



# APPLIED MATERIALS®

## CoolEND™

0190-13674 / 0190-13675

200 kW DI Water-to-Water  
Heat Exchanger for  
208-Volt or 460-Volt  
200mm/300mm Systems

**Installation  
Operation  
Basic Service**

Thermo Manual P/N U00840  
Rev. 06/15/04



FOR SALES AND SERVICE PLEASE CALL:

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# Table of Contents

## PREFACE

Compliance .....	3
After-sale support .....	3
Unpacking .....	3

## SECTION I

### Safety

Warnings .....	4
Emergency Off (EMO) .....	5
Lockout/Tagout .....	5
Chemicals .....	5
Labels & Locations .....	6

## SECTION II

### General Information

Description .....	8
Specifications .....	9

## SECTION III

### Installation

Site .....	10
Facility Water Requirements .....	10
Electrical Requirements .....	12
Electrical Wiring Installation .....	13
Plumbing Requirements .....	14
DEI Cartridge .....	16
Fluids .....	16
Filling Requirements .....	17
Draining .....	17
Microprocessor Controller .....	18
LEDs .....	19
Fault Messages .....	23

## SECTION IV

### Operation

Start Up .....	25
Flow Transducers .....	26
Low Fluid Level Safety .....	27
Autorefill .....	27
Variable Frequency Drive .....	27
Emergency Off (EMO) .....	27
Remote Interface .....	28
Resistivity Sensor .....	29
DeviceNet .....	29
DeviceNet Interface .....	30
DeviceNet Messaging .....	31
MODULE STATUS LED .....	32
NETWORK STATUS LED .....	32
Connectors .....	34

## **SECTION V**

### **Periodic Maintenance**

Service Contracts .....	35
Deionizing Cartridge .....	35
Periodic Cleaning .....	36
Heat Exchanger and Pump Lifting Procedures .....	36
Waste Disposal .....	36

## **SECTION VI**

### **Troubleshooting**

Checklist .....	37
Displaying Software Version .....	38
Service Assistance .....	38

## **SECTION VII**

### **Diagrams**

Flow Diagram .....	39
Unit Dimensions and Center of Gravity .....	40
Seismic Tie Downs and Leveling Feet .....	41
Wiring Diagram .....	42

## **Appendix - Applied Materials LOTO Procedure**

## Preface

### Compliance

Products tested and found to be in compliance with the requirements defined in the EMC standards defined by 89/336/EEC can be identified by the CE label on the rear of the unit. The testing has demonstrated compliance with the following standards:

EMC Directive, 89/336/EEC  
EN 61326-1:1987, +A1:1998, Class A Equipment

Low Voltage Directive, 73/23/EEC  
EN61010-1:1993, +A1:1994, +A2:1995

The unit also complies with SEMI S2-0200 and F-47.

For any additional information refer to the Letter of Compliance that shipped with the unit.

### After-sale Support

Thermo Electron Corporation is committed to customer service both during and after the sale. If you have questions concerning the operation of your unit, contact our Sales Department. If your unit fails to operate properly, or if you have questions concerning spare parts or Service Contracts, contact our Customer Service Department. Before calling, please obtain the following information from the unit's serial number label:

- *BOM number* \_\_\_\_\_
- *Serial number* \_\_\_\_\_
- *Software version (see page 38)* \_\_\_\_\_

### Unpacking

Retain all cartons and packing material until the unit is operated and found to be in good condition. If the unit shows external or internal damage contact the transportation company and file a damage claim. Under ICC regulations, this is your responsibility.

## Section I Safety

### Warnings

Make sure you read and understand all instructions and safety precautions listed in this manual before installing or operating your unit. If you have any questions concerning the operation of your unit or the information in this manual, contact our Sales Department for assistance (see Preface, After-sale Support).

Warnings are posted throughout the manual. Read and follow these important instructions.



**DANGER**

**DANGER** indicates an imminently hazardous situation which, if not avoided, will result in serious injury or death. This signal word is limited to the most extreme situations.



**WARNING**

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



**CAUTION**

**CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

**Performance of installation, operation, or maintenance procedures other than those described in this manual may result in a hazardous situation and may void the manufacturer's warranty.**

**Transport the unit with care. Sudden jolts or drops can damage the coolant lines.**

**Do not attempt to defeat any of the interlock switches or safety features built into the unit.**

**Observe, and never remove, all warning labels.**

**Never operate damaged or leaking equipment.**

**Never operate the unit without cooling fluid in the fluid reservoir.**

**Use lockout tag-out procedures, local or remote, prior to servicing the unit. There is a circuit breaker mechanism on the rear of the unit. Make sure the unit is off before connecting or disconnecting the power cord or other cables.**

**Always disconnect power from the power source before performing any service or maintenance procedures, or before moving the unit.**

**Always empty the fluid reservoir before moving the unit.**

**Never operate equipment with damaged power cords.**

**Refer service and repairs to a qualified Thermo technician.**

## Emergency Off (EMO)

A guarded red mushroom shaped push-button switch with twist-to-reset is provided in the front of the unit to turn off the unit in case of an emergency. The button head is engraved with "EMO" in large white filled letters.

Activation of the EMO button will remove power from the main contactor coil stopping operation of the unit.

Resetting of the EMO button will not restart the unit. After all hazards have been removed and the EMO is reset, the unit must be reset by pushing the PUMP ON button on the control panel.

## Lockout/Tagout (LOTO)

Before performing heat exchanger maintenance, the energy sources associated with the chiller system must be lockout and tagged out (LOTO). Hazard control features added to the system (e.g., safety interlocks, EMO) are not a substitute for turning off and locking out electrical or fluid energy.

Electrical LOTO is accomplished by locking the circuit breaker on the right side of the unit in the open (0) position. Electrical LOTO can also be provided by:

- Using the unit's circuit breaker.

- Using the main disconnect.

- Disconnecting main power at the facility power source prior to the system.





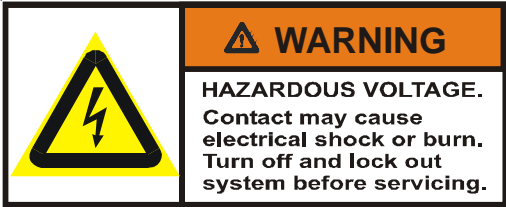
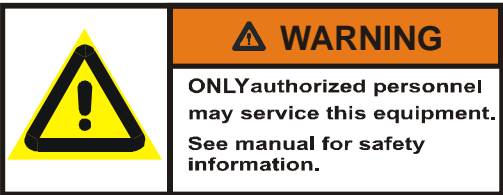
In addition, follow all OSHA and local facility LOTO directives.

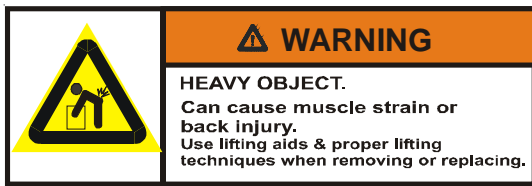
**NOTE:** The unit does not provide LOTO for the facility water flow. An external customer-supplied device is required.

## Chemicals

There are no hazardous chemicals associated with this unit.

# Labels and Locations

		Caution, refer to accompanying documents for explanation.	2-rear
		Main system ground	1-inside electrical panel
		Secondary Ground	4-inside electrical panel, behind cover
		The label indicates the use of Lockout/Tagout procedures.	1-top rear panel
		This label indicates Hazardous Voltage.	2-rear panel,controller door
		This label warns the operator that service must be performed by a qualified technician.	1-controller door
1			
0		This indicates unit power.	1-next to circuit breaker



#### Label

Heavy Object warns the operator about the weight of the object.

#### Quantity-Location

2-pump motor, heat exchanger



These labels indicate the direction of fluid flow with respect to the unit. The box represents the unit, the arrow the direction of flow.

8-next to facility/ process water connections



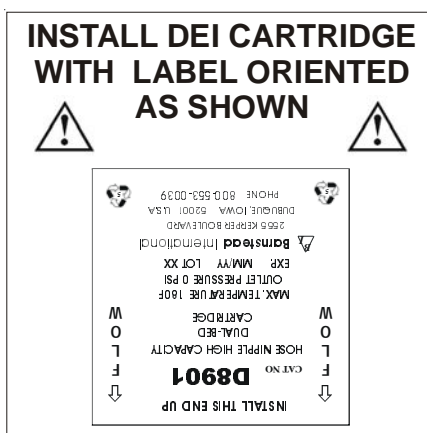
This label indicates the direction of fluid flow.

Internal plumbing

**MAXIMUM  
FACILITY WATER  
PRESSURE  
80 PSI (551KpA)**

This label indicates the maximum facility water pressure.

1-rear



This label indicates the correct fluid flow direction through the DI cartridge as well as the orientation of the DI cartridge when correctly installed. The direction of the arrows on the cartridge must agree with the arrows on the label. The proper flow direction is downward. Disregard the INSTALL THIS END UP indication on the cartridge label.

