

USER MANUAL

RECIRCULATING CHILLER

RC8057G1

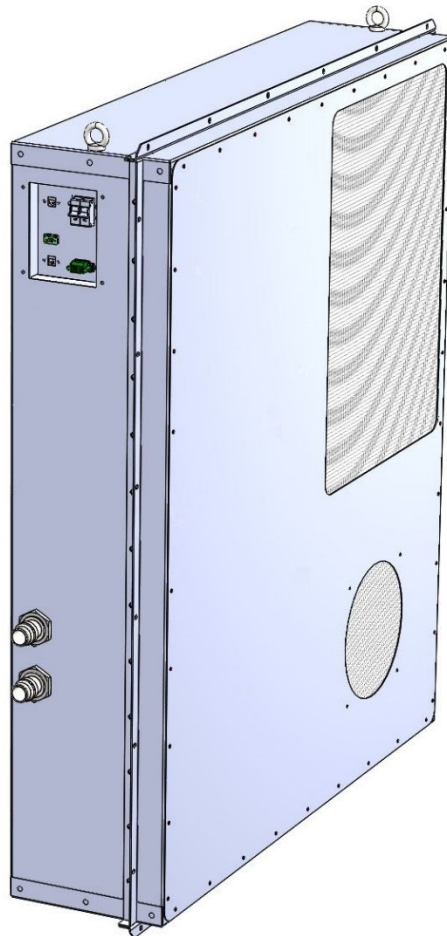


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Introduction

Unpacking & Receiving the New Chiller

Your Chiller was packed with care and its container was inspected prior to shipment. Upon receiving your unit, immediately inspect the outside of the shipping container. If there is any major damage (holes in the container, crushing, etc.), insist that a representative of the carrier be present when you unpack the contents.

Remove the top side panels from crate and set aside.

Inspect the new chiller immediately upon receiving it. If the unit shows shipping damage, contact the transportation company and file a Freight Damage Claim. Retain all cartons and packing material until the unit is operated and found to be in good condition.

The chiller has been fully tested at the Boyd Inc. factory with clean water (refer to D22995). Although the system has been drained, some residual fluid may remain. This will not hinder the performance of the chiller.

About the Warranty

All units returned for warranty claims must have an RMA (Return Material Authorization) number on the outside of the container. Call Boyd's Customer Service at +1-781-933-7300 for an RMA number. Refer to the end of manual for the chiller warranty. Units should be drained of all fluids and packaged in its original packaging.

Customer Service Support

Boyd Inc. is committed to servicing the customer, both during and after the sale. If you have any questions concerning the operation of your unit, contact our Application Engineering Department at +1-781-933-7300. To facilitate your call, please have the **part number** and **serial number** of the unit (located on the rear of the chiller) for the Applications Engineer.

Service Hotline

Boyd has a 24-hour per day, 7 day per week service hotline to help you with questions on the startup and operation of your chiller. (Boyd recommends consulting the troubleshooting guide in this manual before calling the service hotline.) Boyd's Customer Service can be reached at +1-781-933-7300. To facilitate your call, please have the **part number** and **serial number** of the unit (located on rear of the chiller) for the Service Technician.

NOTICE

USER SHOULD READ ENTIRE MANUAL PRIOR TO ANY INSTALLATION OR OPERATION OF THE UNIT!

Certifications

RoHS Statement

RoHS Directive 2011/65/EU On July 1, 2006, European directive 2002/95/EC, the RoHS directive, restricted the use of certain hazardous substances in products sold into countries of the European Union. The restricted substances are lead, mercury, cadmium, hexavalent chromium, and two flame-retardants: polybrominated biphenyls and polybrominated diphenyl ethers. As of January 2, 2013, the 2002/95/EC RoHS directive was repealed and replaced by European directive 2011/65/EU. This RoHS directive restricts the same substances and additionally made RoHS a CE marking directive, that is, if a product is CE marked and is not specifically exempted from the RoHS directive, the RoHS directive must be listed on the product's EU declaration of conformity. If the 2011/65/EU directive is listed on the Boyd declaration of conformity, this means that Boyd has received written documentation supplied by our component suppliers attesting to the RoHS compliance of their products, which is on file and available upon request. Boyd has not conducted chemical analysis or materials testing of the individual components used in its products. Boyd makes no representation or warranty as to the accuracy of the information provided by our component suppliers.

Specifications

Air-cooled chiller rated to remove 7500 Watts (25614 Btu/hr) with 35°C ambient air at a coolant process supply temperature of 15°C (59°F).

Process fluid temperature range: 39-104°F (4-40°C)

Process fluid temperature stability: +/- 3°C (5.4°F) adjustable

Process fluid pump will provide up to 80 lpm (21.5 gpm) at 75 kPa (10.9 psi) available at 3.5 bar (50 psig) maximum pressure.

Process fluid type: Water/Ethylene Glycol 50/50 mix
Not suitable for abrasive corrosion inhibitors.

Dual rated electrical configuration of 208 Volt (+/-10% variance), single-phase, 60Hz or 220-240 Volt (+/- 10% variance), single-phase, 50Hz

Refrigerant type: R-32

Coolant loop: Standard (Copper, Stainless Steel, Brass, Plastic, Rubber, etc)

Fluid conditioning: 20 mesh

Fluid control: Variable speed process pump

Process fluid flow sensor: Internal flow sensing only

Process heater capacity: 2 kW at 208 Volt input power

Communications/Signal output: Modbus RTU with RS485 TCP/IP with ethernet

Ambient air temperature: -25°C to 55°C (-13°F to 131°F)

Product dimensions (in): 11.8 x 48.4 x 55.1

Product dimensions (mm): 300 x 1230 x 1400

Dry weight: 143 kg (315 lb), preliminary

Compliance: TBD – The design is built designed to meet UL and CE requirements. Testing will be performed to qualify the chiller.

Other features of this product:

IP55 within limitations

NV 26 VDA Supply & Return Connections

Supply and Return Pressure Transducers

Supply & Return Temperature Sensors

Process fluid strainer

Drain Valve

Outdoor Installation within limitations

Variable speed control of compressor

Equipment Precautions

Failure to adhere to these precautions will void the warranty and may damage the chiller.

