F	COOLANT FLOW	15	GPM
CONDENSER INLET WATER TEMPERATURE	50-90	°F	MINIMUM LOAD	1.06	TONS
SPECIFICATIONS					
COMPRESSOR	SCROLL		EVAPORATOR FILTER	20 MESH	
COOLANT PUMP	STAINLESS STEEL CENTRIFUGAL		COOLANT CIRCUIT	NON-FERROUS	
EVAPORATOR	BRAZED PLATE		CAPACITY CONTROL	HOT GAS BYPASS	
CONDENSER	TUBE IN TUBE		REFRIGERANT	3 LBS R-410A	
			FRAME	GALVANIZED STEEL	
			PANELS	POWDER COATED STEEL	
RESERVOIR	20 GALLON POLYETHYLENE		WEIGHT (OPERATING)	690	LBS
POWER	460V/3PH/60HZ		WEIGHT (SHIPPING)	520	LBS
CONTROL CIRCUIT	120	VDC	ELECTRICAL ENCLOSURE	NEMA 12	
COMPRESSOR FULL LOAD AMPS	10.7	AMPS	CONTROL	MICROPROCESSOR	

G-PWC-30

PERFORMANCE (NOMINAL DESIGN CONDITIONS)					
COOLING CAPACITY	7.98	TONS	ALTITUDE	SEA LEVEL	
COOLANT SUPPLY TEMPERATURE	50	°F	COMPRESSOR POWER	6416	WATTS
CONDENSER INLET WATER TEMPERATURE	85	°F	EER	14.92	BTU/WATT
COOLANT	WATER		CONDENSER WATER FLOW	25.08	GPM
COOLANT FLOW	20	GPM	SOUND POWER LEVEL	dBA	
UNIT PRESSURE DROP	7	PSID	SOUND PRESSURE LEVEL @ 1 METER		
OPERATING PARAMETERS					
COOLANT SUPPLY TEMPERATURE	20-80	°F	COOLANT FLOW	22.5	GPM
CONDENSER INLET WATER TEMPERATURE	50-90	°F	MINIMUM LOAD	1.672	TONS
SPECIFICATIONS					
COMPRESSOR	SCROLL		EVAPORATOR FILTER	20 MESH	
COOLANT PUMP	STAINLESS STEEL CENTRIFUGAL		COOLANT CIRCUIT	NON-FERROUS	
EVAPORATOR	BRAZED PLATE		CAPACITY CONTROL	HOT GAS BYPASS	
CONDENSER	TUBE IN TUBE		REFRIGERANT	4 LBS R-410A	
			FRAME	GALVANIZED STEEL	
			PANELS	POWDER COATED STEEL	
RESERVOIR	20 GALLON POLYETHYLENE		WEIGHT (OPERATING)	870	LBS
POWER	460V/3PH/60HZ		WEIGHT (SHIPPING)	700	LBS
CONTROL CIRCUIT	120	VDC	ELECTRICAL ENCLOSURE	NEMA 12	
COMPRESSOR FULL LOAD AMPS	16.4	AMPS	CONTROL	MICROPROCESSOR	

G-PWC-40

PERFORMANCE (NOMINAL DESIGN CONDITIONS)					
COOLING CAPACITY	10.94	TONS	ALTITUDE	SEA LEVEL	
COOLANT SUPPLY TEMPERATURE	50	°F	COMPRESSOR POWER	8450	WATTS
CONDENSER INLET WATER TEMPERATURE	85	°F	EER	15.53	BTU/WATT
COOLANT	WATER		CONDENSER WATER FLOW	33.93	GPM
COOLANT FLOW	27	GPM	SOUND POWER LEVEL		dBA
UNIT PRESSURE DROP	7	PSID	SOUND PRESSURE LEVEL @ 1 METER	dBA	
OPERATING PARAMETERS					
COOLANT SUPPLY TEMPERATURE	20-80	°F	COOLANT FLOW	30	GPM
CONDENSER INLET WATER TEMPERATURE	50-90	°F	MINIMUM LOAD	2.262	TONS
SPECIFICATIONS					
COMPRESSOR	SCROLL		EVAPORATOR FILTER	20 MESH	
COOLANT PUMP	STAINLESS STEEL CENTRIFUGAL		COOLANT CIRCUIT	NON-FERROUS	
EVAPORATOR	BRAZED PLATE		CAPACITY CONTROL	HOT GAS BYPASS	
CONDENSER	TUBE IN TUBE		REFRIGERANT	6 LBS R-410A	
			FRAME	GALVANIZED STEEL	
			PANELS	POWDER COATED STEEL	
RESERVOIR	40 GALLON POLYETHYLENE		WEIGHT (OPERATING)	1090	LBS
POWER	460V/3PH/60HZ		WEIGHT (SHIPPING)	760	LBS
CONTROL CIRCUIT	120	VDC	ELECTRICAL ENCLOSURE	NEMA 12	
COMPRESSOR FULL LOAD AMPS	20	AMPS	CONTROL	MICROPROCESSOR	

G-PWC-50

PERFORMANCE (NOMINAL DESIGN CONDITIONS)					
COOLING CAPACITY	16.66	TONS	ALTITUDE	SEA LEVEL	
COOLANT SUPPLY TEMPERATURE	50	°F	COMPRESSOR POWER	12778	WATTS
CONDENSER INLET WATER TEMPERATURE	85	°F	EER	15.65	BTU/WATT
COOLANT	WATER		CONDENSER WATER FLOW	50.28	GPM
COOLANT FLOW	40	GPM	SOUND POWER LEVEL		dBA
UNIT PRESSURE DROP	7	PSID	SOUND PRESSURE LEVEL @ 1 METER	dBA	
OPERATING PARAMETERS					
COOLANT SUPPLY TEMPERATURE	20-80	°F	COOLANT FLOW	45	GPM
CONDENSER INLET WATER TEMPERATURE	50-90	°F	MINIMUM LOAD	3.352	TONS
SPECIFICATIONS					
COMPRESSOR	SCROLL		EVAPORATOR FILTER	20 MESH	
COOLANT PUMP	STAINLESS STEEL CENTRIFUGAL		COOLANT CIRCUIT	NON-FERROUS	
EVAPORATOR	BRAZED PLATE		CAPACITY CONTROL	HOT GAS BYPASS	
CONDENSER	TUBE IN TUBE		REFRIGERANT	8 LBS R-410A	
			FRAME	GALVANIZED STEEL	
			PANELS	POWDER COATED STEEL	
RESERVOIR	40 GALLON POLYETHYLENE		WEIGHT (OPERATING)	1290	LBS
POWER	460V/3PH/60HZ		WEIGHT (SHIPPING)	950	LBS
CONTROL CIRCUIT	120	VDC	ELECTRICAL ENCLOSURE	NEMA 12	
COMPRESSOR FULL LOAD AMPS	30	AMPS	CONTROL	MICROPROCESSOR	

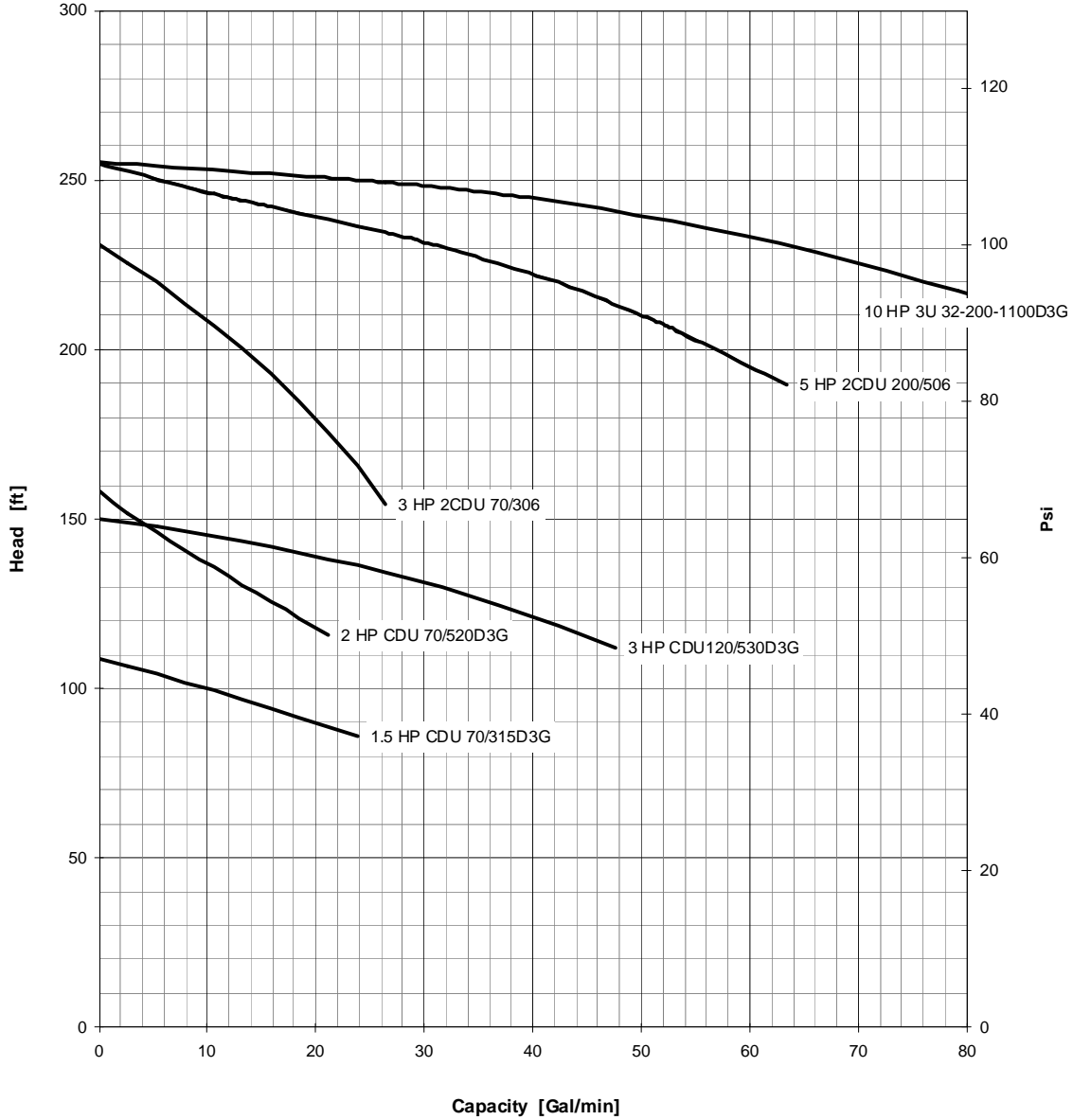
7-4 Pump Curves, Flow, and Pressure Considerations