1-front



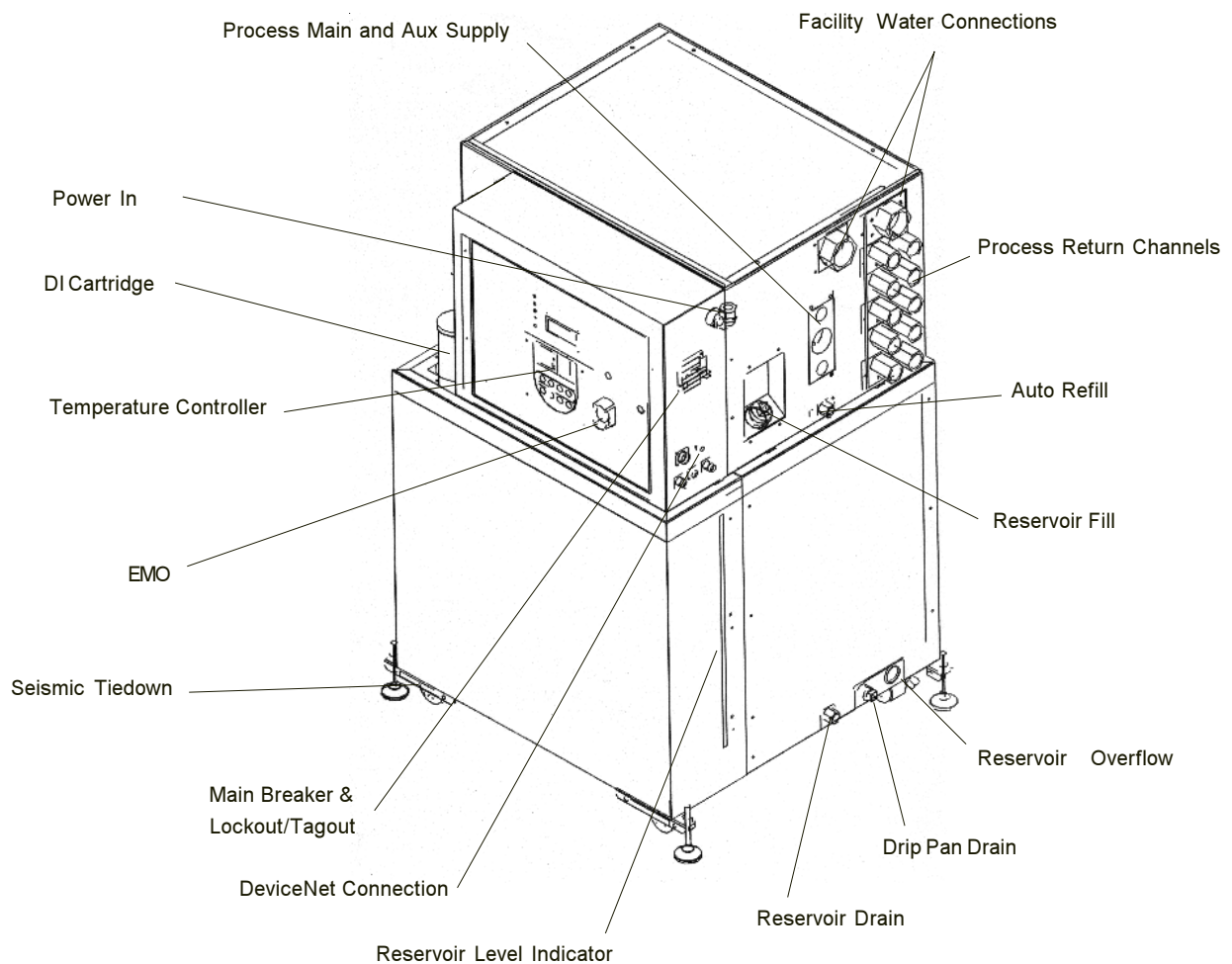
## Section II General Information

### Description

The **CoolEND™** is designed to remove heat loads from liquid-cooled instruments. The unit uses facility cooling or tap water as the secondary cooling medium to remove heat from the primary fluid in the closed recirculation loop.

The unit consists of a plate heat exchanger, recirculation pump, stainless steel reservoir, replaceable deionizing cartridge, and a microprocessor controller. The controller monitors temperature, displays all fluid flows, and controls both resistivity and pressure.

The unit has 10 return lines. The flow rate in 8 of these lines as well as the facility flow line is monitored by flow transducers. The unit also has fluid level sensors designed to protect the unit's pump and the application. A resistivity sensor monitors resistivity and sends a signal to the controller when DI cannister replacement is necessary.



## Specifications

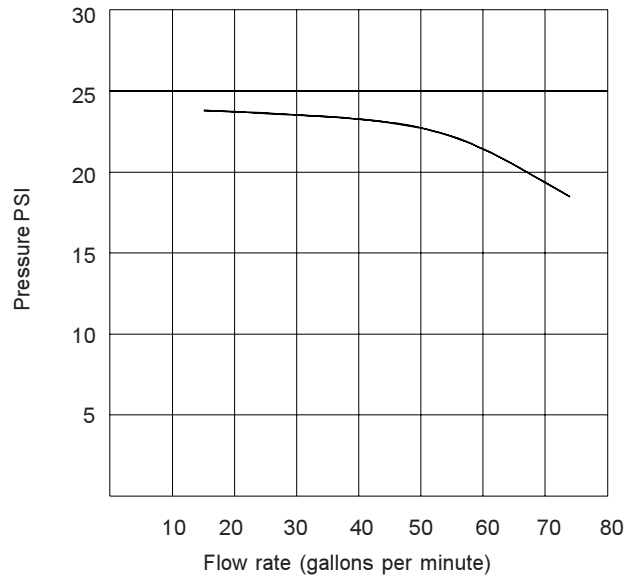
**Temperature Range<sup>1,2</sup>**

+20°C to +30°C

**Cooling Capacity<sup>2,3</sup>**

200 Kw @ 50 gpm

**Pumping Capacity<sup>3</sup>**



**Reservoir Volume<sup>4</sup>**

*Gallons*

18 to 25

**Unit Dimensions<sup>5</sup>**

(H x W x D)

*Inches*

53 9/16 x 32 x 32 1/8

*Centimeters*

136.0 x 81.3 x 81.6

**Weight**

*Empty*

626 pounds 284 kilograms

*Full*

1299 pounds 589 kilograms

*Shipping*

972 pounds 441 kilograms

**Noise Level**

66 db(A)

1. Lower limit determined by facility water temperature.

2. Specifications are for the unit operating up to 5000 feet. Contact Thermo for ratings at higher altitudes.

3. Based on DT 8°C between process water out and facility water in.

4. Total volume, including drainback capability. Nominal run is 83 gallons.

5. For complete dimensions and CG information see pages 40 and 41.

## Section III Installation

### Site

The unit should be placed in a location with easy access to a facility cooling water and a drain. For proper ventilation, a minimum clearance of 6 inches (15 centimeters) at the rear of the unit is necessary.



**CAUTION**

Ensure there is enough clearance on the right side of the unit to access the power disconnect breaker.



**CAUTION**

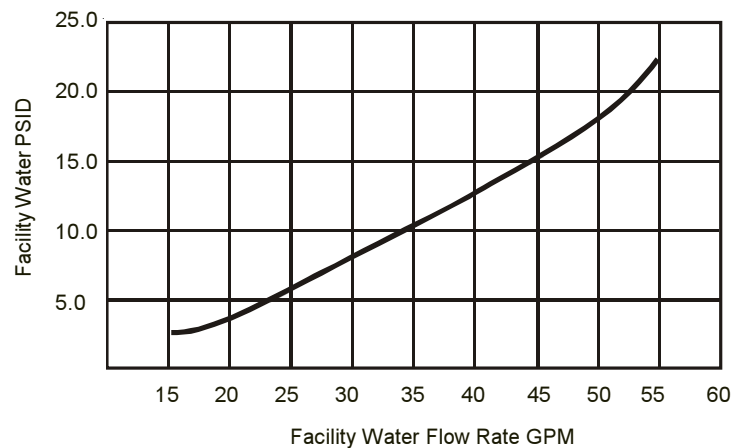
Never place the unit in a location where excessive heat, moisture, or corrosive materials are present.

Ambient temperatures should be between 20°C and 30°C, relative humidity less than 80%.

### Facility Water Requirements

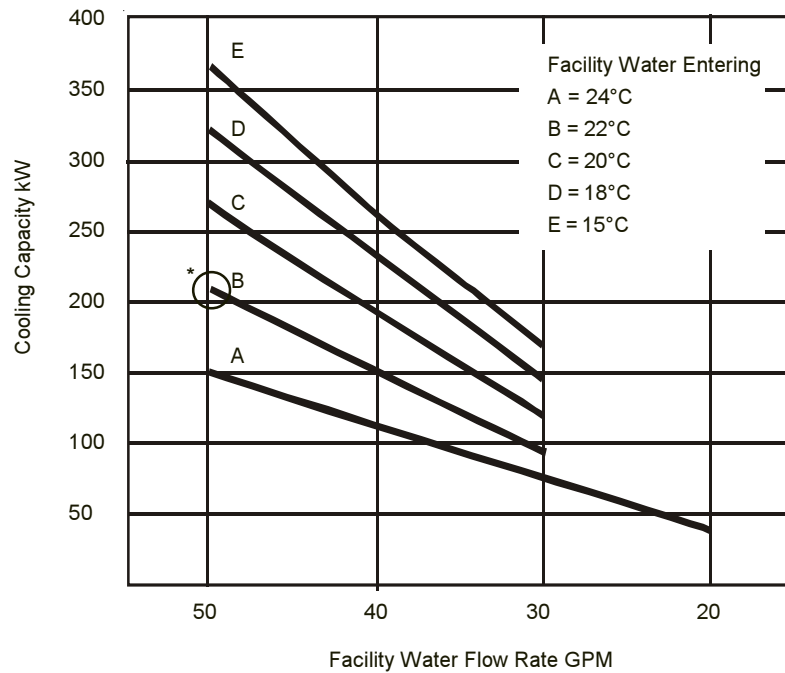
Use the following graphs to determine the facility water requirements. If the facility water does not meet these requirements, the cooling capacity will be reduced.

#### Minimum Recommended Facility Water Pressure Differential \* (@ 20°C Facility entry water temperature)



\* Unrestricted pressure delivered at the unit connections.

