



Manufacturers of Affinity™ Chillers



Lydall Industrial Thermal Solutions Inc.

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www.affinitychillers.com

AFFINITY™ F-SERIES CHILLER

FFA-032L-DD05CBC4

Part Number 5845362

Lydall Industrial Thermal Solutions Inc. Part Number 22771

User Manual D6360

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Introduction



Congratulations on your purchase of an Affinity™ product.

I want to personally welcome you to the Lydall larger family. In October of 2001, Lydall purchased Affinity Industries, in an effort to expand capability as a Total Thermal Solutions Provider. Affinity's chillers and heat exchangers complement Lydall's existing wide array of Passive Thermal Solutions, augmenting Lydall's engineered thermal solutions for use in appliance, cryogenic, building products, and automotive markets. Our group is market driven as a formidable thermal solution manufacturer.

Lydall, Inc. is a New York Stock Exchange listed company (NYSE: LDL) headquartered in Manchester, CT. Our company, with ten operations in the United States, France, one in Germany, and Sales/Service Offices in Japan and Singapore, is recognized for working with customers to satisfy their unique thermal solution needs, and for delivering high quality, innovative products, and exceptional service.

Affinity™ products are high-precision specialty temperature-controlled equipment. The following product manual is designed to help you realize the full value of your purchase.

We highly recommend that you read this manual in its entirety. The manual will assist your company with the installation, operation, and routine maintenance of your Affinity™ product. Please keep this manual readily accessible to operation and service personnel to ensure you get the most out of our product.

If you have any questions about this model, or have other thermal solution needs, do not hesitate to call our Sales department (603-539-3600) or the 24/7 Service department (603-539-5005).

Thank you for your confidence in our ability to meet and/or exceed your needs and expectations.

Sincerely,

John Tattersall
Group Vice President
Lydall Industrial Thermal Solutions, Inc.

Equipment Precautions

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

1. This chiller has been shipped without coolant. Do not run it without connecting the coolant lines and keeping them filled with the appropriate coolant. Never run the pump without prime because it will quickly be damaged without liquid.
2. Never use coolants which are incompatible with the components in the chiller's coolant loop. Some coolants may not damage the coolant loop components yet may significantly derate the chiller's cooling capacity. **Never use automotive antifreeze or other antifreeze containing silicates because they will cause the pump seals to fail.** Check with Lydall if there are questions about the coolant.
3. Maximum storage temperature for the unit is 52°C (125°F).
4. The chiller is designed for indoor use only. Do not operate the chiller in ambient temperatures below -20°C (-4°F) or above 50°C (122°F). Operation above 50°C will derate the chiller's cooling capacity. Prior to operation of the unit the crankcase heater must be on for a period of not less than twenty-four hours. This heater will be energized when the fused disconnect switch is closed and is automatically de-energized when the compressor begins operation. If the unit will be operated at ambient temperatures below freezing, freeze protection (antifreeze) must be provided.
5. The cabinet of the chiller is designed to vent air. Maintain free space, equal to the height of the chiller, for flow of air on the condenser side of the chiller (opposite to where the coolant lines connect). The two sides or the top must have an equal amount of free space. When air flow becomes impeded, cooling capacity decreases and electrical efficiency drops as motor load increases.
6. Regularly check the condenser for dirt, dust, etc.. To clean, disconnect the electrical power cord and remove the bonnet. Check and clean the condenser as required. Condenser fins bend easily. Use care when cleaning.
7. This chiller operates on three phase electricity. Some components are sensitive to phase sequence. The chiller is designed and wired so that all components will operate properly if the phase sequence is correct. This unit is protected by a Phase Reverse Relay, to **prevent it from running** if the sequence is incorrect. If the chiller fails to start on installation, reverse the phase sequence **external to the chiller. Do not modify the wiring inside the electrical box.**
8. Routinely inspect the pump inlet strainer located in the reservoir for buildup of debris. Turn the chiller off, then remove and clean the strainer as required to permit free flow of coolant. Prevent foreign debris from entering coolant lines while the strainer is removed. Hint: A plastic sandwich bag may be used to wrap the strainer to contain most of the debris. Failure to keep the strainer clean will reduce coolant flow and may damage the pump.