60 Hertz Pump Curves

ACS CHILLER PUMPS

5-15 ALL 60 Hz

September 8, 2009



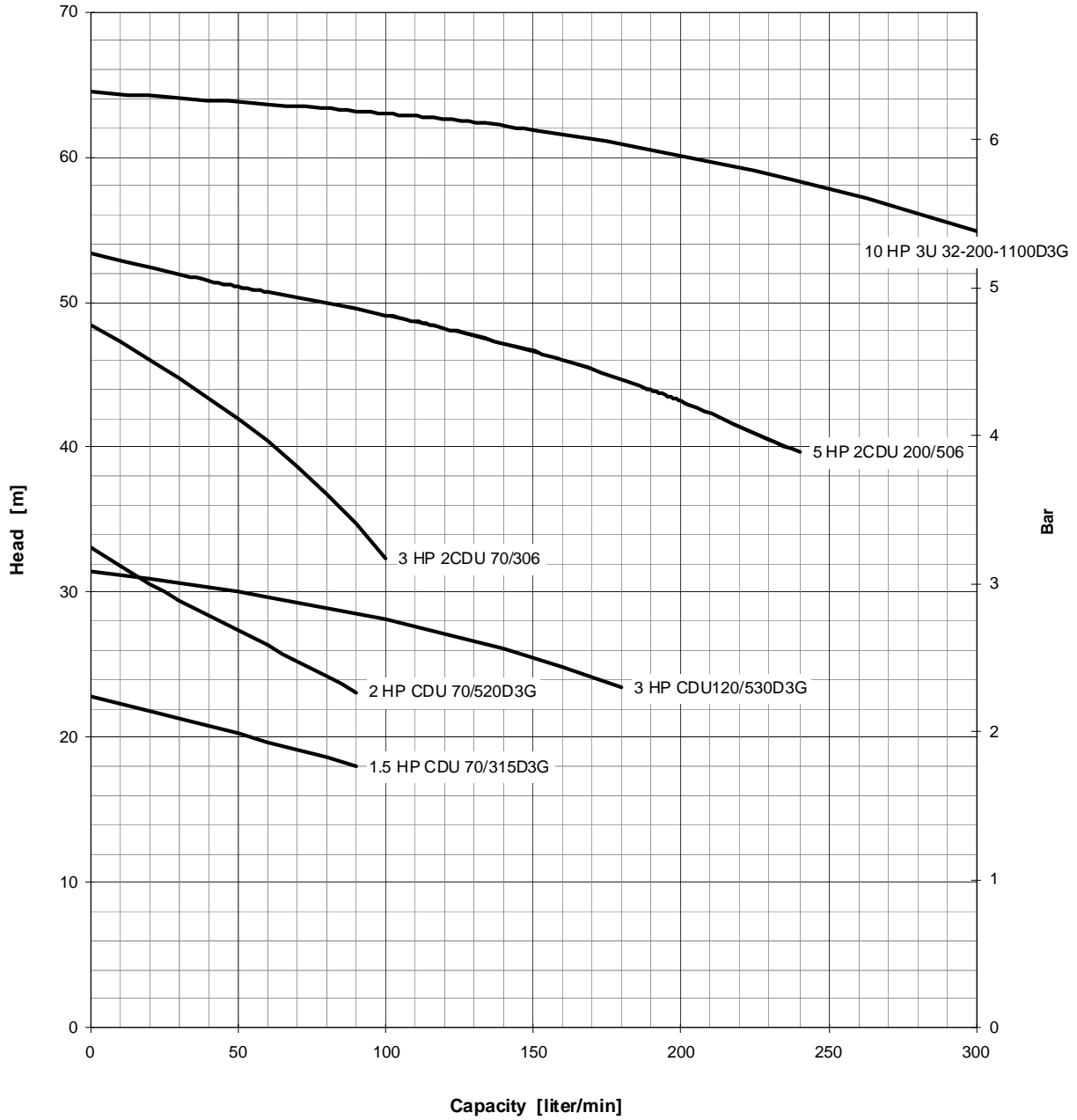
HP	Model	GP 20	GP 30	GP 40	GP 50
1.5	CDU 70/315D3G	STD			
2	CDU 70/520D3G		STD	STD	
3	CDU 120/530D3G	OPT	OPT	OPT	STD
3	2CDU 70/306	OPT			
5	2CDU 200/506	OPT	OPT	OPT	OPT
10	3U 32-200-1100D3G			OPT	OPT

50 Hertz Pump Curves

ACS CHILLER PUMPS

5-15 ALL 50 Hz

September 8, 2009



HP	Model	GP 20	GP 30	GP 40	GP 50
1.5	CDU 70/315D3G	STD			
2	CDU 70/520D3G		STD	STD	
3	CDU 120/530D3G	OPT	OPT	OPT	STD
3	2CDU 70/306	OPT			
5	2CDU 200/506	OPT	OPT	OPT	OPT
10	3U 32-200-1100D3G			OPT	OPT

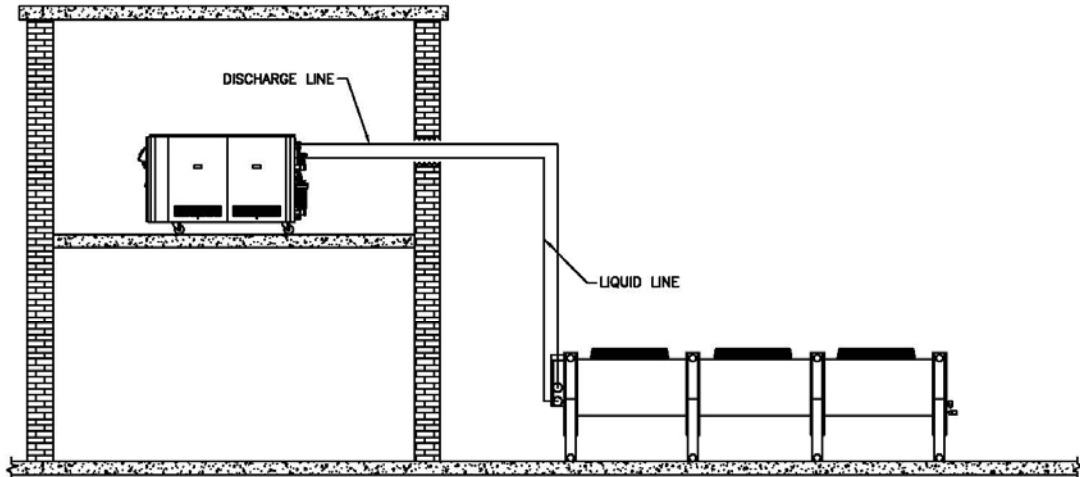
Pure Water at >40°F								
	GPXC-20		GPXC-30		GPXC-40		GPXC-50	
	GPM	DP (PSI)	GPM	DP (PSI)	GPM	DP (PSI)	GPM	DP (PSI)
0.5X Nominal	6	1.7	9	1.7	12	1.6	18	1.8
1.0X Nominal	12	5.9	18	6.1	24	5.8	36	6.4
2.0X Nominal	24	21.4	36	21.9	48	20.7	72	23.3

Calculating Chiller Nominal Flow and Pressure to Process

- **Flow rate:** Obtain the flow reading from the appropriate pump curve.
- **Pressure:** Obtain a corresponding pressure reading from the pump curve you selected, then **subtract** the one-pump pressure drop listed in the above table using the appropriate chiller hp and flow rate.

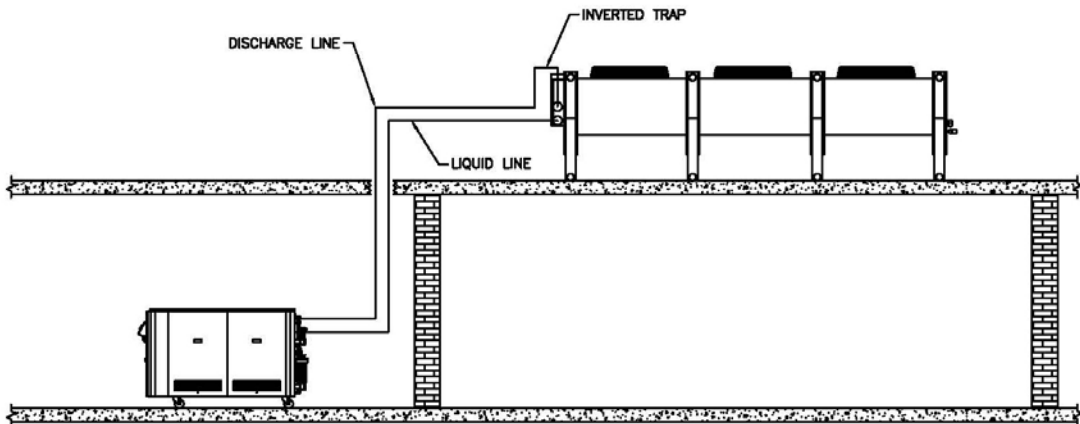
7-5 Remote Air-Cooled Chiller Configurations

Configuration A:

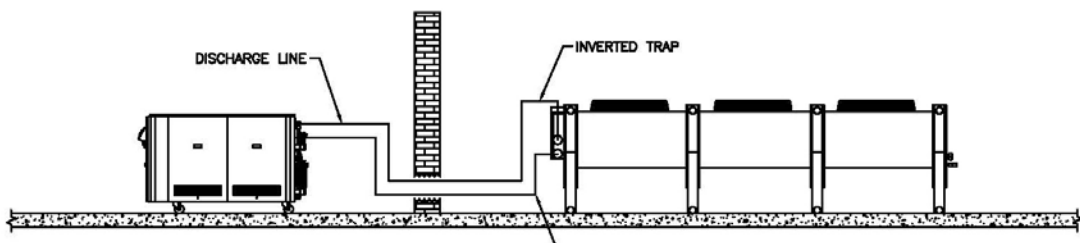


* Liquid line riser should not exceed 15 feet from base of air-cooled condenser.

