Thermo Scientific NESLAB ThermoFlex™

Recirculating Chillers

(Basic Controller)

Thermo Scientific Manual P/N U00933 Rev. 07/24/09

Installation
Operation
Basic Maintenance

Visit our Web site at:

http://www.thermo.com/tc

Product Service Information, Applications Notes, MSDS Forms, e-mail.

Voice Info: (800) 258-0830

C US

Label 1

Label 2

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Contents

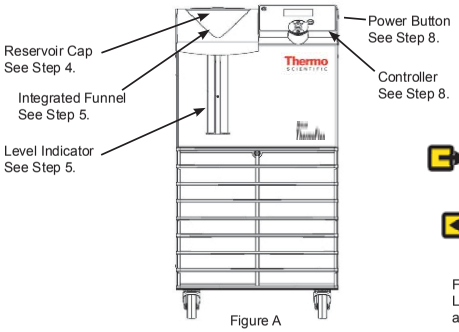


Figure A

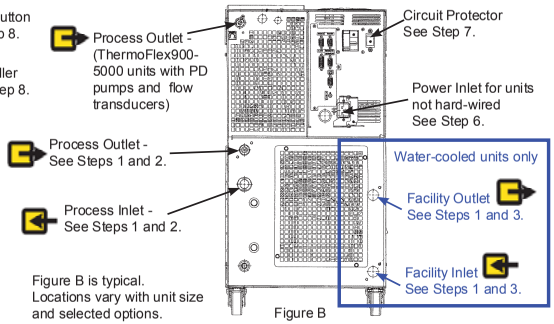


Figure B is typical. Locations vary with unit size and selected options.

Figure B

What you need to get started:

- An adjustable wrench
- Facility water supply and return (water-cooled units)
- Appropriate hose or plumbing
- Appropriate size clamps or connection type
- Teflon® Tape or appropriate sealant

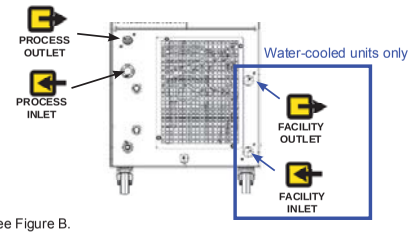
Process Fluid Connections (FNPT)

Outlet		
ThermoFlex900 - 10000	P1 P2 T1	1/2" cast bronze
ThermoFlex3500 - 5000	P3 P4	3/4" cast bronze
ThermoFlex7500 - 10000	P3 P5	1" wrought copper
Inlet - Same size as outlet		all units stainless steel

Facility Water Connections (FNPT)

Inlet/Outlet	
ThermoFlex1400 - 5000	½" cast bronze
ThermoFlex7500 - 10000	¾" cast bronze

1 Pull out the plastic shipping plugs.



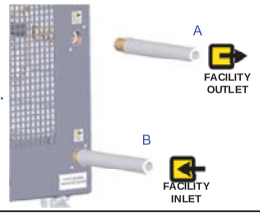
See Figure B.

2 Connect the ThermoFlex PROCESS OUTLET (A) to the fluid inlet on your application. Connect the ThermoFlex PROCESS INLET (B) to the fluid outlet on your application. Ensure the connections are sealed and secure. **For air-cooled units skip to Step 4.**

See Figure B.

3 Connect the ThermoFlex FACILITY OUTLET (A) to your facility water return or drain. Connect the ThermoFlex FACILITY INLET (B) to your facility water supply. Ensure the connections are sealed and secure.

For water-cooled units only.

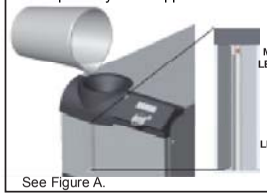


See Figure B.

4 Remove the reservoir cap by unscrewing it counter-clockwise.

See Figure A.

5 *Slowly* fill reservoir with clean process fluid (see Table 1), utilizing sight tube for easy fluid level monitoring. When the reservoir is full replace the reservoir cap, hand tight. Since the reservoir capacity may be small compared to your application and air may need to be purged from the lines, have extra cooling fluid on hand to keep the system topped off when external circulation is started.



Note: Be careful not to fill the reservoir above MAX LEVEL fill line. This will result in a unit over flow error (O FLO) which will cause the unit to shut down.

See Figure A.

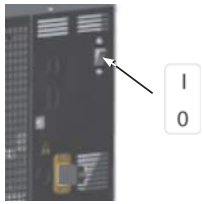
6 Verify the appropriate voltage. For units supplied with a line cord, insert female end of power cord into chiller and then insert male end of power cord into power outlet. (The line cord is located under the shipping crate's lid. Do not discard the lid until the cord is located.)

Note: ThermoFlex900-5000 units equipped with the Variable Voltage or Global Voltage option have a voltage configuration panel located behind an access panel on the rear of the unit. Refer to the Voltage Instruction Sheet shipped with the unit, or see manual Appendix B.

Note: For units requiring hard wiring see Section 3 in the manual.

See Figure B.

7 Place the circuit protector to the on (I) position. The controller display will indicate a series of scrolling bars ( ). The bars will scroll upward indicating the unit is initializing, this takes approximately 15 seconds.



See Figure B.

8 Press .

The controller will display **SEtuP**.

Note: If the unit is equipped with a deionization filter cartridge refer to the manual, Section 5, for installation.

Please see reverse side for additional steps.

See Figure A.

Safety Precautions:

The unit is designed for indoor use only.

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

Never use flammable or corrosive fluids with this unit.

Never connect process fluid lines to your facility water supply or to any pressurized liquid source.

If your unit is equipped with a positive displacement pump (P1 or P2), ensure your application plumbing lines and fittings are rated to withstand a minimum of 185 psi.

Before using any fluid or performing maintenance where contact with the fluid is likely refer to the manufacturer's MSDS for handling precautions.

Table 1 - Acceptable Fluids:

Use of any fluid not listed below will void the manufacturer's warranty.

- Filtered/Single Distilled Water
- Deionized water (1-3 MΩ-cm, compensated)
- 0 – 75% Ethylene Glycol/Water
- 0 – 75% Propylene Glycol/Water

Quick Start - Used for Initial Start Up Only — perform steps 9 to 20 for all units.

NOTE: Some ranges/defaults are pump dependent, see Section 4 in the manual. Once any Setup step is completed, meaning you pressed the enter key a second time, you can not repeat the step to make corrections. You *can* make changes after the unit is started.

SEtuP — Press enter to continue the setup procedure.

9 UnitS — **UnitS are the temperature, fluid flow (optional) and pressure scales.**

Scales: °C/°F GPM/LPM PSI/Bar/KPAS

- Press enter
- The display will flash between **UnitS** and **°C**
- If desired, use ▲ to change the scale to °F
- Press enter to sequence to the next display
- Do the same for **Flow** and Pressure scales

10 Hi t — **Hi t sets the fluid's High Temperature Alarm Limit.**

Range: +3°C to +42°C
Factory Default: +42°C

- Press enter
- The display will flash between **Hi t** and **42**
- If desired, use ▲▼ to adjust the value
- Press enter to sequence to the next display

11 Lo t — **Lo t sets the fluid's Low Temperature Alarm Limit.**

Range: +3°C to +42°C
Factory Default: 3°C

- Press enter
- The display will flash between **Lo t** and **3**
- If desired, use ▲▼ to adjust the value
- Press enter

12 Hi P1 — **Hi P1 sets the Pump's High Pressure Discharge Alarm Limit.**

Range: Varies by pump
Factory Default: Varies by pump

- Press enter
- The display will flash between **Hi P1** and the default
- If desired, use ▲▼ to adjust the value
- Press enter

13 dELAY — **dELAY is the length of time the pump can exceed the Hi P1 Alarm Limit before shutting down.**

Range: Varies by pump
Factory Default: 0 seconds

- The display will flash between **dELAY** and **0**
- If desired, use ▲▼ to adjust the value
- Press enter

NOTE This feature is active only if the unit is configured to shut down, see Step 16.

14 Lo P1 — **Lo P1 sets the Pump's Low Pressure Discharge Alarm Limit.**

Range: Varies by pump
Factory Default: Varies by pump

- Press enter
- The display will flash between **Lo P1** and the default
- If desired, use ▲▼ to adjust the default
- Press enter

15 dELAY — **dELAY is the length of time the pump can exceed the Lo P1 Alarm Limit before shutting down.**

Range: 0 to 30 seconds
Factory Default: 10 seconds

- The display will flash between **dELAY** and **10**
- If desired, use ▲▼ to adjust the value
- Press enter

NOTE This feature is active only if the unit is configured to shut down, see Step 16.

16 ALr — **ALr configures the unit's reaction to temperature, pressure, and flow (optional) alarm limits - either shut down (fLt) or continue to run (indC). See Section 4 in the manual for more information.**

Range: fLt* or indC**
Factory Default: fLt

- Press enter
- The display will flash between **ALr** and **fLt**
- If desired, press ▼ to display **indC**
- Press enter

*fLt = fault (shut down)
**indC = indicate (continue to run)

17 Sound — **Turns the unit's audible alarm on or off.**

Range: on or OFF
Factory Default: on

- Press enter
- The display will flash between **Sound** and **on**
- If desired, press ▼ to display **OFF**
- Press enter

18 StArt — **StArt enables/disables auto restart.**

Range: on or OFF
Factory Default: OFF

- Press enter
- The display will flash between **StArt** and **OFF**
- If desired, press ▲ to display **on**
- Press enter

19 CArE — **CArE is used to set the preventative care cleaning frequency reminder for the unit's air and fluid filters.**

Range: off, L1 - 1000 hours, L2 - 2000 hours, L3 -3000 hours
Factory Default: L1

- Press enter
- The display will flash between **CArE** and **L1**
- If desired, use ▲▼ to change display to off, L2 or L3
- Press enter

If applicable, see boxes on right to set up options. For units with Analog I/O (ACOM) refer to the additional quick start supplied with your unit.

20 StorE

- Press ▲ to save *all* settings

The unit will automatically start.

- Press ▼ to disregard *all* changes and restore the factory default values.

The display will go blank.

The Setup procedure is now complete.

When the unit starts the controller will display the process fluid temperature.

If desired, you can change/verify the unit's setpoint by pressing mode.

SP — **SP is used to adjust the setpoint.**

Range: +5°C to +40°C
Factory Default: +20°C

- The display will flash between **SP** and **20**
- If desired, use ▲▼ to change the setting
- Press enter to save the new setpoint and return to the temperature display

Option - Voltage — Step A

A HZ — **HZ is used to identify the incoming frequency for units with P3 - P5 pumps *and* variable voltage capability. The selected frequency automatically adjusts the firmware's *fixed* high pressure default setting.**

- Press enter
- The display will flash between **HZ** and **60**
- If needed, use ▲▼ to change the frequency
- Press enter

If your unit does not have a flow transducer or serial communications see Step 20.

Option - Flow Transducer — Steps B and C

B HiFLO — **HiFLO sets the high flow alarm limit.**

Range: Varies by pump
Factory Default: Varies by pump

- Press enter
- The display will flash between **HiFLO** and the default
- If desired, use ▲▼ to adjust the value
- Press enter

C LoFLO — **LoFLO sets the low flow alarm limit.**

Range: Varies by pump
Factory Default: Varies by pump

- Press enter
- The display will flash between **LoFLO** and the default
- If desired, use ▲▼ to adjust the value
- Press enter

If your unit does not have serial communications see Step 20.

Option - Serial Communications (DCOM) — Steps D to I

D SEr — **SEr is used to enable/disable and to configure serial communications mode.**

Range: off, rS232, rS485
Factory Default: off

- Press enter
- The display will flash between **SEr** and **OFF**
- If desired, use ▲▼ to change the mode
- Press enter

E BAud — **BAud is used to select the baud rate (speed) for serial communication.**

Range: 9600, 4800, 2400, 1200, 600, or 300 bits per second.

- Press enter
- The display will flash between **BAud** and **9600**
- If desired, use ▲▼ to change the rate
- Press enter

F dAtA — **dAtA is used to display the number of bits.**

Display: 8

- Press enter
- The display will flash between **dAtA** and **8**
- Press enter

G StoP — **StoP is used to indicate the number of stop bits.**

Range: 2 or 1
Factory Default: 1

- Press enter
- The display will flash between **StoP** and **1**
- If desired, use ▲▼ to change the setting
- Press enter

H PAr — **PAr is used as a means to check for communication errors.**

Range: even, odd, or none
Factory Default: none

- Press enter
- The display will flash between **PAr** and **none**
- If desired, use ▲▼ to change the setting
- Press enter

I u id — **u id (unit id) is used in RS485 only. Identifies devices connected to the RS485 port.**

Range: 1 to 99
Factory Default: 1

- Press enter
- The display will flash between **u id** and **1**
- If desired, use ▲▼ to change the setting
- Press enter

See Step 20.

Preface

Compliance

CSA Approved - Laboratory equipment-electrical

File # 105974_C_000

CLASS: 8721-05 CAN/CSA-C22.2 No. 61010-1-04

CLASS: 8721-05 ANSI/UL Standard 61010-1

Products tested and found compliant with the requirements defined in the EMC standards defined by 89/336/EEC as well as Low Voltage Directive (LVD) 73/2 can be identified by the CE Mark on the rear of the unit. The testing has demonstrated compliance with the following directives:

- LVD, 73/23/EEC IEC/EN 61010-1
- EMC, 89/336/EEC IEC/EN 61326-1

For any additional information, refer to the Declaration of Conformity that shipped with the unit.