1. The unit has been shipped without coolant. Do not run it without connecting the coolant lines and keeping them filled with the proper coolant. Never run the pump without prime because it will be quickly damaged without liquid.
2. Never use coolants which are incompatible with the components in the unit's coolant loop. Some coolants may not damage the coolant loop components yet may significantly derate the unit's cooling capacity. Check with the factory if there are questions about the coolant.
3. Heat generated by motors and electrical components must be dissipated.
4. Do not operate the unit at coolant temperatures above or below the values it was specified to deliver.
5. Do not operate damaged or leaking equipment.
6. Do not operate outside of the specified ambient temperature range.
7. The unit must not be transported unless suitably protected. Original factory packaging in good condition or equivalent is required. Request air-ride trucks if transporting over land.
8. The chiller should be thoroughly drained, and the coolant lines blown dry with low pressure compressed air or vacuumed dry including filters before shipping or storing.
9. Modifying the unit without express written consent from Boyd will void the warranty.
10. Training requirement: All information contained in this manual must be read, understood, and followed before operating or performing maintenance on this chiller.
11. Do not operate this chiller at >5 degree angle of tilt from normal.
12. Tools required to perform inspection and maintenance on this unit are:
 - Screwdriver
 - Hex wrenches, 3 mm
 - multimeter (including AC voltmeter)
 - safety glasses
 - gloves
13. Tuning of the chiller temperature stability by adjusting the control parameters is limited to the specified stability limit of the chiller. Increasing the stability of the unit above the chiller design limits by using the control parameters to adjust for applications where operating parameters change often will increase the number of cycles and wear. Any failure due to excessive cycling is not covered by Boyd's Warranty. Call Boyd Service with any questions regarding the tuning limits of the chiller.
14. This chiller contains refrigerant, there is an oxygen depletion risk that should be considered. It must be placed in a room with adequate volume based on the amount of refrigerant in the chiller. If additional refrigeration equipment is in the room, additional space must be provided. In the **Placement** section, under **Installation**, refer to the **Warning: Oxygen Depletion Risk** for more details.

Safety Precautions

1. Heed all warning labels. Do not remove.
2. Coolant lines and other components which connect to the chiller must be capable of withstanding the maximum pressure that the pump in the chiller can deliver at the maximum expected temperature.
3. The coolant loop has not been designed for potable water applications. Do not use the chiller for potable water. A loss of pressure in the water source could lead to a back flow of the fluid in the unit, resulting in a possible contamination of the potable water source.
4. Refer servicing of the refrigeration system to certified refrigeration technicians.
5. The chiller is designed to be hoisted using the (2) eye hooks. Proper equipment rated to lift the weight of the chiller should be used. When hoisted, the chiller will tilt. Care should be taken to maintain personnel safety and prevent damage to the chiller.
6. The chiller is designed to be inserted into a structure and secured to that structure. If the chiller is to be operated separately, care should be taken to properly secure the chiller to prevent tipping and prevent damage to the mounting flange that is located along the entire perimeter of the chiller frame.
7. The rear panels of the chiller are secured in place with M5 screws. Between these panels and the frame is a closed cell foam seal. This seal is important for proper operation of the chiller. When the panels are removed or installed, care should be taken to not damage the seal. If this seal is damaged, air from the condenser fan may escape and chiller performance will be degraded.

Safety Precautions

Warning and Caution Symbols

The following symbols appear on the unit for your protection. Take note of their location on the unit and their definitions as listed below.



Safety Alert Symbol: Indicates a possible human injury hazard exists. Take note of the adjacent signal word and label information and act accordingly.



This symbol is to alert you of the presence of “dangerous voltage” within the unit’s enclosure. The voltage is of sufficient magnitude to constitute a risk of electrical shock.



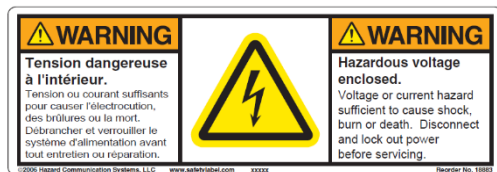
This symbol appears on the unit next to a protective earth ground terminal.



This caution symbol indicates a hot surface in the vicinity where the label is located. Do not touch surfaces, including piping in the area around this warning label.



This label indicates a hot surface in the vicinity where the label is located. Use caution when working in the area around this warning label.



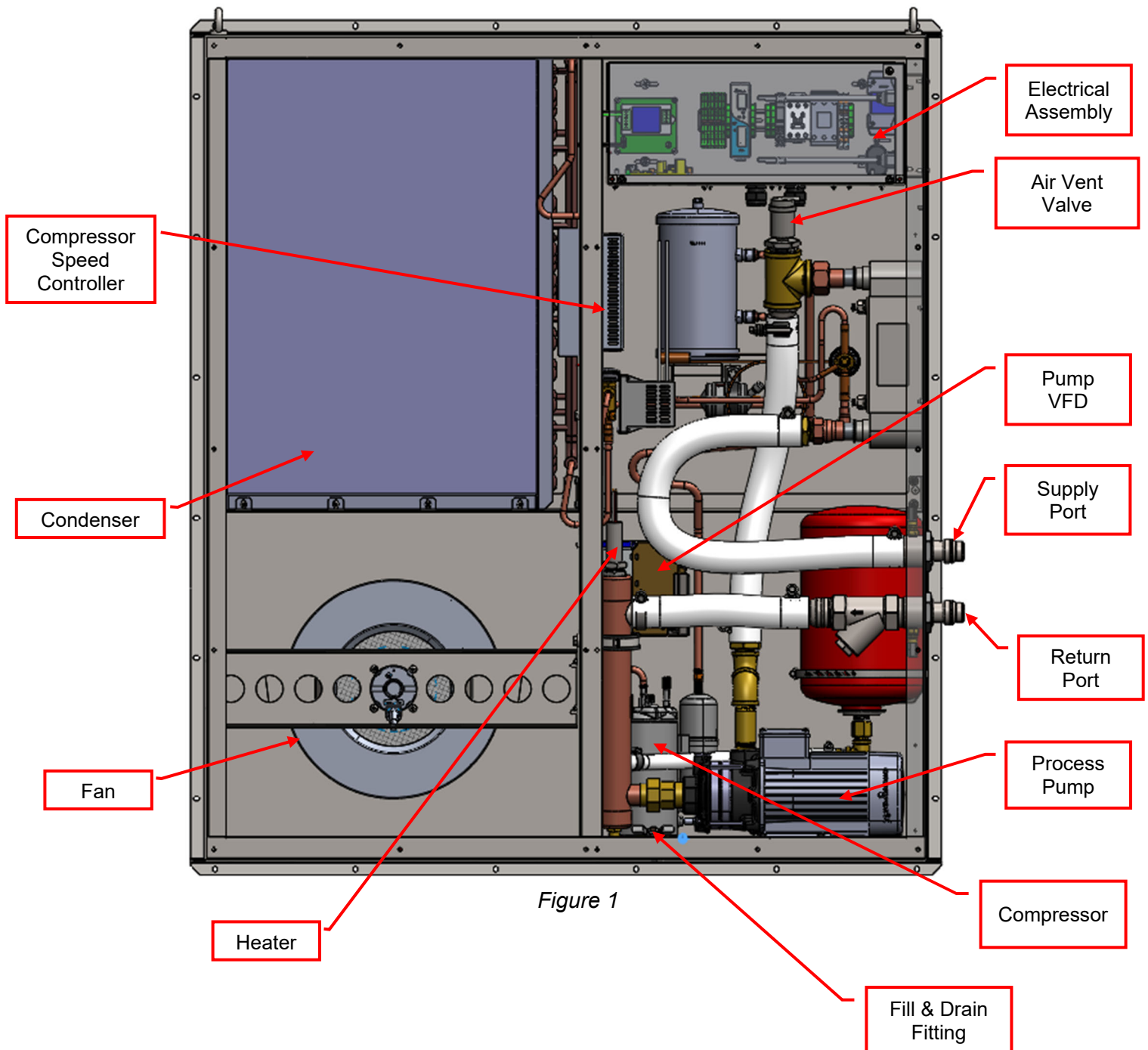
This symbol is to alert you of the presence of “dangerous voltage” within the unit’s enclosure. The voltage is of sufficient magnitude to constitute a risk of electrical shock.



