Installation, Operation and Maintenance Manual

IOMM AGZ1-2
Group: **Chiller**
Part Number**: 331373801**
Effective: **February 2005**
Supersedes: **IOMM AGZ1-1**

Air-Cooled Scroll Compressor Water Chillers

AGZ 010A – AGZ 034A

10 to 34 Tons, 35 to 120 kW

R-22, 407C

60 Hertz

McQuay®
Air Conditioning

Table of Contents

Introduction

General Description

McQuay air-cooled water chillers are complete, self-contained automatic refrigerating units. Every unit is completely assembled, factory wired, charged, and tested. Each unit consists of air-cooled condensers, Copeland Compliant Scroll® hermetic compressor, brazed plate-to-plate evaporator, and complete refrigerant piping. Liquid line components include sight-glass/moisture indicator, solenoid valve, and thermal expansion valve. Other features include a compressor heater, and evaporator heater for chilled water freeze protection.

The electrical control center includes all equipment protection and operating controls necessary for automatic operation. Condenser fan motors are three-phase (except single-phase on No. 1 fan with SpeedTrol option) and started by their own contactors and have inherent overload protection. The compressor has solid-state motor protection for inherent thermal overload protection except Model AGZ 010 that has internal line breakage.

Software Version

This manual is based on software version AGZSU0102D. The software version can be displayed by pressing the Enter and Menu keys simultaneously. Exit by pressing Menu.

Inspection

Check all items carefully against the bill of lading. Inspect all units for damage upon arrival. Report shipping damage and file a claim with the carrier. Check the unit nameplate before unloading to be sure it agrees with the power supply available. Units are shipped FOB factory and McQuay is not responsible for physical damage after unit leaves the factory.

Note: Unit shipping and operating weights are listed on pages 14 and 15.

Installation

Note: Installation must be performed by trained, experienced personnel who are familiar with local codes and regulations, especially concerning refrigerant release to the atmosphere.

⚠ WARNING

Sharp edges and coil surfaces can cause personal injury.
Avoid contact with them.

Handling

Be careful to avoid rough handling of the unit. Do not push or pull the unit from anything other than the base. Block the pushing vehicle away from the unit to prevent damage to the sheet-metal cabinet and end frame (see Figure 1).

To lift the unit, lifting slots are provided in the base of the unit. Arrange spreader bars and cables to prevent damage to the condenser coils or cabinet (see Figure 2).

Figure 1, Suggested Pushing Arrangement

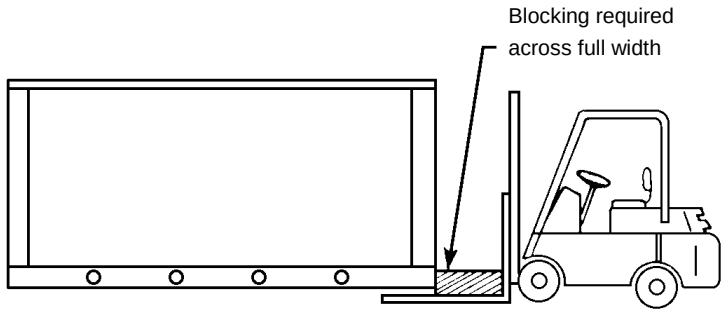
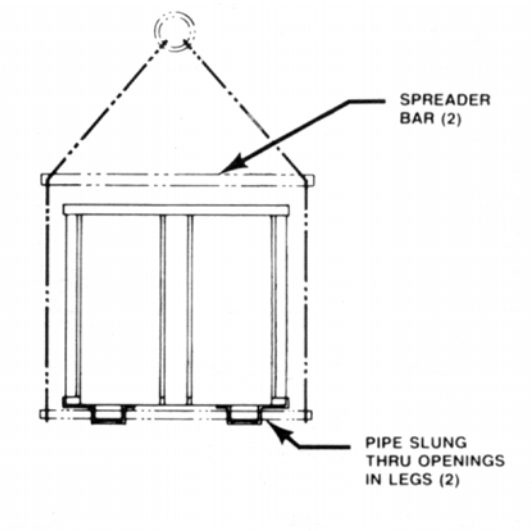


Figure 2, Suggested Lifting Arrangement



Location

Unit Placement

AGZ units are for outdoor applications and can be mounted on a roof or at ground level. Set units on a solid and level foundation. For roof-mounted applications, install the unit on a steel channel or I-beam frame to support the unit above the roof. For ground level applications, install the unit on a substantial base that will not settle. A one-piece concrete slab with footings extended below the frost line is recommended. Be sure the foundation is level (within 1/2" [13 mm] over its length and width). The foundation must support the operating weights listed in the Physical Data Tables on pages 14 and 15.

Since its operation is affected by wind, the unit should be located so that its length is parallel with the prevailing wind. If this is not practical, use field fabricated wind deflectors.

Service Access

Each end of the unit must be accessible after installation for periodic service. Compressors, filter-driers, and liquid line solenoid valve are accessible from the end of the unit. High-pressure, low-pressure, and motor protector controls are on the compressor. Most operating, equipment protection, and starting controls are located in the unit control box.

The fan deck with the condenser fans and motors can be removed from the top of the unit.

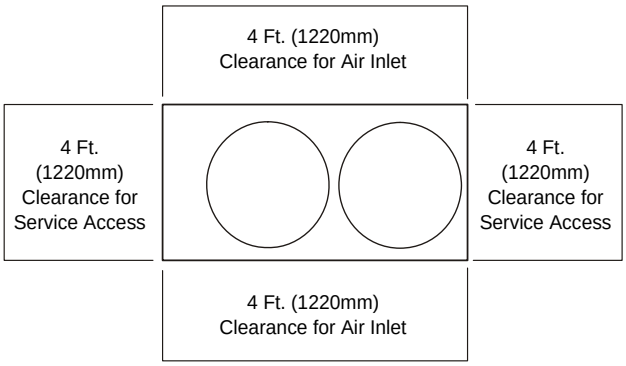
Clearances

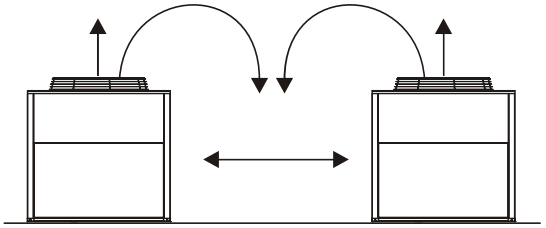
The flow of air to and from the condenser coil must not be limited. Restricting airflow or allowing air recirculation will result in a decrease in unit performance and efficiency. There must be no obstruction above the unit that would deflect discharge air downward where it could be recirculated back to the inlet of the condenser coil. The condenser fans are propeller type and will not operate with ductwork on the fan outlet.

Install the unit with enough side clearance for air entrance to the coil and for servicing. Provide service access to the evaporator, compressors, electrical control panel and piping components as shown in Figure 3. Do not block access to the unit with piping or conduit.

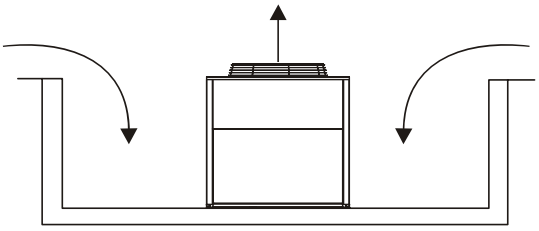
Do not allow debris to accumulate near the unit. Air movement may draw debris into the condenser coil causing air starvation. Give special consideration to low ambient operation where snow can accumulate. Keep condenser coils and fan discharge free of snow or other obstructions to permit adequate airflow.

Figure 3, Clearance requirements

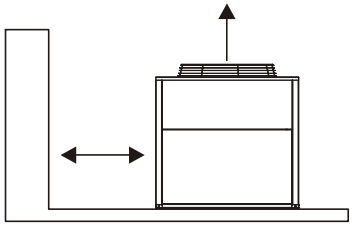




The recommended minimum side clearance between two units is 8 feet (2440mm).



The unit must not be installed in a pit or enclosure that is deeper or taller than the height of the unit unless extra space is provided. The minimum clearance on each side of the unit is 6 feet (1828mm) when installed in a pit. The pit cannot be deeper than the unit.



The minimum clearance to a side wall or building taller than the unit height is 6 feet (1828mm) provided no solid wall above 6 feet (1828mm) tall is closer than 12 feet (3658mm) to the opposite side of the unit.

Sound Isolation

The low sound levels of the AGZ chiller are suitable for most applications. When additional sound reduction is necessary, locate the unit away from sound sensitive areas. Avoid locations beneath windows or between structures where normal operating sounds may be objectionable. Reduce structurally transmitted sound by isolating water lines, electrical conduit and the unit itself. Use wall sleeves and rubber isolated piping hangers to reduce transmission of water or pump noise into occupied spaces. Use flexible electrical conduit to isolate sound through electrical conduit. Spring isolators are effective in reducing the low amplitude sound generated by the Discus semi-hermetic compressors and for unit isolation in sound-sensitive areas.

Vibration Isolators

Vibration isolators are recommended for all roof-mounted installations or wherever vibration transmission is a consideration.

The unit should be initially placed on shims or blocks at the listed free height. When all piping, wiring, flushing, charging, etc. is completed, the springs are adjusted upward to loosen the blocks or shims that are then removed.

A rubber anti-skid pad is part of the isolator. Installation of spring isolators requires flexible piping connections and at least three feet of flexible conduit to avoid straining the piping and transmitting vibration and noise. These units cannot be bolted to isolators.

Table 1, Recommended Vibration Isolators

Neoprene-in-Shear					Kit P/N
Model	**RF**	**LF**	**RB**	**LB**	
010, 013, 017	RP-3 Red	RP-3 Red	RP-3 Red	RP-3 Red	350014858
020, 025, 029, 034	RP-3 Green	RP-3 Green	RP-3 Red	RP-3 Red	350014857

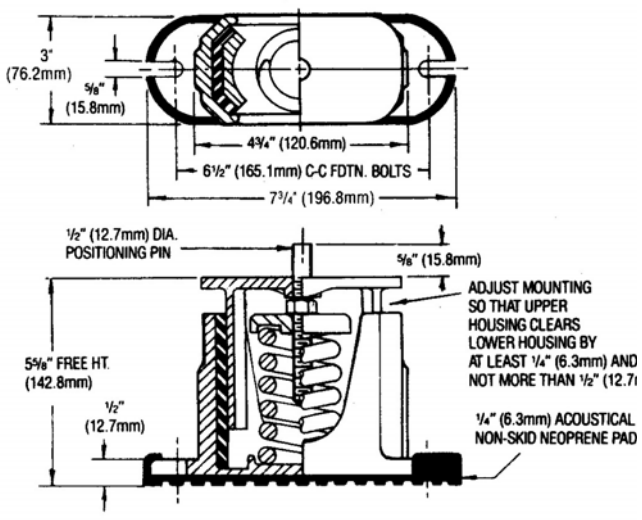
Spring					Kit P/N
Model	**RF**	**LF**	**RB**	**LB**	
010	CP 1-24 Brown	CP 1-24 Brown	CP 1-24 Brown	CP 1-24 Brown	350014832
013, 017	CP 1-25 Red	CP 1-25 Red	CP 1-25 Red	CP 1-25 Red	350014834
020, 025	CP1-26 Purple	CP1-27 Orange	CP 1-24 Brown	CP 1-24 Brown	350014836
029	CP1-27 Orange	CP1-27 Orange	CP 1-25 Red	CP 1-25 Red	350014838
034	CP1-27 Orange	CP1-28 Green	CP 1-25 Red	CP 1-25 Red	350014840

Note: See dimension drawing for location of isolators

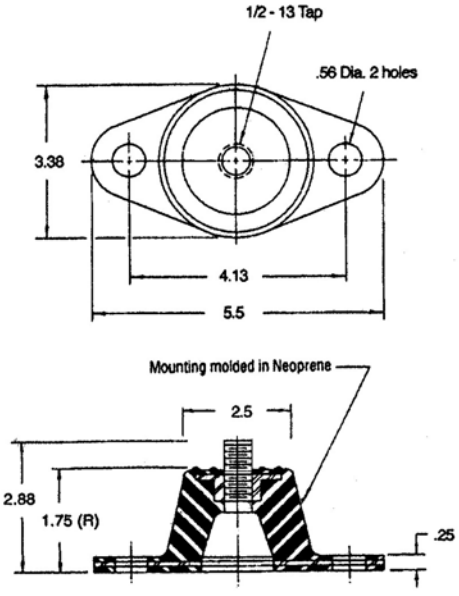
Corner Weights

AGZ	RF	LF	RB	LB
010A	243	262	243	262
013A	358	390	284	310
017A	374	410	319	349
020A	525	570	253	274
025A	539	594	259	286
029A	628	647	324	334
034A	731	747	348	356

CP-1, Spring Isolator



RP-3 Neoprene-in-Shear Isolator



Chilled Water System

Water Piping

Local authorities can supply the installer with the proper building and safety codes required for proper installation.

Install piping with minimum bends and changes in elevation to minimize pressure drop. Consider the following when installing water piping:

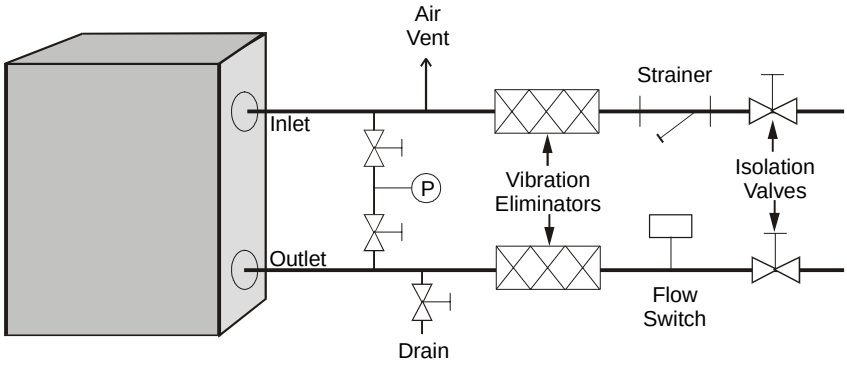
1. Vibration eliminators to reduce vibration and noise transmission to the building.
2. Shutoff valves to isolate the unit from the piping system during unit servicing.
3. Manual or automatic air vent valves at the high points of the system. Install drains at the lowest points in the system.
4. Maintaining adequate system water pressure (expansion tank or regulating valve).
5. Temperature and pressure indicators located at the unit to aid in unit servicing. Pressure gauge taps must be installed in the chilled water inlet and outlet piping or as shown in Figure 4.
6. A strainer or other means of removing foreign matter from the water before it enters the pump. Place the strainer far enough upstream to prevent cavitation at the pump inlet (consult pump manufacturer for recommendations). The use of a strainer can prolong pump life and keep system performance up.
7. A 40-mesh strainer *is required* in the water line just before the inlet of the evaporator. This will help prevent foreign material from entering and decreasing the performance of the evaporator.

⚠ CAUTION

If a separate disconnect is used for the 110V supply to the evaporator heating cable, mark the disconnect clearly so the disconnect is not accidentally shut off during cold seasons. This could cause a failure of the evaporator.

8. The brazed plate evaporator has a thermostat and heating cable to prevent freeze-up down to -20°F (-29°C). The heating cable should be wired to a separate 110V supply circuit. As shipped from the factory, the heating cable is wired to the control circuit. Protect all water piping to the unit from freezing.
9. If the unit is used as a replacement chiller on a previously existing piping system, flush the system thoroughly before unit installation. Perform regular water analysis and chemical water treatment on the evaporator immediately at equipment start-up.
10. When glycol is added to the water system for freeze protection, the refrigerant suction pressure will be lower, cooling performance less, and water side pressure drop greater. If the percentage of glycol is high, or if propylene is used instead of ethylene glycol, the added pressure drop and loss of performance could be substantial. Reset the freezestat and low leaving water alarm temperatures. The freezestat is factory set to default at 38°F (3.3°C). Reset the freezestat setting to approximately 4 to 5 degrees F (2.3 to 2.8 degrees C) below the leaving chilled water setpoint temperature. See the section titled “Glycol Solutions” on page 9 for additional information concerning glycol.
11. Perform a preliminary leak check before insulating the piping and filling the system.
12. Include a vapor barrier on the piping insulation to prevent condensation and possible damage to the building structure.

Figure 4, Typical Field Evaporator Water Piping



NOTES:
1. Chilled water piping within the unit enclosure must be insulated in the field.
2. Support piping independently of the unit and install per local codes.

System Volume

It is important to have adequate water volume in the system to provide an opportunity for the chiller to sense a load change, adjust to the change and stabilize. As the expected load change becomes more rapid, a greater water volume is needed. The system water volume is the total amount of water in the evaporator, air handling products and associated piping. If the water volume is too low, operational problems can occur, including rapid compressor cycling, rapid loading and unloading of compressors, erratic refrigerant flow in the chiller, improper motor cooling, shortened equipment life and other undesirable occurrences.