Equipment Precautions

9. Copper is used extensively in Affinity™ units because of its excellent heat transfer characteristics and long term corrosion resistance. However, it may corrode under certain unusual conditions, and care must be taken to ensure proper water quality. Some factors that will increase the risk of copper corrosion are the presence of chlorides, sulfates, sulfites, unusually high or low pH values, high oxygen concentrations, and high temperatures. In addition, combinations of these factors may be especially severe in their cumulative effects.
10. Do not operate damaged or leaking equipment.
11. Do not operate the chiller at coolant temperatures above or below the values it was specified to deliver.
12. Do not operate the chiller with cooling loads that exceed its factory rated cooling capacity.
13. The chiller 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.
14. The chiller should be thoroughly drained and the coolant lines blown dry with low pressure compressed air before shipping or storing.
15. Modifying the chiller without express written consent from Lydall will void the warranty.

Safety Precautions

1. Heed all warning labels. Do not remove.
2. Do not operate the chiller with the bonnet removed. The bonnet protects personnel from rotating parts and hot surfaces and also protects the chiller's components.
3. Connect the chiller to a properly fused disconnect box in compliance with the NEC (National Electric Code) as well as state and local codes for American usage, or local and national codes for European usage. Maximum fuses must not exceed the maximum rating found on the serial tag on the electrical box. The voltage, phase, and frequency of the power source must also match the requirements specified on the serial tag. To reduce the risk of electric shock:

Do not remove cover of the remote control box (if included). Refer servicing to properly qualified and licensed personnel.

Disconnect electrical power before opening the electrical box, except for the checking of the phase reverse relay or phase monitor if included with this unit (phase reverse relays or phase monitors will never be included in single phase units). Power must be applied in order for the phase reverse relay or phase monitor to indicate phase sequence.

Do not operate equipment with damaged electric power cords.

Turn off the chiller and disconnect electric power before servicing or moving.

4. Coolant lines, filters, 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.
5. The coolant loop has not been designed for potable water applications. Do not use the chiller for potable water. Never hook the water lines of a water-cooled unit to a potable water source or immerse a hose connected to a potable water source in the reservoir without providing back flow protection. 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.
6. Vapors of some alcohol based antifreezes as well as other coolants may cause explosion if exposed to flame or spark.
7. Certain antifreezes may be poisonous if ingested.

Installation

Transporting

An Affinity™ Chiller rolls easily on its four swivel casters. The brakes must be off on the two locking casters when moving the unit. Roll the chiller gently to its operating location. The cushioned casters will help to dampen shock. Lock the casters when the unit is in place. If the chiller is carried with a forklift, proceed slowly and carefully to avoid jarring the chiller. When a forklift is used to move the chiller, insert the forks from the condenser or electrical box side (the longer dimension) to catch both of the reinforcing rails of the chassis, being careful to prevent damage to the casters.

If the chiller will be shipped, protect it from shock and vibration or the warranty will be void. The chiller must not be transported unless suitably protected. Original factory packaging in good condition or equivalent is required. Request air-ride trucks when transporting over land.

Thoroughly drain all coolant lines and blow them dry with low pressure air before transporting. Lydall 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

Select a level location near the application, free from dripping or spraying moisture and excessive dust. Keep the coolant lines short to allow the pump to provide maximum pressure and flow to the application. If the chiller will be placed more than 25 feet from the application, call Lydall to discuss placement and how it might affect performance.

Units with non-pressurized reservoirs should never be installed more than 25 feet below the process or overflow may occur. Distances may vary slightly due to elevations above sea level. Call Lydall service (603-539-5005) for more information.

Electrical Requirements

Connect the chiller to a properly fused disconnect box in compliance with the NEC (National Electric Code) as well as state and local codes for American usage, or national and local codes for European usage as well as local codes, to a fused disconnect box. Maximum fuse sizes in the disconnect box must not exceed the maximum ratings specified on the serial tag of the chiller (found on the electrical box near where the power cord connects). The voltage, phase, and frequency of the power source must also match the requirements specified on the serial tag.

Note: This Affinity™ Chiller has been set at the factory to run at 460 volts, 60 Hertz and is configured for 460Y power service (277 volts maximum to ground). To change to 380-400 volts, 50 Hertz, remove the black/red wire from the contactor and replace it with the brown wire taken from the dummy fuse block. Attach the black/red wire to the dummy fuse block.