### Estimated Cooling Capacity (kW)

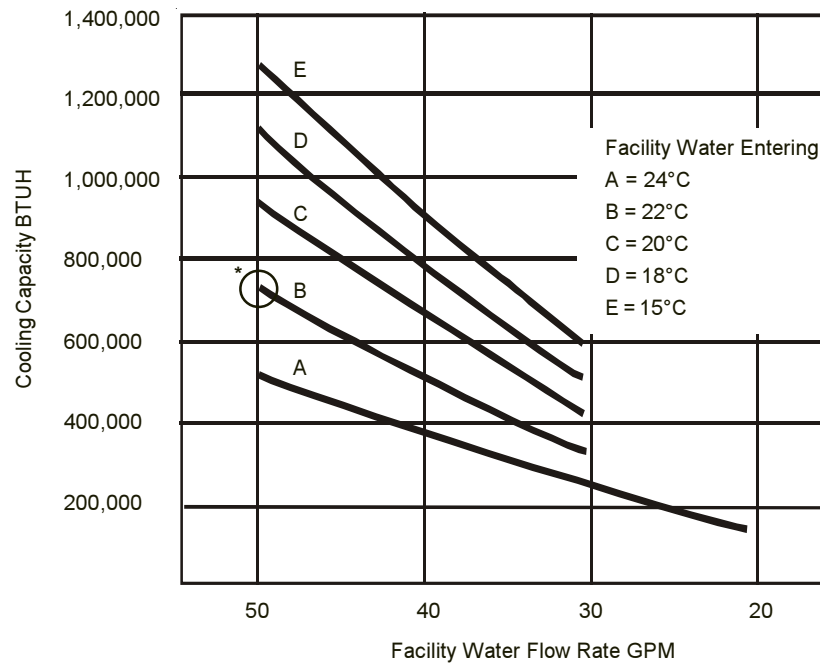


Nominal process side delivery of 50 GPM @ 30°C

Deduct approximately 2.2 kW for 3HP pump

\*nominal rating point (200kW)

### Estimated Cooling Capacity (BTUH)



Nominal process side delivery of 50 GPM @ 30°C

Deduct approximately 7632 BTUH for 3HP pump


\*nominal rating point (682427 BTUH)

# Electrical Requirements and Ratings



**WARNING**

The unit construction provides protection against the risk of electric shock by grounding appropriate metal parts. The protection may not function unless the unit is properly grounded. It is the user's responsibility to assure a proper ground connection is provided to the main ground

connection point of the unit marked with the green . The ground connection is to the ground stud.

Refer to the serial number label on the side of the unit for the specific electrical requirements of your unit.

<b>Volts</b>	200-208	380-400	460
<b>Hertz</b>	50/ 60±1%	50±1%	60±1%
<b>Phase</b>	3Ø	3Ø WYE	3Ø WYE
<b>Amperes</b>	10	5	5



**WARNING**

For high-voltage units, ensure the terminal block (4TB), located in the electrical enclosure, is configured in the correct position to meet the power source rating. 4L1 is shipped in position 4TB1. For 60Hz operation reposition 4L1 to 4TB2, for 50Hz operation reposition it to 4TB3.

Make sure the voltage of the power source agrees with the unit's voltage and frequency rating. The unit is designed to tolerate deviations of ±10% from the rated line voltage.

Ensure your power cable meets the electrical requirements of the unit and all applicable codes.

If using an external Main Power Disconnect, we recommend locating the switch or circuit-breaker near the equipment.

This unit should not be powered from an Uninterruptable Power Supply (UPS) or other source of non-linear voltage and current. Doing so may result in nuisance trips of the main circuit protector.

Transient overcurrent protection is category II. The pollution degree is 2.

## Electrical Wiring Installation




**WARNING**

The following should be performed only by a qualified technician.

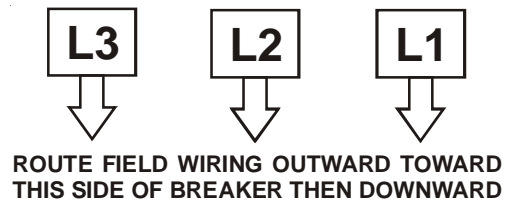
Remove the Lockout/Tagout (LOTO) assembly.

Remove the yellow plastic cover on the circuit breaker (CB).

Route the power cable through the strain relief and into the unit.

Connect the primary ground to the main ground stud  located near the CB.

Connect the L1, L2, and L3 power leads as shown on the yellow plastic cover.



Place the yellow plastic cover back on the CB.

Reinstall the LOTO assembly.

## Plumbing Requirements



### CAUTION

**Facility water supply should not exceed 80 psi. Facility water supply should not exceed 75 gpm.**

Flexible tubing, if used, should be of heavy wall or reinforced construction. The FACILITY WATER IN is subjected to the maximum pressure of the facility cooling water. Hose connections should be securely clamped and rated to withstand the maximum pressure of the system.

The plumbing connections are located on the right side of the unit and are labelled: FACILITY WATER SUPPLY (2"FPT), FACILITY WATER RETURN (2"FPT), MAIN PROCESS SUPPLY (2"FPT), AUX PROCESS SUPPLY 1 - 2 (1"FPT), PROCESS RETURN LINES 1 - 8 (1"FPT), AUXILIARY RETURN LINES 1 - 2 (1"FPT), and AUTO REFILL FLUID SUPPLY (½" FPT). See illustration on page 8.

In order to isolate the flow of facility water for lockout/tagout, user-supplied isolation valves must be installed on the supply and return lines to the **CoolEND™**.

Before installing the unit to an instrument that previously used tap water as a cooling fluid, flush the instrument several times to remove any rust or scale that has built up.



### CAUTION

**The unit's pump is capable of generating up to 40 psi. The SUPPLY plumbing should be rated to withstand that pressure.**

Connect the MAIN PROCESS SUPPLY line to the inlet of your application. Connect the eight MONITORED RETURN LINES and the two UNMONITORED AUXILIARY RETURN LINES to the applicable lines (monitored or unmonitored). Connect the FACILITY WATER SUPPLY to the cooling water supply and the FACILITY WATER RETURN to the cooling water drain or return.

If substantial lengths of cooling lines are required, they should be pre-filled with cooling fluid before connecting them to the unit.

Avoid running tubing near radiators, hot water pipes, etc. If substantial tubing lengths are necessary, insulation may be required to prevent loss of cooling capacity.

It is important to keep the distance between the unit and the instrument being cooled as short as possible, and to use the largest diameter tubing practical. Tubing should be straight and without bends. If diameter reductions must be made, they should be made at the inlet and outlet of the instrument being cooled, not at the unit.

Facilities Type	Fitting Size	Fitting Type	Material	Pressure	Flow	Comments
Monitored return	1"	FPT	Stainless Steel	~5 psi	2 -10 gpm at <15psi	Per channel
Auxiliary return	1"	FPT	Stainless Steel	~5 psi		
Main Supply	2"	FPT	Stainless Steel	25 psi max	50gpm at ≤21psi at supply manifold*	
Auxiliary supply	1"	FPT	Stainless Steel	25 psi max		
Facility water In	2"	FPT	Stainless Steel	80 psi max**	50gpm max	Higher pressures-consult Thermo
Facility water Out	2"	FPT	Stainless Steel	80 psi max**	50gpm max	Higher pressures-consult Thermo
Autorefill	1/2"	FPT	Stainless Steel	80 psi max	Unregulated	Higher pressures-consult Thermo
Reservoir Drain	1/2"	FPT	Stainless Steel	Atmospheric	N/A	
Reservoir Overflow	1"	FPT	Stainless Steel	Atmospheric	N/A	
AC Power Input	Customer Supplied	N/A	N/A	N/A	N/A	

\*Flow at main supply may be reduced is auto supply connections are used.

\*\*Minimum pressure differential between facility water supply and return should be at least 20 psid.

Table 1 Facilities Requirements



Tubing and insulation are available from Thermo. Contact our Sales Department for more information (see Preface, After-sale Support).

Connect the reservoir and drip pan overflows to a suitable DI drain. **NOTE:** To remain compliant to SEMI S2-0200, the drip pan drain must be connected at all times.

To drain the unit's tank remove the right side panel. The valve is located at the bottom of the unit. Connect the fitting to an appropriate drain and then open the valve.

## DEI Cartridge

The De-ionization (DEI) cartridge is shipped in a sealed plastic bag. The DEI hose with quick disconnects (QD) ships separately. Open the plastic bag, remove the DEI cartridge.

*The cartridge must be installed according to the instruction label on the unit.*

Install the hose with QD onto the inlet end of the cartridge. Secure the hose to the cartridge by tightening the provided hose clamp to approximately four inch-pounds.

## Fluids

For day-to-day operation the unit is designed to use DEI water, up to 0.8 megohm.



### CAUTION

**The unit is not designed to run with resistivity above 3 megohm for extended periods of time, but higher resistivity fluid, up to 18 megohms can be added during start-up or via the auto refill.**

The DEI cartridge is intended for maintaining resistivity only. Filling the system with high purity DEI water will increase the life of the DEI Cartridge. If tap water is used the cartridge may become depleted during start-up and may require premature replacement.

## Filling Requirements

Consult Applied Materials for filling procedure.



### CAUTION

**The unit is not designed to run with resistivity above 3 megohm for extended periods of time, but higher resistivity fluid, up to 18 megohms can be added during start-up or via the auto refill.**

For initial fill press and hold the up arrow key on the controller for 10 seconds. The controller will display MANUAL FILL IN PROGRESS PRESS ANY KEY TO STOP. Filling will automatically stop once it fluid reaches the full level or after the auto refill mechanism has run for 20 minutes of continuous operation.

**NOTE:** Continuous operation of the auto refill mechanism for periods of 20 minutes or more generally indicates a problem.



### CAUTION

**The reservoir must be filled with a minimum of 14 gallons to ensure the pump head remains submerged.**

The unit has a nominal evaporation rate of up to 2.5 gallons per day. Ensure the autorefill system is installed. Autorefill activates if the level is below 20 gallons and deactivates above 25 gallons.

The total reservoir capacity is 83 gallons (including shutdown and floodback). To prevent siphoning, all tank return lines are located at the top of the tank.

The FLUID RESERVOIR FILL PORT located on the right side of the unit is available for manually filling the reservoir.

## Draining

Connect the reservoir and drip pan drains, both located on the right hand side of the unit, to a suitable DI drain.

**NOTE:** In order to drain the DEI and auto refill solenoids you must press and hold the up arrow key on the controller for 10 seconds. The controller will display MANUAL FILL IN PROGRESS PRESS ANY KEY TO STOP. Vacuum the fluid out of the lines through the process supply and auto refill fittings.