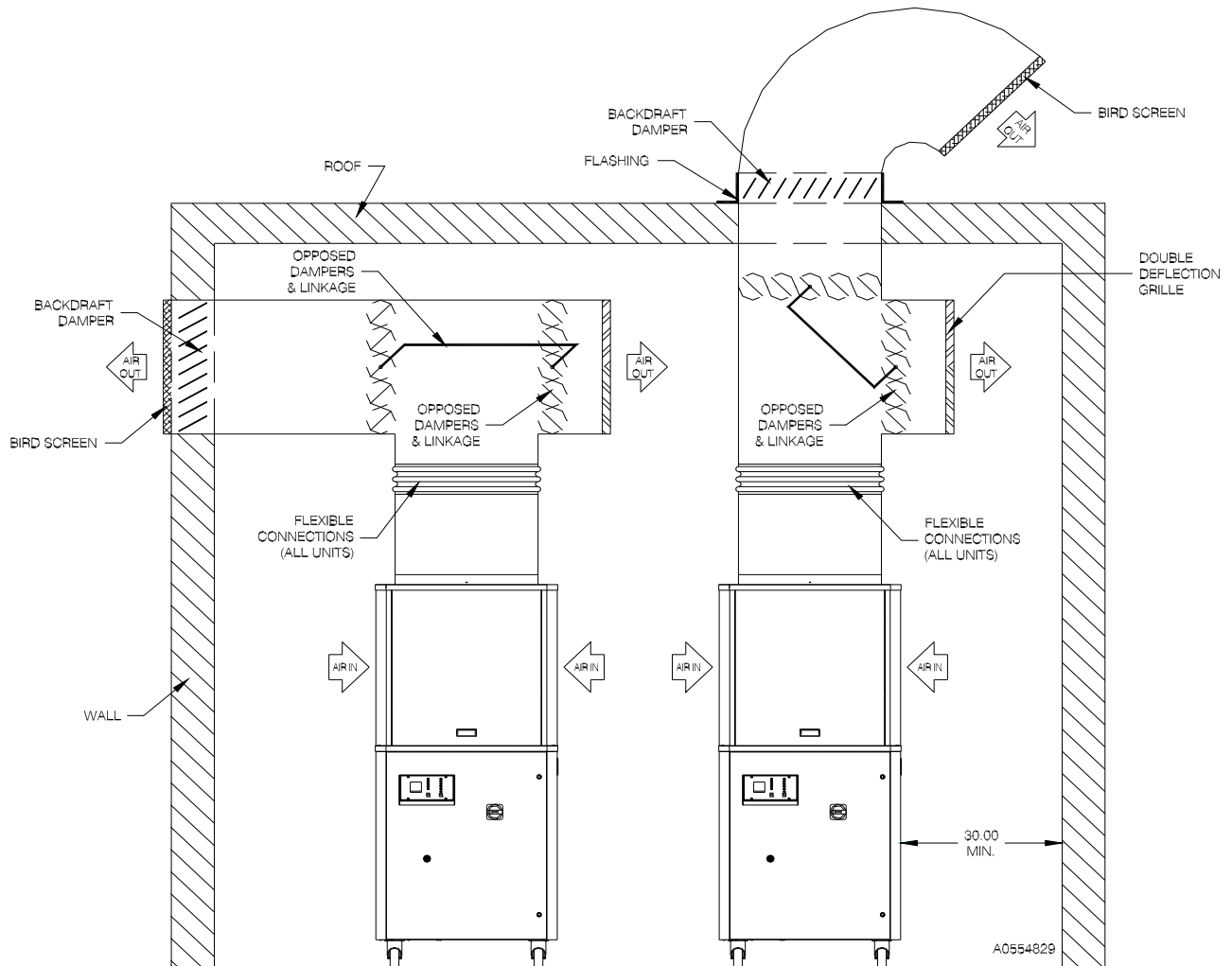
Configuration B:



Configuration C:



7-6 Typical Ductwork for Air-Cooled Chillers



Model	Fan		60 Hz Discharge air volume		50 Hz Discharge air volume	
	HP	kW	CFM	m ³ /min	CFM	m ³ /min
GPAC-20	0.5	0.4	4230	120	3525	100
GPAC-30	1.0	0.7	6343	180	5286	150
GPAC-40	1.0	0.7	8458	240	7048	200
GPAC-50	2.0	1.5	12687	360	10573	300

When locating your air-cooled portable chiller and designing its ductwork, note any potential high temperature conditions when discharging into your building and any negative pressures with the building when discharging air outside.

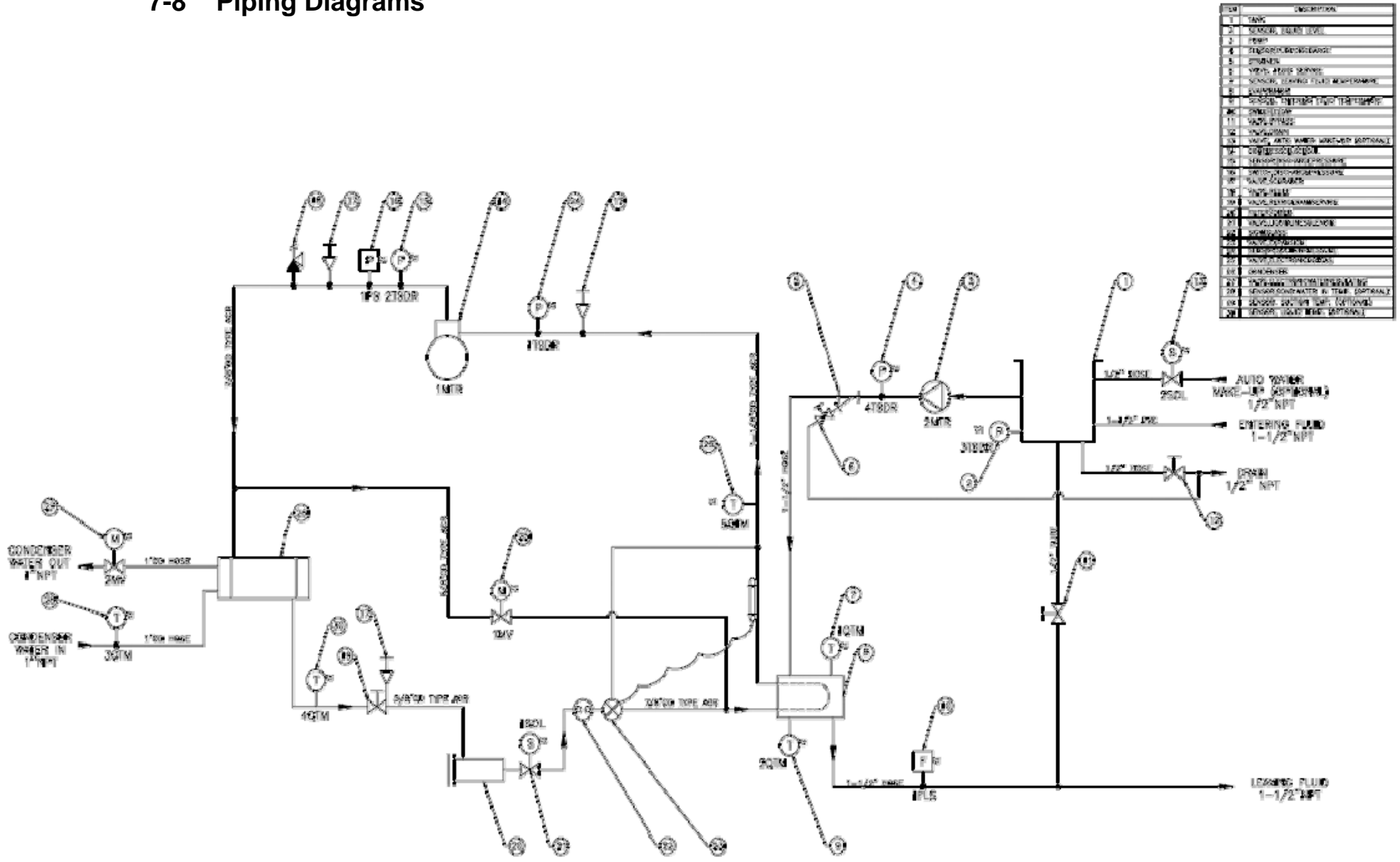
Notes:

- Customer use of ductwork requires the high pressure fan option.
- Allow 30" (77 cm) minimum clearance around the chiller footprint to facilitate free passage of cooling air and service accessibility
- Size the ductwork for maximum capacity
- Support ductwork from the building structure, not off of the chiller
- Back draft damper to outside must be closed at all times when fan/blower is not operating

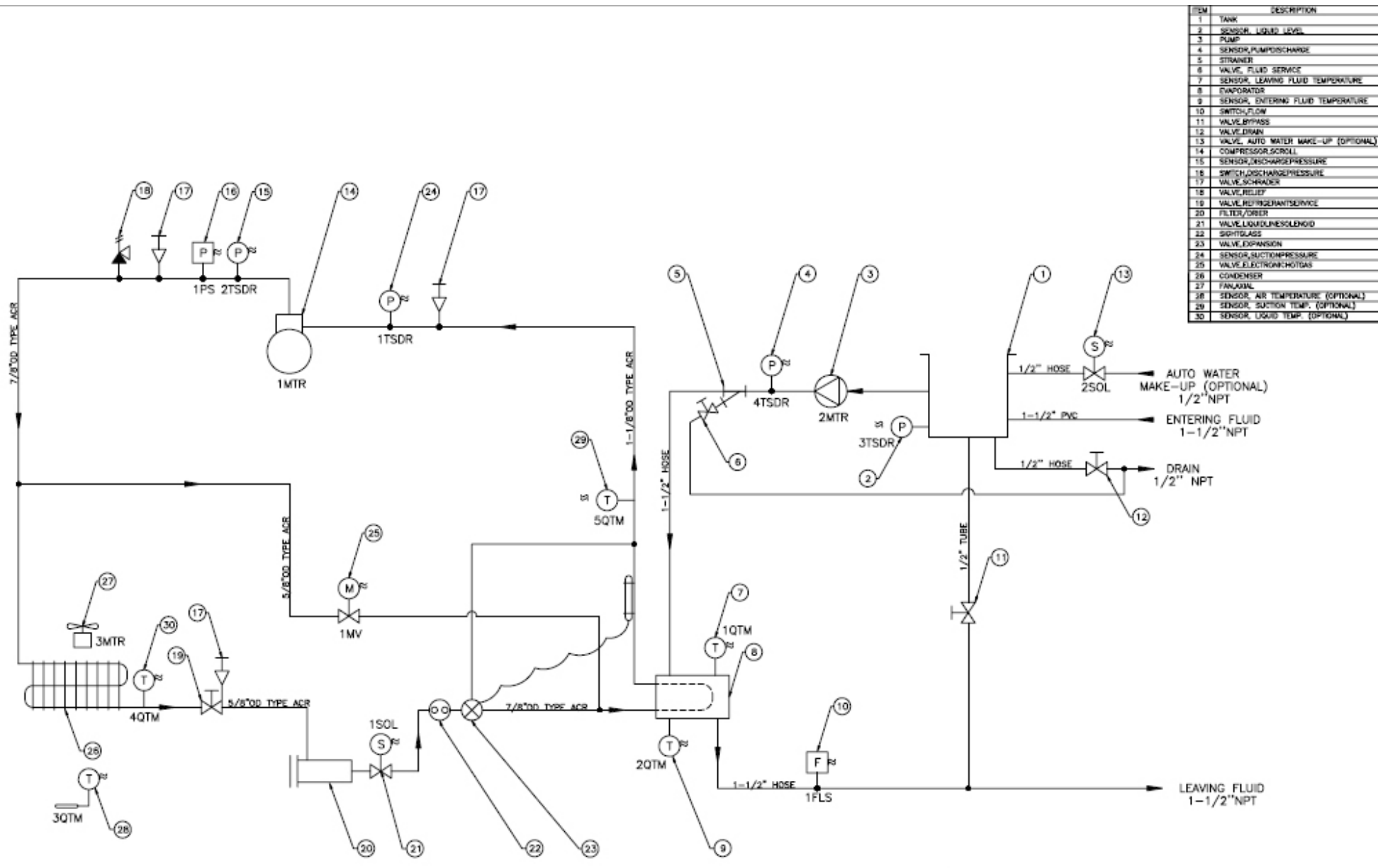
Chillers with dual fans/blower must have a back draft damper on the cycling fan/blower to prevent recirculation of hot discharge air • Chillers are designed to operate at a condensing entering air temperature of 60°F (16°C) minimum without optional Variable Frequency Drive • Maximum total static pressure drop external to the chiller must not exceed 0.30" WG (75 Pa)