NOTE ThermoFlex7500 and ThermoFlex10000 compliance is pending. ▲

WEEE

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:

Thermo Fisher Scientific has contracted with one or more recycling/ disposal companies in each EU Member State, dispose of or recycle this product through them. Further information on Thermo Fisher Scientific's compliance with these Directives is available at:

www.thermo.com/WEEERoHS

After-sale Support

Thermo Fisher Scientific is committed to customer service both during and after the sale. If you have questions concerning the unit operation, or questions concerning spare parts or Service Contracts, call our Sales, Service and Customer Support phone number, see inside cover for contact information.

When calling, please refer to the labels on the inside cover. These labels list all the necessary information needed to properly identify your unit.

Feedback

We appreciate any feedback you can give us on this manual. Please e-mail us at thermoscientificmanuals@thermofisher.com. Be sure to include the manual part number and the revision date listed on the front cover.

Warranty

Thermo Scientific NESLAB ThermoFlex units have a warranty against defective parts and workmanship for 24 months from date of shipment. See back page for more details.

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.

Out of Box Failure
An Out of Box Failure is defined as any product that fails to operate in conformance with sellers published specifications at initial power up. Install the unit in accordance with manufacturer's recommended operating conditions within 30 days of shipment from the seller.

Any Temperature Control product meeting the definition of an Out of Box Failure must be packed and shipped back in the original packaging to Thermo Fisher Scientific for replacement with a new unit; seller to pay the cost of shipping. Customer must receive a Return Material Authorization (RMA) from Thermo Fisher prior to shipping the unit.

Section 1 Safety

Safety Warnings

Warnings are posted throughout the manual. These warnings are designated by an exclamation mark inside an equilateral triangle and text highlighted in bold. Read and follow these important instructions. Failure to observe these instructions can result in permanent damage to the unit, significant property damage, or personal injury or death.

The lightning flash with arrow symbol, within an equilateral triangle, is intended to alert the user to the presence of non-insulated "dangerous voltage" within the unit's enclosure. The voltage magnitude is significant enough to constitute a risk of electrical shock.

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, please contact us. See inside cover for contact information.

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

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

Always turn the unit off and disconnect the supply voltage from its power source before moving the unit. ▲

Never connect the process fluid inlet or outlet fittings to your building water supply or any water pressure source. ▲

Never use flammable or corrosive fluids with this unit. Use of these fluids will void the manufacturer's warranty. ▲

Do not use automotive antifreeze. Commercial antifreeze contains silicates that can damage the pump seals. Use of automotive antifreeze will void the manufacturer's warranty. ▲

To prevent freezing/glazing of the plate exchanger, ThermoFlex7500 and ThermoFlex10000 units require the use of 50/50 EG/water or 50/50 PG/water below 10°C process temperature. ▲

Before using any fluid or performing maintenance where contact with the fluid is likely refer to the manufacturer's MSDS for handling precautions. ▲

When using a process fluid mixture of ethylene glycol and water or propylene glycol and water, check the fluid concentration and pH on a regular basis. Changes in concentration and pH can impact system performance. See Section 3. ▲

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 unit's components. ▲

Drain the unit before it is transported and/or stored in near or below freezing temperatures, see Draining in Section 8. Store the unit in the temperature range -25°C to 60°C (with packaging), and <80% relative humidity. ▲

The circuit protector located on the rear of the unit is not intended to act as a disconnecting means. ▲

Observe all warning labels. ▲

Never remove warning labels. ▲

Never operate damaged or leaking equipment. ▲

Never operate the unit without process fluid in the reservoir. ▲

Always turn off the unit and disconnect the power cord from the power source before performing any service or maintenance procedures, or before moving the unit. ▲

Never operate the unit with panels removed. ▲

Never operate equipment with damaged power cords. ▲

Refer service and repairs to a qualified technician. ▲

Section 2 General Information

Description

The Thermo Scientific NESLAB ThermoFlex™ recirculating chiller is designed to provide a continuous supply of fluid at a constant temperature and volume. The unit consists of an air-cooled or water-cooled refrigeration system, heat exchanger, recirculating pump, polyethylene reservoir, and a microprocessor controller.

Specifications

	ThermoFlex900	ThermoFlex1400	ThermoFlex2500
Process Fluid Temperature and Setpoint Range	+5°C to +40°C +41°F to +104°F	+5°C to +40°C +41°F to +104°F	+5°C to +40°C +41°F to +104°F
Ambient Temperature Range	+10°C to +40°C +50°F to +104°F	+10°C to +40°C +50°F to +104°F	+10°C to +40°C +50°F to +104°F
Temperature Stability	±0.1°C	±0.1°C	±0.1°C
Cooling Capacity at 20°C 60 Hz 50 Hz	900 W (3074 BTU) 750 W (2561 BTU)	1400 W (4781 BTU) 1170 W (3996 BTU)	2500 W (8538 BTU)* 2200 W (7513 BTU)
	*To meet this specification, the ThermoFlex2500 air-cooled units require the fan to be operating in the high-speed mode, see Section 3.		
Refrigerant	R134A	R134A	R134A
Reservoir Volume Gallons Liters	1.9 7.2	1.9 7.2	1.9 7.2
Footprint or Dimensions (H x W x D)			
Inches Centimeters	27.3 x 14.2 x 24.6 69.2 x 36.0 x 62.4	27.3 x 14.2 x 24.6 69.2 x 36.0 x 62.4	29.0 x 17.2 x 26.5 73.6 x 43.6 x 67.3
Unit Weight (empty) lb kg	130.5 59.2	130.5 59.2	175.5 79.6
Pumping Capacity			
P1 - Positive Displacement 60 Hz 50 Hz	2.1 gpm @ 60 psig (7.9 lpm @ 4.1 bar) 1.7 gpm @ 60 psig (6.4 lpm @ 4.1 bar)		
P2 - Positive Displacement 60 Hz 50 Hz	4.0 gpm @ 60 psig (15.1 lpm @ 4.1 bar) 3.3 gpm @ 60 psig (12.5 lpm @ 4.1 bar)		
T1 - Turbine 60 Hz* 50 Hz*	3.5 gpm @ 60 psig (13.3 lpm @ 4.1 bar) 2.5 gpm @ 60 psig (9.5 lpm @ 4.1 bar)		
* Pumping capacity pressure values for turbine pumps are differential pressures between the inlet and the outlet of the unit.			

- Cooling capacity based on P2 pumps with no backpressure. Heat input from the pump will result in a reduction in cooling capacity. The cooling capacity reduction will vary based on the pump chosen as well as pump backpressure and flow.
- Specifications obtained at sea level using water as the recirculating fluid, at a 20°C process setpoint, 25°C ambient condition, at nominal operating voltage. Other fluids, fluid temperatures, ambient temperatures, altitude or operating voltages will affect performance. See Section 3.
- Additional dimensions are at the end of this section, add 1/8" (3 mm) to height for SEMI units.
- Add 5 pounds (2 kilograms) for global voltage units.
- Thermo Fisher Scientific reserves the right to change specifications without notice.

Specifications

	ThermoFlex3500	ThermoFlex5000
Process FluidTemperature and Setpoint Range	+5°C to +40°C +41°F to +104°F	+5°C to +40°C +41°F to +104°F
Ambient Temperature Range	+10°C to +40°C +50°F to +104°F	+10°C to +40°C +50°F to +104°F
Temperature Stability	± 0.1°C	± 0.1°C
Cooling Capacity at 20°C 60 Hz 50 Hz	3500 W (11953 BTU) 3050 W (10416 BTU)	5000 W (17076 BTU) 4400 W (15027 BTU)
Refrigerant	R407C	R407C
Reservoir Volume Gallons Liters	1.9 7.2	1.9 7.2
Footprint or Dimensions (H x W x D)		
Inches Centimeters	38.9 x 19.3 x 30.9 98.7 x 48.8 x 78.4	38.9 x 19.3 x 30.9 98.7 x 48.8 x 78.4
Unit Weight P1/ P2/P3/P4 (empty) lb kg	264/264/270/303 120/120/123/138	NA/264/270/303 NA/120/123/138
Pumping Capacity		
P1 - Positive Displacement 60 Hz 50 Hz	2.1 gpm @ 60 psig (7.9 lpm @ 4.1 bar) 1.7 gpm @ 60 psig (6.4 lpm @ 4.1 bar)	Not Available Not Available
P2 - Positive Displacement 60 Hz 50 Hz	4.0 gpm @ 60 psig (15.1 lpm @ 4.1 bar) 3.3 gpm @ 60 psig (12.5 lpm @ 4.1 bar)	4.0 gpm @ 60 psig (15.1 lpm @ 4.1 bar) 3.3 gpm @ 60 psig (12.5 lpm @ 4.1 bar)
T1 - Turbine 60 Hz* 50 Hz*	3.5 gpm @ 60 psig (13.3 lpm @ 4.1 bar) 2.5 gpm @ 60 psig (9.5 lpm @ 4.1 bar)	3.5 gpm @ 60 psig (13.3 lpm @ 4.1 bar) 2.5 gpm @ 60 psig (9.5 lpm @ 4.1 bar)
P3 - Centrifugal Pump 60 Hz* 50 Hz*	10 gpm @ 32 psid (37.9 lpm @ 2.2 bar) 10 gpm @ 20 psid (37.9 lpm @ 1.4 bar)	10 gpm @ 32 psid (37.9 lpm @ 2.2 bar) 10 gpm @ 20 psid (37.9 lpm @ 1.4 bar)
P4 - Centrifugal Pump 60 Hz* 50 Hz*	15 gpm @ 57 psid (56.8 lpm @ 3.9 bar) 15 gpm @ 34 psid (56.8 lpm @ 2.3 bar)	15 gpm @ 57 psid (56.8 lpm @ 3.9 bar) 15 gpm @ 34 psid (56.8 lpm @ 2.3 bar)

* Pumping capacity pressure values for turbine and centrifugal pumps are differential pressures between the inlet and the outlet of the unit.

- Cooling capacity based on P2 pumps with no backpressure. Heat input from the pump will result in a reduction in cooling capacity. The cooling capacity reduction will vary based on the pump chosen as well as pump backpressure and flow.
- Specifications obtained at sea level using water as the recirculating fluid, at a 20°C process setpoint, 25°C ambient condition, at nominal operating voltage. Other fluids, fluid temperatures, ambient temperatures, altitude or operating voltages will affect performance. See Section 3.
- Additional dimensions are at the end of this section, add 1/8" (3 cm) to height for SEMI units.
- Add 30 pounds (14 kilograms) for global voltage units.
- Thermo Fisher Scientific reserves the right to change specifications without notice.