For normal comfort cooling applications, where the cooling load changes relatively slowly, we recommend a minimum system volume of five minutes times the flow rate (GPM). For example, if the design chiller flow rate is 120 GPM, we recommend a minimum system volume of 600 gallons (120 GPM x 5 minutes).

Since there are many other factors that can influence performance, systems may successfully operate below these suggestions. However, as the water volume decreases below these suggestions, the possibility of problems increases.

Variable Chilled Water flow

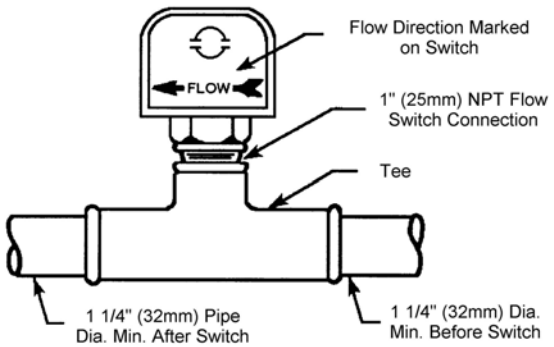
Variable chilled water flow systems are not recommended for this class of equipment due to limited unloading capability.

Flow Switch

Mount a water flow switch in the leaving water line to shut down the unit when water flow is interrupted.

A flow switch is available from McQuay (part number 017503300). It is a “paddle” type switch and adaptable to pipe sizes down to 1 1/4” (32mm) nominal. Certain minimum flow rates are required to close the switch and are listed in Table 2. Install the switch as shown in Figure 5. Connect the normally open contacts of the flow switch in the unit control center at terminals 4 and 5. There is also a set of normally closed contacts on the switch that can be used for an indicator light or an alarm to indicate when a “no-flow”

Figure 5, Flow Switch Installation



condition exists. Freeze protect any flow switch that is installed outdoors. Follow installation instructions provided with the flow switch. Calibrate the flow switch to open at one-half of nominal flow rate.

NOTE: Differential pressure switches are not recommended for outdoor installation. They are subject to damage from freezing.

Table 2, Flow Switch Settings

Pipe Size		inch	1 1/4	1 1/2	2	2 1/2	3	4
		mm	32	38	51	63	76	102
Minimum Adjustment	Flow	gpm	4.8	6.3	9.9	15.3	24.4	33.3
		Lpm	18.2	22.7	37.5	57.9	92.4	126.0
	No Flow	gpm	3.0	3.6	5.9	9.5	15.4	21.1
		Lpm	11.3	13.6	22.3	36.0	58.3	79.9
Maximum Adjustment	Flow	gpm	7.7	10.0	15.8	23.7	35.5	61.4
		Lpm	29.1	37.9	59.8	89.7	134.4	232.4
	No Flow	gpm	5.9	7.0	11.0	17.0	29.2	37.7
		Lpm	22.3	26.5	41.6	64.3	110.5	142.7

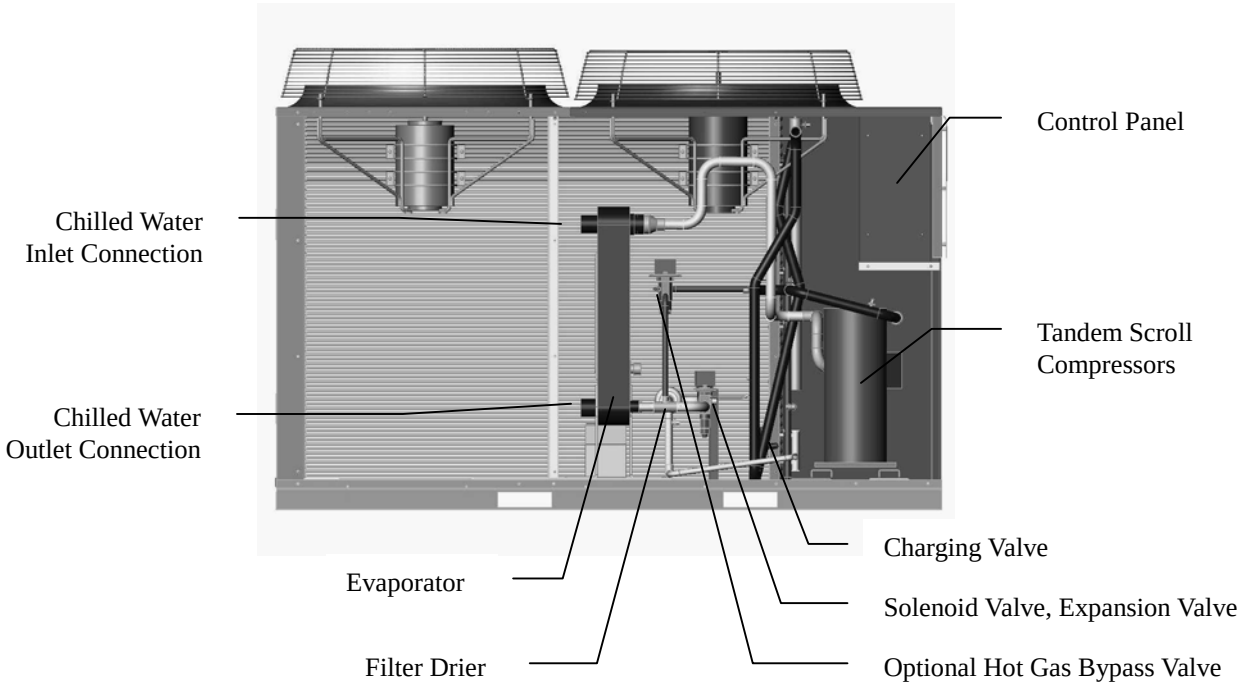
Water Connections

The unit has 3-inch holes for the chilled water piping to enter the unit. The connections are made to the evaporator water connections located within the unit.

Refrigerant Charge

All units are designed with HCFC-22 and are shipped with an operating charge. The operating charge for each unit is shown in in the Physical Data Tables on pages 14 and 15.

Unit Component Location



Glycol Solutions

The use of glycol antifreeze solutions will decrease unit capacity and increase the pressure drop through the cooler. See Product Manual PM AGZ1 for specific ratings and correction factors.

⚠ CAUTION

Do not use automotive grade antifreeze. Industrial grade glycols must be used. Automotive antifreeze contains inhibitors that will cause plating on the copper tubes within the chiller evaporator. The type, storage, disposal, and handling of glycol used must be consistent with local codes.

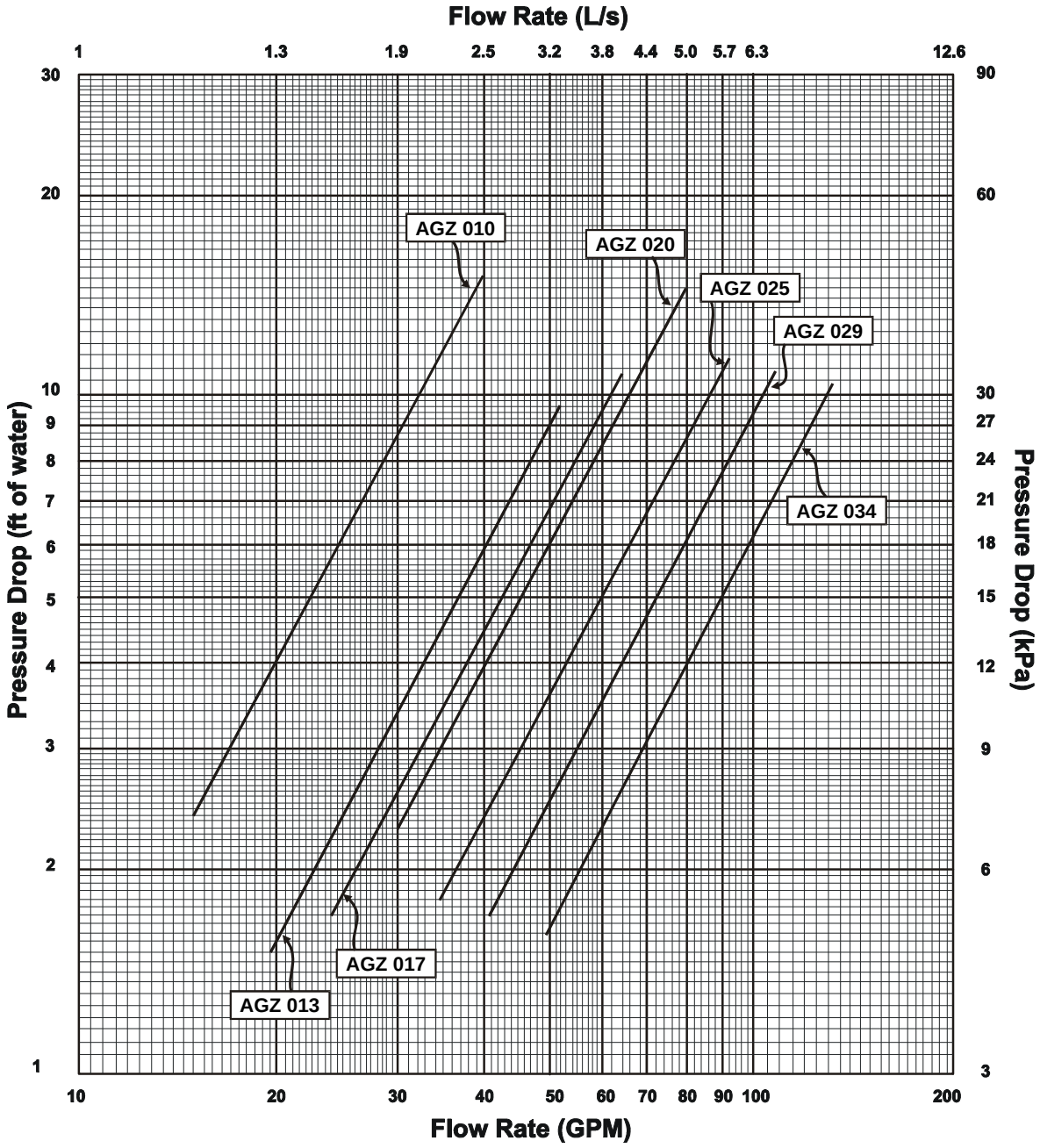
Evaporator Water Flow and Pressure Drop

Evaporator flow rate must fall between the minimum and maximum values shown in the evaporator pressure drop curve, Figure 6. Flow rates outside of these limits result in a chilled water Delta-T outside the operating range of the controller.

Measure the chilled water pressure drop through the evaporator at field-installed pressure taps. It is important not to include the effect of valves or strainers in these readings.

Do not vary the chilled water flow through the evaporator while the compressors are operating.

Figure 6, Evaporator Water Pressure Drop Curve

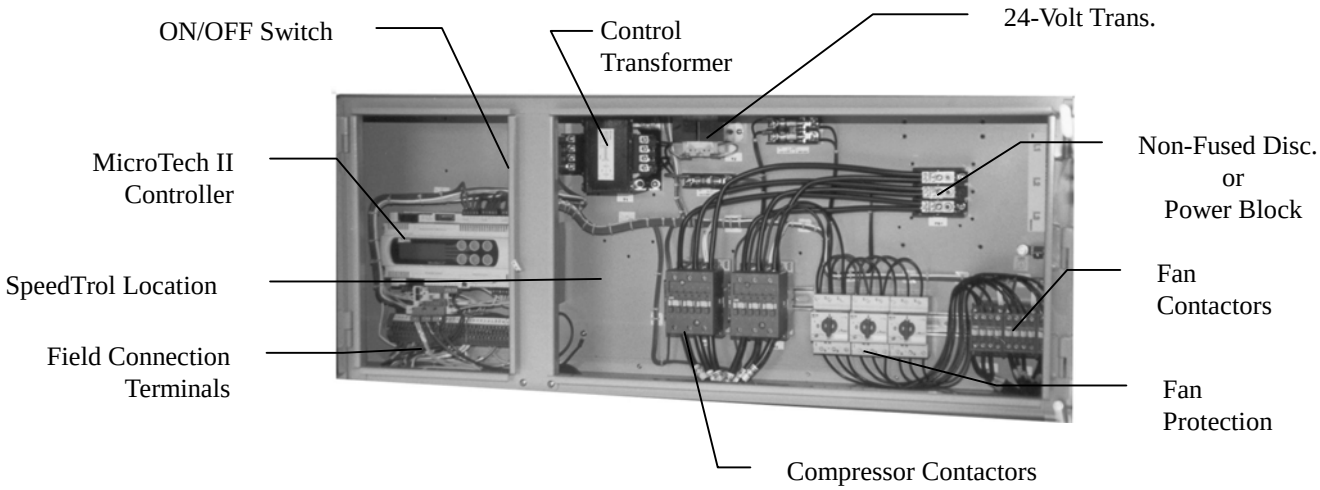


AGZ Model	Minimum Flow				Nominal Flow				Maximum Flow			
	Flow Rate		Pressure Drop		Flow Rate		Pressure Drop		Flow Rate		Pressure Drop	
	gpm	L/s	ft.	kPa	gpm	L/s	ft.	kPa	gpm	L/s	ft.	kPa
010	15.0	0.9	2.4	7.1	24.0	1.5	5.8	17.3	40.0	2.5	15.2	45.5
013	19.5	1.2	1.5	4.5	31.2	2.0	3.7	11.0	52.0	3.3	9.6	28.9
017	24.0	1.5	1.7	5.0	38.4	2.4	4.1	12.2	64.0	4.0	10.7	32.1
020	30.0	1.9	2.3	6.8	48.0	3.0	5.6	16.7	80.0	5.0	14.5	43.4
025	34.5	2.2	1.8	5.3	55.2	3.5	4.3	13.0	92.0	5.8	11.4	34.3
029	40.7	2.6	1.7	5.0	65.0	4.1	4.0	12.1	108.4	6.8	10.9	32.6
034	49.8	3.1	1.6	4.7	79.7	5.0	3.9	11.7	132.8	8.4	10.4	31.2

Control Layout and Operation

Control Center

All electrical controls are enclosed in a weatherproof control center with tool-locked, hinged access doors. The left-hand section contains the microprocessor controller and control input and output terminals. All high-voltage components are located on the right side of the panel.



Start-up and Shutdown

Pre Start-up

1. The chilled-water system should be flushed and cleaned. Proper water treatment is required to prevent corrosion and organic growth.
2. Open all electric disconnects and check all electric connections for tightness.
3. Inspect all water piping for flow direction and correct connections at the evaporator.
4. Verify thermostat water temperature sensor is installed in the leaving water line (supply to building). On all AGZ units the sensor well and sensor are factory mounted.
5. Check compressor oil level. The oil level should be visible in the oil sight glass.
6. Check voltage of the unit power supply and make certain voltage is within ±10% of nameplate rating. Check unit power supply wiring for proper ampacity and a minimum insulation temperature of 75°C. Check for proper phasing using a phase sequence meter.
7. Verify all mechanical and electrical inspections have been completed according to local codes.
8. Open control stop switch S1(off). Turn on the main power and control disconnect switches. This will energize crankcase heaters. Wait at least 24 hours before starting up unit.
9. Open all water flow valves and start the chilled water pump. Check all piping for leaks and vent the air from the evaporator as well as from the system piping. Flush the evaporator and system piping to obtain clean, noncorrosive water in the evaporator.

Start-up

1. Set temperature controller to the desired chilled water temperature. Set the chilled water Delta-T.
2. Start auxiliary equipment by turning on the following: time clock (if present), ambient thermostat and/or remote on/off switch, chilled water pump.

3. If the controller calls for cooling, the unit will begin the start-up sequence.
4. After running the unit for a short time, check the oil level in the compressor (1/4 to 1/3 of the glass), rotation of fans, and flashing in refrigerant sight glass.
5. Verify superheat temperature is at the factory setting of 8 to 12 degrees F (4.4 to 6.7 degrees C).
6. After system performance has stabilized, complete the current AGZ Start-Up Form (obtainable from the local McQuay sales office) to establish inception of warranty benefits. Return the form to McQuay International through your sales representative.

Sequence of Operation

The following sequence of operation is typical. It can vary depending upon options.

Start-Up

With the control circuit power on, 115V power is applied through the control circuit fuse F1 to the compressor crankcase heaters, the compressor motor protections and the primary of the 24V control circuit transformer. The 24V transformer provides power to the microprocessor controller.

When a remote time clock, manual switch, or the unit controller turns on the chilled water pump, the flow switch closes and satisfies the flow requirement. If the chilled water temperature is above the stage-on temperature, and all equipment protection devices are closed, the unit will start. The controller will operate the unit in response to the leaving chiller water temperature, reset signals that may be present and any equipment protection signals that may occur.