Installation

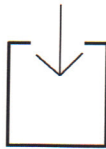


Warning: To minimize the risk of electric shock, do NOT remove cover from the electrical box. It contains exposed high voltage wires. Refer servicing to qualified personnel. Disconnect power to the chiller before performing any service.

Priming the Pump and Connecting the Coolant Loop

DO NOT RUN THE PUMP DRY. If the pump does not establish prime, the pump shaft seal may overheat and be damaged in less than a minute. Use the following instructions when filling and assembling the coolant lines to prevent damage to the pump shaft seal.

1. Close the reservoir drain.
2. Fully open the flow control valve (if included).
3. Have extra coolant to add as the pump primes and the coolant loop fills.
4. Fill the reservoir with coolant. Do not fill above the height of the coolant loop connection fittings or fluid may leak out.
5. Connect the coolant lines from the application to the FPT (female pipe thread) fittings near the top of the chiller as follows. Do not over tighten the insert and do not use a sealant that will lock the male threads to the female threads.
 - a. Connect the coolant line coming back from the application to the RETURN fitting.
 - b. Connect the coolant line going to the application to the SUPPLY fitting.



RETURN



SUPPLY

6. This chiller is equipped with a Phase Reverse Relay. The chiller will not start if the phase sequence is incorrect. If the chiller fails to start upon installation, a qualified electrician should check the Phase Reverse Relay in the electrical box of the chiller. If the LED is not brightly lit, the phase sequence is incorrect. The electrician should switch any two of the wires at the incoming power source. **Do not change any of the wiring in the chiller's electrical box.** Check again for proper phase sequence before proceeding with these instructions.

Installation

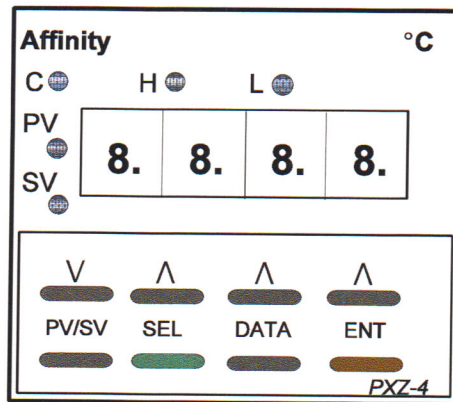
7. When the previous steps are complete, turn the chiller on by placing the ON/OFF/SET switch in the ON position. Immediately check for flow. If within five seconds no turbulence is visible in the reservoir or the supply pressure gauge shows no pressure reading, shut the chiller off by placing the ON/OFF/SET switch in the OFF position. If flow is established, continue filling until the reservoir level rises to within a few inches of the top. Do not allow the reservoir to overflow.
8. If the pump does not establish prime, disconnect the SUPPLY coolant line to vent any trapped air, reconnect the line, and repeat step 7.
9. If the pump still does not prime, use the following steps:
 - a. Disconnect both coolant lines (have a container handy to catch any overflow from the RETURN fitting).
 - b. Force coolant into the SUPPLY fitting. The fluid will force the air out of the lines in the chiller and out of the pump head, causing it to escape into the reservoir. If tap water will be the source of coolant, simply connect the tap water line to the SUPPLY fitting and turn on the tap. If a source of coolant other than tap water will be used, elevate the coolant a few feet above the chiller, connect to the SUPPLY fitting, and let gravity force the air out into the reservoir. Remember to have a container handy to catch any overflow from the RETURN fitting.
 - c. Reconnect the coolant lines and repeat step 7. Stop filling when fluid leaks out of the RETURN fitting, or when the reservoir is full to within a few inches of the top. Do not allow the reservoir to overflow.

A stainless steel mesh strainer attaches to the pump suction port near the bottom of the reservoir. It can easily be removed for cleaning. First turn the pump off, then pull off the strainer, rinse it clean, and push it back on. To protect the pump, routinely inspect the strainer to be sure it is clean and properly attached. Hint: If the strainer is coated with debris, wrap it with a plastic sandwich bag before pulling it off to prevent most of the debris from escaping into the reservoir.

Operation

Using the Controller

This Affinity™ chiller comes standard with a FUJI 1/16 DIN temperature controller. This controller is a programmable microprocessor, which offers many more features than are necessary to master at this point. If more than the basic instructions provided in this manual will be needed, call Lydall service (603-539-5005) for technical assistance or consult the FUJI Instruction Manual.