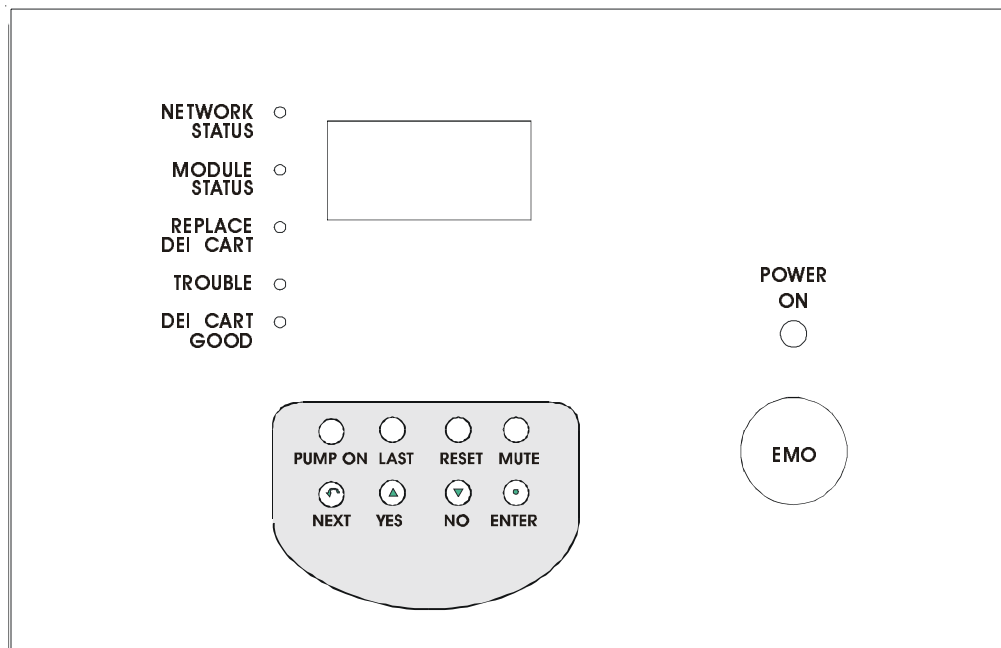
## Microprocessor Controller

An alphanumeric LCD display presents numeric readings of various operating conditions within the chiller. Display function is selected by pressing the appropriate keys to move through a menu of available information.

The controller has two different loops: Operator's and Setup. The controller loops allow the operator to display and/or alter different parameters of the controller. When the controller is first powered up it goes through a short self test sequence and then enters the Operator's Loop, displaying the reservoir fluid temperature.

In the Setup Loop, the **YES** key increments the value and the **NO** key decrements the value. Pressing either key for over three seconds accelerates the changing value. The display will flash as soon as any value is changed, and will continue to flash until the **ENTER** key is pressed to accept the new value. The new value will not be used by the controller until the **ENTER** key is depressed and the display stops flashing.

If the **NEXT** key is pressed while the value is flashing, the new value will not be accepted. The display will stop flashing and the original value will be displayed. In this case the **NEXT** key can be used to abort data entry. The display will not sequence unless the **NEXT** key is depressed again.



## LEDs

The bicolor NETWORK STATUS LED indicates the status of the communication link. Reference page 32 for DeviceNet LED status.

The bicolor MODULE STATUS LED indicates whether or not the device has power and is operating properly. Reference page 32 for DeviceNet LED status.

The yellow REPLACE DEI CART indicates the resistivity is below the setpoint.

The yellow TROUBLE indicates a unit fault. The LCD display will indicate the specific fault, see Fault Messages on page 23.

The green DEI CART GOOD indicates the resistivity is above the low level setpoint.

### Operator's Loop

When the controller is first powered it goes through a short self test and then enters the Operator's Loop, displaying the temperature of the fluid at the supply manifold, the operating pressure, the resistivity of coolant leaving the chiller, the facility water flow rate and any fault message.

By pressing the NEXT key the controller will step through the menus shown.

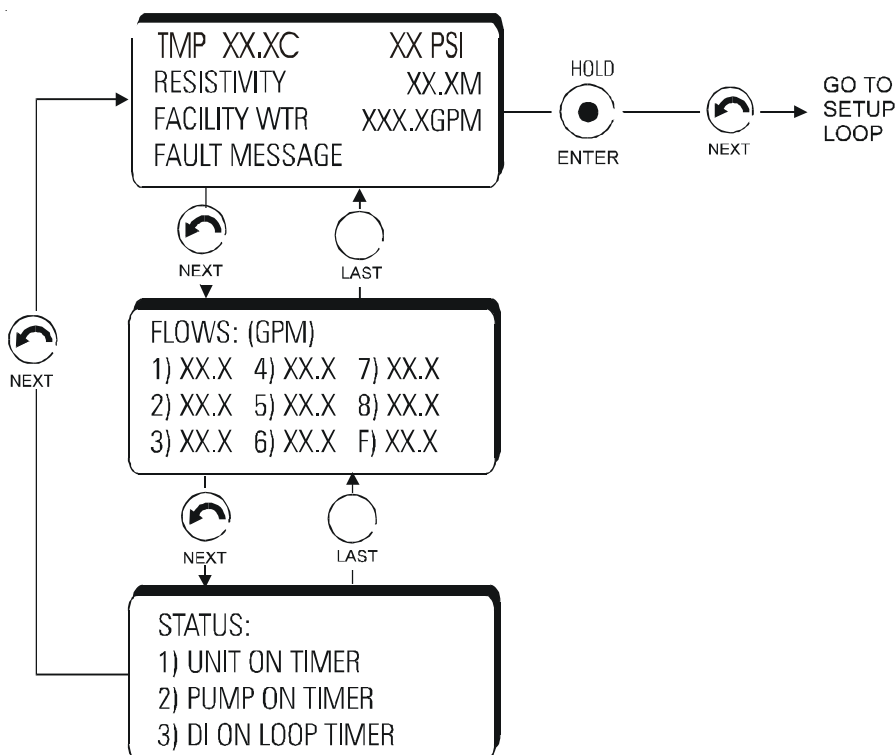


Figure 1 Operator's Loop

TMP displays the temperature of the coolant leaving the chiller in °C. PSI, or BAR, is the process fluid output pressure. RESISTIVITY is the resistivity of the coolant leaving the chiller in megohm-cm. FACILITY WTR is the facility water flow rate in gallons per minute (GPM), or liters per minute (LPM). The most current fault message is also displayed.

**NOTE:** The unit of measure display, PSI/BAR or GPM/LPM, is changed using the Setup Loop, see next page.

FLOWS displays the flow rate in each of the eight process return lines (1 - 8) and the facility water return line (F) in gallons per minute.

**NOTE:** Flow rate may be present but OFF will be displayed for any line if that line's alarm is set to zero using the Setup Loop discussed on the next page.

STATUS displays the unit, pump and DI loop on time in hours.

### **Setup Loop**

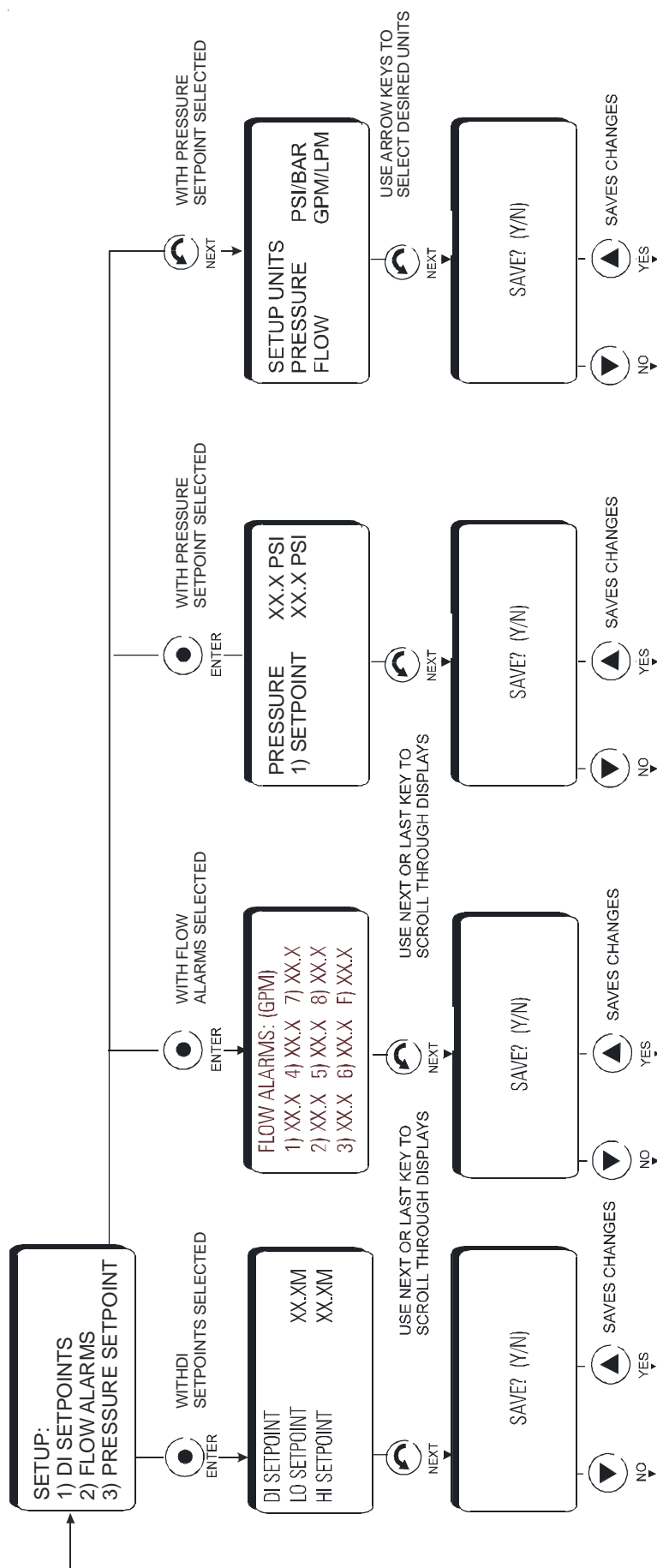
The Setup Loop allows the operator to change the DI setpoints, the flow alarm limits, the high pressure setpoint, and select the units of measure for pressure and flow.