Equipment Protection Alarms

The following conditions will shut down the unit and activate the alarm circuit:

- No evaporator water flow
- High condenser pressure
- Phase voltage protection (Optional)
- Evaporator freeze protection
- Low evaporator pressure
- Motor protection system
- Outside ambient temperature
- Sensor failures

The following alarms will limit unit operation:

- Condenser pressure stage down, unloads unit at high discharge pressures
- Low ambient lockout, shuts off unit at low ambient temperatures
- Low evaporator pressure hold, holds stage #1 until pressure rises
- Low evaporator pressure unload, shuts off stage #2

Unit Enable Selection

Enables unit operation from local keypad, digital input, or Building Automation System.

Unit Mode Selection

Selects standard cooling, ice, glycol, or test operation mode.

Condenser fan control

Control of condenser fans is provided by the MicroTech II controller. The control steps condenser fans based on discharge pressure.

Shutdown

As the leaving water control is satisfied, it will stage off the lag compressor unloading the unit. The second stage will de-energize the liquid line solenoid valve SV1 and shut off the lead compressor. The compressor crankcase heaters will energize when the compressors shut off, keeping the small amount of refrigerant in the plate heat exchanger from migrating to the compressor. See page 46 for detailed explanation of compressor staging.

Physical Data

Table 3, Physical Data, AGZ 010A through 017A

PHYSICAL DATA	AGZ MODEL NUMBER		
	010A	013A	017A
BASIC DATA			
Unit Capacity @ ARI Conditions (1), Tons (kW)	9.8 (34.3)	13.3 (46.6)	15.9 (55.7)
Number Of Refrigerant Circuits	1	1	1
Unit Operating Charge, R-22, Lb. (kg)	22.0 (10.0)	24.0 (10.9)	31.0 (14.1)
Cabinet Dimensions, LxWxH, In.	73.6 x 46.3 x 50.8	73.6 x 46.3 x 50.8	73.6 x 46.3 x 50.8
Cabinet Dimensions, LxWxH, (mm)	(1869) x (1176) x (1289)	(1869) x (1176) x (1289)	(1869) x (1176) x (1289)
Unit Operating Weight, Lb. (kg)	1008 (457)	1340 (608)	1450 (658)
Unit Shipping Weight, Lb. (kg)	1000 (453)	1327 (601)	1434 (650)
Add'l Weight If Copper Finned Coils, Lb. (kg)	220 (99.7)	220 (99.7)	220 (99.7)
COMPRESSORS			
Type	Scroll	Scroll	Scroll
Nominal Tons Per Compressor	6.0 / 6.0	7.5 / 7.5	9.0 / 9.0
Oil Charge Per Compressor, oz. (g)	60 (1701)	140 (3969)	140 (3969)
CAPACITY REDUCTION STEPS - PERCENT OF COMPRESSOR DSPLACEMENT			
Standard Staging	0 – 50 – 100	0 – 50 – 100	0 – 50 – 100
CONDENSERS - HIGH EFFICIENCY FIN AND TUBE TYPE WITH INTEGRAL SUBCOOLING			
Coil Face Area, One of Two Sides, Sq. Ft. (M^2)	30.3 (2.8)	30.3 (2.8)	30.3 (2.8)
Finned Height x Finned Length, In.	84 x 52	84 x 52	84 x 52
Finned Height x Finned Length, (mm)	(2134) x (1321)	(2134) x (1321)	(2134) x (1321)
Fins Per Inch x Rows Deep	16 x 2	16 x 2	16 x 3
Pumpdown Capacity Lb. (kg)	35.3 (16.0)	35.3 (16.0)	50.3 (22.8)
CONDENSER FANS - DIRECT DRIVE PROPELLER TYPE			
Number Of Fans - Fan Diameter, In. (mm)	2 – 26 (660)	2 – 26 (660)	2 – 26 (660)
Number Of Motors - HP (kW)	2 – 1.0 (0.75)	2 – 1.0 (0.75)	2 – 1.0 (0.75)
Fan And Motor RPM, 60 Hz	1140	1140	1140
60 Hz Total Unit Airflow, CFM (l/s)	13950 (6584)	13950 (6584)	12000 (5664)
DIRECT EXPANSION EVAPORATOR - BRAZED PLATE-TO-PLATE			
Connection Size Victaulic, In. (mm)	2 (51)	2 (51)	2 (51)
Water Volume, Gallons (L)	.94 (3.6)	1.66 (6.3)	2.00 (7.6)
Maximum Refrigerant Working Pressure, psig (kPa)	450 (3103)	450 (3103)	450 (3103)
Maximum Water Pressure, psig (kPa)	350 (2413)	350 (2413)	350 (2413)

NOTE: Nominal capacity based on 95°F ambient air and 54°F/44°F water range.

Table 4, Physical Data, AGZ 020A through 034A

PHYSICAL DATA	AGZ MODEL NUMBER			
	020A	025A	029A	034A
BASIC DATA				
Unit Capacity @ ARI Conditions (1), Tons (kW)	20.4 (71.4)	22.7 (79.5)	28.2 (98.7)	34.0 (119.0)
Number Of Refrigerant Circuits	1	1	1	1
Unit Operating Charge, R-22, Lb. (kg)	34.0 (15.4)	36.0 (16.3)	47.0 (21.3)	50.0 (22.7)
Cabinet Dimensions, LxWxH, In.	106.2x 46.3 x 50.8	106.2x 46.3 x 50.8	106.2x 46.3 x 58.8	106.2x 46.3 x 58.8
Cabinet Dimensions, LxWxH, (mm)	(2697) x (1176) x (1289)	(2697) x (1176) x (1289)	(2697) x (1176) x (1493)	(2697) x (1176) x (1493)
Unit Operating Weight, Lbs. (kg)	1620 (735)	1675 (760)	1930 (876)	2180 (990)
Unit Shipping Weight, Lbs. (kg)	1602 (726)	1650 (747)	1898 (859)	2135 (967)
Add'l Weight If Copper Finned Coils, Lb. (kg)	350 (159)	350 (159)	435 (197)	435 (197)
COMPRESSORS				
Type	Scroll	Scroll	Scroll	Scroll
Nominal Horsepower	10.0 / 13.0	13.0 / 13.0	15.0 / 15.0	20.0 / 20.0
Oil Charge Per Compressor, Oz. (g)	140 (3969)	140 (3969)	140 (3969)	296 (8392)
CAPACITY REDUCTION STEPS - PERCENT OF COMPRESSOR DISPLACEMENT				
Standard Staging	0 – 45 - 100	0 – 50 – 100	0 – 50 – 100	0 – 50 – 100
CONDENSERS - HIGH EFFICIENCY FIN AND TUBE TYPE WITH INTEGRAL SUBCOOLING				
Coil Face Area, One of Two Sides, Sq. Ft. (M^2)	49.0 (4.6)	49.0 (4.6)	58.3 (5.4)	58.3 (5.4)
Finned Height x Finned Length, In.	84 x 84	84 x 84	100 x 84	100 x 84
Finned Height x Finned Length, (mm)	(2134) x (2134)	(2134) x (2134)	(2545) x (2134)	(2545) x (2134)
Fins Per Inch x Rows Deep	16 x 2	16 x 2	16 x 3	16 x 3
Pumpdown Capacity lb. (kg)	53.1 (24.0)	53.1 (24.0)	90.7 (41.1)	92.8 (42.0)
CONDENSER FANS - DIRECT DRIVE PROPELLER TYPE				
Number Of Fans - Fan Diameter, In. (mm)	3 – 26 (660)	3 – 26 (660)	3 – 26 (660)	3 – 26 (660)
Number Of Motors - HP (kW)	3 – 1.0 (0.75)	3 – 1.0 (0.75)	3 – 1.0 (0.75)	3 – 1.0 (0.75)
Fan And Motor RPM, 60 Hz	1140	1140	1140	1140
60 Hz Total Unit Airflow, CFM (l/s)	20925 (9877)	20925 (9877)	19800 (9346)	19800 (9346)
DIRECT EXPANSION EVAPORATOR - BRAZED PLATE-TO-PLATE				
Connection Size Victaulic, In. (mm)	2 (51)	2 (51)	2 (51)	2 (51)
Water Volume, Gallons (L)	2.16 (8.2)	3.05 (11.5)	4.00 (15.1)	5.55 (21.0)
Max. Refrigerant Working Pressure, psig (kPa)	450 (3103)	450 (3103)	450 (3103)	450 (3103)
Maximum Water Pressure, psig (kPa)	350 (2413)	350 (2413)	350 (2413)	350 (2413)

NOTE: Nominal capacity based on 95°F ambient air and 54°F/44°F water range.

Electrical Data

Field Wiring

Wiring must comply with all applicable codes and ordinances. Warranty is void if wiring is not in accordance with specifications. Copper wire is required for all power lead terminations at the unit.

AGZ 010A through AGZ 034A units have single point power connection. A single field supplied fused disconnect is required. The control transformer is factory mounted.

If the evaporator heater is on a separate disconnect switch from the main unit power supply, the unit may be shut down without defeating the freeze protection provided by the evaporator heater.

Table 5. AGZ 010A – 034A Electrical Data Single Point

AGZ Unit Size	Volts	Hz.	Minimum Circuit Ampacity (MCA)	Power Supply				Field Fuse Size or HACR Breaker Size	
				Field Wire		Hub			
				Quantity	Wire Gauge	Quantity	Nominal Size In. (mm)	Recommended	Maximum
010A	208	60	54	3	6	1	1.00 (25)	60	70
	230		54	3	6	1	1.00 (25)	60	70
	460		26	3	10	1	1.00 (25)	30	35
	575		23	3	10	1	1.00 (25)	25	30
013A	208	60	65	3	6	1	1.00 (25)	80	80
	230		65	3	6	1	1.00 (25)	80	80
	460		34	3	10	1	1.00 (25)	40	45
	575		27	3	10	1	1.00 (25)	30	35
017A	208	60	79	3	4	1	1.00 (25)	90	100
	230		79	3	4	1	1.00 (25)	90	100
	460		41	3	8	1	1.00 (25)	45	50
	575		33	3	10	1	1.00 (25)	40	40
020A	208	60	103	3	2	1	1.25 (32)	125	125
	230		103	3	2	1	1.25 (32)	125	125
	460		53	3	6	1	1.00 (25)	60	70
	575		45	3	8	1	1.00 (25)	50	60
025A	208	60	110	3	2	1	1.25 (32)	125	150
	230		110	3	2	1	1.25 (32)	125	150
	460		58	3	6	1	1.00 (25)	70	80
	575		48	3	8	1	1.00 (25)	60	60
029A	208	60	127	3	1	1	1.50 (38)	150	175
	230		127	3	1	1	1.50 (38)	150	175
	460		62	3	6	1	1.00 (25)	70	80
	575		58	3	6	1	1.00 (25)	70	70
034A	208	60	182	3	3/0	1	1.50 (38)	225	250
	230		182	3	3/0	1	1.50 (38)	225	250
	460		79	3	4	1	1.00 (25)	90	100
	575		63	3	6	1	1.00 (25)	80	80

See "Electrical Notes" on page 19.

Table 6, AGZ 010A – 034A Compressor and Condenser Fan Motor Amp Draw

AGZ Unit Size	Volts	Hz.	Rated Load Amps			No. of Fan Mtrs	Locked Rotor Amps		
			Compressors		Fan Motor (Each)		Fan Motor (Each)	Compressors Across-The-Line	
			No. 1	No. 2				No. 1	No. 2
010A	208	60	18.6	18.6	5.8	2	23.7	156	156
	230		18.6	18.6	5.8	2	21.4	156	156
	460		9.1	9.1	2.8	2	10.7	75	75
	575		7.4	7.4	2.5	2	11.0	54	54
013A	208	60	23.7	23.7	5.8	2	23.7	189	189
	230		23.7	23.7	5.8	2	21.4	189	189
	460		12.5	12.5	2.8	2	10.7	99	99
	575		9.1	9.1	2.5	2	11.0	74	74
017A	208	60	29.9	29.9	5.8	2	23.7	232	232
	230		29.9	29.9	5.8	2	21.4	232	232
	460		15.3	15.3	2.8	2	10.7	125	125
	575		11.6	11.6	2.5	2	11.0	100	100
020A	208	60	33.6	41.0	5.8	3	23.7	278	350
	230		33.6	41.0	5.8	3	21.4	278	350
	460		16.5	21.8	2.8	3	10.7	127	158
	575		13.7	17.3	2.5	3	11.0	100	125
025A	208	60	41.0	41.0	5.8	3	23.7	350	350
	230		41.0	41.0	5.8	3	21.4	350	350
	460		21.8	21.8	2.8	3	10.7	158	158
	575		17.3	17.3	2.5	3	11.0	125	125
029A	208	60	48.5	48.5	5.8	3	23.7	425	425
	230		48.5	48.5	5.8	3	21.4	425	425
	460		23.7	23.7	2.8	3	10.7	187	187
	575		21.7	21.7	2.5	3	11.0	148	148
034A	208	60	73.1	73.1	5.8	3	23.7	505	505
	230		73.1	73.1	5.8	3	21.4	505	505
	460		31.0	31.0	2.8	3	10.7	225	225
	575		24.4	24.4	2.5	3	11.0	180	180

See "Electrical Notes" on page 19.

Table 7, AGZ 010A – 034A Field Wiring Data, Single Point Power

AGZ UNIT SIZE	Volts	HZ.	Wiring to Standard Power Block Terminal		Wiring to Optional Disconnect Switch	
			Maximum Terminal Amps	Connector Wire Range (Copper Wire Only)	Disconnect Size	Connector Wire Range (Copper Wire Only)
010A	208	60	175	14 GA – 2/0	100	#8-1/0
	230		175	14 GA – 2/0	100	#8-1/0
	460		175	14 GA – 2/0	63	#1-#14
	575		175	14 GA – 2/0	63	#1-#14
013A	208	60	175	14 GA – 2/0	100	#8-1/0
	230		175	14 GA – 2/0	100	#8-1/0
	460		175	14 GA – 2/0	63	#1-#14
	575		175	14 GA – 2/0	63	#1-#14
017A	208	60	175	14 GA – 2/0	100	#10-1/0
	230		175	14 GA – 2/0	100	#10-1/0
	460		175	14 GA – 2/0	63	#1-#14
	575		175	14 GA – 2/0	63	#1-#14
020A	208	60	175	14 GA – 2/0	225	#2-4/0
	230		175	14 GA – 2/0	225	#2-4/0
	460		175	14 GA – 2/0	100	#8-1/0
	575		175	14 GA – 2/0	100	#10-1/0
025A	208	60	175	14 GA – 2/0	225	#2-4/0
	230		175	14 GA – 2/0	225	#2-4/0
	460		175	14 GA – 2/0	100	#8-1/0
	575		175	14 GA – 2/0	100	#10-1/0
029A	208	60	175	14 GA – 2/0	225	#2-4/0
	230		175	14 GA – 2/0	225	#2-4/0
	460		175	14 GA – 2/0	100	#8-1/0
	575		175	14 GA – 2/0	100	#10-1/0
034A	208	60	335	6 GA – 400 kcmil	225	#2-4/0
	230		335	6 GA – 400 kcmil	225	#2-4/0
	460		175	14 GA – 2/0	125	#3-3/0
	575		175	14 GA – 2/0	100	#10-1/0

NOTES:
1. "Size" is the maximum amperage rating for the terminals or the main electrical device.
2. "Size" is the disconnect part number and not the amperage rating for the terminals or the main electrical device.
3. "Connection" is the range of wire sizes that the terminals on the electrical device will accept.
4. See page 19 for additional electrical notes.

Notes for “Electrical Data Single Point"

1. Field Fuse Size for recommended and maximum is based on use of a time-delay fuse.
2. Unit wire size ampacity (MCA) is equal to 125% of the largest compressor-motor RLA plus 100% of RLA of all other loads in the circuit including the control transformer.
3. Since the control transformer is furnished, no separate 115v power is required.
4. If a separate 115V power supply is used for the control circuit, the wire sizing should be 14 GA minimum.
5. Recommended power lead wire sizes for 3 conductors per conduit are based on 100% conductor ampacity in accordance with NEC. Voltage drop has not been included. Therefore, it is recommended that power leads be kept short. All terminal block connections must be made with copper (type THW) wire.
6. Single conductors should be used for power connections as listed under “Recommended Power Lead Wire Size.”
7. “Recommended Fuse Sizes” are selected at approximately 150% to 225% of the largest compressor RLA, plus 100% of all other loads in the circuit.
8. “Maximum Fuse Sizes” are selected at approximately 225% of the largest compressor RLA, plus 100% of all other loads in the circuit.
9. The recommended power lead wire sizes are based on an ambient temperature of 86°F. Ampacity correction factors must be applied for other ambient temperatures. Refer to the National Electrical Code Handbook.