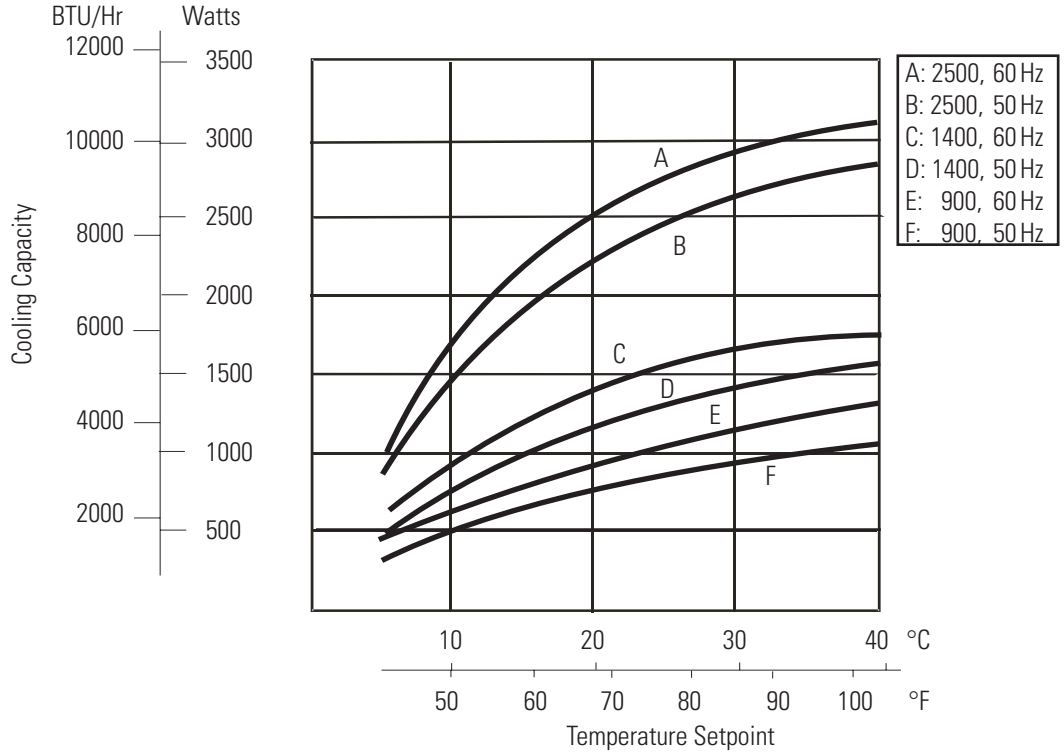
Specifications

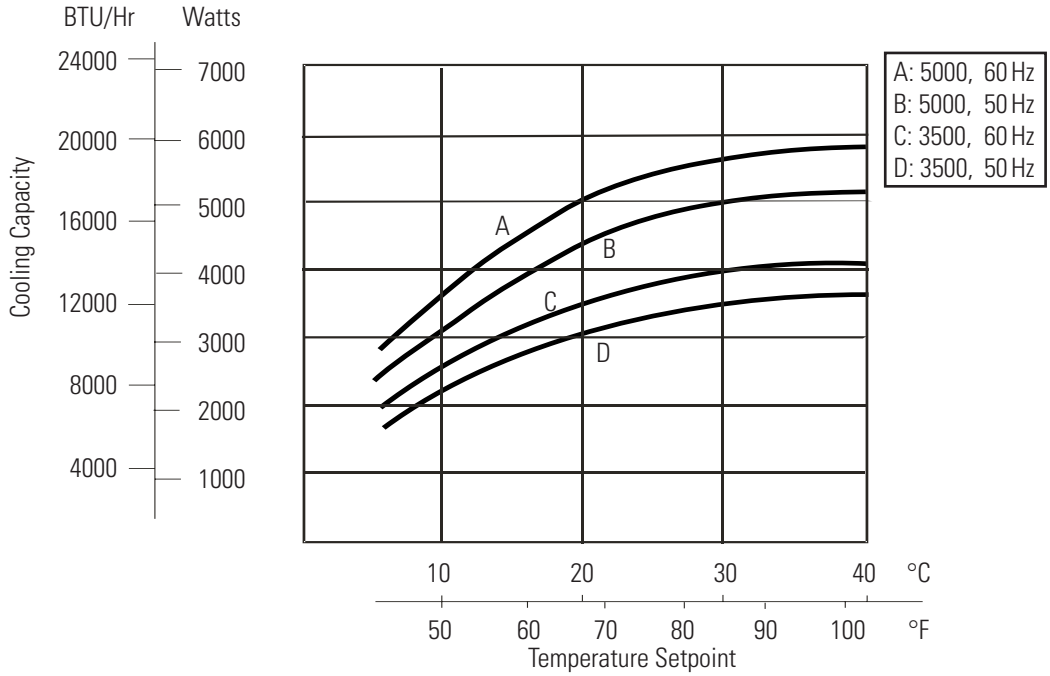
	ThermoFlex7500	ThermoFlex10000
Process Fluid Temperature and Setpoint Range	+5°C to +40°C +41°F to +104°F	+5°C to +40°C +41°F to +104°F
Ambient Temperature Range	+10°C to +40°C +50°F to +104°F	+10°C to +40°C +50°F to +104°F
Temperature Stability	±0.1°C	±0.1°C
Cooling Capacity at 20°C 60 Hz 50 Hz	7500 W (25575 BTU) 6425 W (21910 BTU)	10000 W (34100 BTU) 8500 W (28985 BTU)
Refrigerant	R407C	R407C
Reservoir Volume Gallons Liters	4.75 17.9	4.75 17.9
Footprint or Dimensions (H x W x D)		
Air-Cooled Inches Centimeters	52.3 x 25.2 x 33.8 132.7 x 63.9 x 85.6	52.3 x 25.2 x 33.8 132.7 x 63.9 x 85.6
Water-Cooled Inches Centimeters	45.9 x 25.2 x 33.8 116.6 x 63.9 x 85.6	45.9 x 25.2 x 33.8 116.6 x 63.9 x 85.6
Unit Weight P2/P3/P5 (empty)		
Air-Cooled lb kg	356/372.5/405.5 161.5/169/184	356/372.5/405.5 161.5/169/184
Water-Cooled lb kg	315/331.5/364.5 143/150/165	315/331.5/364.5 143/150/165
Pumping Capacity		
P2 - Positive Displacement 60 Hz 50 Hz	4.0 gpm @ 60 psig (15.1 lpm @ 4.1 bar) 3.3 gpm @ 60 psig (12.5 lpm @ 4.1 bar)	4.0 gpm @ 60 psig (15.1 lpm @ 4.1 bar) 3.3 gpm @ 60 psig (12.5 lpm @ 4.1 bar)
P3 - Centrifugal Pump 60 Hz* 50 Hz*	10 gpm @ 32 psid (37.9 lpm @ 2.2 bar) 10 gpm @ 20 psid (37.9 lpm @ 1.4 bar)	10 gpm @ 32 psid (37.9 lpm @ 2.2 bar) 10 gpm @ 20 psid (37.9 lpm @ 1.4 bar)
P5 - Centrifugal Pump 60 Hz* 50 Hz*	20 gpm @ 60 psid (75.7 lpm @ 4.1 bar) 20 gpm @ 35 psid (75.7 lpm @ 2.4 bar)	20 gpm @ 60 psid (75.7 lpm @ 4.1 bar) 20 gpm @ 35 psid (75.7 lpm @ 2.4 bar)

* Pumping capacity pressure values for centrifugal pumps are differential pressures between the inlet and the outlet of the unit.

- Cooling capacity based on P2 pumps with no backpressure. Heat input from the pump will result in a reduction in cooling capacity. The cooling capacity reduction will vary based on the pump chosen as well as pump backpressure and flow.
- Specifications obtained at sea level using water as the recirculating fluid, at a 20°C process setpoint, 25°C ambient condition, at nominal operating voltage. Other fluids, fluid temperatures, ambient temperatures, altitude or operating voltages will affect performance. See Section 3.
- Additional dimensions are at the end of this section.
- Add 30 pounds (14 kilograms) for global voltage units with a P2 pump. Add 10 pounds (4.5 kilograms) for units with a P3 or P5 pump.
- Thermo Fisher Scientific reserves the right to change specifications without notice.

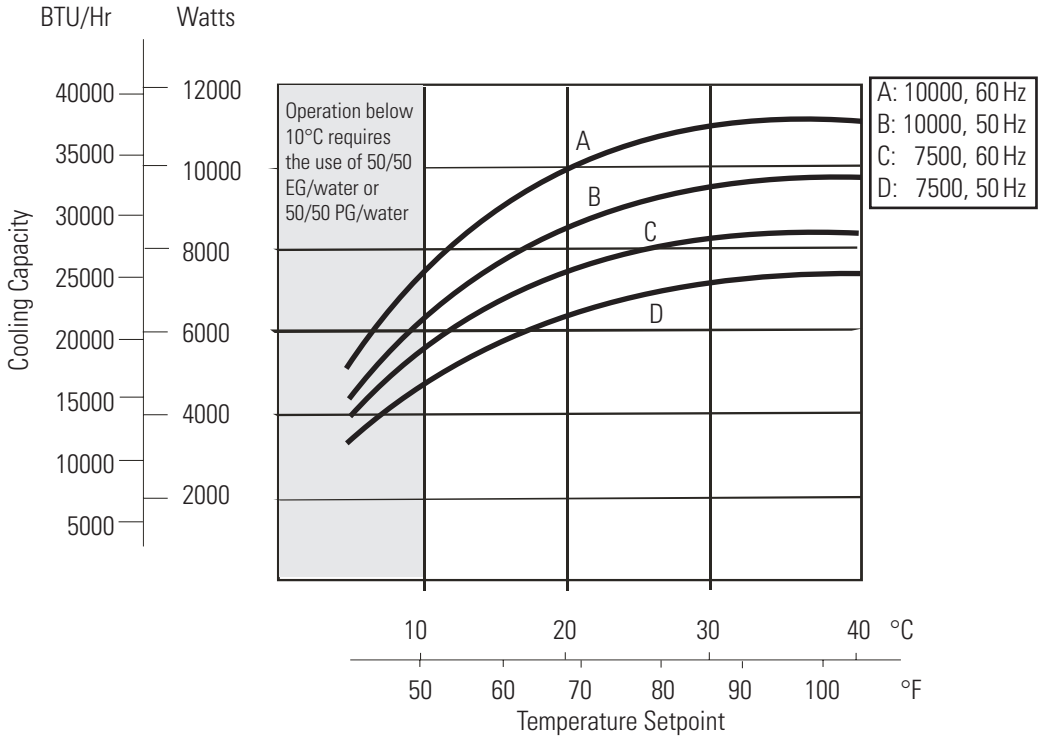
Cooling Capacity





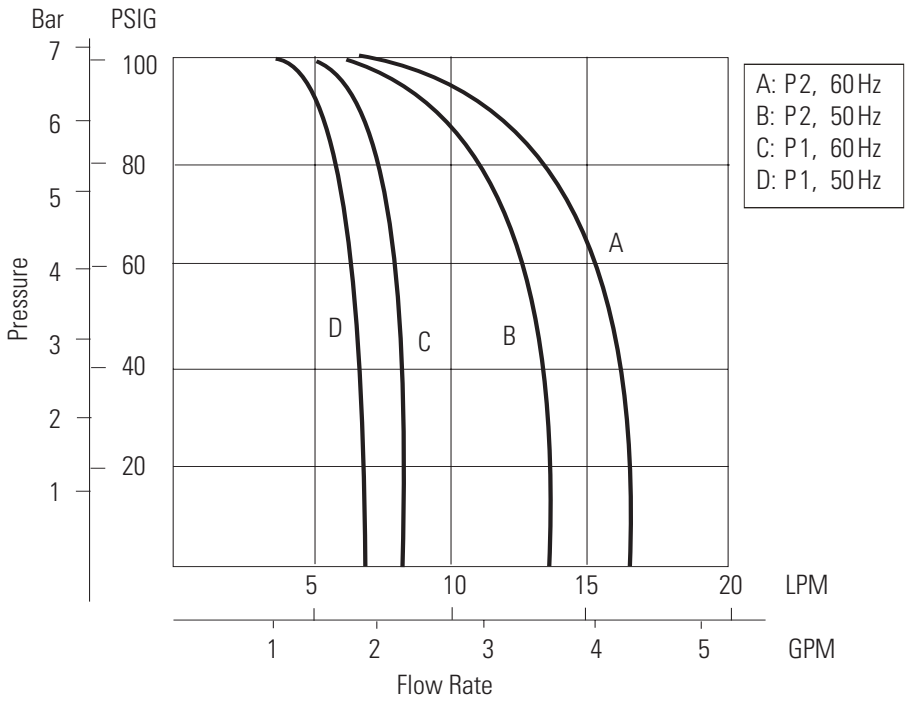
- Specifications obtained at sea level using water as the recirculating fluid, at a 20°C process setpoint, 25°C ambient condition, at nominal operating voltage, on units with P2 pumps with no back pressure. Other fluids, fluid temperatures, ambient temperatures, altitude, operating voltages or pumps will affect performance. See Section 3.
- Thermo Fisher Scientific reserves the right to change specifications without notice.

Cooling Capacity

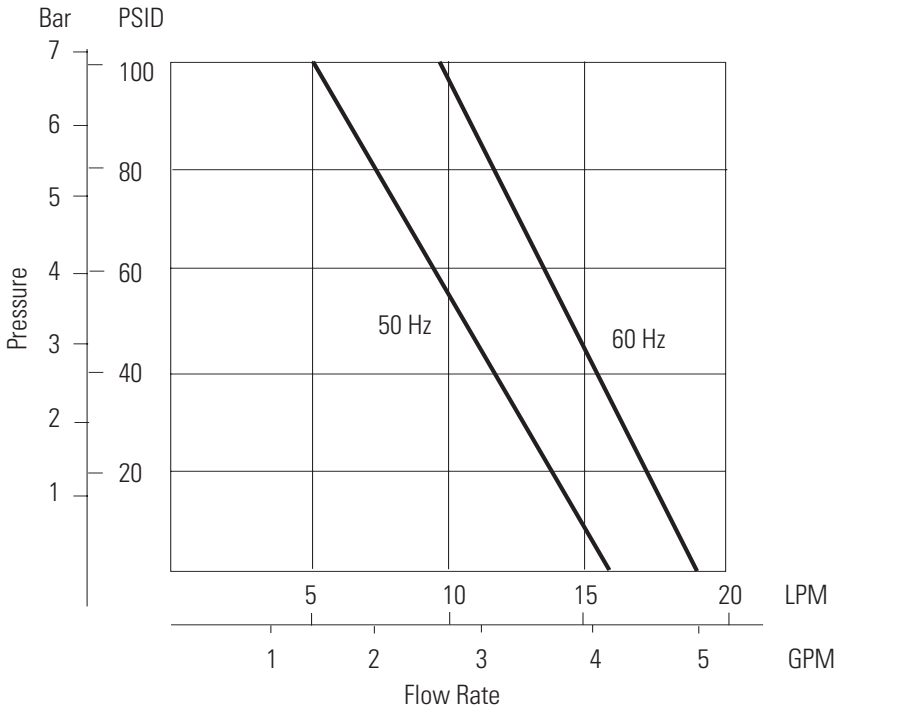


- Specifications obtained at sea level using water as the recirculating fluid, at a 20°C process setpoint, 25°C ambient condition, at nominal operating voltage, on units with P2 pumps with no back pressure. Other fluids, fluid temperatures, ambient temperatures, altitude, operating voltages or pumps will affect performance. See Section 3.
- Units require the use of 50/50 EG/water or 50/50 PG/water below 10°C process temperature to prevent freezing/glazing of the plate exchanger.
- Thermo Fisher Scientific reserves the right to change specifications without notice.