Place the ON/OFF/SET switch on the control box (if included with this chiller) or the chiller's control panel near the Fuji controller in the SET position. SET activates the control display but does not turn on the refrigeration and pump systems of the chiller. Four dots will appear on the display, then in 3-4 seconds the temperature of the coolant will appear plus an indicator light next to PV. Indicator lights next to C, H, or L may also appear. The function of these lights will be discussed later in the section on **Safety Alarms**.

Press PV/SV until the indicator light appears next to SV to display the Set-Value temperature. The Set-Value temperature can be changed to any temperature within the range programmed for this Affinity™ model. Note: Pressing PV/SV allows toggling the indicator light between PV, the actual process coolant temperature, and SV, the Set-Value temperature.

Changing the Set-Value Temperature

Change the Set-Value temperature by pressing PV/SV until the indicator light appears next to SV. Then directly under the digit in the display to be changed, press (∧) and the digit will start blinking. To increase the digit value, press (∧) under the blinking digit as many times as necessary. To decrease the digit value, press (V) at the left side of the controller. Press (∧) under the next digit value to be changed and repeat the process. When all the digits are set to the desired value and with one digit still blinking, press the red (ENT) key at the far right of the controller to enter the new Set-Value temperature.

Operation

A display of letters or numbers which do not indicate temperature may appear. SEL or DATA was probably inadvertently depressed. The FUJI Instruction Manual explains the use of SEL and DATA functions which are used solely in setting the basic program of the microprocessor. Press PV/SV to return to either the PV or SV display.

The controller comes pre-programmed according to the Affinity™ model selected. If the additional features programmed into the controller will be needed, consult the FUJI Instruction Manual, or call Lydall for technical assistance. The highest and lowest SV programmed into the controller depends upon the model selected.

Caution: Never program in a Set-Value temperature of more than 32°C (90°F) unless this Affinity™ model is specially modified to operate at higher coolant temperatures. Never program in a Set-Value temperature of less than 5°C (40°F) unless a suitable antifreeze is used as coolant, **AND** the chiller is designed to operate at below freezing temperatures.

Turn the whole system on by placing the ON/OFF/SET switch in the ON position. The Set-Value temperature can be changed with the switch in either the ON or SET position.

Air bubbles will be visible rising in the reservoir as the pump forces air out of the coolant loop. After the air has been purged from the coolant loop, a steady turbulence may be seen in the reservoir. This turbulence mixes the coolant to deliver more precise temperature stability in the coolant supply than the controller indicates.

Safety Alarms

The "LOW LEVEL" indicator light and the corresponding audible alarm actuate when the coolant level in the reservoir is low and needs to be replenished. This indicator light does not actuate with the ON/OFF/SET switch in the SET position.

The "FAULT" light comes on if too little coolant is circulating through the heat exchanger. The "FAULT" light comes on momentarily upon start-up until the pump establishes sufficient flow. The "FAULT" indicator does not actuate with the ON/OFF/SET switch in the SET position.

If the "FAULT" light remains on for more than a few seconds, the chiller should be turned off and the reason for loss of circulation determined and corrected.

Caution: Although the "FAULT" light alerts the operator that no coolant is flowing, the operator must not assume proper circulation through equipment external to the chiller if the light does not appear. A bypass system built into the chiller to protect the pump may satisfy circulation requirements within the chiller even though flow outside the chiller is blocked. For example, turning the flow control valve on the chiller to no external flow does not actuate the light; similarly, a wheel of a forklift truck standing on an external cooling line, thus stopping the flow to the application, will not actuate the fault light.

Operation

The FUJI controller on this chiller has HIGH and LOW TEMPERATURE ALARM LIGHTS: H and L appear just under the Affinity™ logo at the top of the controller. At the factory, a technician has programmed the alarm light to come on under H if the circulating coolant is above the temperature that this chiller has been set to deliver. The alarm light under L is programmed to come on if the circulating coolant is below the temperature the chiller has been set to deliver. Consult the factory if it is necessary to operate above or below these limits.

The light on the FUJI controller next to C, when lit, indicates that the refrigerant solenoid valve is open to allow refrigerant to flow to the heat exchanger. If the light is on most of the time, most of the capacity of the chiller is in use. If the light is on infrequently, much less than the full capacity of the chiller is being used.