7-7

7-8 Piping Diagrams

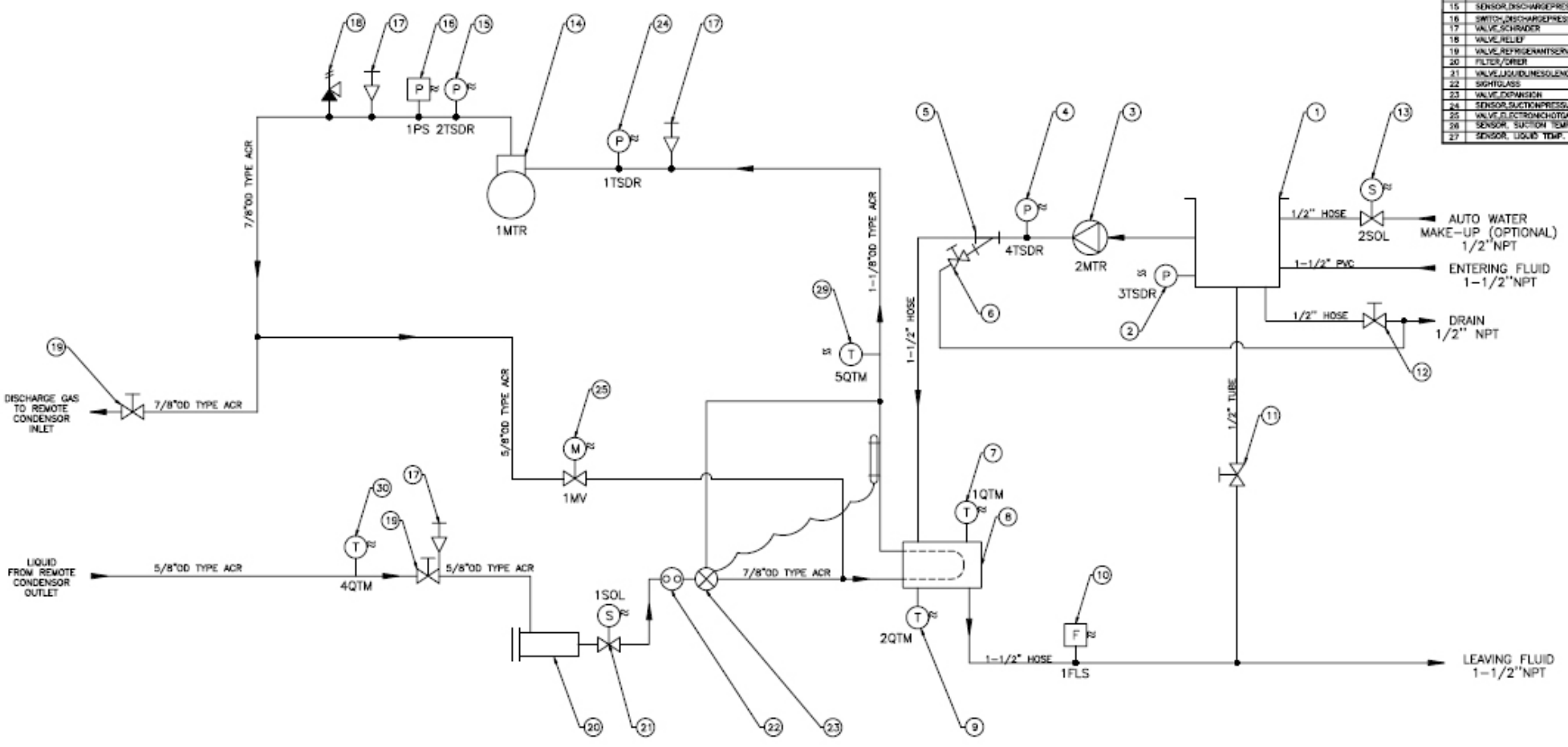


NO	DESCRIPTION
1	TANK
2	SENSOR, LEVEL
3	PUMP
4	VALVE, RECIRCULATE
5	DRUM
6	VALVE, AUTO
7	SENSOR, TEMPERATURE
8	SENSOR, TEMPERATURE
9	COMPRESSOR
10	SENSOR, TEMPERATURE
11	SENSOR, TEMPERATURE
12	SENSOR, TEMPERATURE
13	VALVE, AUTO
14	SENSOR, TEMPERATURE
15	SENSOR, TEMPERATURE
16	SENSOR, TEMPERATURE
17	VALVE, AUTO
18	SENSOR, TEMPERATURE
19	SENSOR, TEMPERATURE
20	SENSOR, TEMPERATURE
21	SENSOR, TEMPERATURE
22	SENSOR, TEMPERATURE
23	SENSOR, TEMPERATURE
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26	SENSOR, TEMPERATURE
27	SENSOR, TEMPERATURE
28	SENSOR, TEMPERATURE

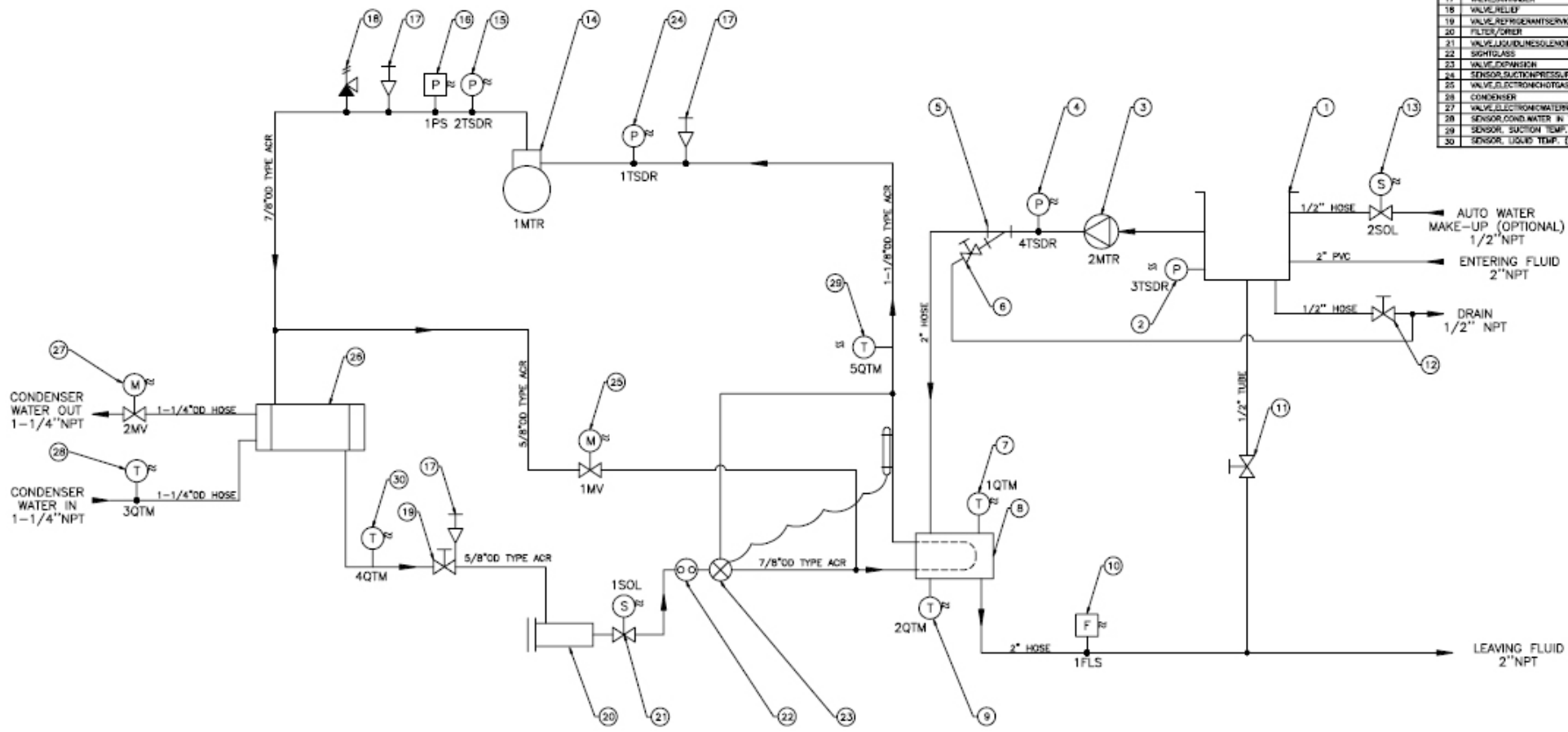


ITEM	DESCRIPTION
1	TANK
2	SENSOR, LIQUID LEVEL
3	PUMP
4	SENSOR, PUMP/CHARGE
5	STRAINER
6	VALVE, FLUID SERVICE
7	SENSOR, LEAVING FLUID TEMPERATURE
8	EVAPORATOR
9	SENSOR, ENTERING FLUID TEMPERATURE
10	SWITCH, FLOW
11	VALVE, BYPASS
12	VALVE, DRAIN
13	VALVE, AUTO WATER MAKE-UP (OPTIONAL)
14	COMPRESSOR SCROLL
15	SENSOR, DISCHARGE PRESSURE
16	SENSOR, DISCHARGE PRESSURE
17	VALVE, SCHRAEDER
18	VALVE, RELIEF
19	VALVE, REFRIGERANT SERVICE
20	FILTER/DRYER
21	VALVE, LIQUID LINE SOLENOID
22	SIGHT GLASS
23	VALVE, EXPANSION
24	SENSOR, SUCTION PRESSURE
25	VALVE, ELECTRONIC HOT GAS
26	CONDENSER
27	FAN/AXIAL
28	SENSOR, AIR TEMPERATURE (OPTIONAL)
29	SENSOR, SUCTION TEMP. (OPTIONAL)
30	SENSOR, LIQUID TEMP. (OPTIONAL)