Pumping Capacity
Positive Displacement Pump P1/P2

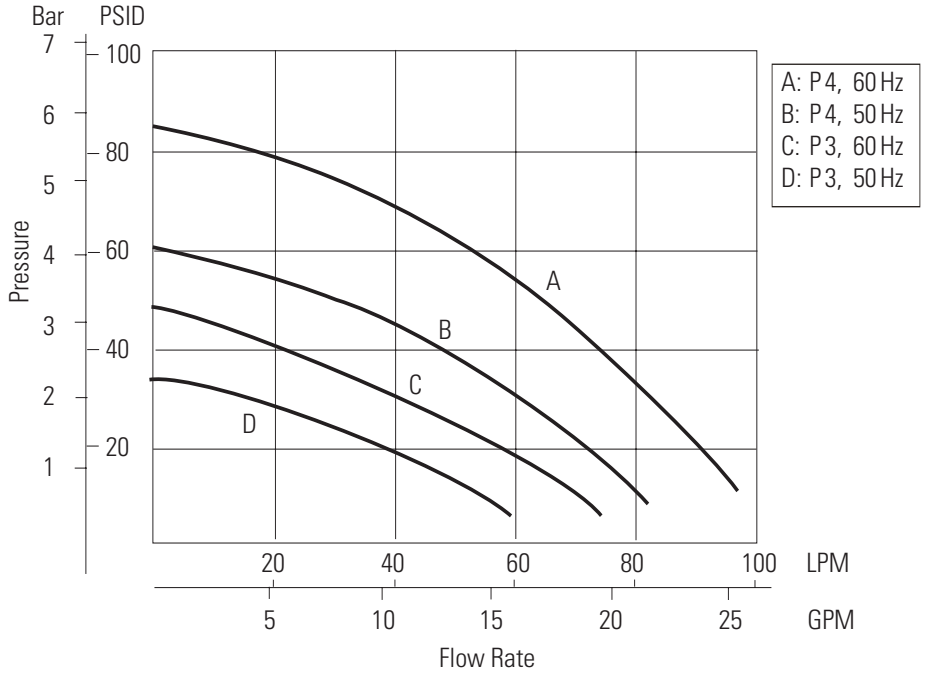


Pumping Capacity
Turbine Pump T1

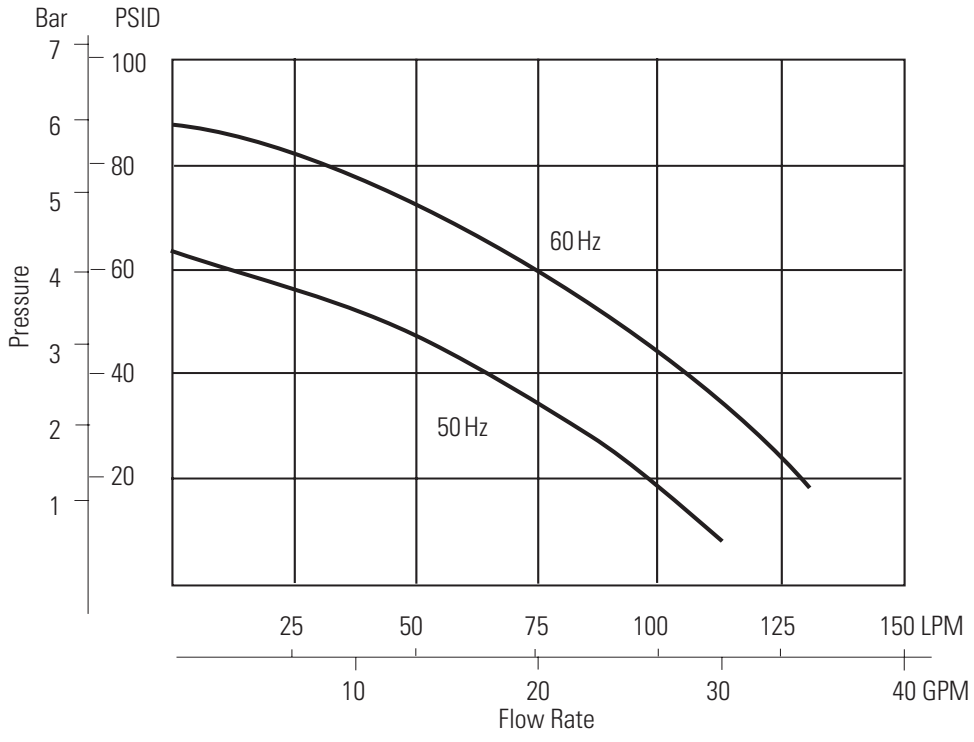


- Pump curves are nominal values. Pressure values for turbine pumps are differential pressures between the inlet and the outlet of the unit.
- Pump performance results were obtained with no restrictions on the return to the system or with any options installed. For example, utilizing the DI option will result in a 0.5 gpm flow reduction .
- Specifications obtained at sea level using water as the recirculating fluid, at a 20°C process setpoint, 25°C ambient condition, at nominal operating voltage. Other fluids, fluid temperatures, ambient temperatures, altitude or operating voltages will affect performance. See Section 3.

Pumping Capacity
Centrifugal Pump P3/P4



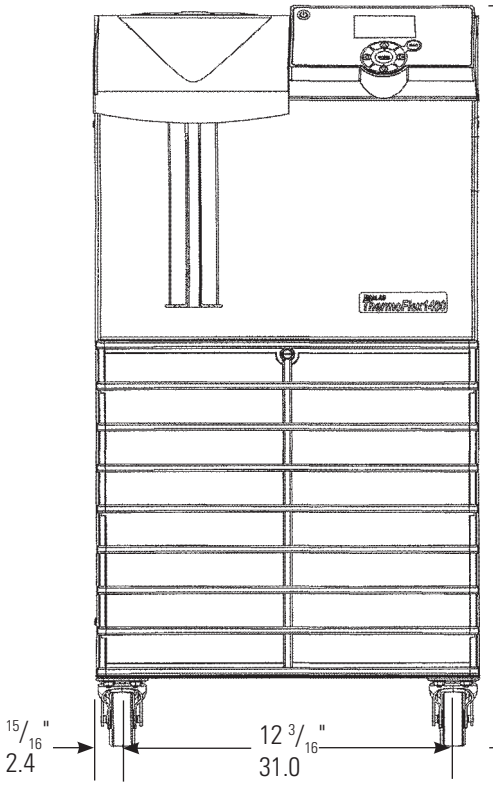
Pumping Capacity
Centrifugal Pump P5



- Pump curves are nominal values. Pressure values for centrifugal pumps are differential pressures between the inlet and the outlet of the unit.
- Pump performance results were obtained with no restrictions on the return to the system or with any options installed. For example, utilizing the DI option will result in a 0.5 gpm flow reduction.
- Specifications obtained at sea level using water as the recirculating fluid, at a 20°C process setpoint, 25°C ambient condition, at nominal operating voltage. Other fluids, fluid temperatures, ambient temperatures, altitude or operating voltages will affect performance. See Section 3.
- Thermo Fisher Scientific reserves the right to change specifications without notice.

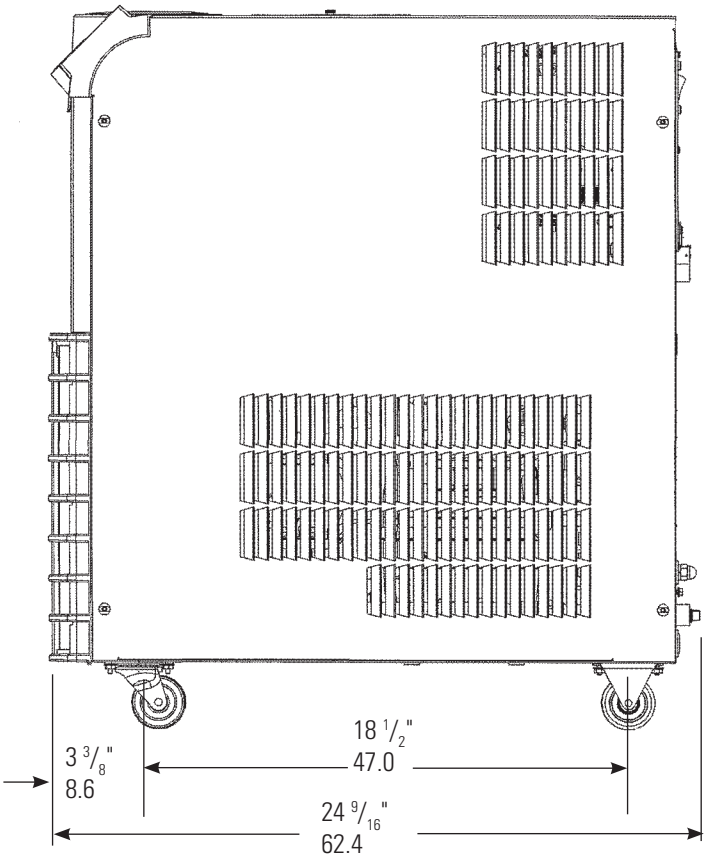
ThermoFlex900/1400
Dimensions
(inches/centimeters)

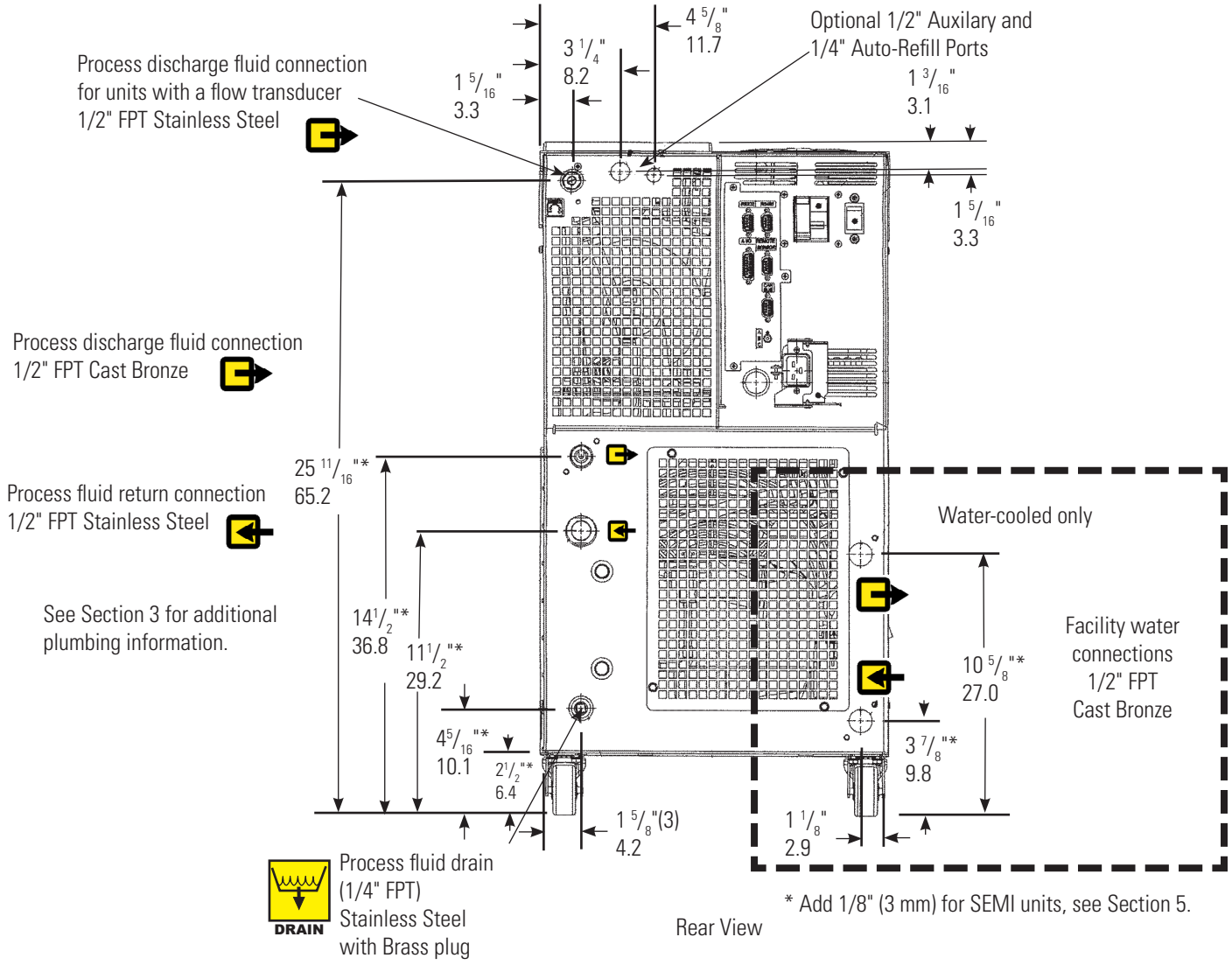
Front View

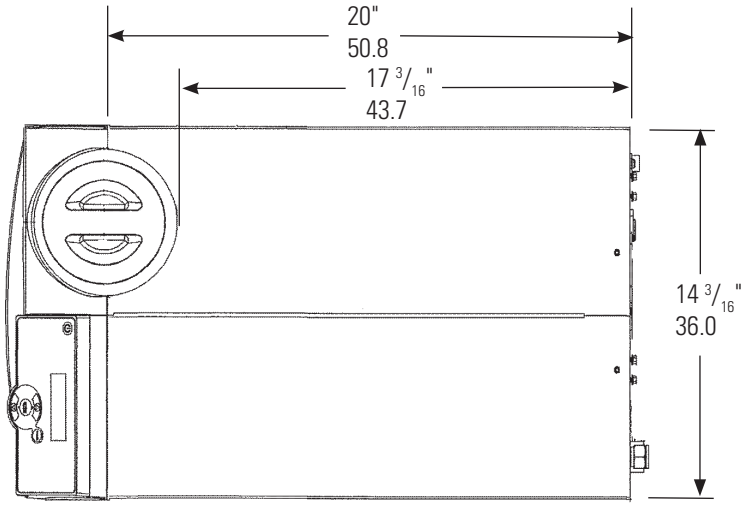


* Add 1/8" (3 mm) for SEMI units, see Section 5.