Preventive Maintenance

A stainless steel mesh strainer attaches to the pump suction port near the bottom of the reservoir. It can easily be removed for cleaning. First turn the pump off, then pull off the strainer, rinse it clean, and push it back on. To protect the pump, routinely inspect the strainer to be sure it is clean and properly attached. Hint: If the strainer is coated with debris, wrap it with a plastic sandwich bag before pulling it off to prevent most of the debris from escaping into the reservoir. The frequency of checking and cleaning this strainer will depend on the cleanliness of the process and the fluid.

Regularly check the condenser, located in front of the fan, for dirt, dust, etc.. To clean, disconnect the electrical power cord and remove the bonnet. Check and clean the condenser as required using a vacuum or low pressure air. Condenser fins bend easily. Use care when cleaning.

Trouble Shooting Guide

Problem	Possible Cause	Possible Remedy
Unit does not start	No power to unit, breaker tripped	Verify power to unit, close breaker after correcting fault
	Low voltage	Check electrical service to unit
	Refrigeration high pressure cut-out tripped	Will automatically reset after correcting fault
	Loose wire	Check wiring after disconnecting power
	Defective contactor or coil	Repair or replace contactor or coil
	Loss of refrigerant	Repair leak, then charge with type and amount of refrigerant listed on serial tag
	Compressor damaged	Replace compressor - Call Lydall
Unit does not cool	Compressor internal thermostat tripped	Allow time for compressor to cool and automatically reset
	Compressor damaged	Replace compressor - Call Lydall
	Ambient temperature exceeds 122°F, causing cooling capacity of unit to be derated	Improve ventilation to maintain ambient temperature < 122°F
	Evaporator damaged	Call Lydall
	Microprocessor programmed incorrectly	Reprogram microprocessor, Call Lydall
	Cooling load exceeds capacity of unit	Reduce cooling load
	Microprocessor failure	Replace microprocessor
	Loss of refrigerant	Locate and repair leak, then charge with type and amount of refrigerant listed on serial tag
Refrigeration solenoid coil failure	Replace solenoid coil	

Problem	Possible Cause	Possible Remedy
Unit does not cool (continued)	Solid State Relay failure Solenoid valve stuck shut Defective refrigeration low pressure cut-out Malfunctioning thermal expansion valve Pump damaged, loss of flow Hot gas bypass valve setting too high Hot gas bypass valve stuck open Dirty condenser fins	Replace Solid State Relay Repair or replace solenoid valve Repair or replace low pressure cut-out Replace thermal expansion valve Replace pump Call Lydall Repair or replace valve Gently clean condenser fins
Pump leaks	Faulty pump casing Shaft seal damaged Pump housing O-Ring damaged Improper fluid	Replace pump assembly Replace shaft seal Remove pump and rebuild Call Lydall
Excessive noise on Start-Up	Low voltage Wrong voltage taps used on transformer Contactor or coil failure	Check electrical service Connect to proper taps Replace contactor or coil
Pump motor overheats	Pump thermal overload protection set too high Improper voltage supplied	Reset pump thermal overload relay or replace if faulty Correct voltage

Problem	Possible Cause	Possible Remedy
Noisy compressor	Flooding of refrigerant into crankcase Worn compressor Refrigeration high pressure cut-out set too high Refrigeration low pressure cut-out set too low	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 Replace compressor - Call Lydall Adjust setting Adjust setting
Level light remains on	Low coolant level Reservoir level switch float stuck Time delay relay malfunction (when used) Level switch failure	Check for leaks then fill reservoir Clean reservoir and level switch Replace time delay relay Replace level switch
Level light does not work	Time delay relay has not timed out (when used) Lamp burned out Level switch failure	Wait for time delay relay to time out Replace lamp Replace level switch
Fault light remains on	Low coolant flow No coolant flow Flow switch sticking	See Problem; Low coolant flow See Problem; No coolant flow Disassemble flow switch, clean, and reinstall or replace