This symbol indicates that there are rotating parts inside the unit that may cause physical injury is contacted while the unit is operating.

Chiller Configuration

- When lifting the chiller, using both eye bolts, located at the top of the chiller. A spreader should be used to improve stability. Caution: when hoisted, the chiller will tilt. Care should be taken to protect personnel and prevent damage to the chiller.
- The rear panels on the chiller are installed with 3 mm Hex head screws.



Chiller Configuration

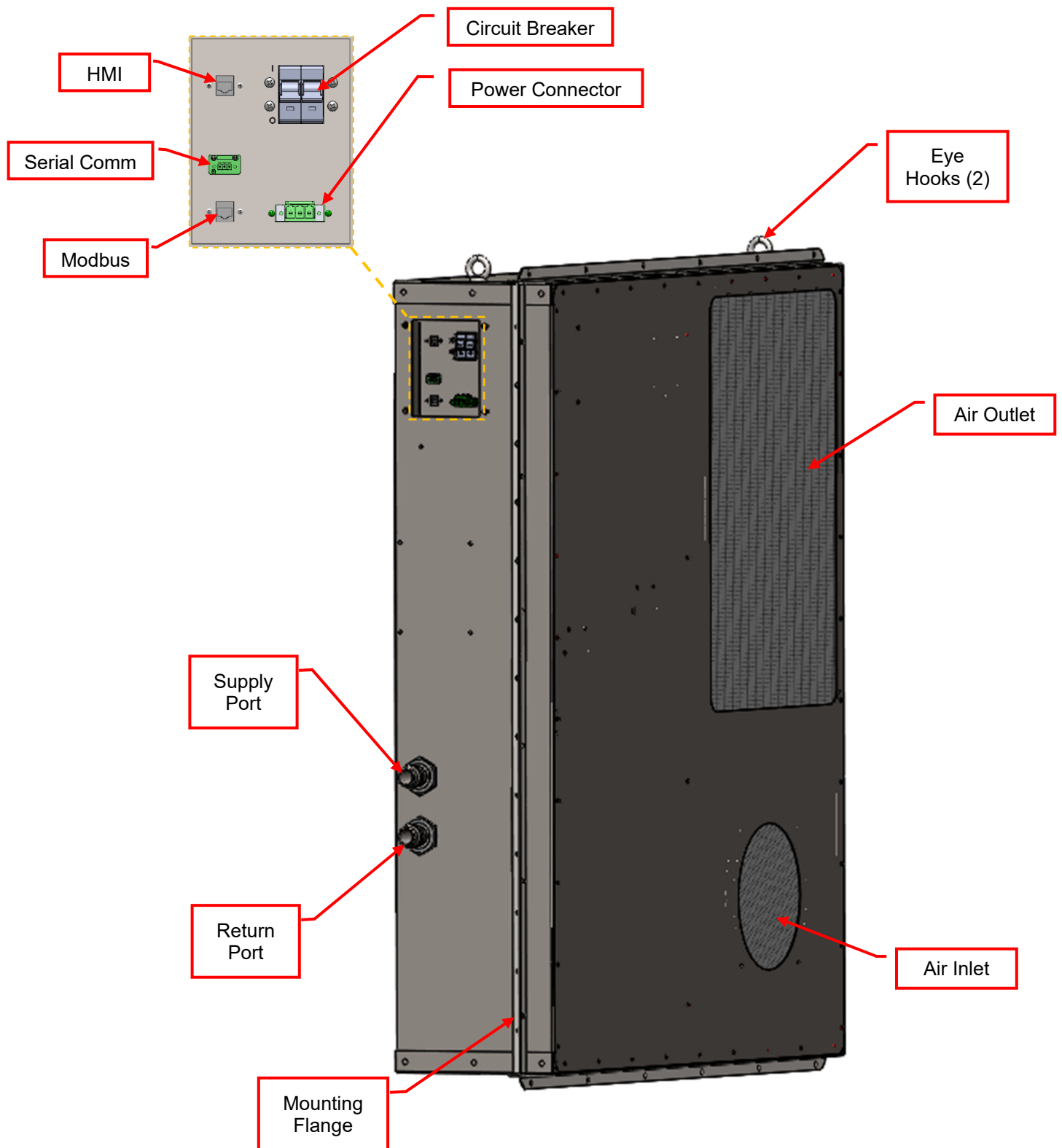


Figure 2

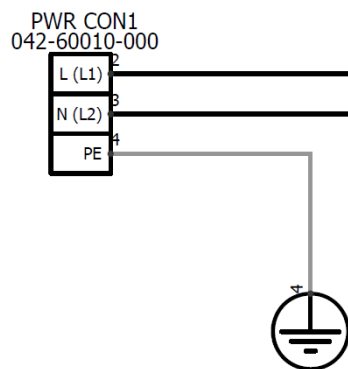
Installation

NOTE: Please read all Installation Instructions prior to install and Operation of the unit.

Electrical Requirements

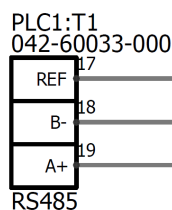
Connect the chiller to a properly fused disconnect box in compliance with the National Electric Code (NFPA-70) as well as state and local codes for American usage or national and local codes for installation sites outside the USA. Maximum fuse sizes and disconnect box must not exceed the maximum ratings specified on the serial tag of the chiller, found below the electrical connections. The voltage, phase and frequency of the power source must also match the requirements specified on the serial tag.

Power Connection



The incoming line power connect to the chiller at the Power Connector, Boyd Part Number 042-60010-000, Phoenix part number 1716629. The mating connector, Phoenix part number 1777846, is required of the customer for installation.

Communication Connection



The communication connection at the chiller is Boyd Part Number 042-60060-000, Phoenix part number 1829358. The mating connector, Phoenix part number 1851245, is required of the customer for installation.



Warning: To reduce the risk of electric shock, do NOT power the unit with the cover of the electrical enclosure off while the system is energized. It contains exposed voltage wires. Refer servicing to qualified personnel. Disconnect power to the chiller before servicing.