Power Limitations:

1. Voltage within 10% of nameplate rating.
2. Phase imbalance within 3%.

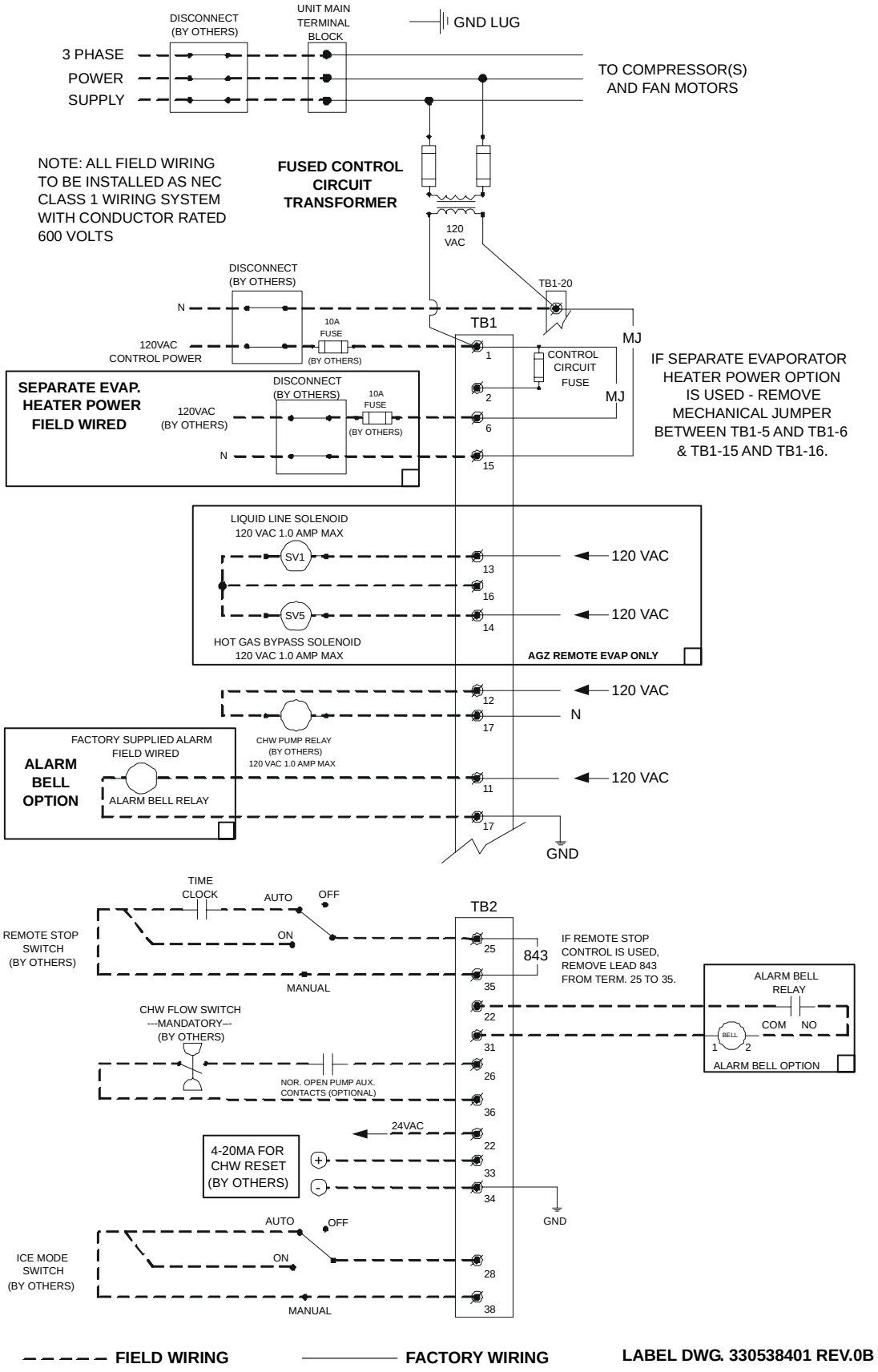
Notes for “Compressor and Condenser Fan Amp Draw”:

1. Compressor RLA values are for wiring sizing purposes only but do not reflect normal operating current draw at rated capacity. If unit is equipped with optional SpeedTrol condenser fan motors, the first motor on each refrigerant circuit is a single phase, 1hp motor, with a FLA of 2.8 amps at 460 volts, 5.6 amps at 208, 230, and 575 volts.
2. Compressor LRA for reduced inrush start are for the first winding only. If the unit is equipped with optional SpeedTrol motors, the first motor is a single phase, 1 hp motor, with a LRA of 7.3 amps at 460 volts, 14.5 amps at 208, 230, and 575 volts.

Notes for “Field Wiring Data” - Single Point Power:

1. Single point power supply requires a single disconnect to supply electrical power to the unit. This power must be fused.
2. All field wiring to unit power block or non-fused disconnect switch must be copper.
3. All field wire size values given in table apply to 75°C rated wire per NEC.

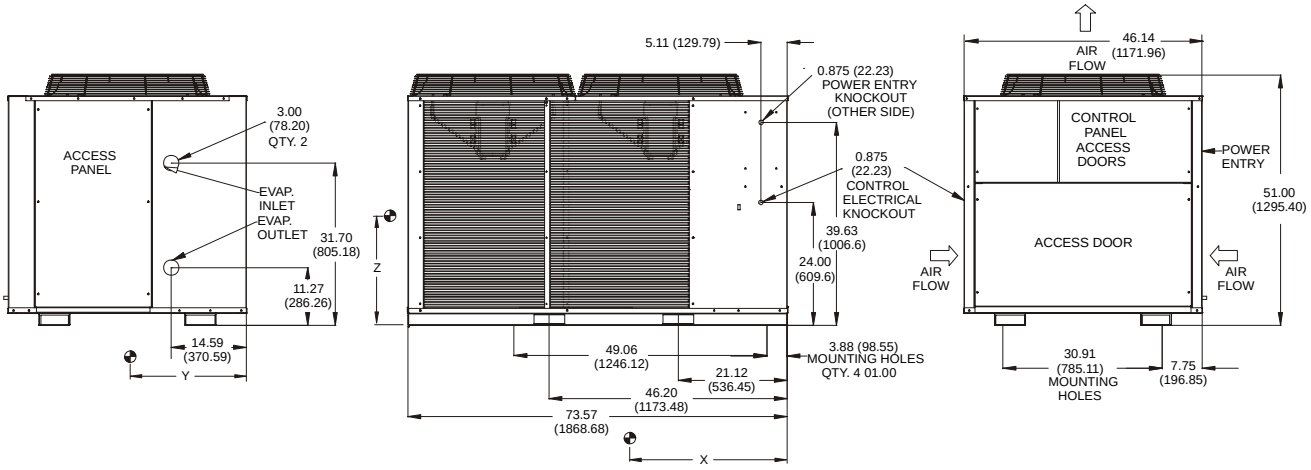
Figure 7, AGZ 010A through AGZ 034A, Typical Field Wiring Diagram



Note: See control and power wiring diagrams on unit control panel for specific unit information.

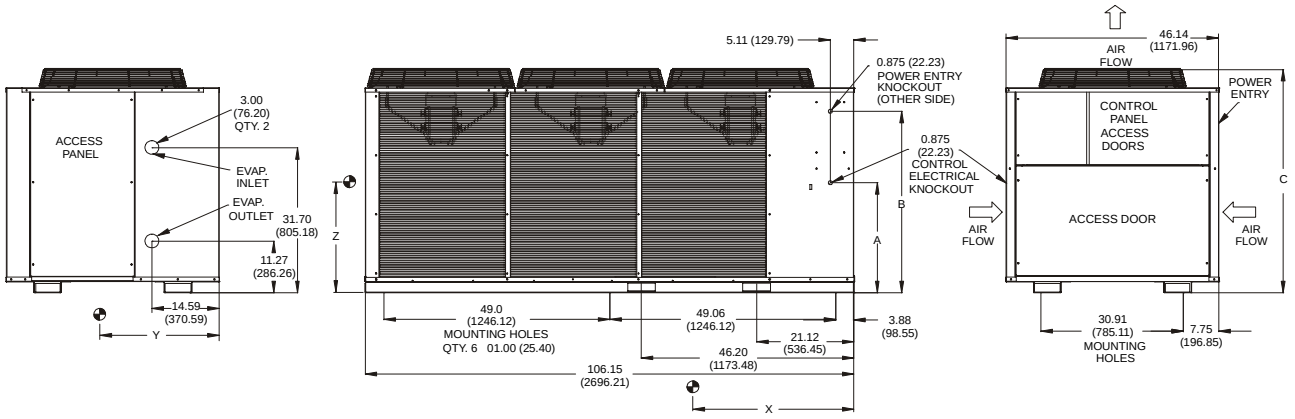
Dimensional Data

Figure 8, AGZ 010A through 017A



AGZ Unit Size	Center of Gravity Inches (mm)			Evaporator Connections Victaulic, Inch
	X	Y	Z	
AGZ 010	27.8 (706.1)	22.7 (576.6)	19.2 (487.7)	2
AGZ 013	24.3 (617.2)	22.5 (571.5)	19.1 (485.1)	2
AGZ 017	24.4 (619.8)	22.4 (569.0)	19.1 (485.1)	2

Figure 9, AGZ 020A through 034A



AGZ Unit Size	Dimensions Inches (mm)			Center of Gravity Inches (mm)			Evaporator Connection Inch Victaulic
	A	B	C	X	Y	Z	
AGZ 020	24.0 (609.6)	39.6 (1006.6)	51.0 (1295.4)	33.8 (858.5)	22.4 (569.0)	20.2 (513.1)	2
AGZ 025	24.0 (609.6)	39.6 (1006.6)	51.0 (1295.4)	33.7 (856.0)	22.2 (564.0)	20.1 (510.5)	2
AGZ 029	33.0 (838.2)	47.6 (1209.8)	59.0 (1498.6)	36.5 (927.1)	23.1 (586.7)	22.6 (574.0)	2
AGZ 034	33.0 (838.2)	47.6 (1209.6)	59.0 (1498.6)	35.0 (889.0)	23.1 (586.7)	21.4 (543.6)	2

System Maintenance

General

On initial start-up and periodically during operation, it will be necessary to perform certain routine service checks. Among these are taking electric leg readings. Some readings are readily available on the MicroTech II controller's display.

Lubrication

No routine lubrication is required on the AGZ units. The fan motor bearings are of the permanently lubricated type and require no lubrication.

Electrical Terminals

⚠ WARNING

Electric shock hazard. Disconnect and tag out all sources of power to the unit before continuing with following service or severe personal injury or death can result.

Normal heating and cooling of the wire will cause terminals to loosen. Retighten all power electrical terminals every six months.

Condensers

Condensers are air-cooled and constructed with 3/8" (9.5mm) O.D. internally finned copper tubes bonded in a staggered pattern into slit aluminum fins. No maintenance is ordinarily required except the occasional removal of dirt and debris from the outside surface of the fins. Use locally purchased foaming condenser coil cleaners for periodic cleaning of the coil. Condenser cleaners may contain harmful chemicals, be careful when using cleaners. Care should be taken not to damage the fins during cleaning. All chemical cleaners should be thoroughly rinsed from the coils.

Refrigerant Sight glass

Observe the refrigerant sight glass monthly. A clear glass of liquid indicates adequate sub-cooled refrigerant charge in the system to ensure proper feed through the expansion valve. Bubbling refrigerant in the sight glass indicates the system is short of refrigerant charge. Sub-cooling should be verified to prevent overcharging. Refrigerant gas flashing in the sight glass could also indicate an excessive pressure drop in the line, possibly due to a clogged filter-drier or a restriction elsewhere in the system. The sight glass indicates what moisture condition corresponds to a given element color. If the sight glass does not indicate a dry condition after about 12 hours of operation, the refrigerant or oil should be tested for moisture.

Standard MicroTech II Controller

Table of Contents

Software Version AGZSU0102D

Overview

The MicroTech II controller's state-of-the-art design will not only permit the chiller to run more efficiently, but will also simplify troubleshooting if a system failure occurs. Every MicroTech II controller is programmed and tested prior to shipment to contribute to a trouble-free start-up.

Release Version

This manual covers Software Release AGZ SU0102D

Operator-friendly

The MicroTech II controller's menu structure is separated into three distinct categories, which provide the operator or service technician with a full description of current unit status, control parameters, and alarms. Security protection prevents unauthorized changing of the setpoints and control parameters.

The MicroTech II controller continuously performs self-diagnostic checks, monitoring system temperatures, pressures and protection devices, and will automatically shut down a compressor or the entire unit should a fault occur. The cause of the shutdown will be retained in memory and can be easily displayed in plain English for operator review. The MicroTech II chiller controller will also retain and display the time the fault occurred. In addition to displaying alarm diagnostics, the MicroTech II chiller controller also provides the operator with a warning of limit (pre-alarm) conditions.

Staging

The two scroll compressors are staged on and off as a function of leaving chilled water temperature. Lead/lag is automatic and switched every ten starts.

General Description

Compressor Motor Protection

AGZ 013 – 034: The solid-state compressor motor protector module incorporates a 2-minute "time-off" relay utilizing the bleed-down capacitor principle. Any time the protection system opens or power to the module is interrupted, the 2-minute "time-off" delay is triggered and the module will not reset for two minutes. Once the 2-minute period has passed the motor protector contacts M1 and M2 reset, provided the protection system is satisfied and power is applied to the module.

Note: If the power circuit is broken once the 2-minute period is passed, the pilot circuit will reset without delay when power is reapplied.

AGZ 010: The model AGZ 010 compressor has internal line breakage with automatic reset.

FanTrol Head Pressure Control

FanTrol is the standard method of head pressure control that automatically cycles the condenser fan motors in response to condenser pressure. This function is controlled by the microprocessor, maintains head pressure and allows the unit to run at low ambient air temperatures down to 35°F (1.7°C). Fans are staged as follows:

Table 8, Fan Staging Pressures

Fan	Two-Fan Unit	Three-Fan Unit
Stage #1	On 150 psig, Off with unit	On 150 psig, Off with unit
Stage #2	On 290 psig, Off 170 psig	On 290 psig, Off 170 psig
Stage #3		On 310 psig, Off 180 psig

Note: Fan #1 is on with first compressor above 75°F (24°C).

Inputs/Outputs

Table 9, Inputs and Outputs

Analog Inputs

#	Description	Signal Source	Range
1	Reset of Leaving Water Temperature	4-20 mA Current	0 to10 degrees 60°F max inlet
2	Evaporator Refrigerant Pressure	0.5 to 4.5 VDC (NOTE 1)	0 to 132 psi
3	Condenser Refrigerant Pressure	0.5 to 4.5 VDC (NOTE 1)	3.6 to 410 psi
4	Leaving Evaporator Water Temperature	Thermister (10k at 77°F, 25°C)	-58 to 212°F
5	Outside Ambient Temperature	Thermister (10k at 77°F, 25°C)	-58 to 212°F

NOTE 1: Value at the converter board input. Value at the converter board output is 0.1 VDC – 0.9 VDC.

Analog Outputs

#	Description	Output Signal	Range
1-4	None		

Digital Inputs

#	Description	Signal	Signal
1	Unit OFF Switch	0 VAC (Stop)	24 VAC (Auto)
2	Remote Start/Stop	0 VAC (Stop)	24 VAC (Start)
3	Evaporator Water Flow Switch	0 VAC (No Flow)	24 VAC (Flow)
4	Motor Protection	0 VAC (Fault)	24 VAC (No Fault)
5	Ice Mode Switch	0 VAC (Normal)	24 VAC (Ice)
6	Phase Voltage Fault	0 VAC (Fault)	24 VAC (No Fault)
7	Open		
8	Open		

Digital Outputs

#	Description	Load	Output OFF	Output ON
1	Alarm	Alarm Indicator	Alarm OFF	Alarm ON
2	Evaporator Water Pump	Pump Contactor	Pump OFF	Pump ON
3	Liquid Line	Solenoid	Cooling OFF	Cooling ON
4	Motor Control Relay #1	Starter	Compressor OFF	Compressor ON
5	Motor Control Relay #2	Starter	Compressor OFF	Compressor ON
6	Condenser Fan #1	Fan Contactor	Fan OFF	Fan ON
7	Condenser Fan #2	Fan Contactor	Fan OFF	Fan ON
8	Condenser Fan #3	Fan Contactor	Fan OFF	Fan ON

Setpoints

The setpoints shown in Table 10 are battery-backed and remembered during power off, are factory set to the **Default** value, and can be adjusted within the value shown in the **Range** column.