Problem	Possible Cause	Possible Remedy
Low coolant flow	Pump suction strainer clogged	Remove strainer, clean and reinstall or replace
	Pump rotating backwards	Reverse one electrical phase
	Flow control valve not fully open	Open flow control valve
	Pressure relief valve set too low (unless not adjustable)	Adjust pressure relief to specification
	Low coolant level in reservoir	Check for leaks, then fill reservoir
	Restriction in coolant lines external to chiller	Eliminate restrictions in coolant lines external to chiller
	Frozen evaporator	Call Lydall
	Flow switch clogged	Disassemble flow switch, clean, and reinstall or replace
No coolant flow	Pump not primed	Prime pump
	Pump suction strainer clogged	Remove and clean strainer, then reinstall
	No coolant in reservoir	Check for leaks, then fill reservoir
	Pump overload tripped	Wait 5 minutes for overload to reset
	Pump motor shaft bound to seal	Replace pump or renew seal
	Pump housing improperly torqued	Remove pump, torque to specifications, test, and reinstall
	Damaged pump	Replace pump
	Frozen evaporator	Call Lydall
	Clogged line or closed valve in external piping	Check external piping for dirt or closed valve
	Leak(s) in external piping	Check for leaks and repair if needed

Problem	Possible Cause	Possible Remedy
Chiller shuts down during operation	Refrigeration high pressure cut-out set too low	Adjust and reset high pressure cut-out
	Refrigeration low pressure cut-out set too high	Adjust and reset low pressure cut-out
	Dirty condenser fins	Gently clean condenser fins
	Excess refrigerant charge	Remove excess refrigerant and recharge to specifications on serial tag
	Pump overload setting too low	Adjust and reset pump thermal overload relay to specifications, or replace if faulty
	Pump overload tripped	Determine reason for trip. If pump is damaged, repair or replace
Temperature display reads incorrectly	Loose wire	Check wiring after disconnecting power
	Broken RTD	Replace RTD
	Microprocessor failure	Replace microprocessor
Too much recirculating pressure to process	Flow control valve set too high	Throttle flow control valve
	Pressure relief valve set too high (unless not adjustable)	Adjust pressure relief valve
Compressor turns on and off automatically	Discharge pressure too high	Determine cause and correct
	Condenser fan(s) not on	Check motor(s) and wiring
	Refrigeration high pressure cut-out set to automatic	Check settings

Problem	Possible Cause	Possible Remedy
Chiller cools well below desired Set-Point	Microprocessor programmed incorrectly	Reprogram microprocessor - Call Lydall
	Malfunctioning solenoid valve	Repair or replace solenoid valve
	Solid State Relay failure	Replace Solid State Relay
	Microprocessor failure	Replace microprocessor
Compressor does not run	Compressor internal thermostat tripped	Allow time for compressor to cool and automatically reset
	Motor burned out	Replace - Call Lydall
Microprocessor does not work	5 second delay has not timed out	Wait at least 5 seconds after turning on
	Microprocessor programmed incorrectly	Reprogram microprocessor - Call Lydall
	Microprocessor failure	Replace microprocessor

Warranty

The Lydall Limited Warranty

Twelve-Month Warranty
Parts and Labor

Lydall Industrial Thermal Solutions Inc. warrants this product to the original Owner for a period of twelve (12) months from the date of shipment. Lydall will repair, or, at its discretion, replace any part found to contain a manufacturing defect in material or workmanship, without charge to the Owner, for twelve months from date of shipment. Shipping costs are excluded from warranty. Service labor will be at no charge during the warranty period as long as the labor is supplied at the Lydall plant in Ossipee, New Hampshire, or by a Lydall approved service provider. Replacement or repaired parts will be warranted only for the un-expired portion of the original Warranty. To obtain prompt warranty service, contact Lydall, PO Box 1000, Ossipee, New Hampshire, 03864, USA.

Before returning any equipment to Lydall for repair, it is necessary to contact the Lydall Service Department for a Return Material Authorization number and an authorized service depot location where the repairs will be completed.

This Warranty does not cover the following: Damage or failure of any part caused by accident, customer shipping, storage, misuse, customer modification, fire, flood, Acts of God, or resulting from failure to properly install, operate, or maintain the product in accordance with the printed instructions provided in the User Manual. As noted in the User Manual, any modification of the unit without expressed written consent from Lydall will void the warranty.

In no event shall Lydall be liable for any repairs or service or any consequence of any repair or service that are not performed in strict accordance with all applicable city, county, state, and federal laws.

Further limitations and exclusions: This Warranty is in lieu of any other warranties, expressed or implied, including merchantability or fitness for a particular purpose. In no event shall Lydall be liable for any consequential or incidental damages that the Owner may incur resulting from purchase or use of this Lydall product. The buyer's sole and exclusive remedy and the liability limit of Lydall, for any loss whatever, shall not exceed the purchase price paid by the purchaser for the Lydall product on which a claim is made.