Installation

Lock Out/Tag Out Procedure

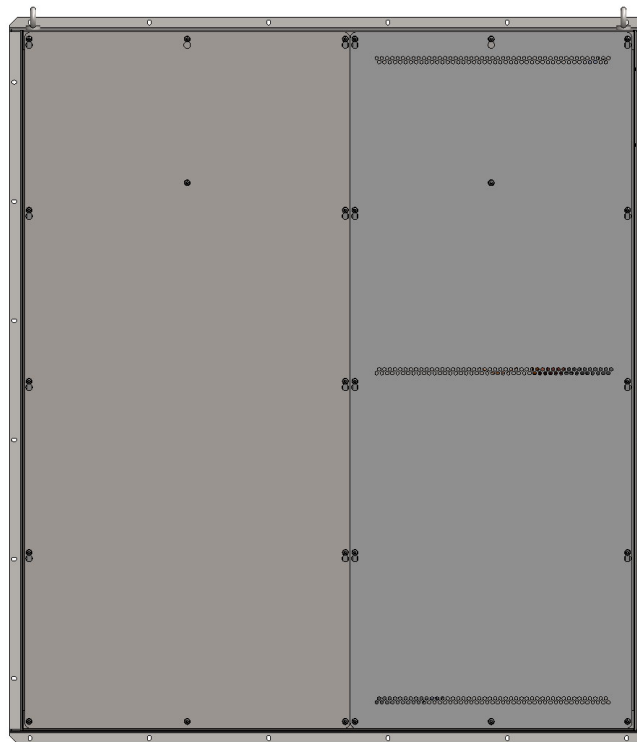
Safe electrical service requires Lock Out/Tag Out of customer supplied power source and/or disconnection of power cord from the supply source outlet.

Other energy sources requiring lockout/tagout are the facility water (if applicable), process fluid, and stored heat sources. Each of these should be isolated and/or disconnected prior to servicing. In the case of stored heat sources, process lines and components that contain fluids above the fluid's boiling point should not be opened until the temperature is reduced to a point well below the boiling point of the fluid. Any other energy sources external to the chiller should be considered and isolated or disconnected if applicable.

Rear Panels

The rear panels are secured with (12) 3 mm hex screws each. These panels provide protection of the parts. The solid panel also provides for a sealed enclosure for the fan and condenser. The chiller should not be operated when the solid panel is removed. The panels seal against the frame using a closed cell foam. This foam should not be removed or damaged. If the foam is damaged, please replace the damaged sections.

When sealed, the panels may resist being removed. In the upper center of each panel, there is an extra screw. This screw is located to provide a push point for removal. If assistance is needed to remove a panel, loosen the center screw a turn and use a small wrench to push the panel upwards. Take care not to damage the paint of the panels. When the panel is removed, tighten the screw back into place. Do not run the chiller with these screws removed.

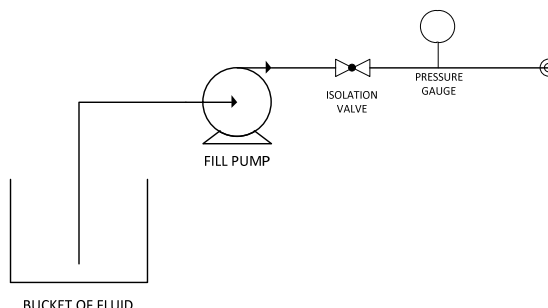


Rear View of Chiller

Installation

Filling Procedure

- This unit must be filled with a glycol mix rated for the temperature range prior to operation.
 - **DO NOT RUN THE PUMP DRY.** If the pump does not establish prime, the shaft seals may overheat and be damaged in less than a minute.
 - Refer to Figure 1 and 2 on Chiller Configuration section for connections
 - Coolant Fluid types: Use the premixed Glystantin G30 or equivalent. Do not use any fluids that have abrasive corrosion inhibitors.
1. Connect all process lines to the chiller.
 2. Remove the sheet metal panel located on the pump side of the cabinet. This panel is located closer to the supply and return fittings.
 3. Verify that the air vent valve is open.
 4. Attach the fill hose assembly to the Fill/Drain port located at the bottom of the heater housing, *Filling Setup* image below.
 5. Open the isolation valve on the outlet of the Fill Pump.
 6. Have an open container of process fluid available, such as a bucket or basin.
 7. Take a second hose and place one end in the bucket of fluid. Ensure that the fluid is filling the hose.
 8. Attach the other end of this hose to the inlet of the Fill Pump.
 9. Plug the Fill Pump into the appropriate power source.
 10. Open the isolation valve located at the bottom of the heater housing.
 11. Turn the Fill Pump On.
 12. Allow the Fill Pump to run until no more fluid enters the chiller and the pressure is 15 psig.
 13. Turn off the Fill Pump.
 14. Close the Isolation Valve at the bottom of the Heater Housing
 15. Turn the chiller On by Selecting SysMode: On.
 16. Select the slowest speed or the lowest flow rate of the pump.
 17. Select the Operation Mode: Circ.
 18. Allow the pump to run for 5 minutes.
 19. Turn the Chiller Off by setting SysMode: Off.
 20. Allow the Chiller to sit for 30 seconds. Air can be heard exiting the Air Vent Valve.
 21. Repeat steps 10 to 20 five to 10 times until no more air is venting out of the system or trapped in the internal or external piping.
 22. Unplug the Fill Pump from the electrical source.
 23. Disconnect the hose and fitting at the Fill/Drain Port.
 24. Replace cap on the Fill/Drain Port.
 25. Replace sheet metal panel and all hardware.
 26. Continue to monitor the system pressure when the chiller off. If the pressure is low, repeat Fill Procedure.



FILLING SETUP

Installation

Transporting

If the unit will be shipped, protect it from shock and vibration or the warranty will be void. The unit must not be transported unless suitably protected. Original factory packaging in good condition or equivalent is required.

Drain all coolant lines and blow them dry with low pressure air or vacuumed dry including all filters before transporting or storing the unit. Boyd will not accept any unit containing measurable amounts of fluid. Fluid left in the unit during shipping may damage components within the unit. Such damage is not covered by warranty.

Placement



WARNING: Oxygen Depletion Risk

In the event of a refrigerant leak, refrigerant gas may displace oxygen that could result in suffocation and death. Never place the chiller in a room that is smaller than the minimum room volume requirement as defined below. If a room is ventilated, the air distribution system must be analyzed to determine the worst case distribution of leaked refrigerant. A leak detector alarm device is always required in a ventilated room that does not meet the minimum room volume. Assure adequate and sufficient room volume and ventilation before placing a chiller that contains refrigerant in a room. Contact Boyd at +1-781-933-7300 if you have any concerns or questions.

Pounds of refrigerant can be read directly from the nameplate on the chiller. Remember to include in your calculations any refrigerant that may be stored in any other container.

Minimum Room Volume = Pounds of Refrigerant x 110 cubic feet.

Example: To chillers are placed in a room, each containing 1 pounds of refrigerant. The minimum room volume shall be 1 x 110 cubic feet or 110 cubic feet.

Operation

Operating the Chiller

The chiller operates and communicates through a standard RS-232 serial port using the MODBUS RTU protocol.

Serial port parameters:

Baud Rate – 19200

Stop Bit – 1

Parity - None

Chiller Faults (Alarms)

If a chiller fault (Alarm) occurs the chiller will indicate the fault (Alarm) and shut down. The chiller fault latches and can only be reset once fault condition is corrected.

Supply (Outlet) High Temperature Fault

A Supply (Outlet) High Temperature Fault occurs when the supply temperature exceeds the high temperature setpoint (20.0 – 50.0°C, Default 40.0°C).

Supply (Outlet) Low Temperature Fault

A Supply (Outlet) Low Temperature Fault occurs when the supply temperature falls below the supply low temperature setpoint (-26.0 – 5.0°C, Default -26.0°C).

Supply (Outlet) Temperature Sensor Fault

A Supply (Outlet) Sensor Fault occurs when a supply sensor fault is detected.