The PW (password) column indicates the password level that must be entered in order to change the setpoint. Passwords are as follows:

O = Operator [0100]

M = Manager, [2001] M level settings are not normally changed for chilled water air-conditioning applications.

Table 10, Setpoints

Description	Default	Range	PW
Unit			
Unit Enable	OFF	OFF, ON	O
Unit Mode	COOL	COOL COOL w/Glycol ICE w/Glycol TEST	O
Control Source	SWITCHES	SWITCHES, KEYPAD, NETWORK	O
Available Modes	COOL	COOL COOL w/GLYCOL COOL/ICE w/GLYCOL TEST	M
Display Units	°F/psi	°F/psi	O
Language	ENGLISH	ENGLISH,	O
Cool LWT	44. 0°F	20.0 to 60.0 °F	O
Ice LWT	40. 0°F	20.0 to 40.0 °F	O
Evap Delta T	10. 0°F	6.0 to 16.0 °F	O
Startup Delta T	10.0°F	1.0 to 15.0 °F	O
Stop Delta T	0.5F	0 to 3.0F	O
Max Pulldown Rate	1.0F	0.5 to 5.0°F	M
* Refrigerant Type (Note 1)	None	R22, R407c	--
BAS Protocol	Modbus	BACnet, LONWORKS, Modbus	M
Ident Number	001	001 to 999	M
Baud rate	9600	1200,2400,4800,9600,19200	M
* SpeedTrol Option	N	N,Y	M
Password	0000	0000 to 9999	--
Staging			
Stage Up Delay	120	20 to 240 sec	M
Stage Down Delay	30	10 to 60 sec	M
Timers			
Evap Flow Proof	3 sec	1 to 10 sec	M
Evap Recirculate Timer	30 sec	15 to 300 sec.	M
Low Evap Pressure Delay	30 sec	15 sec to 30sec	M
Ice Time Delay	12 hrs.	1 to 23 hrs	M
Clear Ice Delay	NO	No, Yes	M
Start-Start	15 min	10 to 60 min	M
Stop-Start	5 min	3 to 20 min	M
Stage Up Delay	240 sec.	20 to 480 sec.	M
Stage Down Delay	30 sec.	10 to 60 sec.	M
Comp 1 Enable	On	Off, On	
Comp 2 Enable	On	Off, On	
Alarms			
Evaporator Freeze	36.0 °F	18 to 42 °F	M
Low Evap Pressure	58 psi	30 to 60 psi	M
Low Evap Pressure-Hold	59 psi	31 to 65 psi	M
Low Evap Pressure-Unload	59 psi	31 to 65 psi	M
High Condenser Stage Down	370 psi	365 to 375 psi	M
High Condenser Pressure	380 psi	380 to 390 psi	M
* Phase Voltage Protection	N	N,Y	M
* Low Ambient Lockout	35.0 °F	–2 to 60 °F	M
Condenser Fans			
Fan Stages	2	2-3	
Speedtrol Option	No	No,Yes	
Stage #1 On (OAT<75°F)	200psi	140 to 200 psi	M
Stage #2 On	290 psi	230 to 330 psi	M
Stage #3 On	300 psi	230 to 330 psi	M
Stage #1 Off	140 psi	130 to 170	M

Continued next page.

Description	Default	Range	PW
Stage #2 Off	180 psi	150 to 200 psi	M
Stage #3 Off	190 psi	150 to 200 psi	M
Sensor Offsets			
Evaporator Refrig Press Sensor Offset	00.0 psi	-20.0 to 20.0 psi	
Condenser Refrig Press Sensor Offset	00.0 psi	-20.0 to 20.0 psi	
Leaving Evaporator Water Temp Sensor	0.0 °F	-5.0 to 5.0 °F	
Outside Ambient Temperature Sensor	0.0 °F	-5.0 to 5.0 °F	

NOTES:

1. This setting is a one-time only setting and is mad in the factory.
2. (*) These items are factory set prior to shipment.

Automatic Adjusted Ranges

The following are setpoints that will be limited based on the option(s) selected.

Evaporator Leaving Water Temperature

Mode	Range
Unit Mode = Cool	40 to 60°F
Unit Mode = Cool w/Glycol	20 to 60°F

Evaporator Freeze Temperature

Mode	Range
Unit Mode = Cool	36 to 42°F
Unit Mode = Cool w/Glycol, Ice w/Glycol	18 to 42°F

Low Ambient Lockout Temperature

SpeedTrol	Range
SpeedTrol = N	35 – 60°F
SpeedTrol = Y	-2 – 60°F

Low Evaporator Pressure Hold and Unload

Mode	Refrigerant	Range
Unit Mode = Cool	R22	55 to 65 Psig
Unit Mode = Cool w/Glycol, Ice w/Glycol	R22	24 to 65 Psig
Unit Mode = Cool	R407c	58 to 65 Psig
Unit Mode = Cool w/Glycol, Ice w/Glycol	R407c	20 to 65 Psig

Dynamic Default Values

Some setpoints will have different default values loaded depending on the value of other setpoints.

Low Evaporator Pressure Hold

Refrigerant	Default Value
R22	59 psi
R407C	60 psi

Low Evaporator Pressure Unload

Refrigerant	Default Value
R22	58 psi
R407C	59 psi

Setpoint Security

All setpoints are protected by using passwords. Two four-digit passwords provide OPERATOR and/or MANAGER levels of access to changeable parameters. Once a password has been entered, it remains valid for 15 minutes after the last key-press on the unit controller.

After a valid password has been entered, setpoints may be changed. If the operator attempts to edit a setpoint on a controller while the correct password is not active, no action will be taken.

Passwords can be entered using the ENTER PASSWORD screen which is the last screen in the SET UNIT SPs column.

The password is entered by pressing the ENTER key, scrolling to the correct value with the UP and DOWN arrow keys, and pressing ENTER again. The entered password is not shown after the enter key is pressed. Once the correct password has been entered, the PASSWORD screen indicates which password is active (operator or manager). If the wrong password is entered, there is no level of access so the active password displays "none". Entering an incorrect password while a password is active will render that password inactive.

Equipment Protection Alarms

Equipment protection alarms execute rapid compressor shutdown (no pumpdown cycle), triggers the alarm output, lights the red alarm light on the controller left arrow button and registers it in the alarm log.

The following table identifies each equipment protection alarm, gives the condition that causes the alarm to occur, and states the action taken because of the alarm. Otherwise, the alarm is manually reset, requiring the operator to clear the alarm.

Table 11, Shutdown Alarms

Description	Occurs When:	Action Taken	Reset
No Evaporator Water Flow (See NOTE)	Evap Pump State = RUN and Flow Switch Digital Input = No Flow and time greater than Evap Flow Proof SP	Rapid Stop	Auto/Manual
Low Evaporator Pressure	Evaporator Press < Low Evap Pressure SP start Low Evap Pressure Time Delay – if after Time Delay if Evap Press > SP continue else stop	Rapid Stop	Manual
High Condenser Pressure	Condenser Press > High Condenser Pressure SP	Rapid Stop	Manual
Mechanical High Pressure	MHP input is low	Rapid Stop	Manual
Motor Protection	Digital Input = High Motor Temperature On Power Up – Delay 150 Sec. before checking	Rapid Stop	Manual
Phase Voltage Protection (opt)	If Phase Voltage Protection = Y, Then Digital Input = Phase/Voltage Problem	Rapid Stop	Phase/Voltage Input Returns to Normal
Low Ambient Restart Fault	Failed three consecutive low ambient start attempts	Rapid Stop	Manual
Evaporator Freeze Protect	Evap LWT < Evaporator Freeze SP	Rapid Stop	Manual
Leaving Evaporator Water Temperature Sensor Fault	Sensor shorted or open	Rapid Stop	Manual
Evaporator Pressure Sensor Fault	Sensor shorted or open	Rapid Stop	Manual
Condenser Pressure Sensor Fault	Sensor shorted or open	Rapid Stop	Manual
Outside Ambient Temperature Sensor Fault	Sensor is open or shorted	Rapid Stop	Manual

NOTE: Beginning with this software version, two automatic resets per day (beginning at 12:00 am) are allowed on the flow loss alarm. The Unit State remains on Auto and the evaporator will go back to Start, waiting for flow.

Events (Limit Alarms)

The following events limit the operation of the chiller in some way as described in the Action Taken column. These alarms are auto-clearing based on reaching the conditions in the reset column.

Table 12, Events (Limit Alarms)

Description	Occurs When:	Action Taken	Reset
Condenser Pressure High Unload	Pressure > High Condenser Stage Down setpoint	Shutoff Stage #2	Condenser Press drops below (SP – 100psi)
Failed Pumpdown	Unit is pumping down for over 60 seconds	Shut down unit	N/A
Low Evaporator Pressure – Hold	Pressure < Low Evap Pressure–Hold setpoint	Hold @ Stage 1	Evap Press rises above (SP + 8psi)
Low Evaporator Pressure – Unload	Pressure < Low Evap Pressure–Unload setpoint	Shutoff Stage 2	Evap Press rises above (SP + 10 psi)

NOTE: SP = Setpoint

Control Functions and Definitions

Control Band

Control Band = Evap delta setpoint * 0.6

Upper and Lower Control Band

The control band is normally centered around the active LWT setpoint. If the chiller is not set up to use glycol, then the control band will be shifted up relative to the LWT setpoint to keep the lower end of the control band at least at 39°F. If the band doesn't need to be shifted to achieve this, it will remain centered on the active LWT setpoint.

In the staging logic, an upper and lower control band are used. The lower control band is calculated as follows:

IF Active LWT Setpoint – 39 < 0.5 * Control Band THEN
    Lower Control Band = Active LWT Setpoint – 39
ELSE Lower Control Band = 0.5 * Control Band

The upper control band is then Control Band – Lower Control Band

Leaving Water Reset

The leaving water reset input uses a 4-20mA signal to reset the leaving water setpoint to a higher value. The adjustment varies linearly from 0 to 10°F, with a reset of 0 for a 4mA signal and a reset of 10 for a 20mA signal.

Active LWT Setpoint

The active LWT setpoint represents the current control setpoint based on unit mode and reset. If unit mode is ice, then the active setpoint is equal to the ice setpoint. If the unit mode is cool, the active setpoint is the cool setpoint plus the leaving water reset value.

LWT Error

LWT error compares the actual LWT to the active LWT setpoint. The equation is:

LWT error = LWT – active LWT setpoint

LWT Slope

LWT slope is calculated such that the slope represents a time frame of one minute.

Every 12 seconds, the current LWT is subtracted from the value 12 seconds back. This value is added to a buffer containing values calculated at the last five intervals. The final result is a slope value that is an average over the past 60 seconds.

Pulldown Rate

The slope value calculated above will be a negative value as the water temperature is dropping. For use in some control functions, the negative slope is converted to a positive value by multiplying by –1.

Refrigerant Saturated Temperature

Methods for calculating saturated refrigerant temperature differ with each refrigerant.

R22 Saturated Temperature

Evaporator saturated temperature and condenser saturated temperature are calculated from the pressures for each circuit. The pressure will be fitted to a curve made up of 13 straight line segments. The points used to define these segments are as follows.

Pressure (PSI)	Temperature (^{o}F)
24.0	0
34.7	12.0
47.6	24.0
62.8	36.0
80.8	48.0
101.6	60.0
126.2	72.0
153.8	84.0
185.2	96.0
220.6	108.0
260.5	120.0
305.2	132.0
355.1	144.0
430.4	160.0

R407C Saturated Temperature

Evaporator dew point and condenser midpoint are calculated using 32-bit math. The equation is as follows:

If Pressure < 120 psi Then

Saturation = [Pressure x 145/105] – [(Pressure^2)/2000] – 250

If Pressure >= 120 psi Then

Saturation = [Pressure x 46/94] – [Pressure^2/25000] + 145

Evaporator Approach

The evaporator approach is calculated for each circuit. The equation is as follows:

Evaporator Approach = LWT – Evaporator Saturated Temperature

Suction Superheat

Suction superheat is calculated for each circuit using the following equation:

Suction superheat = Suction Temperature – Evaporator Saturated Temperature

Pumpdown Pressure

The pressure to which a circuit will pumpdown is based on the Low Evaporator Pressure Unload setpoint. The equation is as follows:

Pumpdown pressure = Low evap pressure unload – 15 psi , with the calculated value limited to a minimum of 10 psi.

Unit Enable

Enabling and disabling the chiller is controlled by the Unit Enable Setpoint with options of OFF and ON. This setpoint can be altered by the Unit OFF input, Remote input, keypad entry, and BAS request. The Control Source Setpoint determines which sources can change the Unit Enable Setpoint with options of SWITCHES, KEYPAD or NETWORK.

Changing the Unit Enable Setpoint can be accomplished according to the following table. NOTE: An "x" indicates that the value is ignored.

Unit Off Input	Control Source Setpoint	Remote Input	Key-Pad Entry	BAS Request	Unit Enable
OFF	x	x	x	x	OFF
x	SWITCHES	OFF	x	x	OFF
ON	SWITCHES	ON	x	x	ON
ON	KEYPAD	x	OFF	x	OFF
ON	KEYPAD	x	ON	x	ON
ON	NETWORK	x	x	OFF	OFF
ON	NETWORK	OFF	x	x	OFF
ON	NETWORK	ON	x	ON	ON

Unit Mode

The overall operating mode of the chiller is set by the Unit Mode Setpoint with options of COOL, COOL w/Glycol, ICE w/Glycol, and TEST. This setpoint can be altered by the keypad, BAS, and Mode input. Changes to the Unit Mode Setpoint are controlled by two additional setpoints.

- Available Modes Setpoint: Determines the operational modes available at any time with options of COOL, COOL w/Glycol, COOL/ICE w/Glycol, ICE w/Glycol and TEST
- Control Source Setpoint: Determines the source that can change the Unit Mode Setpoint with options of KEYPAD, NETWORK, or SWITCHES.

When the Control source is set to KEYPAD, the Unit Mode stays at its previous setting until changed by the operator. When the Control source is set to BAS, the most recent BAS mode request goes into effect even if it changed while the Control source was set to KEYPAD or DIGITAL INPUTS.

Changing the Unit Mode Setpoint can be accomplished according to the following table. NOTE: An "x" indicates that the value is ignored.

Control Source Setpoint	Mode Input	Keypad Entry	BAS Request	Available Modes Setpoint	Unit Mode
x	x	x	x	COOL	COOL
x	x	x	x	COOL w/Glycol	COOL w/Glycol
SWITCHES	OFF	x	x	COOL/ICE w/Glycol	COOL w/Glycol
SWITCHES	ON	x	x	COOL/ICE w/Glycol	ICE w/Glycol
KEYPAD	x	COOL w/Glycol	x	COOL/ICE w/Glycol	COOL w/Glycol
KEYPAD	x	ICE w/Glycol	x	COOL/ICE w/Glycol	ICE w/Glycol
NETWORK	x	x	COOL	COOL/ICE w/Glycol	COOL w/Glycol
NETWORK	x	x	ICE	COOL/ICE w/Glycol	ICE w/Glycol
x	x	x	x	ICE w/Glycol	ICE w/Glycol
x	x	x	x	TEST	TEST

Unit Test Mode

The unit test mode allows manual testing of controller outputs. Entering this mode requires the following conditions.

- Unit Switch = OFF
- Manager password active.
- Available Unit Mode setpoint = TEST

A test menu can then be selected to allow activation of the outputs. It is possible to switch each digital output ON or OFF and set the analog outputs to any value.

Power Up Start Delay

After powering up the unit, the motor protectors may seem to not work properly for up to 150 seconds. After the control is powered up, no compressor can start for 150 seconds. In addition, the motor protect inputs are ignored during this time so as to avoid tripping a false alarm.

Ice Mode Start Delay

An adjustable start to start ice delay timer will limit the frequency with which the chiller may start in Ice mode. The timer starts when the first compressor starts while the unit is in ice mode. While this timer is active, the chiller cannot restart in Ice mode. The time delay is user adjustable.

The ice delay timer may be manually cleared to force a restart in ice mode. A setpoint specifically for clearing the ice mode delay is available. In addition, cycling the power to the controller will clear the ice delay timer.

Unit State

The Unit shall always be in one of three states. These states are Off, Auto, and Pumpdown. Transitions between these states are shown in the following diagram (Figure 10, Unit State Diagram).