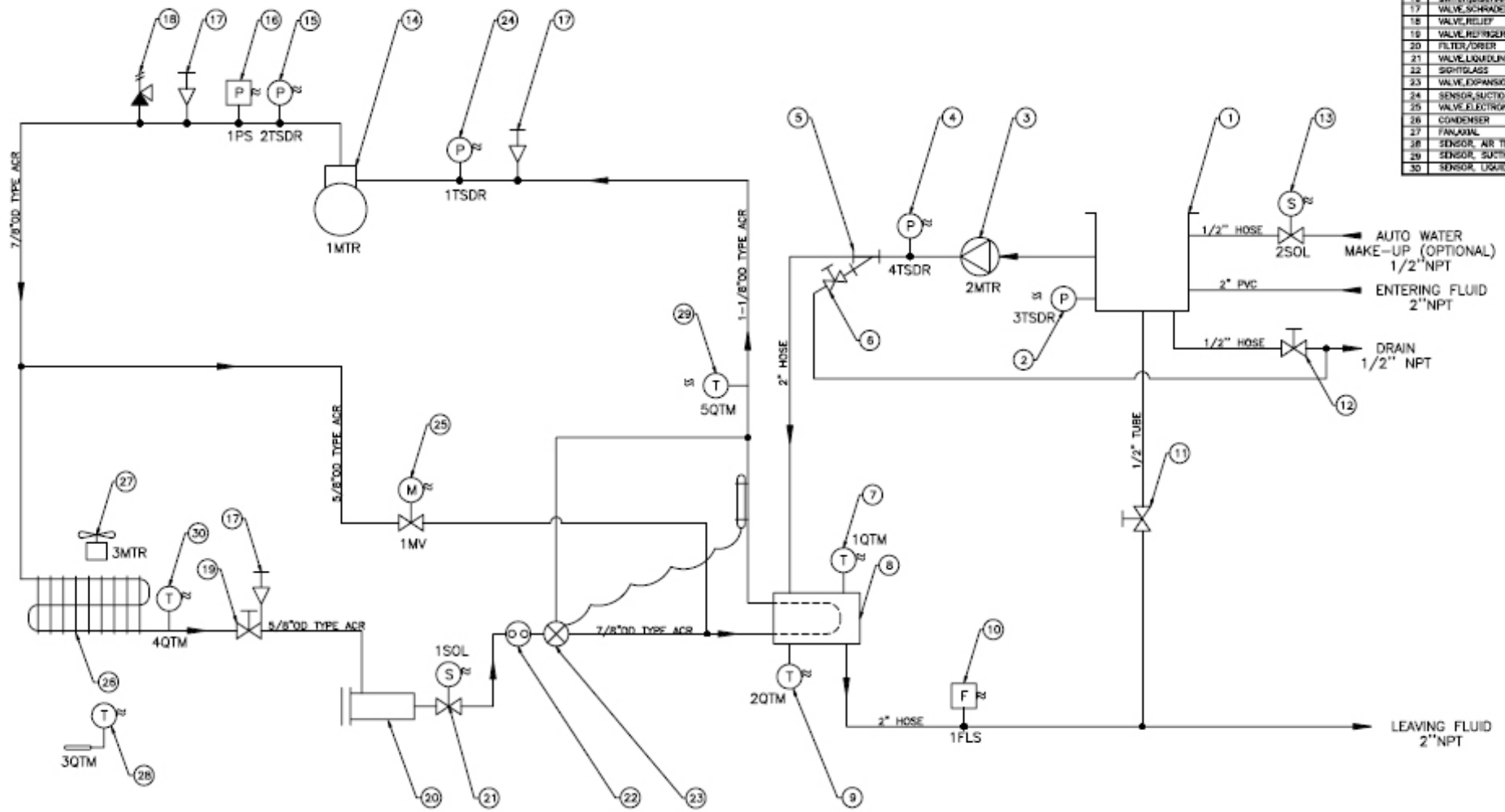
ITEM	DESCRIPTION
1	TANK
2	SENSOR, LIQUID LEVEL
3	PUMP
4	SENSOR, PUMP DISCHARGE
5	STRAINER
6	VALVE, FLUID SERVICE
7	SENSOR, LEAVING FLUID TEMPERATURE
8	EVAPORATOR
9	SENSOR, ENTERING FLUID TEMPERATURE
10	SWITCH, FLOW
11	VALVE, BYPASS
12	VALVE, DRAIN
13	VALVE, AUTO WATER MAKE-UP (OPTIONAL)
14	COMPRESSOR, SCROLL
15	SENSOR, DISCHARGE PRESSURE
16	SWITCH, DISCHARGE PRESSURE
17	VALVE, SCROLL
18	VALVE, RELIEF
19	VALVE, REFRIGERANT SERVICE
20	FILTER/ORDER
21	VALVE, LIQUID LINE SOLENOID
22	SIGHTGLASS
23	VALVE, EXPANSION
24	SENSOR, SUCTION PRESSURE
25	VALVE, FLOW METER SOLENOID
26	SENSOR, SUCTION TEMP. (OPTIONAL)
27	SENSOR, LIQUID TEMP. (OPTIONAL)



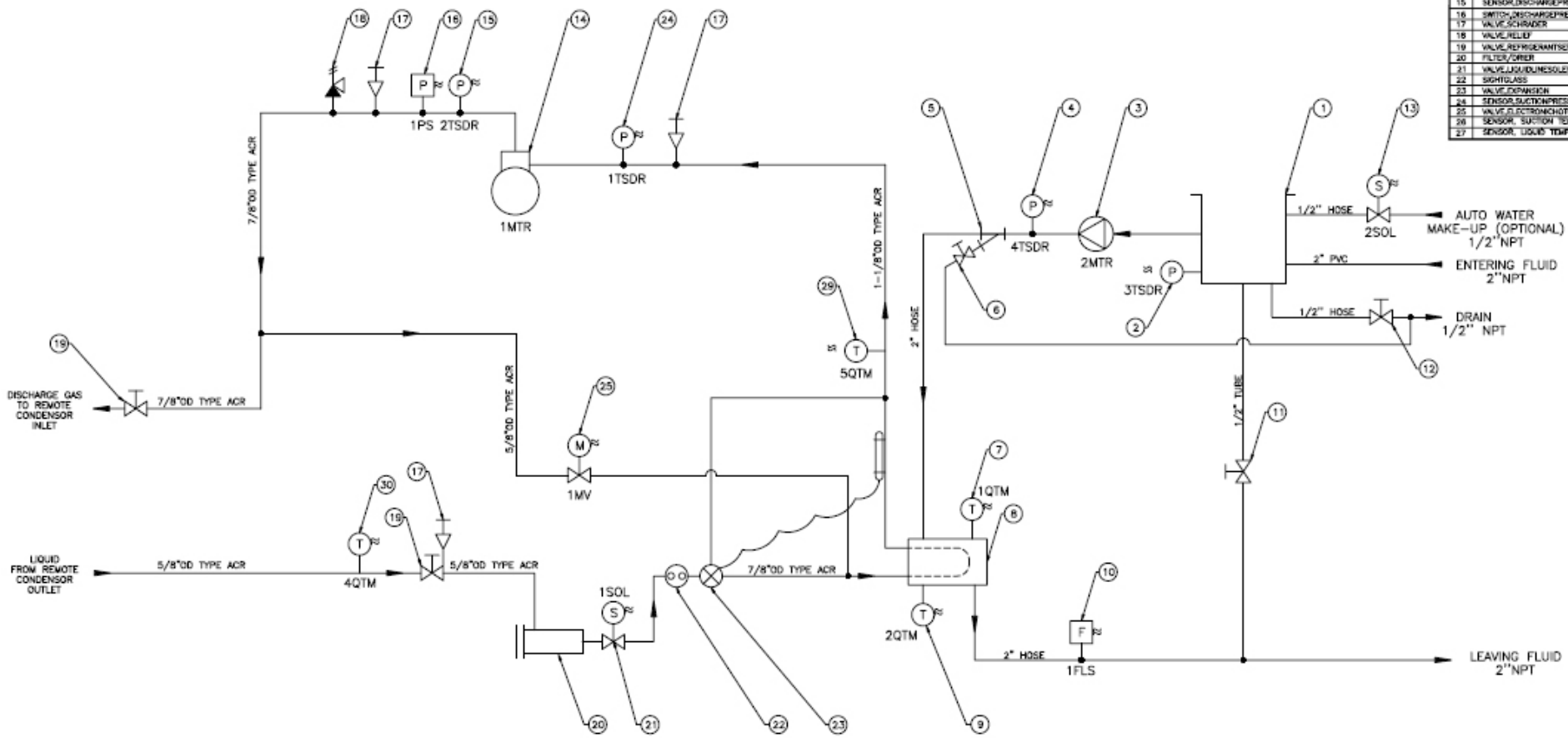
ITEM	DESCRIPTION
1	TANK
2	SENSOR, LIQUID LEVEL
3	PUMP
4	SENSOR,PUMPDISCHARGE
5	STRAINER
6	VALVE, FLUID SERVICE
7	SENSOR, LEAVING FLUID TEMPERATURE
8	EVAPORATOR
9	SENSOR, ENTERING FLUID TEMPERATURE
10	SWITCH,FLOW
11	VALVE,BYPASS
12	VALVE,DRAIN
13	VALVE, AUTO WATER MAKE-UP (OPTIONAL)
14	COMPRESSOR,SCROLL
15	SENSOR,DISCHARGE PRESSURE
16	SWITCH,DISCHARGE PRESSURE
17	VALVE,SHRADER
18	VALVE,RELIEF
19	VALVE,REFRIGERANT SERVICE
20	FILTER, DRIER
21	VALVE,LIQ/LIQUID/SOLENOID
22	SIGHTGLASS
23	VALVE,EXPANSION
24	SENSOR,DISCHARGE PRESSURE
25	VALVE,ELECTRONIC/OTGAS
26	CONDENSER
27	VALVE,ELECTROMOTOR/REGULATING
28	SENSOR,COND.WATER IN TEMP. (OPTIONAL)
29	SENSOR, SUCTION TEMP. (OPTIONAL)
30	SENSOR, LIQUID TEMP. (OPTIONAL)