Return (Inlet) Temperature Sensor Fault

A Return (Inlet) Sensor Fault occurs when a return sensor fault is detected.

Compressor High Discharge Fault

A Compressor High Discharge Fault (System over pressure alarm) occurs when the compressor discharge pressure exceeds the setpoint.

Supply (Outlet) High Pressure Fault

A Supply (Outlet) High Pressure Fault (Outlet water over pressure alarm) occurs when the supply pressure exceeds the high pressure setpoint (2.00 – 3.50bar, Default 3.25bar).

Operation

MODBUS Address Table

Refer to the MODBUS Memory Map below to operate the chiller.

Description	MODBUS Address	R / W	Range	Default	Unit of Measure	Value
System on/off	0x0400	W	0 TO 1	1		0: Off 1: On
Mode setting	0x0401	W	0 TO 6	4		0: Stop (or Sleep), 1: Internal circulation, 2: Cooling, 3: Heating, 4: Automatic 5: Override Full Cooling, 6: Override Full Heating
Fault Reset	0x0402	W	0 TO 1	1		0: Off 1: On
Cooling set point	0xE600	R/W	-50 TO 550	150	°C	One implied decimal place. Note: Cooling Set Point > Heating Set Point
Heating set point	0xE601	R/W	-40 TO 300	100	°C	One implied decimal place Note: Heating Set Point < Cooling Set Point
Cooling delta T	0xE602	R/W	10 TO 100	30	°C	One implied decimal place.
Heating delta T	0xE603	R/W	10 TO 100	30	°C	One implied decimal place.
Pump gear selection	0xE604	R/W	0 TO 4	0		Scope: [0,4] 0: 60L/min@115Kpa 1: 80L/min@75Kpa 2: 50L/min@75Kpa 3: 50L/min@30Kpa 4: Future
ID	0xE605	R/W	1 TO 247	1		
Baud rate	0xE606	R/W		19200		9600,19200,38400, 115200
Stop position	0xE607	R/W	0 TO 1	1		0: 1 stop bit 1: 2 stop bits
Compressor gear selection	0xE608	R/W	0 TO 3	0		0: 100% 1: 75% 2: 60% 3: 50%
Protocol control mode selection	0xE60A	W	0 TO 1	0		0: Modbus mode 1: Future
Outlet water temperature	0xE700	R			°C	One implied decimal place.
Inlet water temperature	0xE701	R			°C	One implied decimal place.
Inlet water pressure	0xE704	R			Bar	Two implied decimal places.
Outlet water pressure	0xE705	R			Bar	Two implied decimal places.
High outlet water temperature	0xE706	R	0, 1, 32			0 normal, 1 alarm, 32 alarm failed
Low outlet water temperature	0xE707	R	0, 1, 32			0 normal, 1 alarm, 32 alarm failed
Outlet water temperature sensor fault	0xE708	R	0, 1, 32			0 normal, 1 alarm, 32 alarm failed
Inlet water temperature sensor fault	0xE709	R	0, 1, 32			0 normal, 1 alarm, 32 alarm failed
System over pressure alarm	0xE718	R	0, 1, 32			0 normal, 1 alarm, 32 alarm failed
Outlet water over pressure alarm	0xE719	R	0, 1, 32			0 normal, 1 alarm, 32 alarm failed
Current pump speed	0xE71A	R	0 TO 1000		%	One implied decimal place.
Pump status	0xE71B	R	0 TO 1			0: Closed 1: Open
Heartbeat	0xE71C	R	0 TO 32767		# / sec	Counts per second
Compressor status	0xE71D	R	0 TO 1			0: Closed 1: Open
Software part number	0xE71E	R				
Software version	0xE71F	R				

Operation

Description	MODBUS Address	R / W	Range	Default	Unit of Measure	Value
Total compressor operating time	0xE720	R			seconds	
Compressor opening times	0xE722	R			# times	
Total electric heating operating time	0xE724	R			seconds	
Electric heating opening times	0xE726	R			# times	
Total water pump operating time	0xE728	R			seconds	
Water pump opening times	0xE72A	R			# times	
Total external fan operating time	0xE72C	R			seconds	
External fan opening times	0xE72E	R			# times	
Current system mode	0xE730	R	0 TO 6			0: Stop (or Sleep) 1: Internal circulation, 2: Cooling, 3: Heating, 4: Automatic 5: Override Full Cooling 6: Override Full Heating
Current protocol control mode	0xE731	R	0 TO 1			0: Modbus mode 1: CAN mode

Starting the Chiller

1. Connect the Line power connector (PWRCON1).
2. Connect the RS-485 serial communication connector (SIGCON1).
3. Turn ON the Circuit Breaker.
4. Select the Pump Speed for required flow and pressure.
5. Select the Compressor maximum speed.
6. Enter Cooling Setpoint and Cooling Delta T (ΔT) (if desired).
7. Enter Heating Setpoint and Heating Delta T (ΔT) (if desired).
8. Select the Chiller Mode.
9. Select the mode of operation to turn the system On.



Warning: Hazardous voltage is present inside the electrical enclosure even after the Emergency Stop is activated. Do not open the electrical enclosure without following proper lockout/tagout procedures to secure chiller supply power off.

Operation

Preventive Maintenance

Boyd requires that preventive maintenance be done on this unit at least once every year. This is above and beyond the normal cleaning of strainers and filters as may be described elsewhere in this manual. Only qualified service personnel are permitted to perform preventive maintenance. Contact Boyd at +1-781-933-7300 if you have any concerns or questions about any of the required maintenance.

The following items must be serviced during the annual preventive maintenance, PM.



WARNING: *Before proceeding with the PM, disconnect power to the unit and follow a lock-out and tag-out procedure.*

Pump Motors

The pumps and motors should be inspected to make sure the unit is running smoothly at its desired performance level. Annual inspection is required. Replace any parts that are not running smoothly or meeting performance requirements.

Air Flow

This system is dependent on proper air flow to the air cooled condenser. Inspect for debris and dust regularly. Do not blow the debris into the condenser or refrigeration system, this will cause damage to the components. Annual inspection and cleaning is required to ensure proper product life.

Process Fluid

This system was designed to run with a water/glycol blend. The fluid contains inhibitors for corrosion and biological growth. These inhibitors protect the wetted surfaces. Over time, the inhibitors in the fluid will be exhausted. The fluid must be changed out before the inhibitors are exhausted. The recommended interval for changing the fluid is every two years.

Annual inspection of the fluid is required to maintain proper concentration, pH and other properties of the specified fluid.

Draining Chiller Procedure

- Before draining, follow lock out tag out procedures and isolate the process fluid loop and any electrical power sources.
- Shop or wet vacuum is required if all fluid is to be removed.
- Have a container large enough to handle fluid in lines and disconnect external lines from the chiller with the vessel under them to catch fluid.
- Connect hose to Fill/Drain fitting. 3/8-37° Flare fitting (see Figure 1).
- Open valve and drain into vessel.
- When flow stops, disconnect hose.
- Use Shop or wet Vac to suck remaining fluid out of drain and bulkhead line ports.