Lydall Industrial Thermal Solutions Inc.

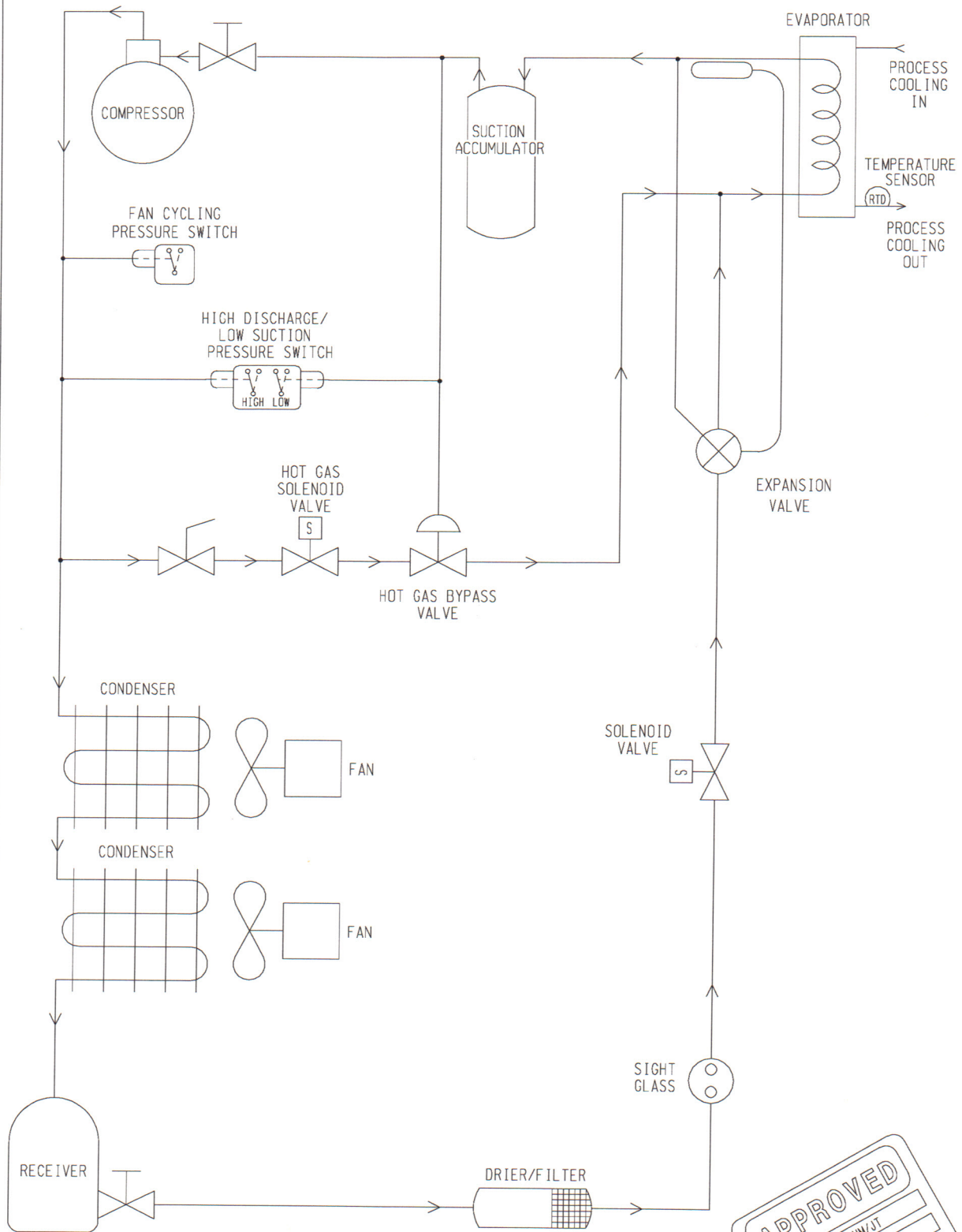
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LTR:	REVISION:	DATE:	BY:
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APPROVED
 APPROVED BY: GHW/JT
 DATE: 10/18/99