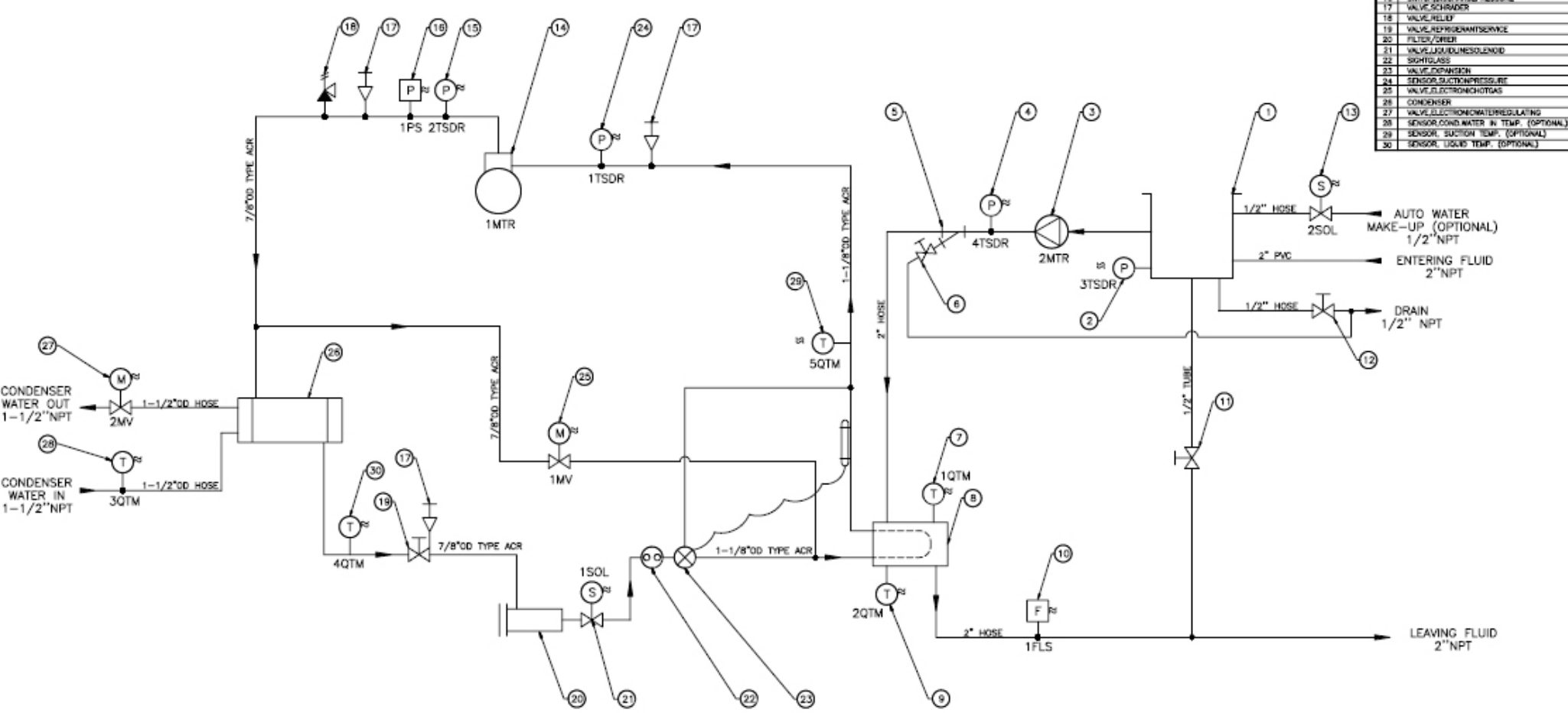
ITEM	DESCRIPTION
1	TANK
2	SENSOR, LIQUID LEVEL
3	PUMP
4	SENSOR, PUMP/DISCHARGE
5	STRAINER
6	VALVE, FLUID SERVICE
7	SENSOR, LEAVING FLUID TEMPERATURE
8	EVAPORATOR
9	SENSOR, ENTERING FLUID TEMPERATURE
10	SWITCH, FLOW
11	VALVE, BYPASS
12	VALVE, DRAIN
13	VALVE, AUTO WATER MAKE-UP (OPTIONAL)
14	COMPRESSOR SCROLL
15	SENSOR, DISCHARGE PRESSURE
16	SWITCH, DISCHARGE PRESSURE
17	VALVE, SCHRAEDER
18	VALVE, RELIEF
19	VALVE, REFRIGERANT SERVICE
20	FILTER, DRIER
21	VALVE, LIQUID LINE SOLENOID
22	SIGHTGLASS
23	VALVE, EXPANSION
24	SENSOR, SUCTION PRESSURE
25	VALVE, ELECTRIC HEAT/ GAS
26	CONDENSER
27	FAN/LAMP
28	SENSOR, AIR TEMPERATURE (OPTIONAL)
29	SENSOR, SUCTION TEMP. (OPTIONAL)
30	SENSOR, LIQUID TEMP. (OPTIONAL)



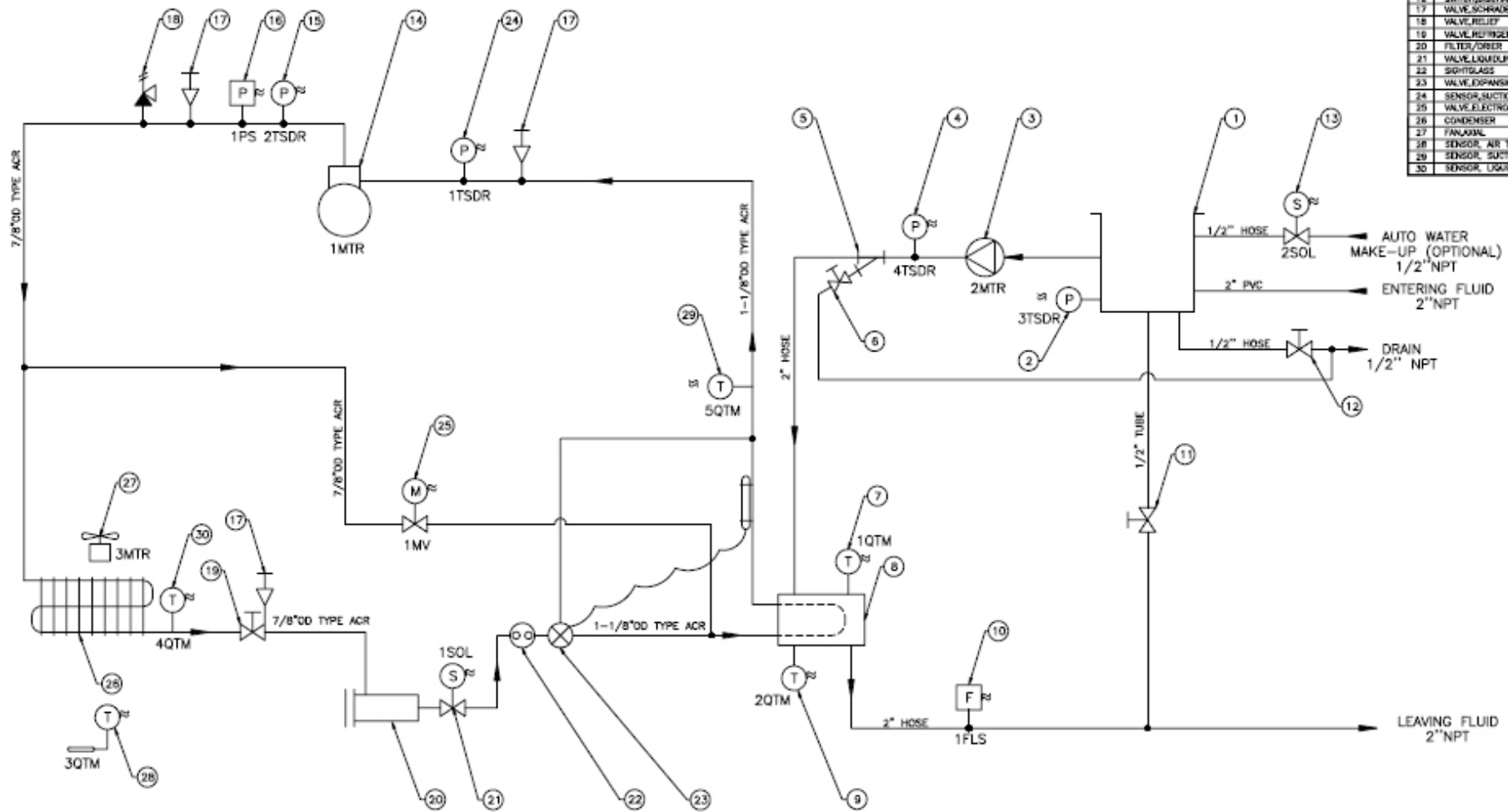
ITEM	DESCRIPTION
1	TANK
2	SENSOR, LIQUID LEVEL
3	PUMP
4	SENSOR, PUMP DISCHARGE
5	STRAINER
6	VALVE, FLUID SERVICE
7	SENSOR, LEAVING FLUID TEMPERATURE
8	EXHHAUSTOR
9	SENSOR, ENTERING FLUID TEMPERATURE
10	SWITCH, FLOW
11	VALVE, BYPASS
12	VALVE, DRAIN
13	VALVE, AUTO WATER MAKE-UP (OPTIONAL)
14	COMPRESSOR, SCROLL
15	SENSOR, DISCHARGE PRESSURE
16	SWITCH, DISCHARGE PRESSURE
17	VALVE, SCHRADER
18	VALVE, RELEIF
19	VALVE, REFRIGERANT SERVICE
20	FILTER/ORDER
21	VALVE, LIQUID/SOLENOID
22	SIGHTGLASS
23	VALVE, EXPANSION
24	SENSOR, SUCTION PRESSURE
25	VALVE, ELECTRONIC GAS
26	SENSOR, SUCTION TEMP. (OPTIONAL)
27	SENSOR, LIQUID TEMP. (OPTIONAL)