To enter this loop you must be in the Operator's Loop and displaying the temperature. Depress and hold the ENTER key while pressing the NEXT key.

Scroll through the SETUP menu using the NEXT or LAST key, press ENTER or NEXT to go to the desired sub-menu. Scroll through the sub-menu options using the NEXT or LAST key, change the values or units of measure using the YES or NO key. Leave the sub-menu using the NEXT or LAST key. The display will indicate the save prompt, press YES or NO.

**NOTE:** To disable the flow alarm for return lines which are off, set the flow alarm to zero. At least one flow sensor must be set greater than zero for the pump to come on.

**NOTE:** If the units of measure are changed the corresponding setpoints will be recalculated but the display may exhibit rounding errors.



## Fault Messages

Fault messages are displayed in the Operators Loop and the alarm will sound. The faults are prioritized. When a fault is cleared and RESET is pressed, the next prioritized fault is displayed. The messages below are listed from highest to lowest priority.

**NOTE:** Use the controller's MUTE button to silence the alarm.

### LOW LEVEL CUTOUT

Displayed when the tank level is less than 14 gallons. The message clears after the fault is cleared and the controller's RESET button is depressed.

### VFD FAULT

Displayed when the motor overload trips. The message clears after the fault is cleared and the controller's RESET button is depressed.

### RTD FAIL

Displayed when the temperature is over 100°C (RTD open circuit). The message clears after the fault is cleared and the controller's RESET button is depressed.

### WARNING LOW LEVEL

Displayed when the tank level is less than 20 gallons for more than 5 minutes. Check the auto refill. The message clears after the fault is cleared and the controller's RESET button is depressed.

1. If the fluid level drops below the 20 gallon level then the auto refill solenoid will energize.
2. The auto refill solenoid will continue to be energized until the fluid level reaches approximately 25 gallons. Then it will shut off.
3. If the fluid level does not reach 25 gallons within 5 minutes then the warning message will display but the auto refill solenoid will stay energized.
4. If the 25 gallon level is not reached within 20 minutes then the auto refill solenoid coil will de-energize and lock itself out. The reset button will have to be pressed to unlock the auto refill, reset the timer, and clear the WARNING LOW LEVEL message.



**HIGH TEMPERATURE**

Displayed when the temperature is over 30°C. The message clears after the fault is cleared and the controller's RESET button is depressed.

**LOW FLOW**

Displayed when a return line flow drops below the alarm setpoint. The message clears after the fault is cleared and the RESET button is depressed.

**REPLACE CARTRIDGE**

Displayed when the resistivity drops below the low setpoint for more than one hour. The message clears after the fault is cleared and the controller's RESET button is depressed.

**RESISTIVITY HIGH**

Displayed when the resistivity is greater than the high setpoint for more than eight hours. The message clears after the fault is cleared and the controller's RESET button is depressed.

**EMO**

Displayed when the EMO button is depressed. The message self-clears when the EMO is returned to the normal position.

**LEAK**

Displayed when the drip pan is full. The pump will shut down and, if required, the auto refill solenoid will de-energize.

**HIGH FLOW**

Displayed when the facility flow exceeds 75 gpm.

**HIPRESSURE**

Displayed when a fault condition that caused an over-pressure condition (greater than 25 psi) remains present for 10 seconds, or reoccurs 3 times within 90 seconds. The pump is immediately throttled to a minimum speed (35 Hz) and waits 5 seconds before accelerating to reach the pressure setpoint.

**FLOW COMP**

Displayed when any single return channel flow exceeds 12 gpm. This fault overrides the pressure setpoint control to prevent the flow transducers from over spinning. The pressure reading will be below the setpoint.

## Section IV Operation

### Start Up

Connect the unit to a power source, refer to Section III Installation. See unit serial tag for power supply requirements.

This unit should not be powered from an Uninterruptable Power Supply (UPS) or other source of non-linear voltage and current. Doing so may result in nuisance trips of the main circuit protector.

Before starting the unit, check all plumbing connections and make sure the circulating system (the chiller, your application, and the tubing that connects them) has been properly filled with cooling fluid, see Filling Requirements in Section III. The reservoir level must be above the low level switches before the unit will start.

For units with the GFI option, be sure the GFI is in the ON position before closing the circuit breaker and turning on the unit.

Ensure the DI cartridge is installed in the proper direction as indicated by the label on the unit. **NOTE:** Disregard the THIS END UP indication on the cartridge itself, see page 35.

Close the main circuit breaker (1) on the right side of the unit. The white POWER ON light will illuminate, and the controller initializes and displays the Operator's Loop. If a fault is present, it will be displayed. **NOTE:** Certain faults prevent the pump from starting, see Fault Messages on previous page.

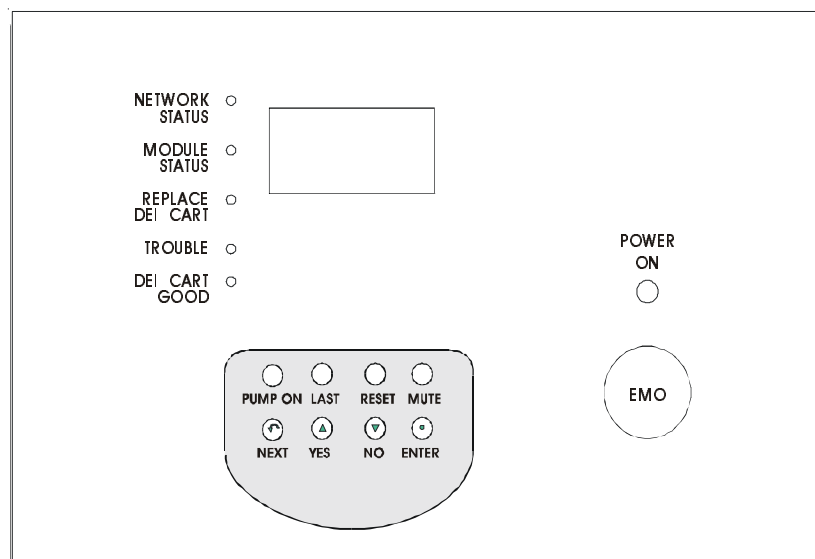
Depress the PUMP ON button on the controller to start the pump. **NOTE:** At least one flow sensor must be set greater than zero for the pump to come on.



#### CAUTION

**Do not top off the unit once it has started.**

Depress the PUMP ON button on the controller to stop the pump. Turn the unit off by opening the main circuit breaker (0).



### **Pressure Control**

The unit is designed to automatically adjust the pump speed to maintain a selectable supply (process) output pressure. This is accomplished by means of a Variable Frequency Drive (VFD) which can vary the AC frequency in the pump motor circuit.

A pressure transducer provides an electronic input signal to the main microprocessor-based controller. Through a control algorithm, the controller varies an output signal to the VFD, continuously adjusting the motor between preset maximum and minimum speeds in order to maintain the desired output pressure.

### **Pressure Limits**

Pressure transducer and VFD components are utilized to limit the output pressure below the setpoint value. If there is a sudden spike in the (process) output pressure, a pressure-limiting algorithm in the controller will override the normal pressure control algorithm and immediately drop the pump speed to its minimum level. After this corrective action is taken, the controller will attempt to “ramp up” the motor speed back up to the normal level.

If the fault that caused the over-pressure condition has cleared the controller will return to normal operation. If the fault that originally caused the over-pressure condition has *not* cleared, the limiting algorithm will again drop the pump speed to the minimum level. If the fault condition that is causing the over-pressure condition remains present for 10 seconds or reoccurs 3 times within 90 seconds, the system will shut down and HI PRESSURE fault will be displayed on the LCD display.

## **Flow Transducers**

Flow transducers are connected to return lines one through eight as well as the facility water outlet/return line. The transducers monitor the flow rate of the cooling fluid returning from your application and the facility water flow. Flows are displayed on the controller's Operators Loop. If any flow rate drops below the alarm setpoint, entered in the controller's Setup Loop, a flow error message appears and a flow alarm sounds.

**NOTE:** If the setpoint is set to zero, the flow alarm is disabled.

## **Low Fluid Level Safety**

If the reservoir fluid level drops to 20 gallons, a fault message is displayed on the controller, the TROUBLE LED illuminates, and a remote signal alarm is generated. The alarm has to be reset once the fault is cleared. If the level drops below 14 gallons, the alarm sounds and the pump is de-energized.

**NOTE:** When the fluid level drops below 20 gallons there is a 5-minute delay before the fault message and warning functions are activated. During this period the autorefill will attempt to refill the tank (fill solenoid opens). If the fluid level recovers within the delay period then the warning/fault functions are not activated.

There is no delay in the pump cutout safety when the fluid level drops below the 14 gallon trip point.

## **Autorefill**

The unit has a nominal evaporation rate of up to 2.5 gallons per day. Ensure the autorefill system is installed.

If the fluid level drops below the 20 gallon level then the auto refill solenoid will energize. The auto refill solenoid will continue to be energized until the fluid level reaches approximately 25 gallons. Then it will shut off.

If the fluid level does not reach 25 gallons within 5 minutes then the warning message will display but the auto refill solenoid will stay energized.

If the 25 gallon level is not reached within 20 minutes then the auto refill solenoid coil will de-energize and lock itself out. The reset button will have to be pressed to unlock the auto refill, reset the timer, and clear the WARNING LOW LEVEL message.

## **Variable Frequency Drive**

The unit's pump is equipped with a Variable Frequency Drive (VFD). The VFD is factory preset and requires no adjustment.