Note: Chillers must be drained of all process fluids before shipment or storage in order to prevent damage due to freezing temperatures and algae growth.

Operation

Decommissioning

The European Union, China, and many other countries have specific recycling and restriction requirements that may need to be followed when a chiller reaches its end-of-life. The EU Waste Electrical and Electronic Equipment (WEEE) and Restriction of Use of Hazardous Substances (RoHS) directives and China RoHS have requirements for labeling, recycling, and restriction of certain substances. Boyd chillers have been exempt from these directives based on their classification as large-scale stationary industrial tools when they are used as semiconductor manufacturing equipment and not being listed on the Chinese Ministry of Information Industry List of Electronic Information products. Other chiller applications may not be exempt from these directives and proper recycling of components must be followed.

Decontamination procedures are not required or applicable, as there are no hazardous materials used within this unit. The refrigerant used in this unit is environmentally friendly (a non-ozone depleting HFC) and poses no hazard to the environment. However, a qualified refrigeration service technician must recover the refrigerant in accordance with all applicable laws.

When decommissioning, remove all fluid by opening drains and placing the fluid in an appropriate container. After all flow has ceased, purge the lines with low-pressure air. The unit is comprised of metals that may be recycled. The significant metals that make up the unit are as follows:

- Cold-rolled steel
- Stainless steel
- Copper

Recycle metals appropriately. There are no significant amounts of plastics or other materials incorporated into this unit.

Follow all country, state, and local requirements before disposal of any components of the chiller.

Troubleshooting Guide

Problem	Possible Cause	Possible Remedy
Unit does not start	No power to unit, breaker tripped	Verify supply power is on, close breaker after correcting fault
	High pressure cut-out tripped	Reset after correcting fault
	Loose wire	Check wiring after disconnecting power
	Defective contactor or coil	Repair or replace contactor or coil
	Loss of refrigerant	Have certified technician repair leak, recharge with type and amount of refrigerant specified on serial tag
	Compressor damaged	Replace - Call Boyd Service.
	Communication Setting	Check the communication at the main PLC.
Excessive noise on Start-Up	Low voltage	Check electrical service to unit
	Contactor or coil failure	Replace contactor or coil
Noisy compressor	Flooding of refrigerant into crankcase	Warm crankcase if unit has been off for a long period or has been left in a cool ambient for more than a few hours
	Worn compressor	Call Boyd Service
Unit does not cool	Compressor internal thermostat tripped	Allow time for compressor to cool and automatically reset
	Compressor damaged	Replace - Call Boyd
	Evaporator damaged	Call Boyd
	Cooling load exceeds capacity of unit	Reduce cooling load
	Loss of refrigerant	Consult Boyd Service.
	Malfunctioning thermal expansion valve	Have certified technician replace thermal expansion valve
	Pump damaged, loss of flow	Replace pump

Problem	Possible Cause	Possible Remedy
Pump leaks	Faulty pump casing Shaft seal damaged Improper fluid	Replace pump assembly Remove pump and rebuild Replace shaft seal Call Boyd
Low pressure alarm	Low coolant level	Check for leakage, fill system to 15psi
Low coolant flow	Low coolant Restriction in coolant lines external to chiller Frozen evaporator	Fill system to 15psi Eliminate restriction in coolant lines external to chiller Call Boyd
Fault	Low coolant flow No coolant flow	See Problem; Low coolant flow See Problem; No coolant flow
Chiller shuts down during operation	Fault remains On Excess refrigerant charge Pump overload Low voltage	Verify process flow. If symptom recurs, call Boyd. Check for low refrigerant charge. If symptom recurs, call Boyd. Consult Boyd Service. Check VFD settings Check electrical service to chiller
No coolant flow	Pump not primed Not enough coolant Damaged pump Frozen evaporator Clogged line or closed valve in external piping Leak(s) in external piping	Prime pump Check for leaks, then fill system to 15psi Replace pump Call Boyd Check external piping for dirt or closed valve Check for leaks and repair as necessary

Problem	Possible Cause	Possible Remedy
Temperature display reads incorrectly	Loose wire	Check wiring after disconnecting power
	Broken Temperature Sensor	Replace temperature sensor
	Temperature Controller failure	Replace PCB
Compressor turns on and off automatically	Discharge pressure too high	Ambient temperature too high.
	Refrigeration high pressure set to automatic	Consult Boyd Service
Compressor does not run	Compressor internal thermostat tripped	Allow time for compressor to automatically reset
	Motor burned out	Replace - Call Boyd

Appendix



NATIONAL REFRIGERANTS, INC.

R-32

Safety Data Sheet

R-32

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: R-32
OTHER NAME: 1,1-Difluoromethane
USE: Refrigerant Gas
DISTRIBUTOR: National Refrigerants, Inc.
661 Kenyon Avenue
Bridgeton, New Jersey 08302

FOR MORE INFORMATION CALL:
(Monday-Friday, 8:00am-5:00pm)
1-800-262-0012

IN CASE OF EMERGENCY CALL:
CHEMTREC: 1-800-424-9300

2. HAZARDS IDENTIFICATION

CLASSIFICATION: Flammable Gas, Gas under pressure, Compressed Gas
SIGNAL WORD: DANGER
HAZARD STATEMENT(S): Extremely flammable gas, Contains gas under pressure, may explode if heated
SYMBOL(S): Flames, Gas Cylinder



PRECAUTIONARY STATEMENT(S):

Prevention: Keep away from heat, sparks, open flame, and hot surfaces. No Smoking
Response: Leaking gas fire: Do not extinguish unless leak can be stopped immediately. Eliminate all ignition sources if safe to do so.
Storage: Protect from sunlight, store in a well ventilated place.

EMERGENCY

OVERVIEW:

Flammable gas. Liquid under high pressure.

POTENTIAL HEALTH EFFECTS:

Effects of Overexposure:

Eye Contact

Eye Contact with the rapidly evaporation liquid may cause frostbite.

Skin Contact

Skin contact with the rapidly evaporation liquid may cause frostbite. Frostbite effects are a change in color of the skin to



grey or white, followed by blistering.

Inhalation

Vapor is heavier than air and can cause suffocation by reducing oxygen available for breathing. Inhalation of high vapor concentration may cause dizziness, disorientation, incoordination, narcosis, nausea or vomiting, leading to unconsciousness, cardiac irregularities, or death.

Ingestion

Not an expected route of exposure.

OTHER EFFECTS OF OVEREXPOSURE: None Expected.

3. COMPOSITION / INFORMATION ON INGREDIENTS

<u>INGREDIENT NAME</u>	<u>CAS NUMBER</u>	<u>WEIGHT %</u>
1,1-Difluoromethane	75-10-5	100

COMMON NAME and SYNONYMS

R-32; HCFC-32

There are no impurities or stabilizers that contribute to the classification of the material identified in Section 2

4. FIRST AID MEASURES

SKIN:

Immediately wash with plenty of warm water (do not rub). Thaw affected area with water. Remove contaminated clothing. Caution: clothing may adhere to the skin in case of freeze burns. If symptoms (irritation or blistering) develop, get medical attention.