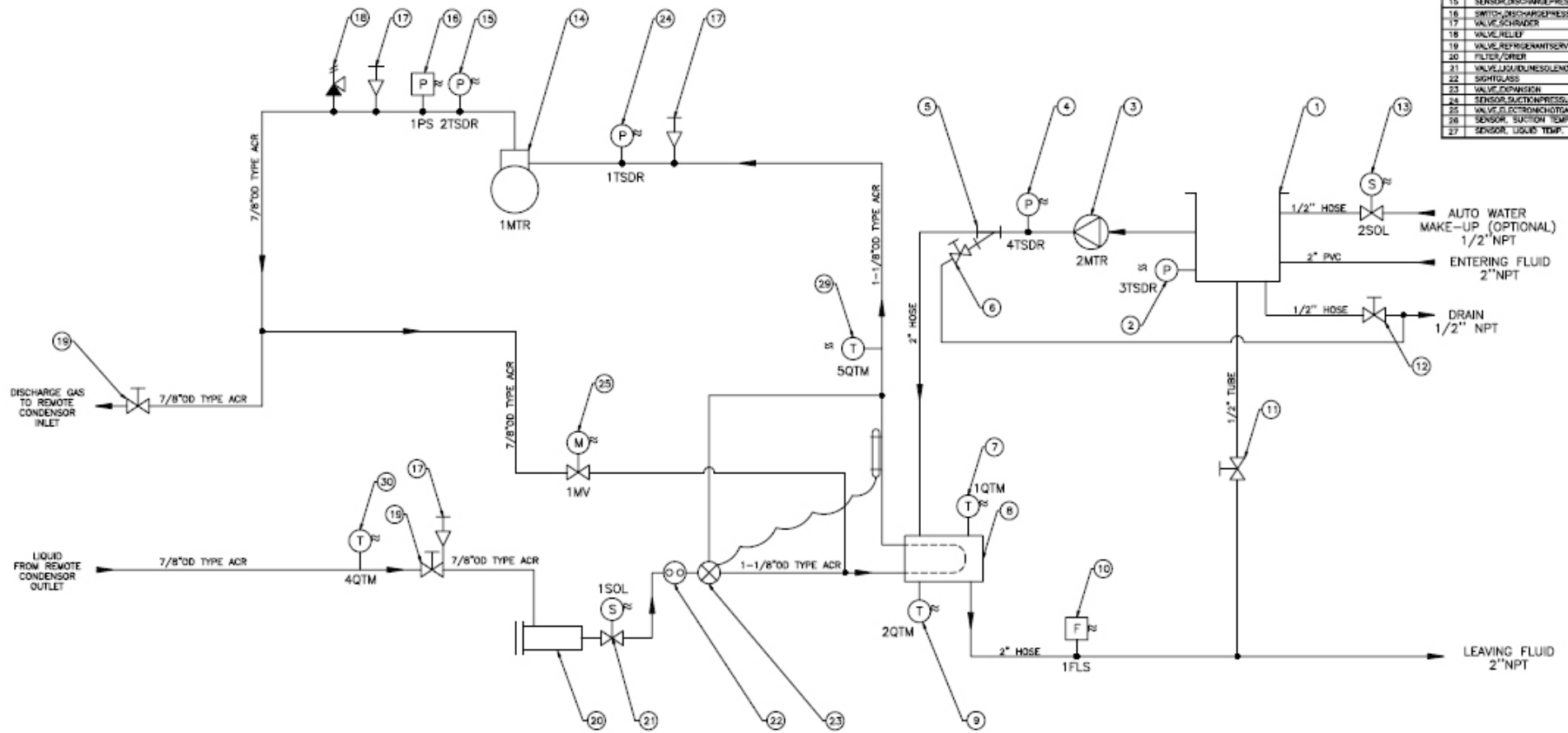
ITEM	DESCRIPTION
1	TANK
2	SENSOR, LIQUID LEVEL
3	PUMP
4	SENSOR,PUMPDISCHARGE
5	STRAINER
6	VALVE, FLUID SERVICE
7	SENSOR, LEAVING FLUID TEMPERATURE
8	EVAPORATOR
9	SENSOR, ENTERING FLUID TEMPERATURE
10	SWITCH,FLOW
11	VALVE,BYPASS
12	VALVE,DRAIN
13	VALVE, AUTO WATER MAKE-UP (OPTIONAL)
14	COMPRESSOR,SCROLL
15	SENSOR,DISCHARGE PRESSURE
16	SWITCH,DISCHARGE PRESSURE
17	VALVE,SHUT-DOWN
18	VALVE,RELIEF
19	VALVE,REFRIGERANT SERVICE
20	FILTER,DRYER
21	VALVE,LIQUIDLINE SOLENOID
22	SIGHTGLASS
23	VALVE,EXPANSION
24	SENSOR,ELECTRONIC PRESS. RT
25	VALVE,ELECTRONIC HOT GAS
26	CONDENSER
27	VALVE,ELECTRONIC WATER REGULATING
28	SENSOR,COND. WATER IN TEMP. (OPTIONAL)
29	SENSOR, SUCTION TEMP. (OPTIONAL)
30	SENSOR, LIQUID TEMP. (OPTIONAL)



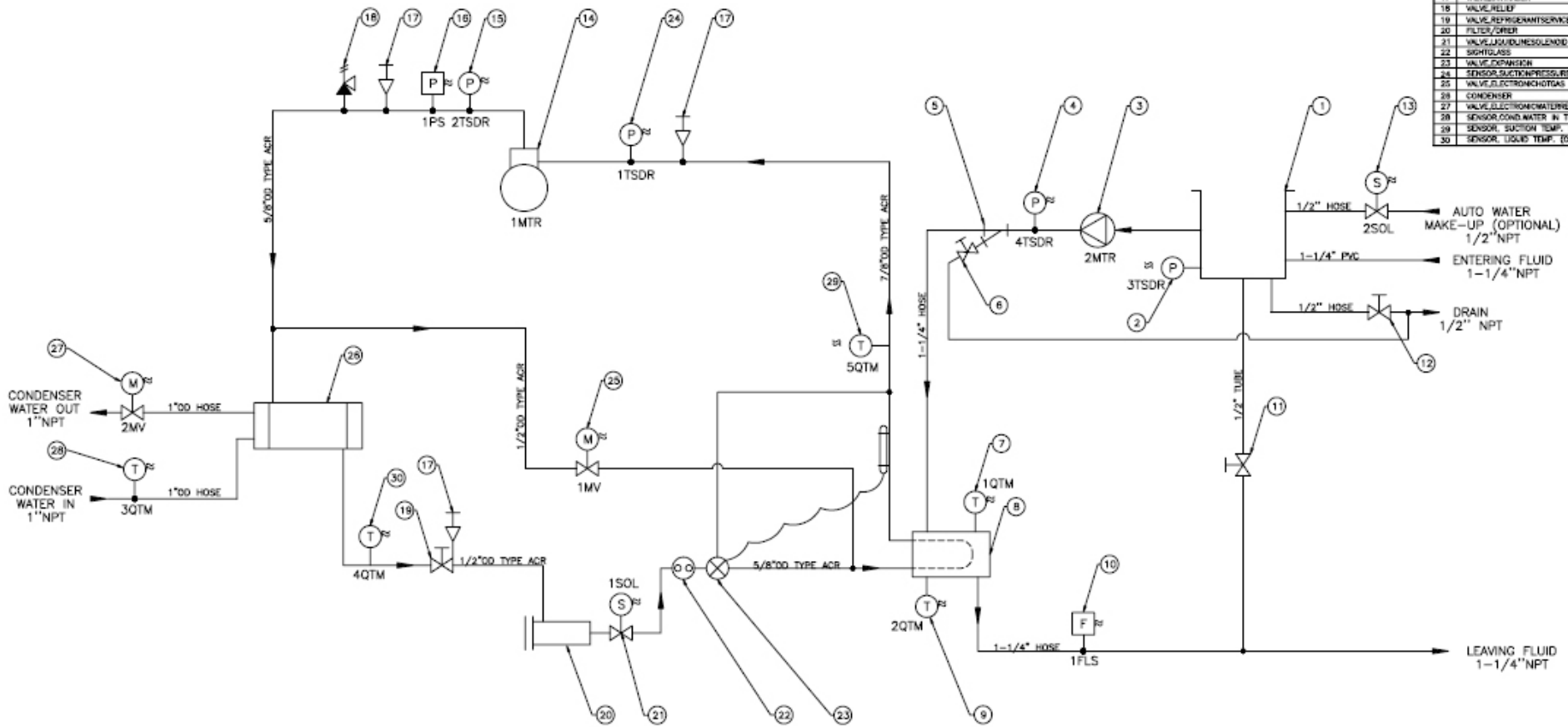
ITEM	DESCRIPTION
1	TANK
2	SENSOR, LIQUID LEVEL
3	PUMP
4	SENSOR, PUMP DISCHARGE
5	STRAINER
6	VALVE, FLUID SERVICE
7	SENSOR, LEAVING FLUID TEMPERATURE
8	EVAPORATOR
9	SENSOR, ENTERING FLUID TEMPERATURE
10	SWITCH, FLOW
11	VALVE, BYPASS
12	VALVE, DRAIN
13	VALVE, AUTO WATER MAKE-UP (OPTIONAL)
14	COMPRESSOR, SCROLL
15	SENSOR, DISCHARGE PRESSURE
16	SWITCH, DISCHARGE PRESSURE
17	VALVE, SCHRADER
18	VALVE, RELIEF
19	VALVE, REFRIGERANT SERVICE
20	FILTER/ORDER
21	VALVE, LIQUID/SOLENOID
22	SHOTS GLASS
23	VALVE, EXPANSION
24	SENSOR, SUCTION PRESSURE
25	VALVE, ELECTRONIC/OTAS
26	CONDENSER
27	FAN/BLADE
28	SENSOR, AIR TEMPERATURE (OPTIONAL)
29	SENSOR, SUCTION TEMP. (OPTIONAL)
30	SENSOR, LIQUID TEMP. (OPTIONAL)