## **Emergency Off (EMO)**

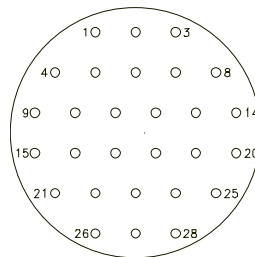
A guarded red mushroom shaped push-button switch with twist-to-reset is provided in the front of the unit to turn off the unit in case of an emergency. The button head is engraved with "EMO" in large white filled letters.

Activation of the EMO button will remove power from the main contactor coil stopping operation of the unit.

Resetting of the EMO button will not restart the unit. After all hazards have been removed and the EMO is reset, the unit must be reset by pushing the PUMP ON button on the control panel.

## Remote Interface

The temperature of the cooling fluid and the status of the low flow and low fluid detectors can be monitored by an external device using the monitor receptacle located on the control panel.



Monitor receptacle

- |         |  |
|---------|--|
| Pin #1  | Flow monitor output (return #1), active if flow is satisfactory sink current.          |
| Pin #2  | Flow monitor output (return #2), active if flow is satisfactory sink current.          |
| Pin #3  | Flow monitor output (return #3), active if flow is satisfactory sink current.          |
| Pin #4  | Flow monitor output (return #4), active if flow is satisfactory sink current.          |
| Pin #5  | Flow monitor output (return #5), active if flow is satisfactory sink current.          |
| Pin #6  | Customer supplied 24VDC power supply to unit (+).                                      |
| Pin #7  | Customer supplied 24VDC supply common.   |
| Pin #8  | Customer supplied +15VDC supply to unit (+).   |
| Pin #9  | Customer supplied $\pm 15$ VDC common.   |
| Pin #10 | Customer supplied -15VDC supply to unit (-).   |
| Pin #11 | Temperature signal output (+). The temperature scale is 100mVDC/ $^{\circ}$ C.         |
| Pin #12 | Analog signal output common (-).   |
| Pin #13 | Low fluid level monitor output, active if level is satisfactory sink current.          |
| Pin #14 | 24VDC common output. Common connection for flow switches and low fluid level safeties. |
| Pin #15 | Flow monitor output (return #6), active if flow is satisfactory sink current.          |
| Pin #16 | Flow monitor output (return #7), active if flow is satisfactory sink current.          |
| Pin #17 | Flow monitor output (return #8), active if flow is satisfactory sink current.          |
| Pin #18 | Not used.  |
| Pin #19 | Cartridge good/bad output, active if resistivity is above low resistivity setpoint.    |
| Pin #20 | Flow monitor output (facility water), active if flow is satisfactory sink current.     |

Flow monitors, low fluid level monitor, and cartridge monitor connections are active (current sink to pin 14) when respective conditions are satisfactory, and open when conditions are unsatisfactory (or when unit is off).

The temperature signal circuit has a differential output. Pin 12 must be connected to ground in the monitoring system. This signal is only available if the unit is on and 24VDC and  $\pm 15\text{VDC}$  is supplied to this connector.

## Resistivity Sensor

The controller displays and maintains resistivity between adjustable setpoints. If the resistivity goes above the high setpoint, the line through the DI cartridge closes. Flow through the DI cartridge resumes when the resistivity drops to the low setpoint. If the resistivity drops below the low setpoint for more than one hour, a fault is displayed, the REPLACE DEI CART LED illuminates and a remote signal is generated.

**NOTE:** Every time the controller is energized, a four-hour clock disables the REPLACE DEI CART fault.

## DeviceNet

The Node Address and baud rate are all set with three rotary switches on the DeviceNet board, see illustration below.

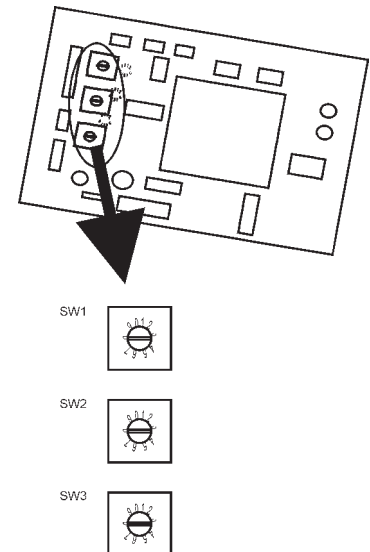
SW1 and SW2 are used to set the MAC ID. The MAC ID can be set from 1 to 63. It is factory set at 60. SW1 is the Most Significant Digit (MSD) and SW2 is the Least Significant Digit (LSD). To set the device to a MAC ID of 60, set SW1 to 6, SW2 to 0.

SW3 is used to set the baud rate. The baud rate is factory set to 500K.

SW3 position

- 0 = 125K
- 1 = 250K
- 2 = 500K
- 3 = Blank

**NOTE:** If the baud rate is changed, recycle the controller for it to read the change.



## DeviceNet Interface

### Resistivity Scaling

Unsigned binary is used to represent the 0V to +10V range. 12 bits of resolution is available at the DeviceNet interface.

0 to +10V range	
AI Digital Value (at the DeviceNet Interface)	Resistivity input to controller
0 4095	0 Mohm 20 Mohm

### Flow Scaling

Unsigned binary is used to represent the 0V to +10V range. 12 bits of resolution is available at the DeviceNet interface.

#### Facility Flow

0 to +10V range	
AI Digital Value (at the DeviceNet Interface)	Flow input to controller
0 4095	0 gpm 100 gpm

#### Process Flow

0 to +10V range	
AI Digital Value (at the DeviceNet Interface)	Flow input to controller
0 4095	0 gpm 20 gpm

### Temperature Scaling

Unsigned binary is used to represent the -5V to +5V range. 12 bits of resolution is available at the DeviceNet interface.

-5V to +5V range	
AI Digital Value (at the DeviceNet Interface)	Temperature input to controller
0 2048 4095	0°C +50°C +100°C

## DeviceNet Messaging

### Poll Command Message:

Byte	7	6	5	4	3	2	1	0
0								PUMP

PUMP = Command for pump to be on or off. 1 = on, 0 = off..

### Respond Message:

Byte	7	6	5	4	3	2	1	0
0	Water Temperature (LSB)							
1	Water Temperature (MSB)							
2	Water Resistivity (LSB)							
3	Water Resistivity (MSB)							
4	Flow 1 (LSB)							
5	Flow 1 (MSB)							
6	Flow 2 (LSB)							
7	Flow 2 (MSB)							
8	Flow 3 (LSB)							
9	Flow 3 (MSB)							
10	Flow 4 (LSB)							
11	Flow 4 (MSB)							
12	Flow 5 (LSB)							
13	Flow 5 (MSB)							
14	Flow 6 (LSB)							
15	Flow 6 (MSB)							
16	Flow 7 (LSB)							
17	Flow 7 (MSB)							
18	Flow 8 (LSB)							
19	Flow 8 (MSB)							
20	Facility Water Flow (LSB)							
21	Facility Water Flow (MSB)							
22			AF	WLW	PUMP	FW	CB	WLF
23	0	0	0	0	0	0	0	0

CB = Cartridge Good/Bad, 1 = Good, 0 = Bad

WLF = Water Level Low Fault, 1 = Good, 0 = Bad

FW = Facilities Water Flow, 1 = Good, 0 = Bad

PUMP=Status of Pump, 1 = ON, 0 = OFF

AF = Autorefill Status, 1 = ON. 0 = OFF

WLW = Water Level Warning, 1 = OK, 0 = WARN

Upon receipt of a poll command, we will send the 23 bytes of data through the DeviceNet. The 23 byte response is in accordance to the Device Net fragmentation protocol of the DeviceNet Specification (revision 1.3).



## MODULE STATUS LED

The bicolor (green/red) LED provides device status. It indicates whether or not the device has power and is operating properly.

Status	LED	Indication
No power	Off	Device not powered
Device operational	Green	Device operating in a normal condition
Device in standby	Flashing Green	Device needs commissioning due to configuration missing, incomplete or incorrect. Device may be in the standby state
Minor fault	Flashing Red	Recoverable fault
Unrecoverable fault	Red	Device has an unrecoverable fault and may need replacing
Device self test	Flashing Red/Green	Device is in self test

## NETWORK STATUS LED

The bicolor (green/red) LED indicates the status of the communication link.

Status	LED	Indication
Not powered/ Not on-line	Off	Device not on line Device has not yet completed the Dup_MAC_ID test Device may not be powered, look at MODULE status LED
On-line, not connected	Flashing Green	Device on-line but has no connection in the established state Device has passed the Dup_MAC_ID test, is on-line, but has no established connection to other nodes For a Group 2 Only device it means that the device is not allocated to a master For a UCMM capable device it means that the device has no established connection
Link OK on-line, connected	Green	Device is on-line and has connections in the established state For a Group 2 Only device it means that the device is not allocated to a master For a UCMM capable device it means that the device has one or more established connection

Connection time-out	Flashing Red	One or more I/O connections are in the timed-out state
Critical link failure	Red	Failed communication device. Device has detected an error that has rendered it incapable of communicating on the network (Duplicate MAC ID, or Bus-off)
Communication faulted and received an identify comm fault Request - Long Protocol	Flashing Yellow/Green	A specific communication faulted device. Device has detected a network access error and is in the communication faulted state. The device has subsequently received and accepted an identify communication faulted request - Long Protocol message

## Connectors

### DeviceNet (J2) (TN # 026044) (Turck # FS4.5-0.5)

Pin	
1	Shield
2	V+
3	V-
4	CAN_H
5	CAN_L

### Leak Detector (P5) (TN # 083904) (Amp # 205841-1)

Pin	
1	NC
2	Normally Closed
3	Normally Closed
4	NC

### EMO In (P3) (TN # 001545) (Amp # 206061-1)

Pin	
1	Normally Closed (to EMO Out Pin 4)
2	to in pin 3
3	to in pin 2
4	to EMO Out pin

### EMO Out (J4) (TN # 001788) (Amp # 206430-1)

Pin	
1	to EMO In pin 4
2	to EMO Out pin 3
3	to EMO Out pin 2
4	Normally Closed (to EMO In Pin 1)

## Section V Periodic Maintenance



**CAUTION**

For personal safety and equipment reliability, the following procedure should only be performed by a qualified technician. Contact our Service Department for assistance (see Preface, After-sale Support).