EYES:

Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Hold eyelids open during flushing. Have eyes examined and treated by medical personnel.

INHALATION:

Move victim to fresh air. Keep warm and at rest. If breathing is labored, give oxygen. If only breathing has stopped, give artificial respiration with a pocket mask equipped with a on-way valve to prevent exposure to product or body fluids. If breathing has stopped and there is no pulse, give cardiopulmonary resuscitation (CPR). Get immediate medical attention.

INGESTION:

Highly unlikely, but should this occur, freeze burns will result. Do not induce vomiting unless instructed to do so by a physician.

ADVICE TO PHYSICIAN:

Symptomatic and supportive therapy, as indicated. Administration of epinephrine or similar sympathomimetic drugs should be with special caution and only in situations of emergency life support as cardiac arrhythmias may result



5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT:	Not applicable
AUTOIGNITION TEMPERATURE:	Not available
UPPER FLAME LIMIT:	31% (% v/v)
LOWER FLAME LIMIT:	14% (% v/v)

HAZARDOUS REACTIONS:

Reacts with finely divided metals such as aluminum, zinc, magnesium, and alloys containing more the 2% magnesium. Can react violently if in contact with alkali metals and alkaline earth metals such as sodium, potassium, or barium.

During a fire the product can form toxic and corrosive gases such as hydrogen fluoride.

EXTINGUISHING MEDIA:

Suitable extinguishing medium is dry powder. Allow escaping gas to urn under controlled conditions. Extinguish only if escape of gas can be rapidly stopped as it may form a flammable vapor cloud.

FIRE AND EXPLOSION HAZARDS:

Flammable liquefied gas. Container may burst under intense heat. Ruptured cylinders may rocket or fragment. Heavy vapor may suffocate.

Certain mixtures of HFC-32 and chlorine may be flammable under some conditions.

FIRE FIGHTING PROCEDURES:

Water spray should be used to cool containers.

FIRE FIGHTING PROTECTIVE EQUIPMENT:

Use self-contained breathing apparatus with a full-face piece and special protective clothing.

6. ACCIDENTAL RELEASE MEASURES

This product is a flammable, liquefied gas, which exits the container at temperatures capable of causing freeze burns (frostbite). Contents under pressure. Ruptured cylinder may rocket or fragment.

Precautions should take into account the severity of the leak or spill.

Move unprotected personnel upwind of leaking container. Remove ignition sources and ventilate the spill area. Use recommended personal protection and shut off the leak, if without risk. If possible, elevate leak position to highest point of container (should leak gas, not liquid). Water should never be put on leak nor should cylinder be immersed. If possible, dike and contain spillage. Prevent liquid from entering sewers sumps, or pit areas since vapor is heavier than air and can create a suffocation atmosphere. Capture material for recycle or destruction if suitable equipment is available.

Notify applicable government authority if release is reportable or could adversely affect the environment.



7. HANDLING AND STORAGE

HANDLING:

Wear appropriate personal protective equipment. A safety shower and eyewash station should be nearby and ready for use.

This product is a flammable, liquefied gas, which exits the container at temperatures capable of causing freeze burns (frostbite). Ensure personnel are trained in handling and storing cylinders. Secure containers at all times. Keep containers closed when not in use.

Ensure there is adequate ventilation or use proper respiratory protection in poorly ventilated or confined areas. Avoid causing and inhaling high concentration or vapor. Atmospheric levels should be controlled to below the occupational exposure limit and kept as low as practicable.

Prevent liquid or vapor from entering sumps or sewers since vapor is heavier than air and may form suffocating atmospheres.

Do not put mixtures of HFC-32 with air or oxygen under pressure; do not use such mixtures for leak or pressure testing. Do not heat containers.

Liquid transfers between containers may generate static electricity. Ensure adequate grounding.

Avoid trapping liquid between closed valves or overfilling containers as high pressures can develop with an increase in temperature.

Avoid HFC-32 contact with flames or very hot surfaces.

STORAGE RECOMMENDATIONS:

Keep containers tightly closed, in a cool, well-ventilated place. Keep containers dry. Keep from incompatibles, open flames, hot surfaces, welding operations, and other heat sources.

STORAGE TEMPERATURE:

Store at temperature not exceeding 125 deg. F. (52deg. C).

INCOMPATIBILITIES:

Freshly abraded aluminum surfaces at specific temperatures and pressures may cause a strong exothermic reaction. Chemically reactive metals: potassium, calcium, powdered aluminum, magnesium, and zinc.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS:

Use ventilation to maintain safe levels. Where appropriate engineering controls are not in place or are inadequate, wear suitable respiratory equipment.

PERSONAL PROTECTIVE EQUIPMENT

SKIN PROTECTION:

Take all precautions to prevent skin contact. Use gloves and protective clothing made of material that has been found by user to be impervious under conditions of use to prevent the skin from becoming frozen for contact with liquid. User should verify impermeability under normal conditions of use prior to general use. Additional protection such as an apron, arm covers, or full body suit may be needed depending on conditions of use.

**EYE PROTECTION:**

Use chemical safety goggles or safety glasses and a face shield when there is potential for eye contact.

RESPIRATORY PROTECTION:

Not normally needed if controls are adequate. If needed, use NIOSH/MSHA approved respirator for organic vapors. For high concentrations and oxygen-deficient atmospheres, use positive pressure air-supplied respirator.

OTHER PROTECTION:

Shower and eye wash station.

EXPOSURE GUIDELINES**INGREDIENT NAME**

Difluoromethane

ACGIH TLV

None

OSHA PEL

None

OTHER LIMIT

*1000 ppm TWA (8hr)

* = Workplace Environmental Exposure Level (AIHA)

Minimize exposure in accordance with good hygiene practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:	Colorless liquefied gas
PHYSICAL STATE:	Gas at ambient temperature
ODOR:	Faint ethereal odor
SOLUBILITY IN WATER (weight %):	Insoluble
BOILING POINT:	-51.7°C (-61.1°F)
VAPOR PRESSURE (mmHg at 20 deg. C):	10,319
FLASH POINT:	>662F (ASTM-D-1929 Method B)
EVAPORATION RATE	Not Available
FLAMMABILITY:	Mildly flammable
LEL/UEL:	14.4% / 31%
PARTITION COEFF (n-octanol/water)	Log Pow: 0.21. Note: This product is more soluble than octanol
AUTO IGNITION TEMP:	648°C / 1198°F
DECOMPOSITION TEMPERATURE:	No data available
VISCOSITY:	Not applicable
VAPOR DENSITY (air = 1.0):	1.86 at normal boiling point
% VOLATILES BY VOLUME	100 WT%
DENSITY:	0.96 g/cm ³ at 77F (25°C)
pH:	Not applicable
MELTING POINT:	280°F
SPECIFIC GRAVITY (water = 1.0):	0.98 at 68F (20°C)
MOLECULAR FORMULA:	CH₂F₂
MOLECULAR WEIGHT:	50.02

10. STABILITY AND REACTIVITY**CHEMICAL STABILITY:**

Stable under normal conditions.

INCOMPATIBILITIES:

Reacts with finely divided metals such as aluminum, zinc, magnesium, and alloys containing more than 2% magnesium. Can react violently if in contact with alkali metals and alkaline earth metals such as sodium, potassium, or barium.