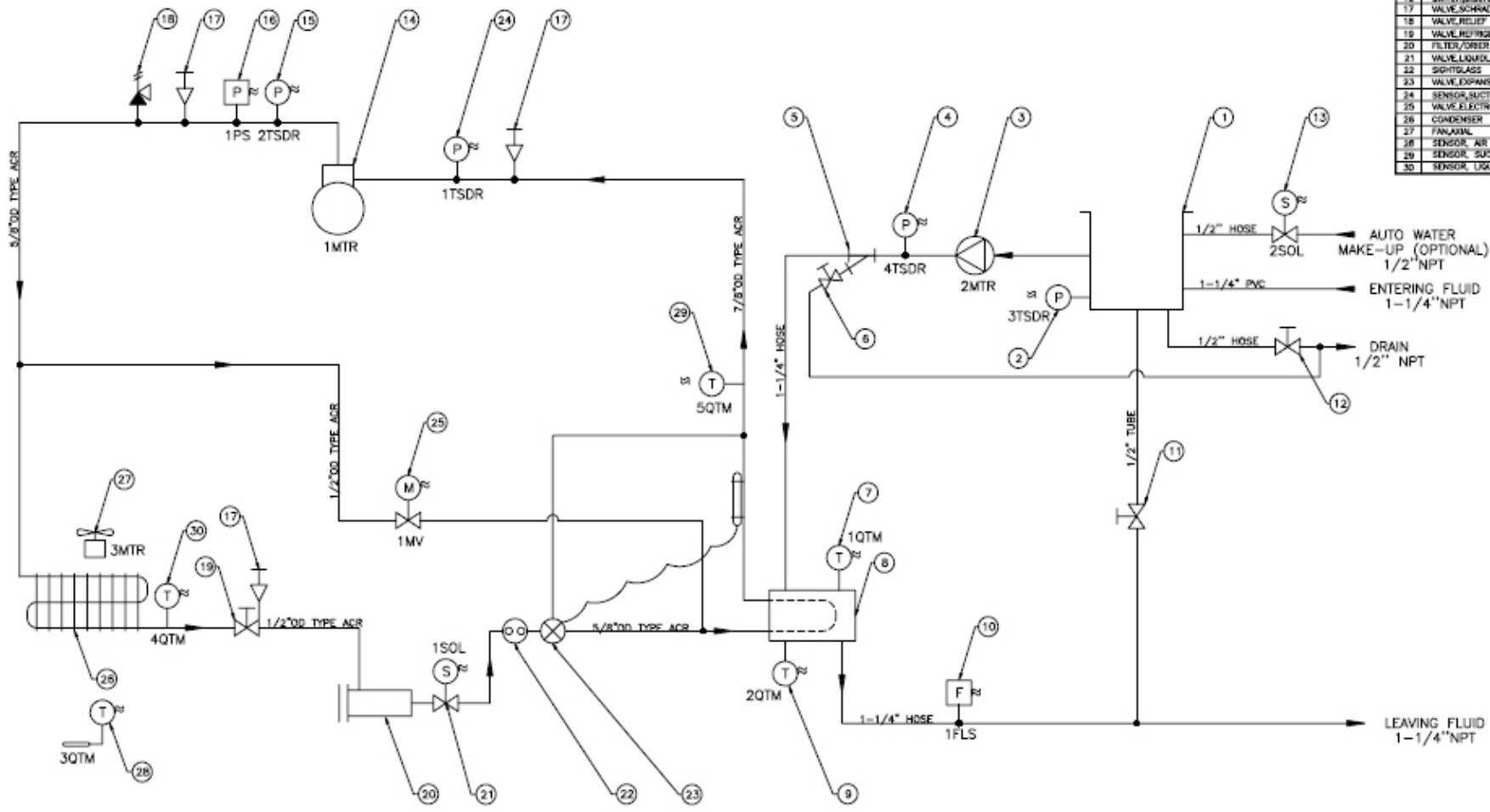
ITEM	DESCRIPTION
1	TANK
2	SENSOR, LIQUID LEVEL
3	PUMP
4	SENSOR, PUMP/DISCHARGE
5	STRAINER
6	VALVE, FLUID SERVICE
7	SENSOR, LEAVING FLUID TEMPERATURE
8	EVAPORATOR
9	SENSOR, ENTERING FLUID TEMPERATURE
10	SWITCH, FLOW
11	VALVE, BYPASS
12	VALVE, DRAIN
13	VALVE, AUTO WATER MAKE-UP (OPTIONAL)
14	COMPRESSOR, SCROLL
15	SENSOR, DISCHARGE PRESSURE
16	SWITCH, DISCHARGE PRESSURE
17	VALVE, SCHRAEDER
18	VALVE, RELIEF
19	VALVE, REFRIGERANT SERVICE
20	FILTER/DRIER
21	VALVE, LIQUID LINE SOLENOID
22	SIGHT GLASS
23	VALVE, EXPANSION
24	SENSOR, SUCTION PRESSURE
25	VALVE, ELECTRONIC DRY GAS
26	SENSOR, SUCTION TEMP. (OPTIONAL)
27	SENSOR, LIQUID TEMP. (OPTIONAL)

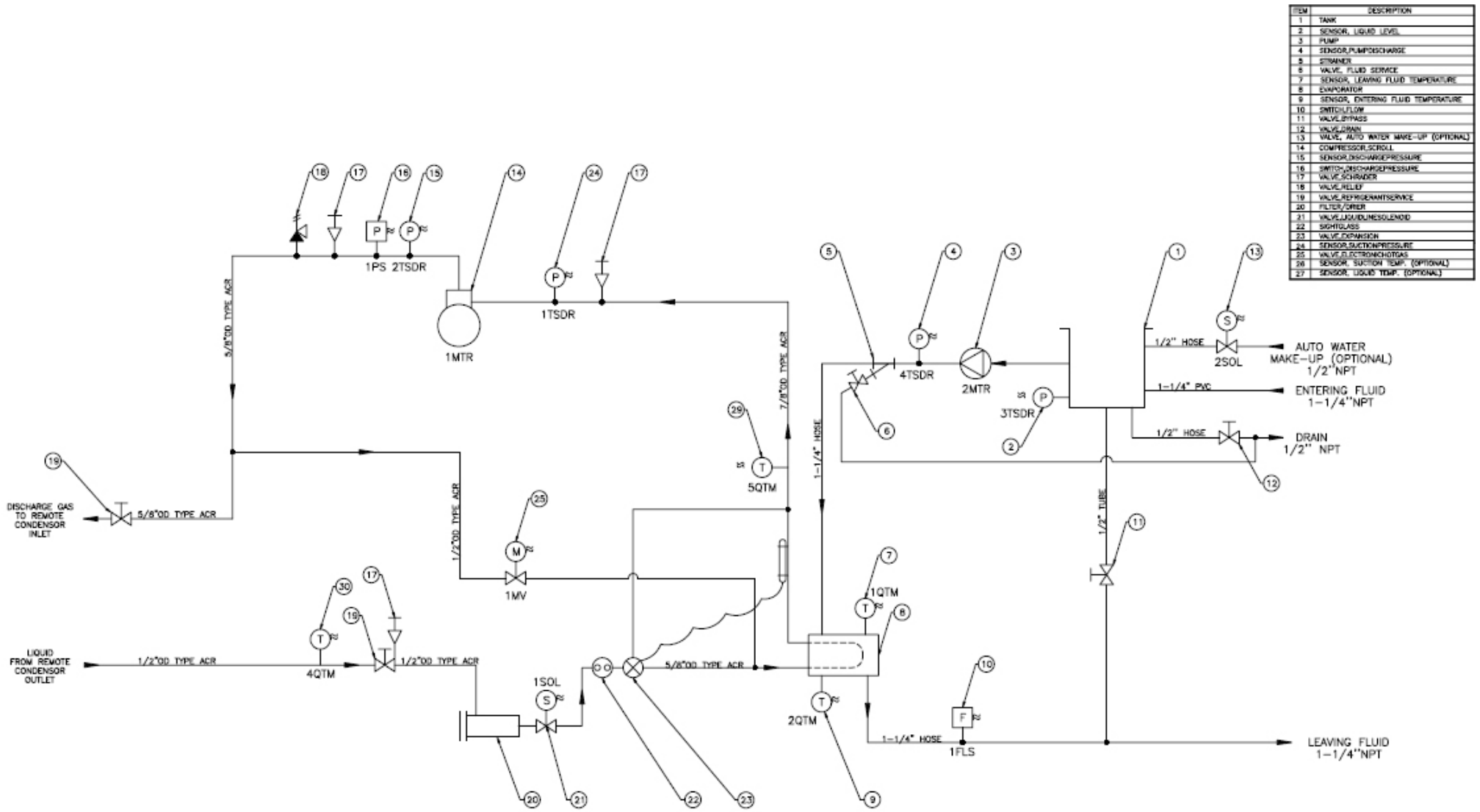


ITEM	DESCRIPTION
1	TANK
2	SENSOR, LIQUID LEVEL
3	PUMP
4	SENSOR, PUMP DISCHARGE
5	STRAINER
6	VALVE, FLUID SERVICE
7	SENSOR, LEAVING FLUID TEMPERATURE
8	EVAPORATOR
9	SENSOR, ENTERING FLUID TEMPERATURE
10	SMTC/FLOW
11	VALVE, BYPASS
12	VALVE, DRAIN
13	VALVE, AUTO WATER MAKE-UP (OPTIONAL)
14	COMPRESSOR, SCROLL
15	SENSOR, DISCHARGE PRESSURE
16	SWITCH, DISCHARGE PRESSURE
17	VALVE, SCHRADER
18	VALVE, RELIEF
19	VALVE, REFRIGERANT SERVICE
20	FILTER/ORDER
21	VALVE, LIQUID LINE/SOLENOID
22	SIGHTGLASS
23	VALVE, COMPRESSOR
24	SENSOR, SUCTION PRESSURE
25	VALVE, ELECTRONIC HOT GAS
26	CONDENSER
27	VALVE, ELECTRONIC WATER REGULATING
28	SENSOR, CONDENSER W/ TEMP. (OPTIONAL)
29	SENSOR, SUCTION TEMP. (OPTIONAL)
30	SENSOR, LIQUID TEMP. (OPTIONAL)



ITEM	DESCRIPTION
1	TANK
2	SENSOR, LIQUID LEVEL
3	PUMP
4	SENSOR, PUMP DISCHARGE
5	STRAINER
6	VALVE, FLUID SERVICE
7	SENSOR, LEAVING FLUID TEMPERATURE
8	FLAPDRIVER
9	SENSOR, ENTERING FLUID TEMPERATURE
10	SWITCH, FLOW
11	VALVE, BYPASS
12	VALVE, DRAIN
13	VALVE, AUTO WATER MAKE-UP (OPTIONAL)
14	COMPRESSOR, SCROLL
15	SENSOR, DISCHARGE PRESSURE
16	SWITCH, DISCHARGE PRESSURE
17	VALVE, SCROLLDR
18	VALVE, RELIEF
19	VALVE, REFRIGERANT SERVICE
20	FILTER, ORDER
21	VALVE, LIQUID LINE SOLENOID
22	SIGHTGLASS
23	VALVE, EXPANSION
24	SENSOR, SUCTION PRESSURE
25	VALVE, ELECTRONIC HOT GAS
26	CONDENSER
27	FAN/BLAS
28	SENSOR, AIR TEMPERATURE (OPTIONAL)
29	SENSOR, SUCTION TEMP. (OPTIONAL)
30	SENSOR, LIQUID TEMP. (OPTIONAL)





ITEM	DESCRIPTION
1	TANK
2	SENSOR, LIQUID LEVEL
3	PUMP
4	SENSOR, PUMP DISCHARGE
5	SENSOR, VALVE SERVICE
6	VALVE, LEAVING FLUID TEMPERATURE
7	SENSOR, ENTERING FLUID TEMPERATURE
8	EMPOVATOR
9	SENSOR, ENTERING FLUID TEMPERATURE
10	PTFE FLOW
11	VALVE, BYPASS
12	VALVE, DRAIN
13	VALVE, AUTO WATER MAKE-UP (OPTIONAL)
14	COMPRESSOR, SCROLL
15	SENSOR, DISCHARGE PRESSURE
16	SENSOR, DISCHARGE PRESSURE
17	VALVE, SCHRAEDER
18	VALVE, RELIEF
19	VALVE, REFRIGERANT SERVICE
20	FILTER, DRIER
21	VALVE, FLUSHING SOLENOID
22	SOLENOID
23	VALVE, EXPANSION
24	SENSOR, SUCTION PRESSURE
25	VALVE, ELECTRONIC HOT GAS
26	SENSOR, SUCTION TEMP. (OPTIONAL)
27	SENSOR, LIQUID TEMP. (OPTIONAL)