T1: Off to Auto
All of the following must be true:

- Unit Enabled
- No Alarm
- IF Unit Mode = Ice THEN [Ice Timer Expired]

T2: Auto to Pumpdown
Any of the following must be true:

- Keypad Enable = Off
- BAS Enable = Off
- Remote Switch = Off
- Pumpdown Alarm Active

T3: Pumpdown to Off
Any of the following must be true:

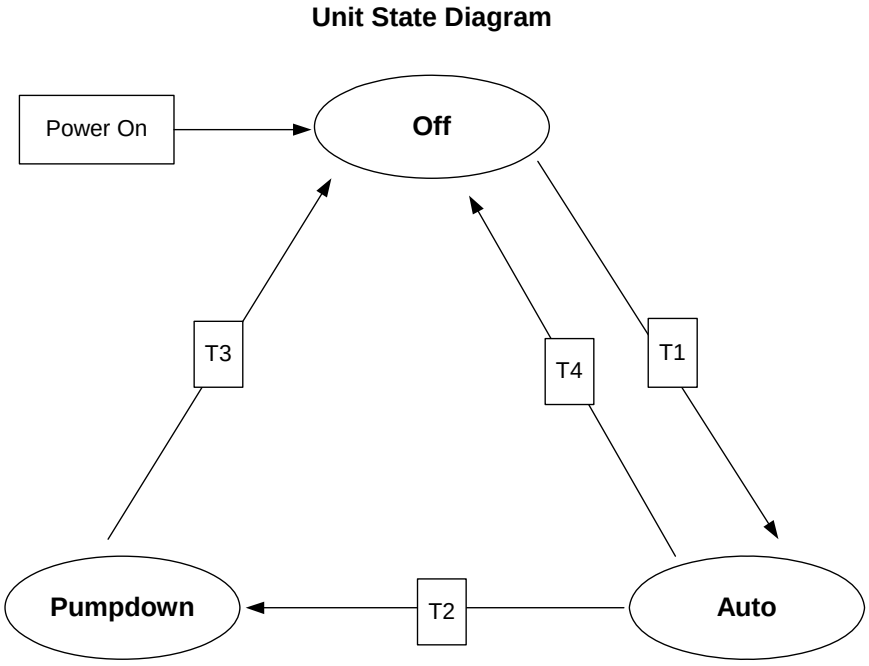
- Unit Alarm
- Unit Switch Off
- No Compressors Running

T4: Auto to Off
Any of the following must be true:

- Unit Alarm

- Unit Switch Off
- No Compressors Running AND [Unit Mode = Ice AND Ice Delay Active]

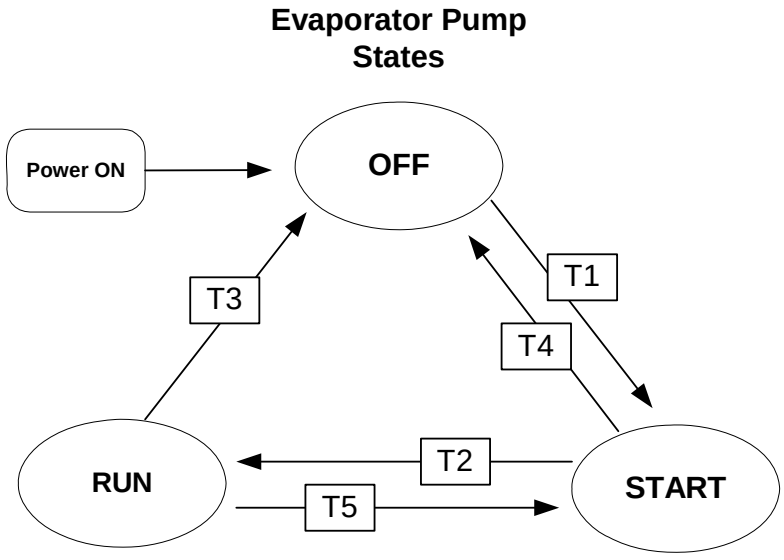
Figure 10, Unit State Diagram



Evaporator Water Pump State Control

Operation of the evaporator pump is controlled by the state-transition diagram shown below.

Figure 11, Evaporator Pump State



See transition code on following page.

Transitions:

T1 – Transition from Off to Start

Requires **any** of the following

- Unit state = Auto
- LWT < Freeze setpoint - 1

T2 – Transition from Start to Run

- Flow ok for time > evaporator recirculate time

T3 – Transition from Run to Off

- Unit state = Off AND LWT > Freeze setpoint

T4 – Transition from Start to Off

- Unit state = Off AND LWT > Freeze setpoint

T5 – Transition from Run to Start

Requires **all** of the following

- Evaporator water flow loss for time > evaporator flow proof setpoint

Condenser Fans

Condenser fans are staged up and down based on the fan stage setpoint. These setpoints define pressures at which fans will start or stop.

Fan 1 will start with the first compressor when the ambient temperature is greater than 75°F. Below 75°F, this fan starts when the condenser pressure gets up to the Stage #1 On setpoint. Fan 2 will start when the condenser pressure gets up to the Stage #2 On setpoint, and fan 3 will start when the condenser pressure gets up to the Stage #3 On setpoint.

Fan 3 will stop when the condenser pressure drops to the Stage #3 Off setpoint, and Fan 2 will stop when the condenser pressure drops to the Stage #2 Off setpoint. Fan 1 will stop when the pressure drops down to the Stage #1 Off setpoint.

Low OAT Start

In order to avoid low pressure alarms at startup, low OAT start logic allows for running at low pressures for a longer time than normal as well as multiple start attempts.

A low OAT start is initiated if the condenser saturated temperature is less than 85°F when the compressor starts. Once this happens, the circuit is in this low OAT start state for a time equal to the low OAT start timer setpoint. During this time, the freezestat logic and the low pressure events are disabled. The absolute limit of 5 psi is still enforced.

At the end of the low OAT start, the evaporator pressure is checked. If the pressure is greater than, or equal to, the low evaporator pressure unload setpoint, the start is considered successful. If the pressure is less than the unload setpoint, the start is not successful and the compressor will stop. Three start attempts are allowed before tripping on the restart alarm. So if on the third attempt, the start is not successful, the restart alarm is triggered.

The restart counter is be reset when either a start is successful or the circuit is off on an alarm.

Circuit Capacity Overrides

The following conditions override the automatic capacity control when the chiller is in Cool Mode only. These overrides keep the unit from entering a condition in which it is not designed to run.

Low Evaporator Pressure

If the evaporator pressure drops below the Low Evaporator Pressure Hold setpoint, the Low Evaporator Pressure Inhibit event is triggered. This can occur with either one or two

compressors running. When triggered, the second compressor will not be allowed to start if only one is currently running. If both compressors are already running, no action is taken.
If the evaporator pressure drops below the Low Evaporator Pressure Unload setpoint, the Low Evaporator Pressure Unload event is triggered. This can only occur when both compressors are running. When triggered, one compressor is shut off.

These events are logged to an event log when they occur. Both remain active until the evaporator pressure rises 5 psi above the hold setpoint or both compressors are off.

High Condenser Pressure

If the discharge pressure rises above the High Condenser Pressure Unload setpoint and both compressors are running, the High Condenser Pressure Unload event is triggered. One compressor will be shut off when this occurs.

This event will also be logged to an event log when it occurs. It will remain active until the condenser pressure drops 100 psi below the unload setpoint. While active, the second compressor cannot turn back on.

Maximum LWT Rate

The maximum rate at which the leaving water temperature can drop is limited by the Maximum Pulldown Rate setpoint when the unit mode is Cool. If the rate exceeds this setpoint, no more compressors can be started until the Pulldown Rate is less than the setpoint. Running compressors will not be stopped as a result of exceeding the maximum pulldown rate.

Low Ambient Lockout

If the OAT drops below the low ambient lockout setpoint, then the unit will do a normal stop. Once the lockout has been triggered, no compressors will start until the OAT rises to the lockout setpoint plus 5°F.

Compressor Control

Compressor Available

A compressor is available to start when the following are true:

- Unit state = auto
- Evap state = run
- Low OAT lockout is not active
- Power up start delay is expired
- No limit events active
- No cycle timers active for the compressor
- Compressor enable setpoint = On

Compressor Start/Stop Timing

This section determines when to start or stop a compressor. There are two separate functions used, one for staging up and one for staging down.

Stage Up Now

The **Stage Up Now** flag is set based on the following tests:

If Unit mode = Cool, *AND*
no compressors are running, *AND*
LWT error > Start delta + Upper Control Band, *AND*

Motor Protect Timer is expired, *AND*
Stage up timer is expired, *THEN*
Stage Up Now = True

ALSO
If Unit Mode = Cool, *AND*
At least one compressor is running, *AND*
LWT error > Upper Control Band, *AND*
Pulldown rate <= Max pulldown rate, *AND*
Compressors running < unit capacity limit, *AND*
Stage up timer is expired, *THEN*
Stage Up Now = True

ALSO
If Unit Mode = Ice, *AND*
no compressors are running, *AND*
LWT error > Start delta + Upper Control Band, *AND*
Motor Protect Timer is expired, *AND*
Ice Delay Timer is expired, *AND*
Stage up timer is expired, *THEN*
Stage Up Now = True

ALSO
If Unit Mode = Ice, *AND*
LWT error > 0, *AND*
At least one compressor running, *THEN*
Stage Up Now = True

Stage Down Now

The **Stage Down Now** flag is set based on the following tests:
If Unit Mode = Cool, *AND*
LWT error < -(Lower Control band), *AND*
More than one compressor is running, *AND*
Stage down timer is expired, *THEN*
Stage Down Now = True

ALSO
If Unit Mode = Cool, *AND*
LWT error < -(Lower Control band) - stop delta, *AND*
One compressor is running, *AND*
Stage down timer is expired *THEN*
Stage Down Now = True

ALSO
If Unit Mode = Cool, *AND*
Number of compressors running > Demand limit, *AND*
Stage down timer expired, *THEN*
Stage Down Now = True

ALSO

If Unit Mode = Ice, *AND*
LWT error < 0, *THEN*

Stage Down Now = True

Compressor Sequencing

Compressor staging is based primarily on compressor run-hours and starts. Compressors that have less starts will normally start before those with more starts. Compressors that have more run-hours will normally shut off before those with less run-hours.

In the event of a tie on number of starts, the lower numbered compressor will start first. In the event of a tie on run-hours, the lower numbered compressor will shut off first. Run hours are compared in terms of tens of hours.

Next On = 1 if compressor 1 starts <= compressor 2 starts or compressor 2 not available, and compressor 1 available

Next On = 2 if compressor 1 starts > compressor 2 starts or compressor 1 not available, and compressor 2 available

Next Off = 1 if compressor 1 run hours > compressor 2 run hours

Next Off = 2 if compressor 1 run hours <= compressor 2 run hours

Compressor State

A compressor will start when all of the following conditions exist:

- The compressor is “next on”
- Stage Up Now is set
- The compressor is available to start

A compressor will stop when any of the following conditions exist:

- Unit state = Off
- Low Ambient start attempt failed
- Stage Down Now is set, both compressors are running, and the compressor is “next off”
- Pumpdown is complete

Normal Shutdown

If a condition arises that requires the unit to shut down, but it is not an emergency situation, then a pumpdown will be performed. A normal shutdown will be initiated when any of the following occur:

- Unit State = Pumpdown
- Circuit Switch = Off
- Low Ambient Lockout
- A normal stage down occurs, and only one compressor is running
- Unit mode = Ice AND the ice setpoint is reached

Pumpdown Procedure

- If both compressors are running, shut off the appropriate compressor based on sequencing logic
- With one compressor left running, turn off hot gas output and liquid line output
- Keep running until evaporator pressure reaches the pumpdown pressure, then stop compressor

- If evaporator pressure does not reach pumpdown pressure within two minutes, stop compressor and log pumpdown failure alarm

Rapid Shutdown

A situation may arise that requires the unit to shut down immediately, without doing a pumpdown. This rapid shutdown will be triggered by any of the following:

- Unit State = Off
- Stop Alarm

All compressor and liquid line outputs are turned off immediately for a rapid shutdown.

Liquid Line Solenoid

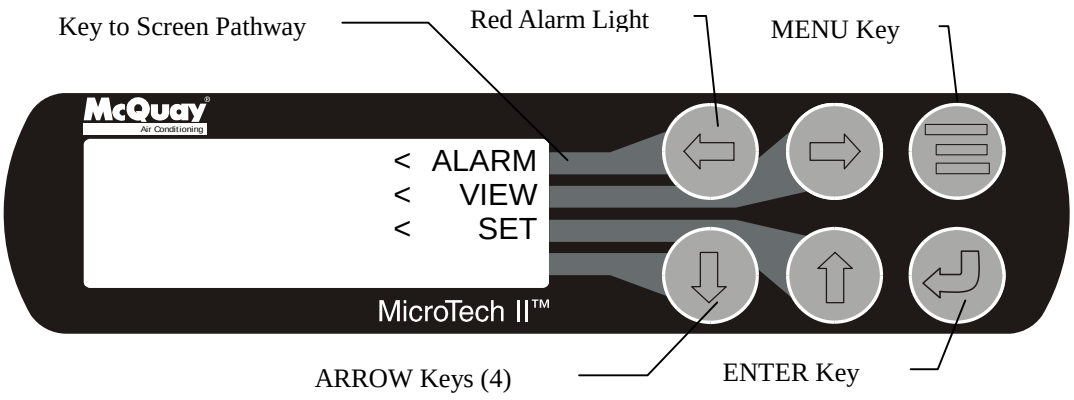
The liquid line output shall be on any time a compressor is running and the unit is not performing a pumpdown. This output should be off at all other times.

Using the Controller

4x20 Display & Keypad

The 4-line by 20-character/line liquid crystal display and 6-key keypad are shown below.

Figure 12, Display (in MENU Mode) and Keypad Layout



Note that each ARROW key has a pathway to a line in the display. Pressing an ARROW key will activate the associated line when in the MENU mode.

Getting Started

There are two basic procedures to learn in order to utilize the MicroTech II controller:

1. Navigating through the menu matrix to reach a desired menu screen and knowing where a particular screen is located.
2. Knowing what is contained in a menu screen and how to read that information or how to change a setpoint contained in the menu screen.

Navigating Through the Menus

The menus are arranged in a matrix of screens across a top horizontal row. Some of these top-level screens have sub-screens located under them. The general content of each screen and its location in the matrix are shown in Figure 14. A detailed description of each menu begins on page 41.

There are two ways to navigate through the menu matrix to reach a desired menu screen.

One is to scroll through the matrix from one screen to another using the four ARROW keys.

The other way is to use shortcuts to work through the matrix hierarchy. From any menu screen, pressing the MENU key will take you to the top level of the hierarchy. The display will show ALARM, VIEW, and SET as shown in Figure 12. This corresponds to the second row of screens on Figure 14. One of these groups of screens can then be selected by pressing the key connected to it via the pathway shown in Figure 12.

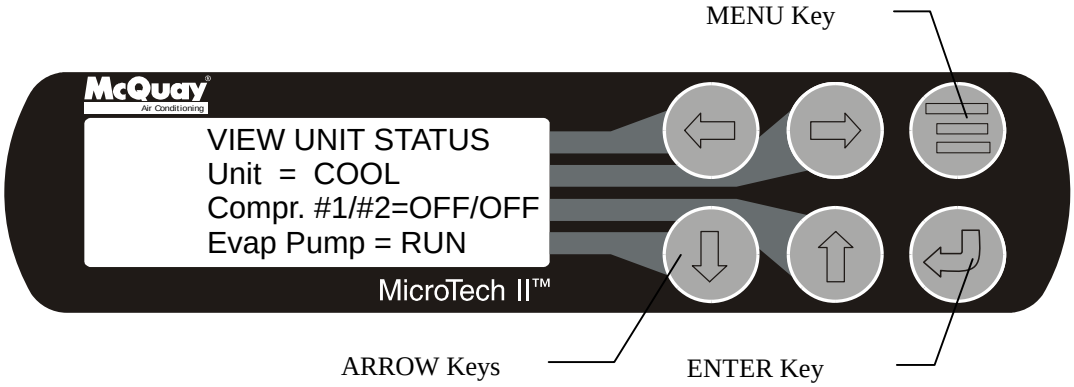
For example, selecting ALARM will go the next row of menus under ALARM (ALARM LOG or ACTIVE ALARM). Selecting VIEW will go the next level of screens under VIEW (VIEW UNIT STATUS or VIEW UNIT TEMP). Selecting SET will go to a series of screens for looking at and changing setpoints.

MENU Key

The MENU key is used to switch between the shortcut method (known as the MENU mode and as shown in Figure 12) and scrolling method (known as the SCROLL mode). The MENU mode is the shortcut to specific groups of menus used for checking ALARMS, for VIEWING information, or to SET setpoint values. The SCROLL mode allows the user to move about the matrix (from one menu to another, one at a time) by using the four ARROW keys. A typical menu screen is shown in Figure 13.

Pressing the MENU key from any menu screen will automatically return you to the MENU mode as shown in Figure 12.

Figure 13, Display in the Shortcut (SCROLL) Mode and Keypad Layout



Menu Screens

Various menus are shown in the controller display. Each menu screen shows specific information; in some cases menus are used only to *view* the status of the unit, in some cases they are used for checking and clearing *alarms*, and in some case they are used to *set* setpoint values.