Side View







Shipping crate dimensions (approximate):

21" (53 cm) wide

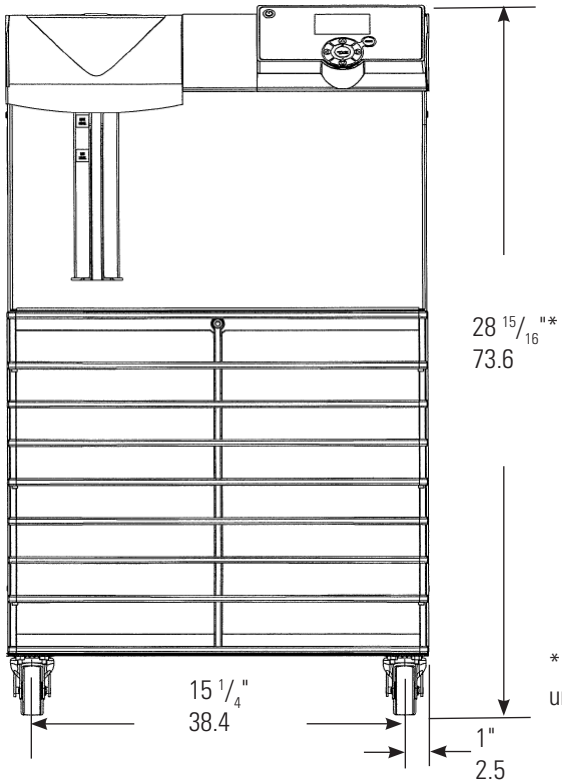
35" (89 cm) tall

40" (102 cm) deep

- Thermo Fisher Scientific reserves the right to change specifications without notice.

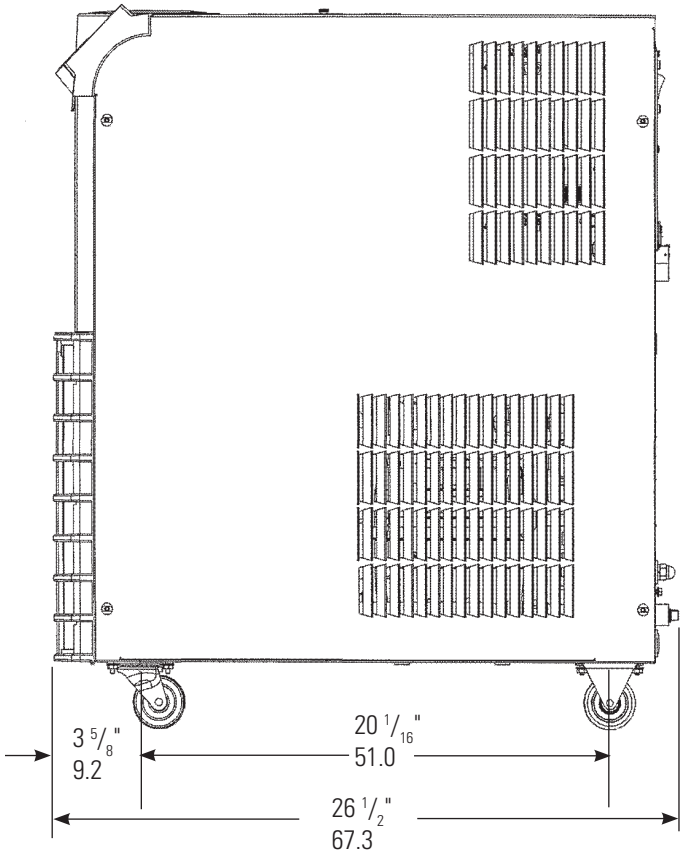
ThermoFlex2500
Dimensions
(inches/centimeters)

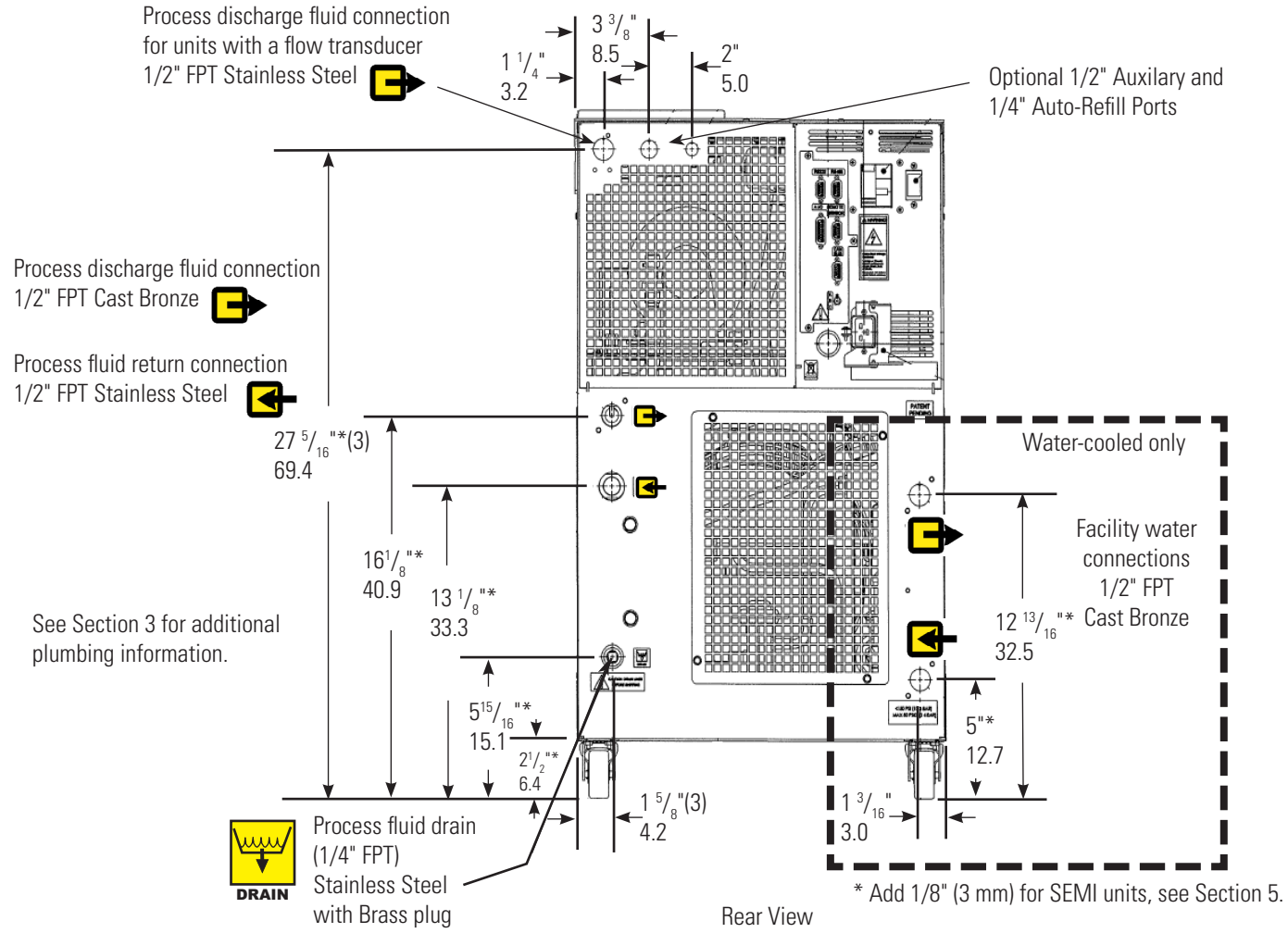
Front View

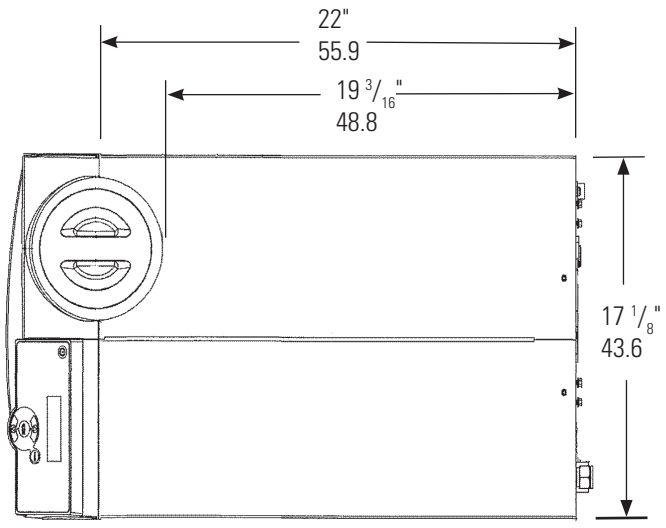


* Add 1/8" (3 mm) for SEMI units, see Section 5.

Side View







Top View

Shipping crate dimensions (approximate):

23" (58 cm) wide

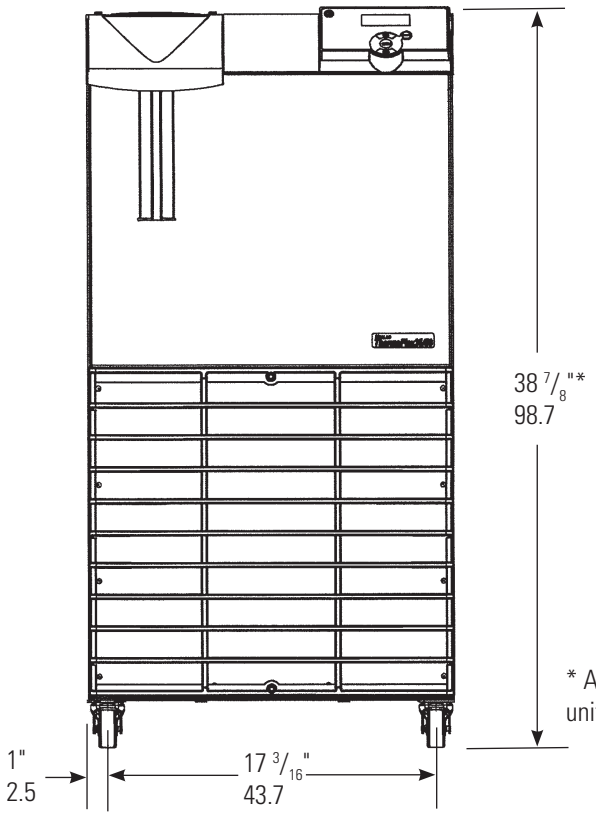
36" (91 cm) tall

40" (102 cm) deep

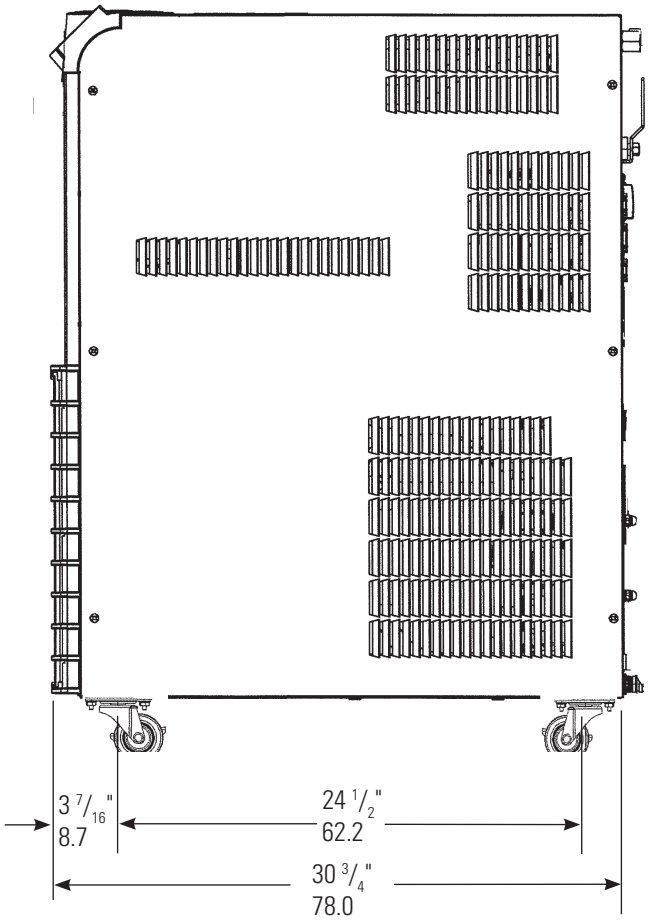
- Thermo Fisher Scientific reserves the right to change specifications without notice.