HAZARDOUS DECOMPOSITION PRODUCTS:

Hydrogen fluoride by thermal decomposition and hydrolysis.

CONDITIONS TO AVOID:

Keep away from heat, sparks, and flame. Avoid high temperatures.

HAZARDOUS POLYMERIZATION:

Will not occur.

11. TOXICOLOGICAL INFORMATION

POSSIBLE HUMAN HEALTH EFFECTS:

Routes of Exposure:

Inhalation, ingestion, eye, and skin contact.

Inhalation: Exposure to high vapor concentrations may cause an abnormal heart rhythm and prove suddenly fatal. Very high atmospheric concentrations can cause anesthetic effects progressing from dizziness, weakness, nausea, to unconsciousness. It can act as an asphyxiant by limiting available oxygen.

Ingestion: Highly unlikely, but should this occur, freeze burns will result.

Eye Contact: Liquid splashes or spray may cause freeze burns.

Skin Contact: Liquid splashes or spray may cause freeze burns.

Other Effects: None anticipated.

Carcinogenicity:

<u>Ingredient Name</u>	<u>NTP STATUS</u>	<u>ACGIH</u>	<u>IARC STATUS</u>	<u>OSHA LIST</u>
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No ingredients listed in this section

ANIMAL DATA:

LC₅₀ 4 hr., (rat inhalation) - > 520,000 ppm

Because of its volatility this compound has not been tested for skin or eye irritancy or skin sensitization.

No cardiac sensitization (arrhythmias) occurred in dogs pretreated with epinephrine at 350,000 ppm. In an earlier cardiac sensitization study, a no observed effect level (NOEL) of 200,000 ppm and threshold of 250,000 ppm were established.

No teratogenic effects were seen in rats or rabbits at dose levels up to 50,000 ppm.

No adverse effects were seen at the highest dose level of 50,000 ppm in a 90-day inhalation.

No genotoxicity was observed in a range of in vitro tests or an in vivo mouse micronucleus assay.

12. ECOLOGICAL INFORMATION

PERSISTENCE AND DEGRADATION:

Decomposes comparatively rapidly in the lower atmosphere (troposphere). Atmospheric lifetime is 4.9 years.

Products of decomposition will be highly dispersed and hence will have a very low concentration. It is not considered an ozone-depleting chemical.



EFFECT ON EFFLUENT TREATMENT:

Discharges of the product will enter the atmosphere and will not result in long-term aqueous contamination.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD:

Discarded product is not a hazardous waste under RCRA, 40 CFR 261. However, HFC-32 should be recycled, reclaimed, or destroyed whenever possible.

CONTAINER DISPOSAL:

May contain explosive vapors. Do not distribute, make available, furnish, or reuse container when emptied of the original product. Do not weld or use cutting torch on or near container. Empty container retains product residue. Return containers to supplier.

REFRIGERATION APPLICATION:

Subject to “no venting” regulations of Section 608 of the Clean Air Act during the service or disposal of equipment.

14. TRANSPORT INFORMATION

US DOT ID NUMBER:

UN3252

US DOT HAZARD CLASS:

US DOT PROPER SHIPPING NAME: Difluoromethane or Refrigerant gas R-32

US DOT HAZARD CLASS: 2.1

US DOT PACKING GROUP: Not applicable

15. REGULATORY INFORMATION

TSCA (TOXIC SUBSTANCES CONTROL ACT) REGULATIONS, 40 CFR 710:

All ingredients are on the TSCA Chemical Substances Inventory.

CALIFORNIA PROPOSITION 65:

The ingredients in this product do not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

CERCLA and SARA REGULATIONS:

40 CFR 372: This product does not contain any chemicals subject to reporting requirements of SARA Section 313.

40 CFR 355: This product does not contain any “extremely hazardous chemical” subject to the requirements of SARA Section 312.

40 CFR 370: Hazardous properties as defined under the Hazard Communication Standard (29 CFR 1910.1200).

Health: Acute effects (CNS depression, cardiac sensitization).

Physical: Flammable liquefied gas.

(Actions may be necessary under SARA Section 311 – consult regulations for applicability).

16. OTHER INFORMATION

CURRENT ISSUE DATE:

May, 2018

SDS: R-32

Current Issue Date: May, 2018

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PREVIOUS ISSUE DATE: May, 2015

OTHER INFORMATION: HMIS Classification: Health – 1, Flammability – 4, Reactivity – 1

Regulatory Standards:

1. OSHA regulations for compressed gases: 29 CFR 1910.101
2. DOT classification per 49 CFR 172.101

DISCLAIMER:

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Boyd Inc. Standard Warranty *

Boyd agrees that the apparatus manufactured by it will be free from defects in materials and workmanship for the warranty period under normal use and service and when properly installed. The warranty period for Kodiak® recirculating chillers is two years from date of shipment of such apparatus to the original purchaser, maintenance items excluded, and one year from date of shipment of such apparatus to the original purchaser for all other products Boyd sells. Boyd's obligation under this agreement is limited solely to repair or replacement, at its option, at its factories, of any part or parts thereof, returned to Boyd with transportation charges prepaid, which examination shall disclose to Boyd's satisfaction to have been defective. THE FOREGOING EXPRESS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. BOYD'S OBLIGATION UNDER THIS WARRANTY IS STRICTLY AND EXCLUSIVELY LIMITED TO THE REPAIR OR REPLACEMENT OF DEFECTIVE COMPONENT PARTS AND BOYD DOES NOT ASSUME OR AUTHORIZE ANYONE TO ASSUME FOR IT ANY OTHER OBLIGATION. BOYD ASSUMES NO RESPONSIBILITY FOR INCIDENTAL, CONSEQUENTIAL, OR OTHER DAMAGES INCLUDING, BUT NOT LIMITED TO LOSS OR DAMAGE TO PROPERTY, LOSS OF PROFITS OR REVENUE, LOSS OF THE UNIT, LOSS OF TIME, OR INCONVENIENCE. Boyd's liability does not include any labor charges for replacement of parts, adjustments, repairs, or any other work done outside its factories and its liability does not include any resulting damage to persons, property, equipment, goods or merchandise arising out of any defect in or failure of its apparatus. Boyd's obligation to repair or replace shall not apply to any apparatus which shall have been repaired or altered outside of its factory in any way, or which has been subject to negligence, to misuse, or to pressures in excess of stated limits. On parts not of Boyd's manufacture, such as motors, controls, etc., Boyd extends only those warranties given to Boyd, Inc. to the extent Boyd can do so. Boyd's agreement hereunder runs only to the immediate purchaser from Boyd, Inc. and does not extend, expressly or by implication, to any other person.

Form F7.02.18 Rev J Effective December 2, 2013

* Please see Boyd order acknowledgement for any modifications to these terms.

* For more information regarding Warranty or Terms and Conditions please go to:

<https://www.boydcorp.com/terms-and-conditions-of-sale.html>

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Revision History

Rev.	Date	COR/ECN #	Description of Change	Initials
1	05/31/2022	N/A	Initial release.	D. Deschamps