The menus are arranged in a matrix of screens across a top horizontal row. Some of these top-level screens have sub-screens located under them. The general content of each screen and its location in the matrix are shown in Figure 14. A detailed description of each menu begins on page 41.

The ARROW keys on the controller are used to navigate through the menus. The keys are also used to change numerical setpoint values contained in certain menus.

Changing Setpoints

Pressing the ENTER key changes the function of the ARROW keys to the editing function as shown below:

LEFT key Default, changes a value to the factory-set default value.
RIGHT key Cancel, cancels any change made to a value and returns to the original setting.
UP key Increment, increases the value of the setting
DOWN key Decrement, decreases the value of a setting.

These four edit functions are indicated by one-character abbreviation on the right side of the display (this mode is entered by pressing the ENTER key).

Most menus containing setpoint values have several different setpoints shown on one menu. When in a setpoint menu, the ENTER key is used to proceed from the top line to the second line and on downward. The cursor will blink at the entry point for making a change. The ARROW keys (now in the edit mode) are used to change the setpoint as described above. When the change has been made, press the ENTER key to enter it. No setting is changed until the ENTER key is pressed.

For example, to change the chilled water setpoint:

1. Press MENU key to go to the MENU mode (see Figure 12).
2. Press SET (the UP Key) to go to the setpoint menus.
3. Press UNIT SPs (the Right key) to go to setpoints associated with unit operation.
4. Press the DOWN key to scroll down through the setpoint menus to the third menu which contains Evap LWT=XX.X°F.
5. Press the ENTER key to move the cursor down from the top line to the second line in order to make the change.
6. Use the ARROW keys (now in the edit mode as shown above) to change the setting.
7. When the desired value is achieved, press ENTER to enter it. The cursor will automatically move down.

At this point, the following actions can be taken:

1. Change another setpoint in this menu by scrolling to it with the ENTER key
2. Using the ENTER key, scroll to the first line in the menu. From there the ARROW keys can be used to scroll to different menus.

Figure 14, Menu Matrix

"**MENU**"					
"**VIEW**" MENUS					
UNIT		COMP		REFRIGERANT	FANS
VIEW UNIT STATUS 1-3	VIEW UNIT TEMP 1-3	VIEW COMP #1 STATUS	VIEW COMP #2 STATUS	VIEW EVAP/COND PRESS (1)	VIEW FAN STAGING
				VIEW EVAP APPROACH (2)	

⇐ Continued ⇐

(Right side of matrix continued from above)

"**ALARM**" MENUS		"**SET**" MENUS			
ALARM LOG (LAST) TYPE, TIME	ACTIVE ALARM (1) TYPE, TIME	SET UNIT SPs, (1) MODE	SET COMP SPs (1) STOP/START	SET LIMIT ALARMS (1) EVAP PRESS	SET FANS (1) STAGES FANTROL
ALARM LOG (NEXT TO LAST)	ACTIVE ALARM (2) TYPE, TIME ADDITIONAL	SET UNIT SPs, (2) MODE COOL/GLYCOL/ ICE	SET COMP SPs (2) INTER-STAGE	SET LIMIT ALARMS (2) FREEZE/ FLOW	SET FANS (2) STAGE ON
ALARM LOG (SECOND TO LAST)	ACTIVE ALARM (3) CLEAR/VIEW	SET UNIT SPs, (3) TEMP EVAP LWT		SET LIMIT ALARMS (3) COND PRESS	SET FANS (3) STAGE OFF
ALARM LOG LAST 25 SHOWN ⇓		SET UNIT SPs, (4) MISC		SET LIMIT ALARMS (4) PHASE/VOLT LOW AMB LOCKOUT	
		SET UNIT SPs, (5) CLOCK		SET LIMIT ALARMS (5) LOW EVAP PR	
		SET UNIT SPs, (6) ENGLISH			
		SET UNIT SPs, (7) PROTOCOL			
		SET UNIT SPs, (8) EVAP OFFSET			
		SET UNIT SPs, (9) COND OFFSET			
		SET UNIT SPs, (10) LWT OFFSET			
		SET UNIT SPs, (11) AMBIENT OFFSET			
		SET UNIT SPs, (12) ENTER PASSWORD			

Menu Structure (Hierarchical)

As discussed previously, a hierarchical menu structure can be used to access the various screens. One to twelve levels are used with two or three being typical. Optionally, the last menu selection can access one of a set of screens that can be navigated with the UP/DOWN ARROW keys (see the scrolled menu structure below).

Menu selection is initiated by pressing the MENU key that changes the display from a regular data screen to a menu screen. Menu selections are then made using the arrow keys according to labels on the right side of the display (the arrows are ignored). When the last menu item is selected, the display changes to the selected data screen. An example follows showing the selection of the "VIEW COMPRESSOR (n) screen.

Suppose the initial screen is as below or any other menu screen:

```
ALARM LOG
      (data)
      (data)
      (data)
```

After pressing the **MENU** key, the top level menu screen will show:

```
               < ALARM
               <  VIEW
               <   SET
```

After pressing the "**VIEW**" menu key, a menu screen will show:

```
VIEW     <        UNIT
         < COMPRESSOR
         < REFRIGRANT
         <        FANS
```

Selection of any of these will advance to the appropriate data menu. For example, after pressing the "**REFRIGERANT**" menu button, the selected data screen will show:

```
VIEW REFRIG
           PSI     °F
SAT EVAP XXX.X   XX.X
SAT COND XXX.X   XX.X
```

The ARROW keys will automatically return to the "scroll" mode at this time.

Screen Definitions VIEW

This section contains information on each screen. The menu screens are in order of the matrix in Figure 14, going from left to right and then down when there are sub-menus. Many menus are self-explanatory.

VIEW UNIT

```
VIEW UNIT STATUS (1)
Unit = AUTO
Cool Stages=0
Evap Pump = RUN
```

Unit states can be:

Auto	Off:Ice Mode Timer	Off:All Comps Disabled
Off:Unit Alarm	Off:Keypad Disable	Off:Remote Switch
Off:BAS Disable	Off:Unit Switch	Auto:High LWT Pulldn
Auto:Cycle Timers	Auto:Wait for load	Auto:OAT Lockout
Auto:Evap Recirc	Auto:Wait for flow	Auto:Pumpdown
Auto:Evap Press Low	Auto:Cond Press High	Off:Test Mode

as determined from the Unit State variable, the Unit Mode setpoint, the Unit Enable and the presence of an alarm.

Pump states can be:

Off Start Run

```
VIEW UNIT STATUS (2)
Stg Up Delay=XXX sec
Stg Dn Delay=XXX sec
Ice Delay=xxhr XX mn
```

Ice delay line is only visible when in the ICE mode.

```
VIEW UNIT STATUS (3)
D.O.          D.I.
12345678   123456
00000000   000000
```

```
VIEW UNIT TEMP  (1)
Evap LWT    = XX.X°F
Outside Amb = XX.X°F
LWT Target  = XX.X°F
```

```
VIEW UNIT TEMP   (2)
LWT Pulldn=XX.X °F/m
Control Band=XX.X °F
```

```
VIEW UNIT TEMP   (3)
StgUp@ XX.X Dn@ XX.X
Start Unit @ XX.X
Shutdown Unit @ XX.X
```

See page 29 for an explanation of these settings.

VIEW COMPRESSORS

```
VIEW COMP#1    (1)
State   = OFF  LEAD
Cycle Timer:  XXmin
Manual Disable
```

Cycle timer only visible when active. Manual Disable visible only when compressor is disabled via manual enable setpoint.

```
VIEW COMP#1      (2)
Hours  = XXXXX
Starts = XXXXX
```

Above two screens duplicated for compressor #2.

VIEW REFRIGERANT

```
VIEW REFRIG       (1)
EVAP Press = XX.Xpsi
COND Press - XX.Xpsi
```

With R22 Refrigerant	With R407C Refrigerant
VIEW REFRIG (2)	VIEW REFRIG (2)
SAT EVAP = XXX.X°F	Evap Dew = XXX.X°F
SAT COND = XXX.X°F	Cond Mid = XXX.X°F
EvapApproach = XX.X°F	EvapApproach = XX.X°F

See page 30 for an explanation of saturated temperatures for R22 and R407C.

Approach is the difference between the leaving fluid temperature and the saturated evaporator temperature. It is an indication of the evaporator efficiency; an increasing approach temperature indicates decreasing heat transfer efficiency.

VIEW FANS

```
VIEW FANS
Stages ON = X of X
```

Screen Definitions – ALARM

ALARM ACTIVE (X)	ALARM ACTIVE (X)
Alarm Description	No more alarms
hh:mm:ss dd/mmm/yyyy	Press ENTER to clear
	all active alarms

If the unit is off on a shutdown alarm or running but in a limit alarm condition, the cause and date will appear in the upper screen. If there is a simultaneous occurrence of more than one alarm, the others will appear in additional screens below this one, accessed by the DOWN ARROW. Either type alarm will light a red light in back of the LEFT-KEY. The light will go out when the fault is cleared.

To clear the fault, scroll down to the last screen and press ENTER. If other faults have appeared, they will all be cleared at the same time.

```
ALARM LOG (1)
High Condenser Press
 hh:mm:ss d/mmm/yyyy
```

The last 25 alarms, either shutdown or limit, are shown in this menu with subsequent menus stored under it. ARROW DOWN from this menu will go to the next-to-last alarm, ARROW DOWN again will go to the second from last, and so on through the last 25 occurrences. The screens are numbered (1), (2), (3), etc.

Screen Definitions – SET

Changing setpoints; in general, setpoints are changed as follows:

1. Select the desired menu by scrolling through SET menus with the UP and DOWN ARROWS.
2. When the desired menu is selected, select the desired entry by moving between lines using the ENTER key.
3. If a numerical value is being changed, use the INCREMENT key (UP ARROW) to increase or the DECREMENT key (DOWN ARROW) to decrease the value of the setpoint.

   If a word type setpoint (for example, YES or NO) is to be selected, the choices are loaded into the menu and selected by scrolling through the available setpoint options using the UP ARROW key.
4. Enter the desired value or word into the controller by pressing the SET key.

SET UNIT SETPOINTS (SP)

```
SET UNIT SPs     (1)
Unit Enable=OFF
Mode=COOL
Source=KEYPAD
```

Unit Enable is an external signal or a keypad setting that keeps the unit off when the setting is OFF and *allows* it to run if there is a call for cooling. The source for the signal is selected in the 4th line and can be:

1. KEYPAD, in which case the selection is made in line 2 and would be normally selected as ON. This is the normal setting when no external signals are controlling the unit.
2. SWITCHES, in which an external switch is wired across terminals #25 and #35. (See wiring diagram page 20).
3. NETWORK, used with BAS signal, which is wired to the three communication ports.

Unit Mode settings can be

1. COOL, normal setting used with chilled water air-condition applications.
2. COOL w/GLYCOL, used with low temperature, glycol applications. It allows a lower LWT setpoint to be used.
3. ICE w/GLYCOL, used with ice storage systems, allows changing from chilled glycol operation to lower temperature ICE operation. In ICE, the unit runs at full load until the ICE setpoint is reached, at which time the unit shuts off. A three-position switch wired to terminals #28 and #38 initiates the change from glycol cooling to making ice. (See wiring diagram on page 20.)

```
SET UNIT SPs    (2)
Available Modes
  =COOL w/Glycol
Set w/ FP Switch Off
```

Available Modes settings can be COOL, COOL w/Glycol, ICE w/Glycol, or TEST as selected from the available modes imbedded in the menu. The 4th line is a reminder that the ON/OFF switch on the front panel (FP) must be in the OFF position before the MODE can be changed. This prevents a mode change while the unit is operating.

```
SET UNIT SPs     (3)
Evap LWT =  XX.X°F
Ice LWT =  XX.X°F
EvapDeltaT= XX.X°F
```

```
SET UNIT SPs    (4)
StartDelta= XX.X°F
StopDelta= XX.X°F
```

Staging

StartDelta is the number of degrees *above* the temperature setting that determines when the lead compressor starts. Compressor start and stop is determined by the control band and StartDelta settings. The control band is automatically set of 60% of the EvapDeltaT (chilled water temperature in minus chilled water temperature out) selected in menu 3 above. The staging routine has been changes in this software version compared to previous versions. See page 29 for more details and an example.

For a warm start-up the lead compressor will start at any temperature above the start temperature. The lag will start after the start interval has timed out. The chilled water temperature will begin to be pulled down. At shut down temperature, the lag compressor will shut off. If the temperature climbs above that temperature within the StageDownTimer setting (default at 30 sec.), the lead compressor will remain on. This would be normal operation. If for some reason the temperature does not rise, the lead compressor will also shut off.

```
SET UNIT SPs    (5)
Max Pulldn=X.X°F/min
Evap Recirc= XXX sec
LowAmbLock= XX.X °F
```

```
SET UNIT SPs    (6)
Ice Time Delay=XXhrs
Clear Ice Delay=No
```

```
SET UNIT SPs     (7)
       CLOCK
     dd/mmm/yyyy
       hh:mm:ss
```

```
SET UNIT SPs (8)
Units = °F/psi
Lang  = ENGLISH
Refrig = Select Type
```

Units settings are only °F/psi at the present time. °C/kPa will be available later.

Lang (Language) settings can be only ENGLISH at present.

Refrig (Refrigerant) selection is done at the factory prior to shippment.

```
SET UNIT SPs      (9)
Protocol = NONE
Ident Number=001
Baud Rate=9600
```

```
SET UNIT SPs     (10)
Evaporator Refrig
Press Sensor
Offset= 00.0 psi
```

The pressure/temperature offsets on menus 10 through 13 correct the controller's display of the parameters. The sensors used in these units have a high degree of repeatability but may need correction (offset). An accurate pressure gauge or thermometer is used to determine the correct temperature or pressure. A positive or negative offset value is then entered to make the controller reading agree with the measured value.

```
SET UNIT SPs     (11)
Condenser Refrig
Press Sensor
Offset= 00.0 psi
```

```
SET UNIT SPs     (12)
Leaving Evaporator
Water Temp Sensor
Offset= 00.0°F
```

```
SET UNIT SPs     (13)
Outside Ambient
Temperature Sensor
Offset= 00.0°F
```

```
SET UNIT SPs    (14)
ENTER PASSWORD XXXX
Active Password
Level:None
```

Two four-digit passwords provide OPERATOR and MANAGER levels of access to changeable parameters. The passwords are preprogrammed into the controller. The Operator Password is 0100. Either password must be entered using the ENTER PASSWORD (12) screen before a protected setting can be changed.

This screen can be accessed either through the SET OTHER menu or by simply pressing the ENTER key while on one of the SET screens. The controller will automatically go from the screen with the setting change to this screen. After the correct password has been entered, the controller will automatically return to the original set screen.

Once a password has been entered, it remains valid for 15 minutes after the last key-press.

SET COMP SPs

```
SET COMP SPs    (1)
Clear Cycle Tmr=No
Stop-Start  =XXmin
Start-Start =XXmin
```

This menu sets the anti-recycle timers. Stop-Start is the time required before starting a compressor after it has *stopped*. Start-Start is the time required before starting a compressor after the last time it has *started*. It recommended that these default values not be changed.

```
SET COMP SPs    (2)
InterStageUp=XXXsec
InterStageDn=XXXsec
```

InterStageUp is the time delay since the last stage change before a compressor can stage on.

InterStageDn is the time delay since the last stage change before a compressor can stage off normally (not by an alarm).

```
SET COMP SPs    (3)
Compressor 1=Enable
Compressor 2=Enable
```

ALARM SETPOINTS

```
SET ALARM LMTS (1)
LowEvPr
     Hold=XXXpsi
   Unload=XXXpsi
```

The LowEvPrHold and LowEvPrUnld have the same default value of 59 psi. If two compressors are running, the LowEvPrUnld is in effect and the lag compressor will be shut off to unload the unit. If one compressor is running, the LowEvPrHold is in effect and the lag compressor is prevented from starting, thereby holding the unit capacity.

The last action to take place is the shutoff of all compressors running when the LowEvPrStop setting is reached (default is 58 psi).

```
SET ALARM LMTS (2)
Evap Freeze= XX.X°F
EvapFlowProof=XXXsec
```

Evap Freeze (the unit freeze protection shutdown) is actually a stop alarm and shuts off the unit when the LWT reaches 36°F. It is cleared by going to the CLEAR ALARM menu in the ACTIVE ALARM hierarchy.