**WARNING**

Performance maintenance and service procedures other than those described in this manual may result in a hazardous situation and may void the manufacturer's warranty.

### Service Contracts

Thermo offers on-site Service Contracts that are designed to provide extended life and minimal downtime for your unit. For more information, contact our Service Department (see Preface, After-sale Support).

### Deionizing Cartridge

When, during normal operation, the resistivity drops below the low setpoint for more than one hour the REPLACE DEI CART LED illuminates. This indicates replacement is necessary.

The Thermo part number for the DEI cartridge is 003500.

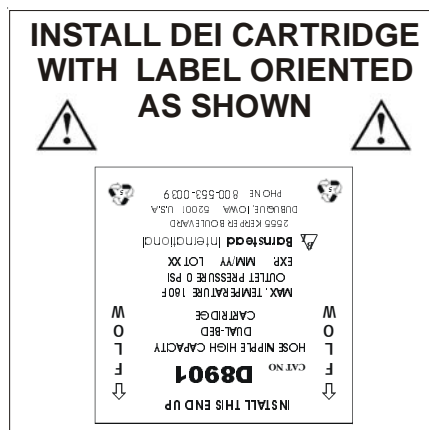
**NOTE:** If the power is cycled the resistivity has to drop below the setpoint for more than four hours before the LED will illuminate.

Disconnect the Quick Disconnect (QD) on top of the DI cartridge and pull the cartridge from the unit. Remove the hose and mating QD from the old cartridge and then reinstall it on the inlet side of the new cartridge. Install the cartridge into the holder/receptacle and reconnect the QD. Secure the hose to the cartridge by tightening the clamp to approximately four inch-pounds.



**CAUTION**

When reinstalling, ensure the DI cartridge is in the proper orientation. The direction of the arrows on the cartridge must agree with the arrows on the unit's label. The proper flow direction is downward. Disregard the THIS END UP indication.



Unit Label

## **Periodic Cleaning**

**The unit is designed for trouble free operation.** There are no internal parts that need periodic cleaning or replacing.

When cleaning the unit's exterior surfaces, Thermo recommends using a general purpose cleaner (i.e. fantastik®), and a soft, clean, lint-free cloth.

## **Heat Exchanger & Pump Lifting Procedures**

The heat exchanger weighs 70 pounds and the pump weighs 71 pounds. They exceed the Recommended Weight Limit (RWL) for (1) and (2) person lifting requirements. Use an adjustable height cart to aid in lifting and removal/installation of these components. Follow all mechanical tool instructions to prevent musculoskeletal stress and injury.

## **Waste Disposal**

Facility water should be disposed of in accordance with the processes used within your facility.

## Section VI Troubleshooting



CAUTION

For personal safety and equipment reliability, the following procedure should only be performed by a qualified technician. Contact our Service Department for assistance (see Preface, After-sale Support).



DANGER

Contact with hazardous voltage inside the chiller can cause severe injury or death. Turn off and Lockout/Tagout (LOTO) power before servicing. Have a qualified technician verify that line voltage is no longer present within the unit after performing a LOTO procedure and before working on system.

### Checklist

#### Unit does not start when turned on.

Check the unit's circuit breaker. For units with the GFI option, be sure the GFI is in the ON position before closing the circuit breaker and turning on the unit. Check fault messages.

Check fluid level in reservoir.

Check power supply.

#### Main circuit breaker trips

This unit should not be powered from an Uninterruptable Power Supply (UPS) or other source of non-linear voltage and current.

#### No/poor controller display

Open up the top panel and locate the white-plastic pot screw located in the middle of 1INST. Use it to adjust the intensity.

#### Pump does not start.

At least one flow sensor must be set greater than zero for the pump to come on. See pages 19 and 20.

#### Unit continues to run for a short period and then stops.

Check reservoir level. The unit has a nominal evaporation rate of up to 2.5 gallons per day. Ensure the autorefill system is installed. Also, check total system for leaks.

Make sure unit running on proper voltage.

#### Unit shuts down.

Check controller for fault message.

The unit may have experienced 3 pressure spikes within a 1½ minute time frame. See **HI PRESSURE** fault message in Section III.

#### Unit does not maintain pressure setpoint.

The pump speed may have been overridden by the flow comp fault. This fault compensates the pump speed in order to keep any 1 of the 8 return channels below 12 gpm. See **FLOW COMP** fault in Section III.

## Displaying Software Version

From the Operator's Loop temperature display, depress and hold the ENTER key. While holding the ENTER key enter the key sequence NO-YES-NO.

Use the NEXT or LAST key to highlight 2) VERSION NUMBER. Press ENTER to display the software version.

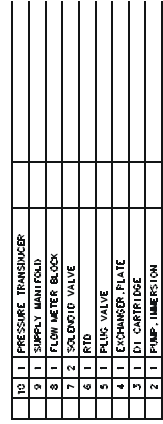
Press NEXT and then NO to return to the temperature display.

## Service Assistance

If, after following these trouble shooting steps, your unit fails to operate properly, contact our Service Department. Before calling, please obtain the following information:

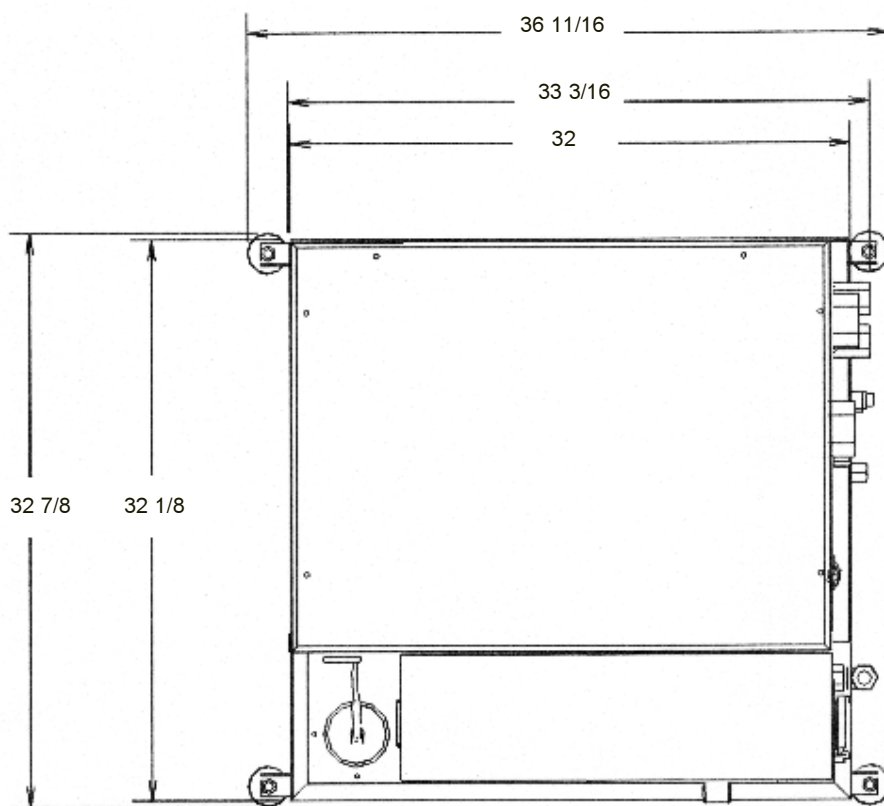
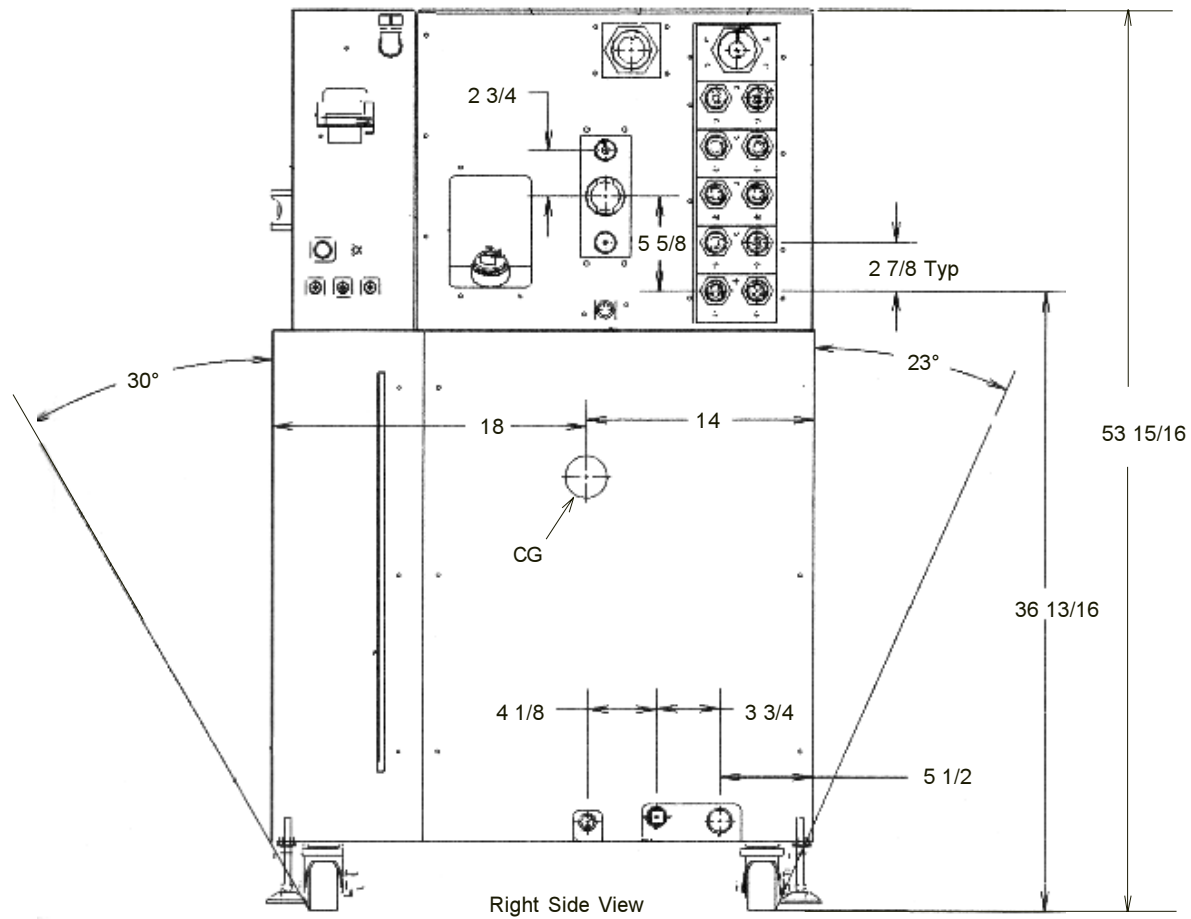
*BOM Number*  
*Serial number*  
*Software Version*  
*Application*  
*Type of fluid used*  
*Temperature at which the problem occurs*  
*Voltage at power supply of unit*  
*Temperature of facility cooling water*  
*Pressure of facility cooling water*  
*Facility water flow rate*