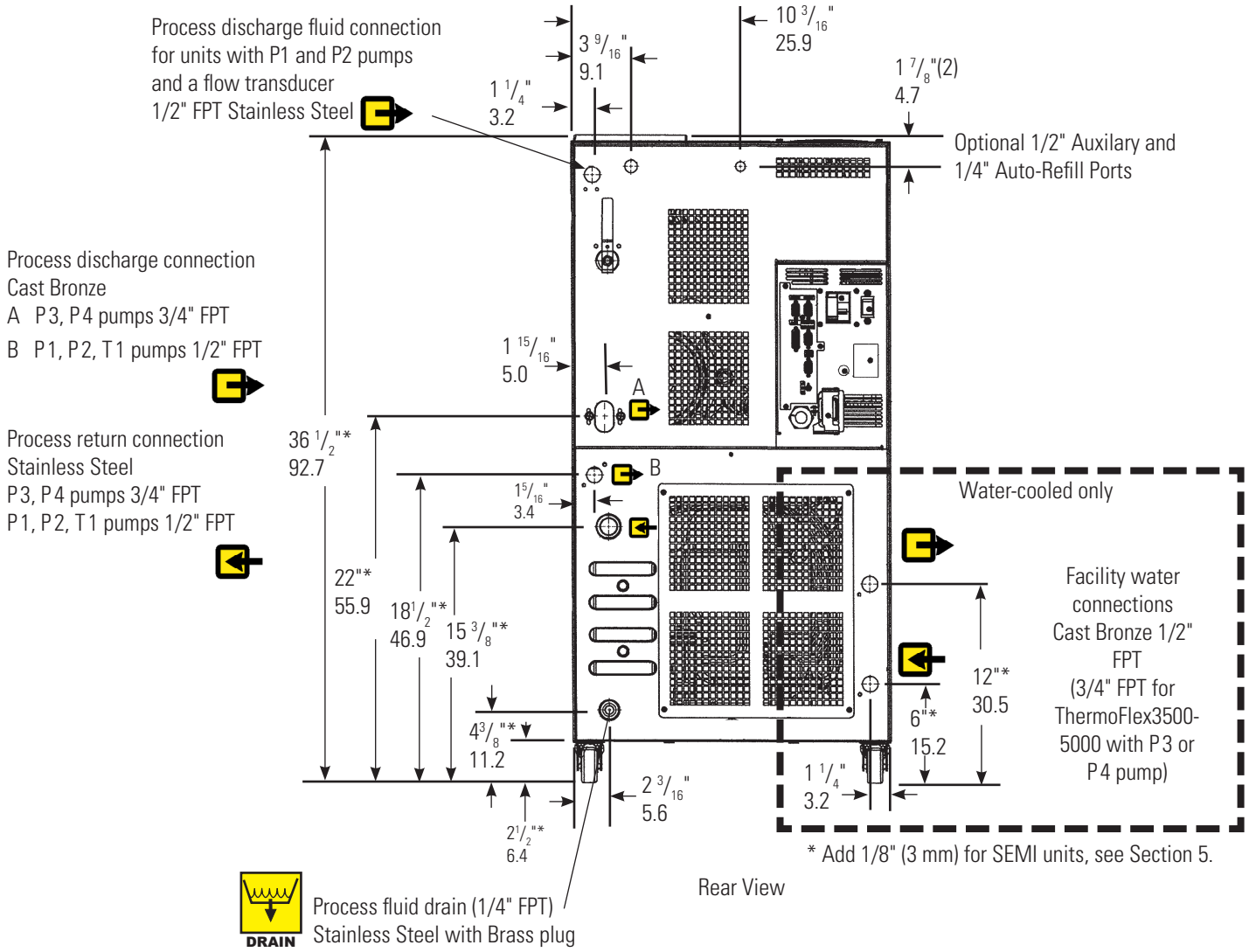
ThermoFlex3500/5000
Dimensions
(inches/centimeters)

Front View

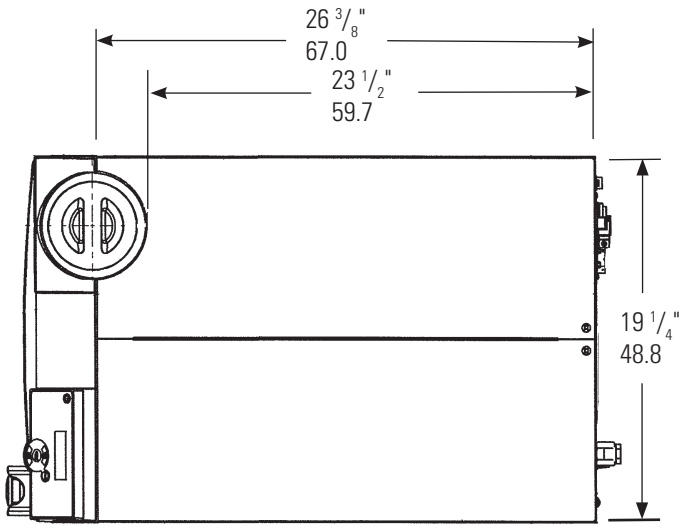


Side View





* Add 1/8" (3 mm) for SEMI units, see Section 5.



Top View

Shipping crate dimensions (approximate):

26" (66 cm) wide

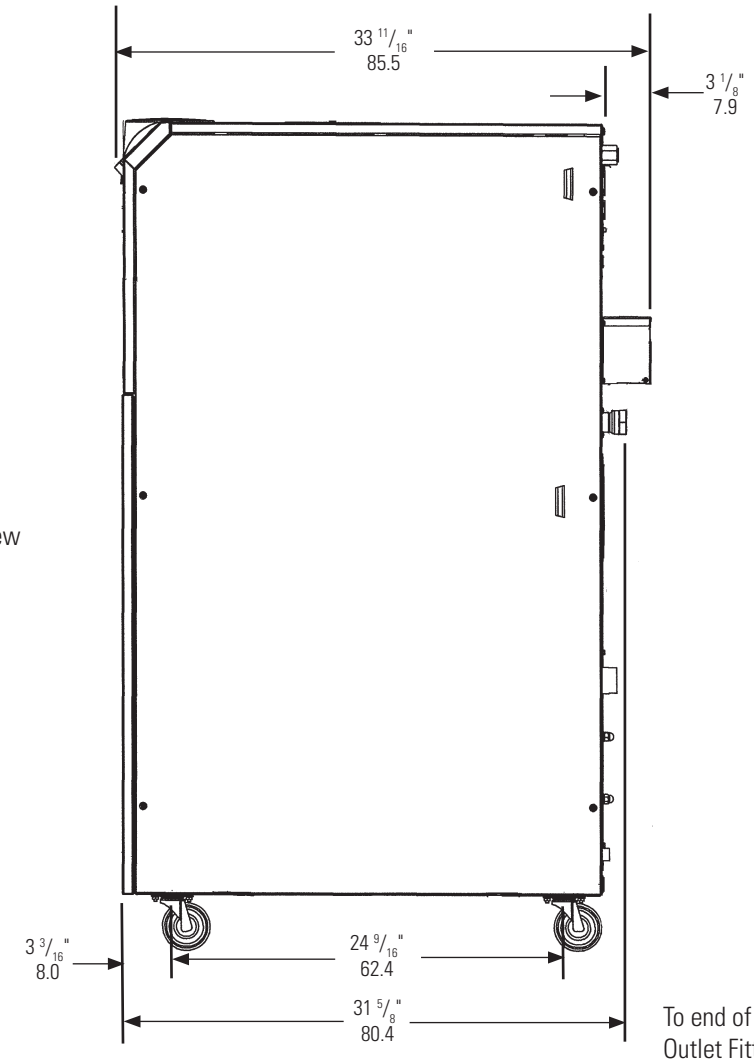
48" (122 cm) tall

47" (119 cm) deep

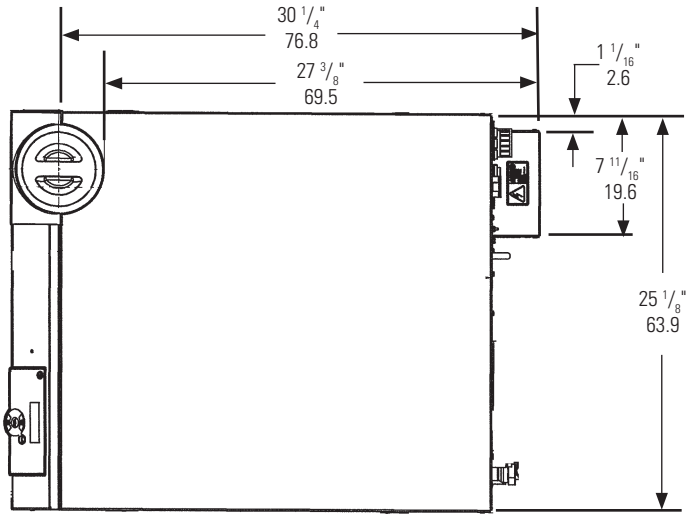
- Thermo Fisher Scientific reserves the right to change specifications without notice.

ThermoFlex7500/10000
Dimensions
(inches/centimeters)

Side View



Top View



Air-cooled shipping crate dimensions (approximate):

35 3/4" (91 cm) wide

61 1/2" (156 cm) tall

46 3/8" (118 cm) deep

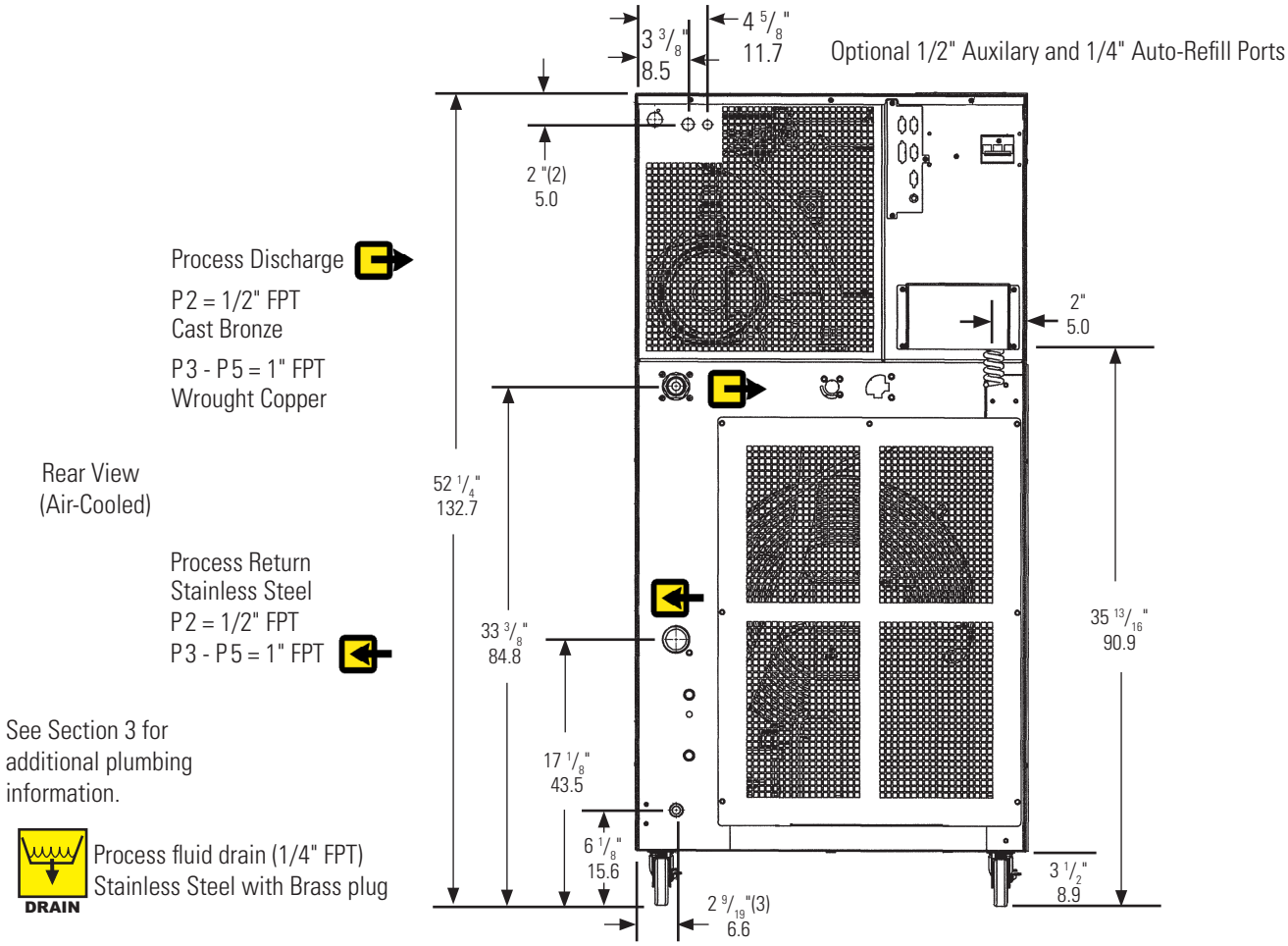
Water-cooled shipping crate dimensions (approximate):