EvapFlowProof is the flow switch interlock. Closing the flow switch and therefor proving the existence of chilled water flow resets this trip.

```
SET ALARM LMTS (3)
High Cond Pressure
   Unload = XXXpsi
    Stop = XXXpsi
```

HighCondPr (the unit high-discharge-pressure shutdown) is a stop alarm that shuts off the unit when the discharge pressure reaches the setting. The default setting is 380 psi. The Stop is a shutdown alarm that stops the unit when the discharge pressure reaches the setpoint.

```
SET ALARM LMTS (4)
PhaseVoltage=YES/NO
LowOATLockTmr=XXXsec
```

LowAmbientLock prevents unit operation below the setting. If the unit is equipped with the standard FanTrol pressure-activated control, the available range is 35°F to 60°F with a default of 35°F. With the optional SpeedTrol variable speed control, the range becomes –2°F to 60°F with default of 0°F. Input to line 3 of the next screen, SET FANS SP (1), informs the controller which type of control is installed and which range of setting to allow.

SET FANS STAGES

```
SET FANS SPs (1)
Fan Stages= X
Speedtrol = NO
```

The Fans line tells the controller the number of fans on the unit. The UP ARROW toggles between 1, 2, and 3. 1 is not used; 2 should be used for Models AGZ 010, 013, and 017; and 3 should be used for AGZ 020, 025, 029, and 034.

Speedtrol tells the controller whether the optional SpeedTrol is installed in the unit. The UP ARROW toggles between YES and NO. The setting changes the range available: YES = 35°F to 60°F, with 35°F being the recommended setting; NO = -2°F to 60°F, with 0°F being the recommended setting.

```
SET FANS SPs (2)
Stage ON psi
  #1    #2     #3
  XXX   XXX    XXX
```

```
SET FANS SPs (3)
Stage Off psi
  #1    #2     #3
 UNIT   XXX   XXX
```

These two menus set the on and off staging pressures for the fans. The third fan stage setting is only for three fan units. These settings are used with both FanTrol and SpeedTrol. SpeedTrol takes effect when the last fan is running after FanTrol cycles off the others.

Screen Definitions – TEST

The test screens are only available when the unit is in TEST mode. Using these screens, any digital output can be controlled manually.

```
TEST UNIT          (1)
Alarm Signal= OFF
Evap Water Pump=OFF
```

```
TEST UNIT          (2)
Liquid Line Sol=OFF
Compressor #1 = OFF
Compressor #2 = OFF
```

```
TEST UNIT          (3)
Fan Motor #1 = OFF
Fan Motor #2 = OFF
Fan Motor #3 = OFF
```

Editing, Review

Editing is accomplished by pressing the ENTER key until the desired field is selected. This field is indicated by a blinking cursor under it. The arrow keys shall then operate as defined below.

CANCEL ..... Reset the current field to the value it had when editing began.
DEFAULT ..... Set value to original factory setting.
INCREMENT ..... Increase the value or select the next item in a list.
DECREMENT ..... Decrease the value or select the previous item in a list.

During edit mode, the display shall show a two-character-wide menu pane on the right as shown below.

```
SET UNIT SPs (X)   <D
     (data)        <C
     (data)        <+
     (data)        <-
```

Additional fields can be edited by pressing the ENTER key until the desired field is selected. When the last field is selected, pressing the ENTER key switches the display out of “edit” mode and returns the ARROW keys to “scroll” mode.

BAS Interface

McQuay’s Protocol Selectability™ feature is available as a factory-installed option or as a retrofit item available for installation after the unit is shipped.

If an interface module was ordered, one of the following BAS interface installation manuals was shipped with the equipment. Additional copies of referenced McQuay documents may be obtained from the local McQuay sales office, from the local McQuay Factory Service office, from the McQuay Technical Response Center, located in Staunton, Virginia (540-248-0711) or downloaded from www,mcquay.com.

- IM 735, LONWORKS® Communication Module Installation
- IM 736, BACnet® Communication Module Installation
- IM 743, Modbus® Communication Module Installation
- ED 15062-0, Microtech II Chiller Protocol Information – BACnet® and LONWORKS®
- ED 15063-0, Microtech II Chiller Unit Controller Protocol Information – Modbus®

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Service

⚠ WARNING

Disconnect and tag out all power sources to the unit before doing any service inside the unit. Failure to do so can cause severe personal injury or death.

⚠ CAUTION

Service on this equipment is to be performed by qualified service personnel with special regard to regulations concerning release of refrigerant to the atmosphere.

Note: Repeated tripping of equipment protection controls must be investigated and corrected.

Thermostatic Expansion Valve

The expansion valve is responsible for allowing the proper amount of refrigerant to enter the evaporator regardless of cooling load. It does this by maintaining a constant superheat. (Superheat is the difference between refrigerant temperature as it leaves the evaporator and the saturation temperature corresponding to the evaporator pressure.) Typically, superheat should run in the range of 8°F to 12°F (4.4°C to 6.6°C).

The superheat setting can be adjusted by removing the cap at the bottom of the valve to expose the adjustment screw. Turn the screw clockwise (when viewed from the adjustment screw end) to increase the superheat setting and counterclockwise to reduce superheat. Allow time for system rebalance after each superheat adjustment.

The expansion valve, like the solenoid valve, should not normally require replacement, but if it does the unit must be pumped down by following the steps involved when changing a filter-drier.

If the problem can be traced to the power element only, unscrew the element from the valve body without removing the valve, but only after pumping the unit down.

Filter-Driers

If the pressure drop across the filter-drier is in the 6 to 10 psi range, it should be monitored and changed when the pressure drop reaches 10 psi. To change the liquid line sealed filter, de-energize the unit and pump out the refrigerant. After changing the filter-drier, check for leaks before recharging and returning unit to operation.

Liquid Line Solenoid

The liquid line solenoid valve does not normally require any maintenance. It may, however, require replacement of the solenoid coil. The solenoid coil may be removed from the valve body without opening the system by disconnecting power to the unit. The coil can then be removed from the valve body by simply removing the nut or snap ring located at the top of the coil.

Optional Controls

SpeedTrol Head Pressure Control

The SpeedTrol method of head pressure control operates in conjunction with FanTrol by modulating the motor speed on system #1 fan in response to condenser pressure. By reducing the speed of the last fan as the condensing pressure falls, the unit can operate to 0°F (-18°C) ambient air temperature.

The SpeedTrol fan motor is a single-phase, 230/460 volt, thermally protected motor specially designed for variable speed operation. The solid-state speed control is mounted in the unit control panel and is connected to a Schrader fitting on the liquid line. The control is factory-set to start modulating fan speed at 230 psig, and it will maintain a minimum condensing pressure of 170 to 180 psig. Minimum starting voltage for SpeedTrol motors is 120 volts.

A low ambient timer function is included in the microprocessor. When the solenoid valve and lead compressor are energized by the controller, the low pressure cutout control is bypassed and the compressor is allowed to start with the low pressure control open.

After about 2-3/4 minutes, the time delay will open and the low pressure cutout function is again operable. If the system has not built up enough evaporator pressure to close the low pressure setting, the compressor will stop.

Due to the vertical condenser design, it is recommended that the unit be oriented so that prevailing winds blow parallel to the unit length, thus minimizing effects on minimum ambient operation. If it is not practical to orient the unit in this manner, a wind deflector should be constructed.

Hot Gas Bypass

Hot gas bypass is a system for maintaining evaporator pressure at or above a minimum value. The purpose for doing this is to keep the velocity of the refrigerant as it passes through the evaporator high enough for proper oil return to the compressor when cooling load conditions are light. It also maintains continuous operation of the chiller at light load conditions.

The solenoid valve should be wired to open whenever the liquid line solenoid valve is energized. This can be accomplished by wiring the hot gas solenoid (SV5) in parallel with the liquid line solenoid at terminals 14 and 16. The pressure-regulating valve is factory-set to begin opening at 58 PSIG (32°F for R-22) when the air-charged bulb is in an 80°F ambient temperature. The bulb can be mounted anywhere as long as it senses a fairly constant temperature at various load conditions. The compressor suction line is one such mounting location. It is generally in the 50°F to 60°F range.

The chart below indicates that when the bulb is sensing 50°F to 60°F temperatures, the valve will begin opening at 54 PSIG. This setting can be changed as indicated above, by changing the pressure setting, remove the cap on the bulb and turn the adjustment screw clockwise. To lower the setting, turn the screw counterclockwise. Do not force the adjustment beyond the range it is designed for, as this will damage the adjustment assembly.

The regulating valve opening point can be determined by slowly reducing the system load (or increasing the required chiller water temperature setting indicated on the unit thermostat), while observing the suction pressure. When the bypass valve starts to open, the refrigerant line on the evaporator side of the valve will begin to feel warm to the touch.

⚠ WARNING

The hot gas line may become hot enough to cause injury in a very short time. Avoid contact during valve checkout.

On installations where the condensing unit is remote from the evaporator, it is recommended that the hot gas bypass valve be mounted near the condensing unit to minimize the amount of refrigerant that will condense in the hot gas line during periods when hot gas bypass is not required.

Figure 15, Hot Gas Bypass Piping

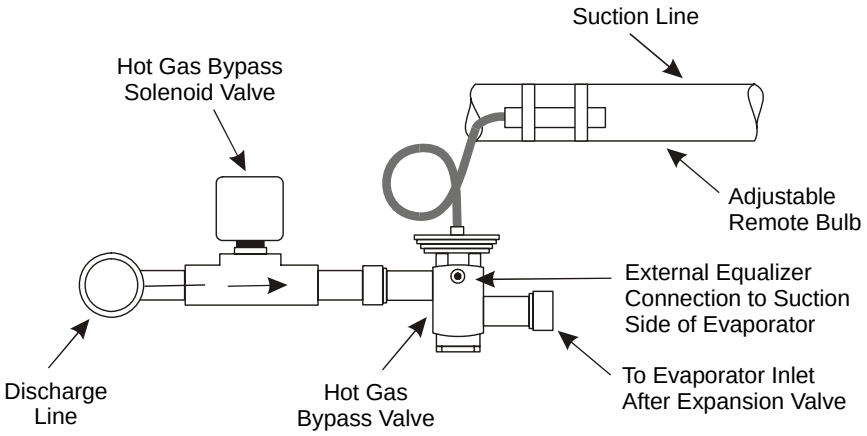
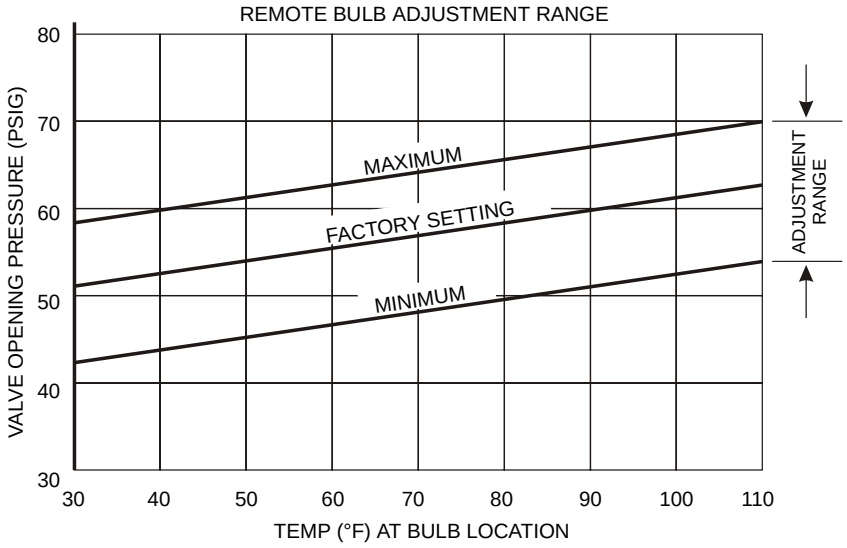


Figure 16, Hot Gas Bypass Adjustment



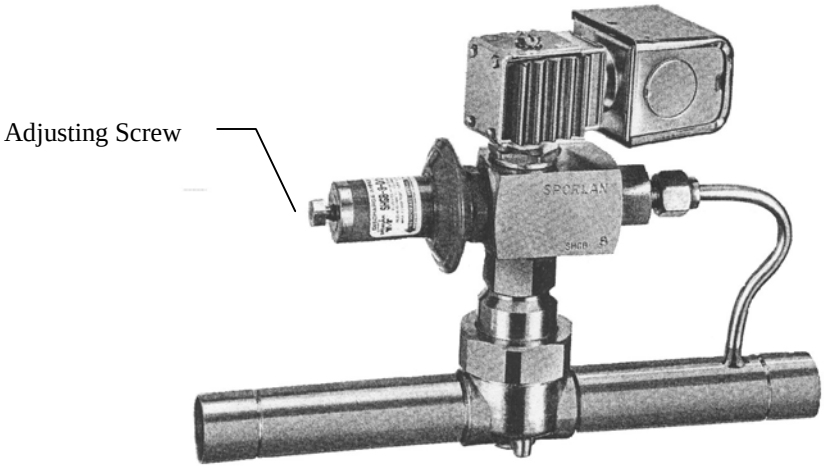
MODEL AGZ 029 – 034, Post 2004 Production

Model AGZ 029 and 034 built after January 2004 may have a hot gas bypass valve as shown as shown in Figure 17.

The valve is adjusted using the adjusting screw show in the drawing. The range is 0 to 100 psi with about 16 psi change for one turn of the screw. Turning clockwise will increase the valve setting.

The load must be varied to properly set these valves. The load should be decreased so that the suction pressure decreases. The valve is then adjusted to maintain the correct suction pressure, which is the normal pressure at full load. The load should then be increases above the valve setting so that it closes. Operation can be checked by again reducing the load and noting when the valve opens (a hissing sound and/or pressure rise at the valve outlet indicates that the valve has opened).

Figure 17, ACZ 033 - 039 Hot Gas Bypass Valve



Troubleshooting Chart

⚠ WARNING

Troubleshooting can present risks of severe personal injury or death from burns, cuts, electrocution, strangulation and asphyxiation. Troubleshooting must be done by trained, experienced technicians only.

Table 13, Troubleshooting Chart

PROBLEM	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
COMPRESSOR WILL NOT RUN	1. Main switch open 2. Fuse blown, breakers open 3. Thermal overloads tripped 4. Defective contactor or coil 5. System off by protection device 6. No cooling required 7. Liquid line solenoid will not open 8. Motor electrical problem 9. Loose wiring	1. Close switch 2. Check electrical circuits and motor windings for shorts. Check for overloads and loose connections. Replace fuse or reset breaker. 3. Check unit when back on line, auto reset 4. Repair or replace 5. Determine cause and correct 6. None, should start on call for cooling 7. Repair or replace coil 8. Check motor for open or short circuit, or burnout 9. Check all wire junctions. Tighten all terminals.
COMPRESSOR NOISY OR VIBRATING	1. Refrigerant flooding compressor 2. Improper line support 3. Worn compressor	1. Check expansion valve setting 2. Relocate or add supports 3. Replace
HIGH DISCHARGE PRESSURE	1. Noncondensables in system 2. Refrigerant overcharge 3. Fan not running 4. Dirty condenser coils 5. FanTrol out of adjustment	1. Remove with authorized procedures 2. Remove excess 3. Check electrical circuit 4. Clean coil 5. Adjust FanTrol setting
LOW DISCHARGE PRESSURE	1. Faulty condenser control 2. Low refrigerant charge 3. Low suction pressure	1. Check condenser control operation 2. Check for leaks. Add refrigerant 3. See low suction pressure steps below
HIGH SUCTION PRESSURE	1. Excessive load 2. Expansion valve overfeeding	1. Reduce load or add capacity 2. Check remote bulb. Regulate superheat
LOW SUCTION PRESSURE	1. Lack of refrigerant 2. Evaporator dirty 3. Clogged filter-drier 4. Expansion valve malfunctioning 5. Low condensing temperature	1. Check for leaks. Repair and replace refrigerant. 2. Clean chemically 3. Replace 4. Check and adjust for proper superheat 5. Check discharge pressure control settings
UNIT WILL NOT LOAD OR UNLOAD	1 Faulty controller sensor/broken wire 2. Stages not set for application	1. Replace 2. Adjust thermostat setting
LOAD/UNLOAD INTERVAL TOO SHORT	1. Erratic water thermostat 2. Insufficient water flow	1. Replace 2. Adjust flow
COMPRESSOR LOSES OIL	1. Lack of refrigerant 2. Suction superheat too high 3. Crankcase heater burned out	1. Check for leaks and repair 2. Adjust superheat 3. Replace crankcase heater
MOTOR OVERLOAD RELAYS OPEN OR BLOWN FUSES	1. Low voltage during high loads 2. Defective or grounded motor wiring 3. Loose power wiring 4. High condensing temperature 5. Unbalanced voltage	1. Check supply voltage 2. Replace compressor 3. Check all connections and tighten 4. See steps for high discharge pressure 5. Check voltage. Contact power company.
COMPRESSOR THERMAL SWITCH OPEN	1. Operating beyond design conditions	1. Add facilities so conditions are within allowable limits