## Flow Diagram



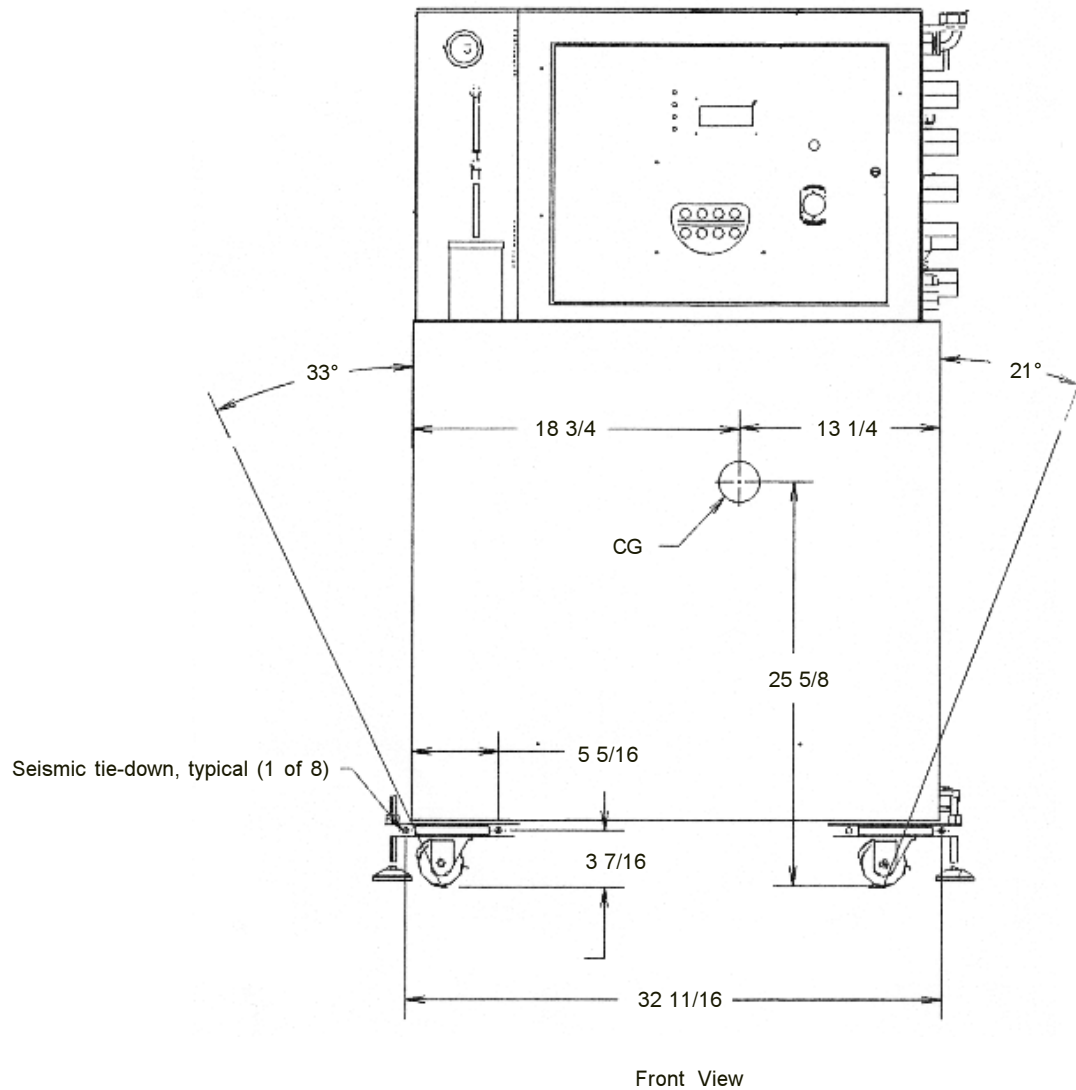
DI MAX II FO1017 REV. -





#### Weight Distribution (pounds)

Empty	
Right Front	165
Left Front	120
Right Rear	210
Left Rear	153
Full	
Right Front	381
Left Front	255
Right Rear	411
Left Rear	276



## Seismic Tie-Downs and Leveling Feet

Seismic tie-downs and leveling feet are installed on the unit. Once the leveling feet are in the desired level use the jam nut to secure it in position.

It is the user's responsibility to secure the unit using the attached tie downs.

## Appendix - Applied Materials LOTO Procedure

### 1. Lockout and Tagout

Prior to performing any Chiller maintenance operation, the energy sources associated with the Chiller system should be lockout and tagged out (LOTO). Hazard control features added to the system (e.g., safety interlocks) are not to be considered or used as a substitute for turning off and locking out electrical, pneumatic and fluid delivery to the Chiller system. This section describes general requirements for lockout/tagout procedures.

#### 1.1. Notification of Maintenance Activity

Make the following notifications before starting a maintenance activity:

1. Notify the personnel working in the immediate area that the system is under maintenance control.
2. Display a "Do Not Operate" tag on the console (in the Production area) and in the maintenance or chase area.

#### 1.2. Use/Availability of Lockout Devices

Observe the following precautions:

1. Lockout/tagout equipment must be available near the equipment or in the possession of service personnel. The equipment consists of locks, tags, multiple lock devices, plug locks, circuit breaker locks, and valve lockout devices.

---

#### NOTE

In compliance with safety regulations, an interlock (hardware or software) or  
Emergency Off

(EMO) is **not** an acceptable lockout device. A physical lock or blocking device must be  
used to isolate the source of hazardous energies during maintenance activities.

---

2. If the required equipment is not available, it should be requested through the supervisor or manager of the area. A task should not be performed in the absence of the proper lockout/tagout equipment.

#### 1.3. Testing and Verification

After applying a lockout device to isolate the hazardous energy, test or verify that the energy source is truly isolated (e.g., view pressure gages, attempt to direct the tool to response, verify voltages with a voltmeter, etc.). Failure to verify isolation of energy could result in serious injury or death if hazardous energies are still present in the system (due to incomplete or ineffective lockout/tagout). Ensure that there are no back-up power sources (i.e., UPS batteries, charged capacitors, etc.) that remain energized even after the system has been locked out.

#### 1.4. Shift Change Lockout/tagout Procedure

If service activities continue beyond the shift and include a change in service personnel, observe the following:

- A complete and accurate pass-down must be provided.
- Incoming service personnel should apply their locks to the system before outgoing service personnel remove their locks, so that the equipment is not left unlocked at any time.

### 1.5. Non-Standard Removal of Lockout/Tagout Equipment

Observe the following precautions:

1. Only the individual who places the locks and tags shall remove them.
2. If necessary, non-standard removal of lockout/tagout equipment can be done only in accordance with OSHA standards and the Applied Materials lockout/tagout standard. A local safety representative may remove a lock ONLY if all of the following conditions are met:
  - a. The employee who placed the lock is unavailable or no lockout tag was placed.
  - b. It is verified that the employee who applied the lockout is not at the facility.
  - c. A reasonable effort is made to notify the employee who applied the lockout.
  - d. The employee who applied the lockout is notified of its removal before he/she resumes work.
  - e. A document is created to describe the event and the procedures that were followed. This document should be kept on file for one year.
  - f. Affected employees are notified and the work area is checked to verify that it is safe to turn on the energy source.

### 1.6. Lockout/tagout Capabilities

This section describes specific Chiller lockout/tagout protocol (capabilities) for the following hazardous energy sources:

- Electrical power (Chiller)
- Fluid energy (Coolant and Facility Water)

#### 1.6.1. Electrical Power LOTO

Electrical power hazards exist at multiple locations within the Chiller. Specific Maintenance and Troubleshooting procedures should be followed to ensure user safety when maintaining the Integrated System. Refer to the appropriate instruction for this information, and the accompanying WARNINGS to address safety prior to specific steps.

To effectively isolate the significant electrical power distribution and consumption components, lockout/tagout provisions are available as summarized in the Table 1 Electrical LOTO Locations.

Chiller Integration Electrical Hazard	Available Lockout Tagout (Isolation) Location
Entire System	Main disconnect (knife-switch at system controller cabinet). <b>OR</b>
Chiller	Main power at the facility source prior to the system controller. Unplug the system and lockout the plug. <b>OR</b> Circuit Breaker on the back of the Chiller. <b>OR</b> Chiller circuit breaker at the system controller cabinet. <b>OR</b> Main disconnect (knife-switch at system controller cabinet). <b>OR</b> Main power at the facility source prior to the system controller cabinet.

**Table 1 Electrical LOTO Locations**

### 1.6.2. Fluid Energy

Fluid energy exists in the form of facility water flowing into and out of the **CoolEND™**. The release of fluid can increase the risk electrical shock, fire, environmental contamination and damage to the system.

To effectively isolate the flow of fluids user-supplied isolation valves must be installed on the facility water supply and return lines.

As an alternative, the plumbing could be disconnected completely from the **CoolEND™**.