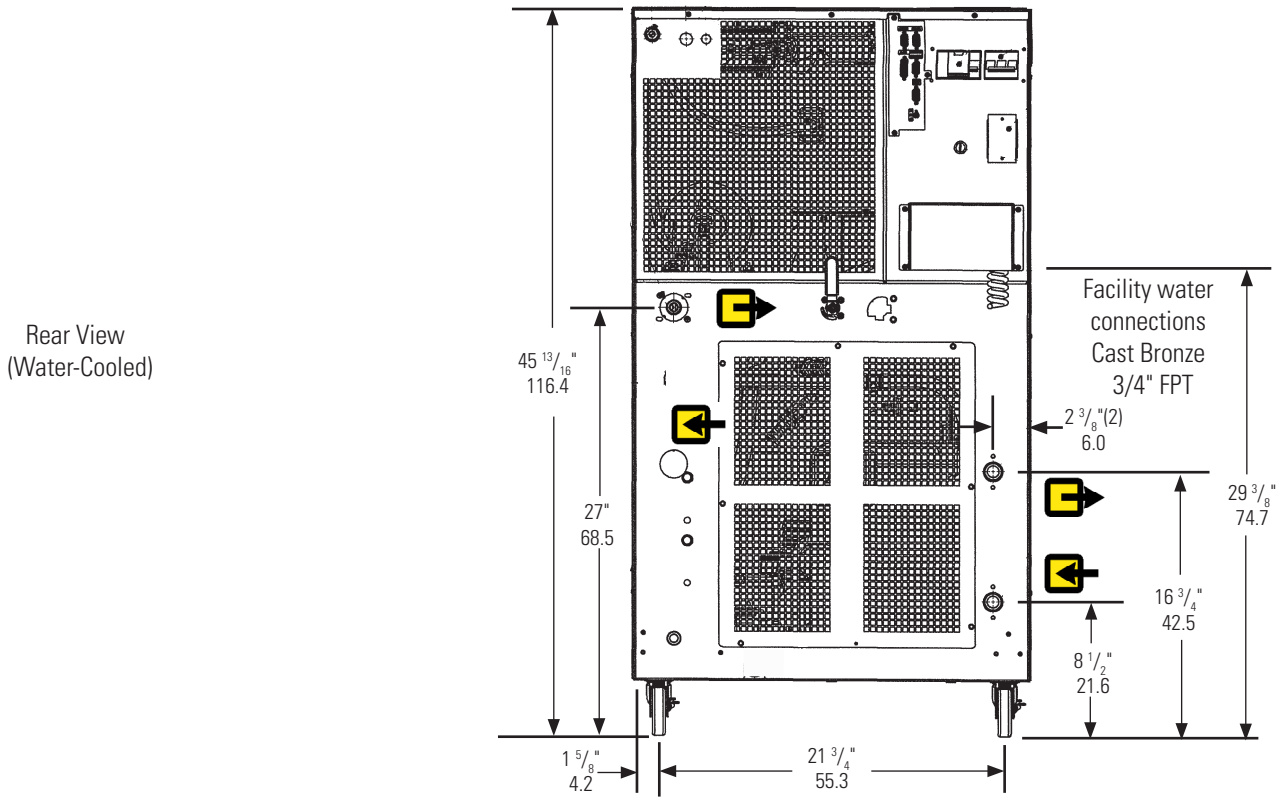
35 3/4" (91 cm) wide

55 1/2" (141 cm) tall

46 3/8" (118 cm) deep

- Thermo Fisher Scientific reserves the right to change specifications without notice.


Optional 1/2" Auxilary and 1/4" Auto-Refill Ports
3 3/8" 8.5
4 5/8" 11.7
2 "(2) 5.0
Process Discharge
P2 = 1/2" FPT
Cast Bronze
P3 - P5 = 1" FPT
Wrought Copper
Rear View
(Air-Cooled)
Process Return
Stainless Steel
P2 = 1/2" FPT
P3 - P5 = 1" FPT
See Section 3 for
additional plumbing
information.
DRAIN
Process fluid drain (1/4" FPT)
Stainless Steel with Brass plug
52 1/4" 132.7
33 3/8" 84.8
17 1/8" 43.5
6 1/8" 15.6
2 9/19"(3) 6.6
2" 5.0
35 13/16" 90.9
3 1/2" 8.9


Rear View
(Water-Cooled)
Facility water
connections
Cast Bronze
3/4" FPT
45 13/16" 116.4
27" 68.5
2 3/8"(2) 6.0
29 3/8" 74.7
16 3/4" 42.5
8 1/2" 21.6
1 5/8" 4.2
21 3/4" 55.3

Section 3 Installation

Site Requirements

Ambient Temperature Range*	10°C to 40°C (50°F to 104°F)
Relative Humidity Range	10% to 80% (non-condensing)
Operating Altitude*	Sea Level to 8000 feet (2438 meters)
Overvoltage Category	II
Pollution Degree	2

*Because of the decrease in air density, maximum temperature for the air entering an air-cooled ThermoFlex is reduced by 1°C per 1,000 feet above sea level. In addition, cooling capacity is reduced 1.2% per 1,000 feet above sea level.

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

Air-cooled units retain their full rated capacity at 20°C setpoint in ambient temperatures up to 25°C (77°F). For ambient temperatures above 25°C please de-rate the cooling capacity 3% for every 1°C above 25°C (77°F), up to a maximum ambient temperature of 40°C (104°F). Please note that when operating at a process temperature lower than 20°C the de-rate percentage may increase due to additional gains from losses to ambient.

NOTE Depending on the setpoint and ambient temperatures, there may be a heat gain or loss through the plumbing resulting in a variation from setpoint temperature at the application inlet. Applications with large temperature variations between ambient and setpoint temperatures, and/or long plumbing lengths, may require additional insulation. ▲

ThermoFlex2500 air-cooled units are equipped with a two-speed fan. Should the unit's internal ambient temperature reach 50°C for 30 seconds, or reach 53°C, the fan speed will switch from slow speed to high speed to maintain internal temperatures within acceptable limits. When the temperature reaches 44°C or below for at least 15 minutes the speed will return to low. When in high speed the unit's decibel level increases significantly.

NOTE High speed is required for the unit to achieve its 2500 watt cooling capacity. At high-end operating conditions the fan can be set to run at high speed all the time using the controller's Setup Loop, see Section 4. ▲

Units installed below the end-user application may enable system fluid to drain back into the chiller and cause spillage. Thermo Fisher offers an anti-drainback kit to prevent any spillage, see Section 5.

Air-cooled units can be installed with both sides blocked, or one side and the rear. See Figure 3-1. The front of the unit needs a minimum clearance of 24". Air will enter the front of the system and exit through the sides and rear.

Having two sides blocked can impact the unit's performance due to changes in air flow. If your installation requires two blocked sides please ensure that the following requirements are met:

Process Setpoint Temperature: Below 30°C (86°F)

Ambient: Below 40°C (104°F)

Before operating the unit in conditions outside any of those listed on this page please contact Thermo Fisher Scientific's Sales, Service and Customer Support to review your installation.

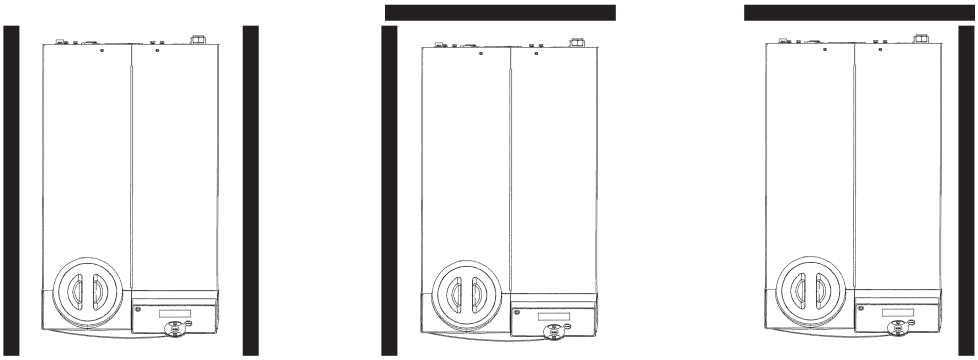


Figure 3-1 Minimum Clearance

Electrical Requirements

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

The user is responsible to ensure that the power cord provided meets local electrical codes. If not, contact qualified installation personnel.

The unit is intended for use on a dedicated outlet. The ThermoFlex has an internal circuit protection that is equivalent (approximately) to the branch circuit rating. This is to protect the ThermoFlex, and is not intended as a substitute for branch circuit protection.

Electrical Service Requirements (Standard units):

ThermoFlex900	Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
	100 VAC	50 Hz	1Ø	15A	5-15P
	115 VAC	60 Hz	1Ø	15A	5-15P
	200 VAC	50 Hz	1Ø	15A	6-15P
	208-230 VAC	60 Hz	1Ø	15A	6-15P
	230 VAC	50 Hz	1Ø	*16A[1], 15A[2], 13A[3]	-

ThermoFlex1400	Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
	100 VAC	50 Hz	1Ø	20A	5-20P
	115 VAC	60 Hz	1Ø	20A	5-20P
	200 VAC	50 Hz	1Ø	15A	6-15P
	208-230 VAC	60 Hz	1Ø	15A	6-15P
	230 VAC	50 Hz	1Ø	*16A[1], 15A[2], 13A[3]	-

ThermoFlex2500	Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
	200 VAC P 1 P 2 Pump	50 Hz	1Ø	15A	6-15P
	208-230 VAC P 1 P 2 Pump	60 Hz	1Ø	15A	6-15P
	200 VAC T 1 Pump	50 Hz	1Ø	20A	6-20P
	208-230 VAC T 1 Pump	60 Hz	1Ø	20A	6-20P
	230 VAC	50 Hz	1Ø	*16A[1], 15A[2], 13A[3]	-

ThermoFlex3500/5000	Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
	200 VAC P 1 P 2 Pump	50 Hz	1Ø	15A	6-15P
	200 VAC T 1 P 3 Pump	50 Hz	1Ø	20A	6-20P
	200 VAC P 4 Pump	50 Hz	1Ø	30A	6-30P
	208-230 VAC P 1 P 2 Pump	60 Hz	1Ø	15A	6-20P
	208-230 VAC T 1 P 3 Pump	60 Hz	1Ø	20A	6-20P
	208-230 VAC P 4 Pump	60 Hz	1Ø	30A	6-30P
	230 VAC P 1 - P 4 Pump	50 Hz	1Ø	*16A[1], 15A[2], 13A[3]	-

ThermoFlex7500/10000	Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
	200 VAC P 2 P 3 Pump	50 Hz	3Ø	20A	L15-20P
	208-230 VAC P 2 P 3 Pump	60 Hz	3Ø	20A	L15-20P
	200 VAC P 5 Pump	50 Hz	3Ø	30A	L15-30P
	208-230 VAC P 5 Pump	60 Hz	3Ø	30A	L15-30P
	400 VAC	50 Hz	3Ø	16A	IEC309

* Refer to Appendix A for country specific ratings.

Electrical Service Requirements (Variable voltage units):

ThermoFlex900	Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
	115 VAC	60 Hz	1Ø	15A	5-15P*
	100 VAC	50/60 Hz	1Ø	15A	5-15P*

ThermoFlex1400	Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
	115 VAC	60 Hz	1Ø	20A	-
	100 VAC	50/60 Hz	1Ø	20A	-

* United States and Japan only. All other plugs are country specific.

Electrical Service Requirements (Global Voltage units):

ThermoFlex900	Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
	200/208/230 VAC	60 Hz	1Ø	15A	-
	200/230 VAC	50 Hz	1Ø	**16A[1], 15A[2], 13A[3]	-

ThermoFlex1400	Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
	200/208/230 VAC	60 Hz	1Ø	15A	-
	200/230 VAC	50 Hz	1Ø	**16A[1], 15A[2], 13A[3]	-

ThermoFlex2500	Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
	200 VAC T 1 Pump	60 Hz	1Ø	15A	-
	208-230 VAC T 1 Pump	60 Hz	1Ø	20A	-
	230 VAC	50 Hz	1Ø	*16A[1], 15A[2], 13A[3]	-

ThermoFlex3500/5000	Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
	200/208-230 VAC P 1 P 3 Pump	50/60 Hz	1Ø	15A	-
	200/208-230 VAC T 1 P 3 Pump	50/60 Hz	1Ø	20A	-
	200/208-230 VAC P 4 Pump	50/60 Hz	1Ø	30A	Hard wired

ThermoFlex7500/10000	Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
	400 VAC	60 Hz	3Ø	20A	Hard wired
	460 VAC	60 Hz	3Ø	20A	Hard wired

** Units selected for 230 VAC operation have a range of -10% to +7%. Refer to Appendix A for country specific ratings.

For installation information on Variable Voltage and Global Voltage units refer to Appendix B.

Refer to the nameplate label located on the rear of the unit for specific electrical requirements.

Hard Wire Installation

For personal safety and equipment reliability, only a qualified technician should perform the following procedure. ▲

- Remove the six screws securing the electrical box cover to the rear of the unit.

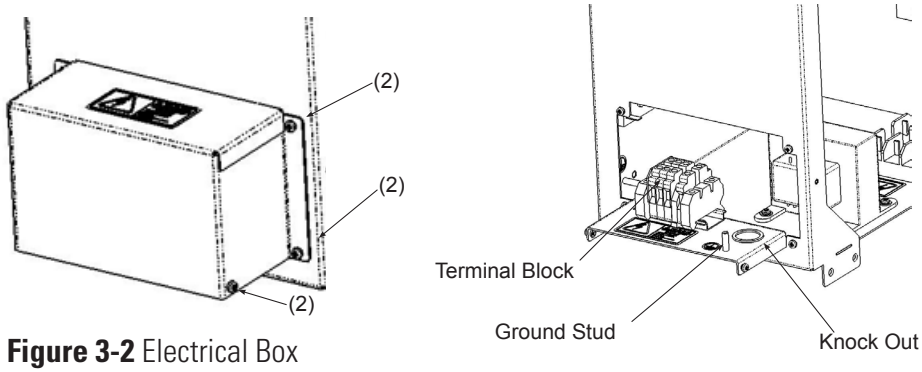


Figure 3-2 Electrical Box

- Remove the double knock out ($^{7}/_{8}$" and 1 $^{3}/_{32}$").
- Insert the cable through the hole.
- Refer to the label in the electrical box to configure your unit, see Figure 3-3.
- Secure the cable's ground wire to the ground stud.
- Reinstall the cover.