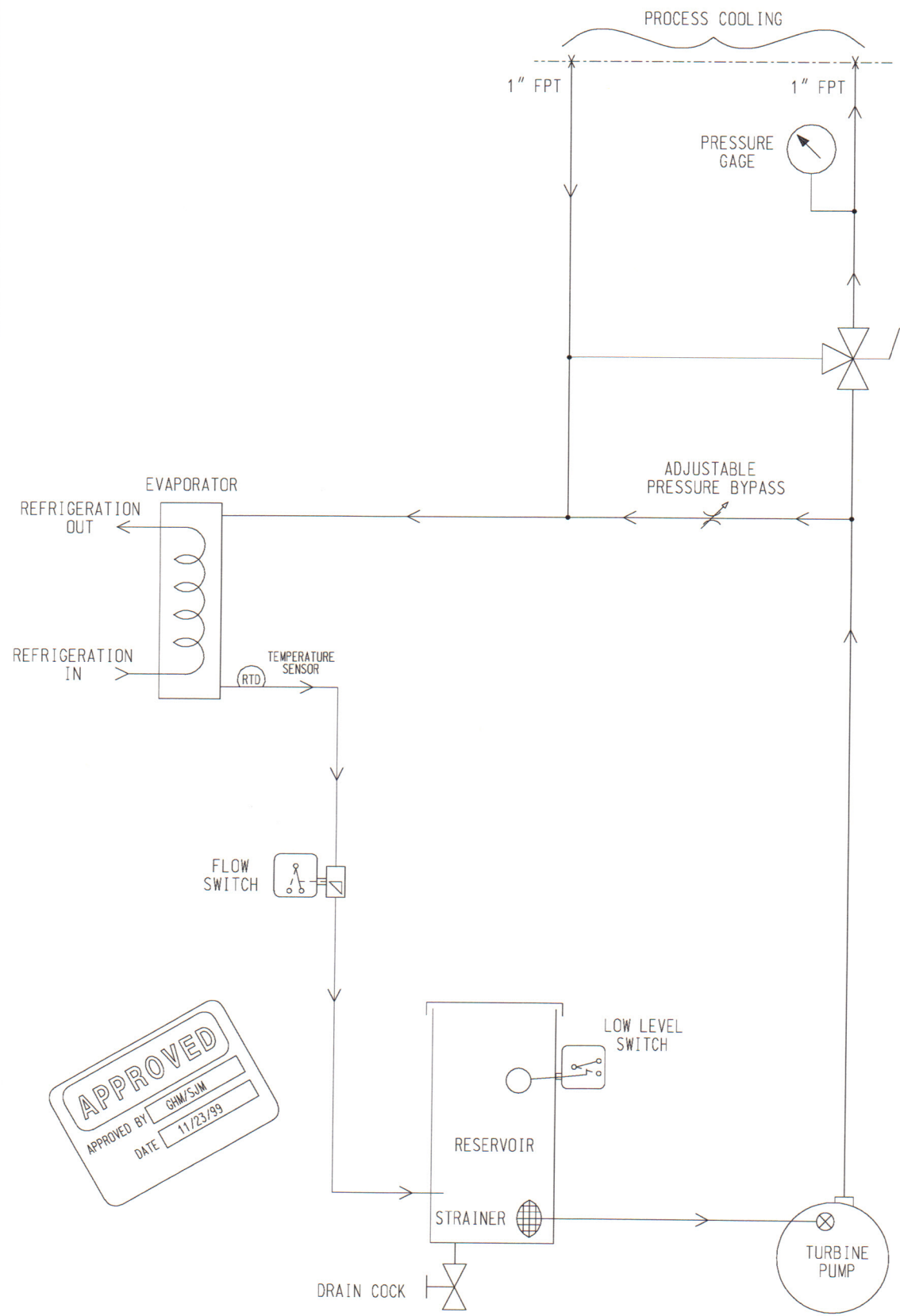
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460 VOLT, 3 PHASE, 60 Hz.
380 VOLT, 3 PHASE, 50 Hz.

LEGEND:

WIRE COLORS = PRIMARY COLOR/TRACER OR MARKER COLOR

- ⊙ = COMPONENT TERMINAL
- = TERMINAL BLOCK
- AR = ALARM RELAY
- CON = MOTOR CONTACTOR
- CT = CONTROL TRANSFORMER
- CR = CONTROL RELAY
- TC = TEMPERATURE CONTROLLER
- TD = SOLID STATE TIME DELAY