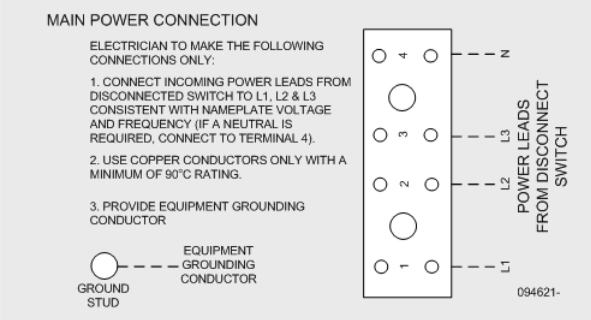


Figure 3-3 Sample Label

Plumbing Requirements

Ensure that all shipping plugs are removed before installation.

Never connect the process fluid lines to your facility water supply or any pressurized liquid source. ▲

To prevent damage to the unit's plate exchanger, centrifugal pumps require a 4.0 gpm (15.1 lpm) minimum flow rate. ▲

P1 and P2 pumps are capable of producing 185 psig. Ensure your plumbing is rated to withstand this pressure at your operating temperature. An external pressure relief valve is available, see Section 5. ▲

NOTE Ensure your plumbing installation will develop a back pressure to the ThermoFlex greater than 3 PSIG. A lack of back pressure will shut down the unit. ▲

The process fluid connections are located on the rear of the unit and are labeled (PROCESS OUTLET) and (PROCESS INLET). Connect the PROCESS OUTLET to the fluid inlet on your application. Connect the PROCESS INLET to the fluid outlet on your application. Ensure all connections are secure and that the proper sealant/lubricant for the fitting material is used. (If Teflon® tape is used, ensure the tape does not overhang the first thread as it could shred and get into the fluid.)

Process Fluid Connections (FNPT)		
Outlet		
ThermoFlex900 - 10000	P1 P2 T1	1/2" cast bronze
ThermoFlex3500 - 5000	P3 P4	3/4" cast bronze
ThermoFlex7500 - 10000	P3 P5	1" wrought copper
Inlet - Same size as outlet		all units stainless steel

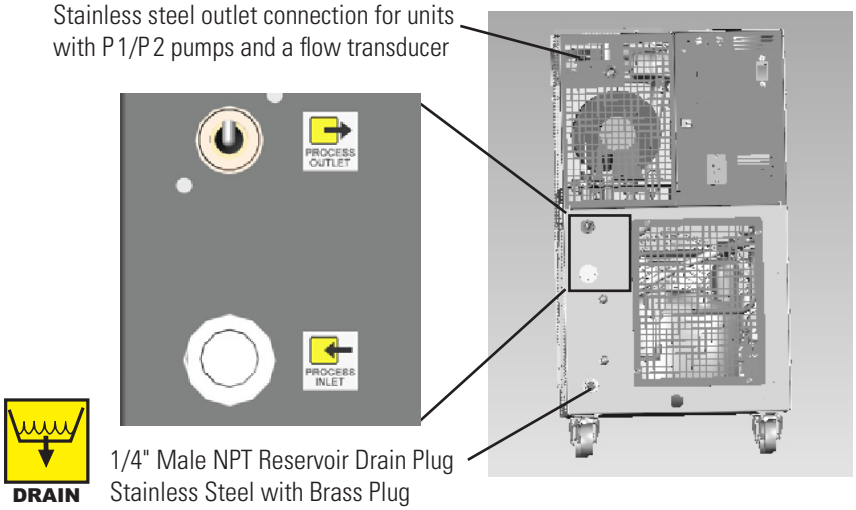
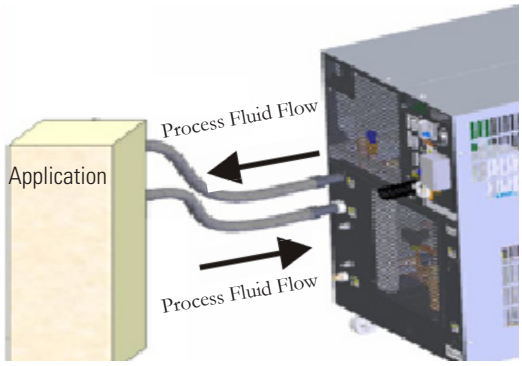


Figure 3-4 Plumbing Connections (1 of 2)



Keep the distance between the unit and the instrument being cooled as short as possible. Ensure tubing is straight and without bends. If diameter reductions are required, make them at the inlet and outlet of your application, not at the ThermoFlex.

Figure 3-4 Plumbing Connections (2 of 2)

Water-cooled Units

For water-cooled units the facility water plumbing connections are also located on the rear of the unit and are labeled FACILITY INLET and FACILITY OUTLET. The connections are ½" Female NPT for ThermoFlex900 - 5000, ¾" Female NPT for ThermoFlex7500 - 10000. For all units, both connections are cast bronze.

Connect the FACILITY INLET to your facility water supply. Connect the FACILITY OUTLET to your facility water return or drain. Ensure all connections are secure and that the proper sealant/lubricant for the fitting material is used. (If Teflon® tape is used, ensure the tape does not overhang the first thread as it could shred and get into the fluid.)

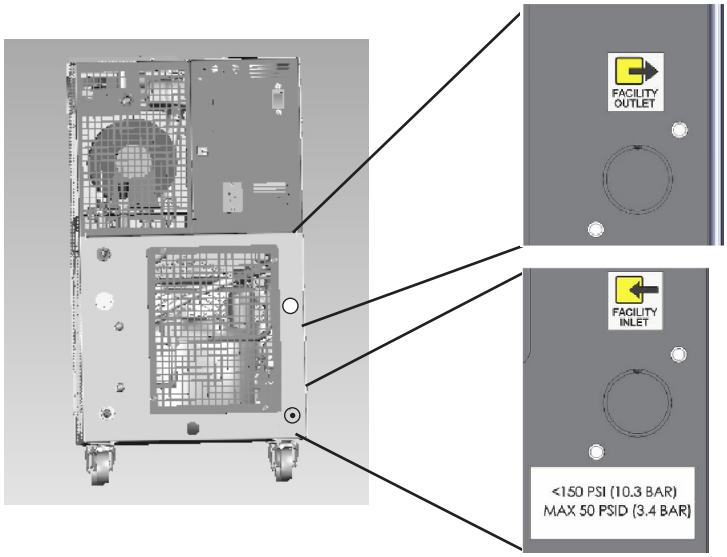


Figure 3-5 Plumbing Connections, Water-cooled Units

Process Fluid Requirements

NEVER use flammable or corrosive fluids with this unit. Do not use automotive antifreeze. Commercial antifreeze contains silicates that can damage the pump seals. Use of any fluid not listed below will void the manufacturer's warranty. ▲

Acceptable fluids are:

- Filtered/Single Distilled water
- 0 - 75% Ethylene Glycol/Water
- 0 - 75% Propylene Glycol/Water
- Deionized water (1 - 3 MΩ- cm, compensated)

Before using any fluid or performing maintenance where contact with the fluid is likely refer to the manufacturer's MSDS for handling precautions. ▲

To prevent freezing/glazing of the plate exchanger, ThermoFlex7500 and 10000 units require the use of 50/50 EG/water or 50/50 PG/water below 10°C process temperature. ▲

When using a process fluid mixture of ethylene glycol and water or propylene glycol and water, check the fluid concentration and pH on a regular basis. Changes in concentration and pH can impact system performance. ▲

Ethylene glycol (EG) is hygroscopic, it will absorb water from its environment. This can affect the freezing point and boiling point of the fluid over time and may result in system failure. ▲

When using EG/water or PG/water, top-off with plain water. After top-off check the fluid concentration. ▲

Do not use a Deionization (DI) filter cartridge with Inhibited EG or Inhibited PG. A DI filter will remove inhibitors from the solution rendering the fluid ineffective against corrosion protection. Also, inhibitors increase fluid conductivity. ▲

Compatibility with Acceptable Fluids

Filtered/Single Distilled Water
This fluid is acceptable primarily because it has all microorganisms that cause biological fouling removed through vaporizing and condensing the water. However, distilled water does not remain pure for very long when exposed to the atmosphere. Air-born spores can contaminate the water and activate algae growth. An effective maintenance plan would include switching out the fluid with newly distilled water every six months. The particulates that have been filtered out in the process are also preventive in keeping the system "clean" of contaminants.

Uninhibited Ethylene Glycol/Water
Ethylene glycol is used to depress the freezing point of water as a coolant. We recommend not using the uninhibited (no corrosion additives) ethylene glycol. It is more corrosive to copper than plain water so it is not recommended unless required for the application.

Inhibited Ethylene Glycol/Water
Inhibited glycol can be used to increase the operating temperature range of the fluid but not as a "pre-mixed anticorrosive" solution. Industry standards use a pH standard of 8 to determine when the fluid has become corrosive. Dowtherm® is an ethylene based product that contains dipotassium phosphates in a 4% concentration. The recommended use of Dowtherm® is mixing with distilled or deionized water or water that contains less than 25 ppm chloride and sulfate and less than 100 ppm total hardness of CACO3.

The general term, inhibited glycol/water, is too close to meaning inhibited water. Inhibited water can have many types of additives including chromate that will quickly foul the cooling system. Some inhibitor additives can release the bonding agent in the carbon graphite in P1 and P2 pumps so they are incompatible, such as Sodium Hydroxide.

Uninhibited Propylene Glycol/Water
Although the use of propylene glycol is similar to ethylene glycol, propylene glycol is considered "safe" to use in the food industry.

Inhibited Propylene Glycol/Water
Same issues as with uninhibited propylene and inhibited ethylene glycol.

Process Water Quality and Standards

Process Fluid	Permissible (PPM)	Desirable (PPM)
Microbiologicals		
(algae, bacteria, fungi)	0	0
Inorganic Chemicals		
Calcium	<25	<0.6
Chloride	<25	<10
Copper	<1.3	<1.0
0.020 ppm if fluid in contact with aluminum		
Iron	<0.3	<0.1
Lead	<0.015	0
Magnesium	<12	<0.1
Manganese	<0.05	<0.03
Nitrates\Nitrites	<10 as N	0
Potassium	<20	<0.3
Silicate	<25	<1.0
Sodium	<20	<0.3
Sulfate	<25	<1
Hardness	<17	<0.05
Total Dissolved Solids	<50	<10
Other Parameters		
pH	6.5-8.5	7-8
Resistivity	0.01*	0.05-0.1*

* MΩ-cm (compensated to 25°C)

Unfavorably high total ionized solids (TIS) can accelerate the rate of galvanic corrosion. These contaminants can function as electrolytes which increase the potential for galvanic cell corrosion and lead to localized corrosion such as pitting. Eventually, the pitting will become so extensive that refrigerant will leak into the water reservoir.

As an example, raw water in the United States averages 171 ppm (of NaCl). The recommended level for use in a water system is between 0.5 to 5.0 ppm (of NaCl).

Recommendation: Initially fill the tank with distilled or deionized water. Do not use untreated tap water as the total ionized solids level may be too high. This will reduce the electrolytic potential of the water and prevent or reduce the galvanic corrosion observed.

Water Treatment Kit (North America Only)

A Thermo Fisher Treatment Kit is available and is designed to minimize the effects of corrosion, scale, fouling, and microbial contamination. It allows the system to continue providing reliable service with optimal efficiency for the life of the unit.

The kit includes a biocide and corrosion inhibitor capable of treating up to ten gallons of application water and is designed to provide protection for a period of six months. This kit is compatible with the following fluids:

- Filtered/Single Distilled Water
- Uninhibited Ethylene Glycol/Water
- Uninhibited Propylene/Water
- Deionized (DI) Water*
- Reverse Osmosis (RO) Water

*Do not use the Thermo Fisher Water Treatment Kit with a DI filtered system; the filter will remove a portion of the reagent's active ingredients limiting its effectiveness.

Facility Water Quality and Standards (water-cooled units)

Facility Water	Permissible (PPM)	Desirable (PPM)
Microbiologicals		
(algae, bacteria, fungi)	0	0
Inorganic Chemicals		
Calcium	<40	<0.6
Chloride	<250	<25
Copper	<1.3	<1.0
0.020 ppm if fluid in contact with aluminum		
Iron	<0.3	<0.1
Lead	<0.015	0
Magnesium	<12	<0.1
Manganese	<0.05	<0.03
Nitrates\Nitrites	<10 as N	0
Potassium	<20	<0.3
Silicate	<25	<1.0
Sodium	<20	<0.3
Sulfate	<250	<50
Hardness	<17	<0.05
Total Dissolved Solids	<50	<10

NOTE A corrosion inhibitor is recommended if mixed metals are in the facility water loop. ▲

Facility Water Requirements (water-cooled units)

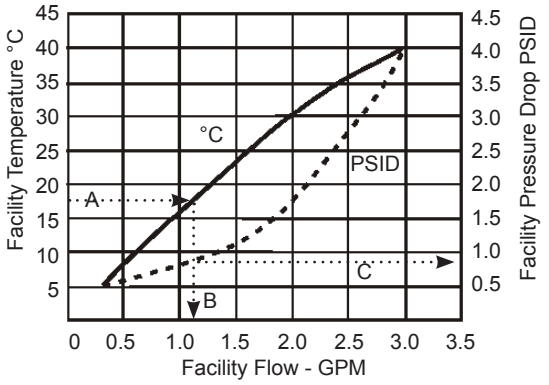
Facility Water Maximum Inlet Pressure must not exceed 150 PSIG.

Facility Water Maximum Pressure Differential must not exceed 50 PSID under any condition.
(Pressure Differential = Inlet Pressure - Outlet Pressure)

NOTE Before using facility water that is above 35°C contact Thermo Fisher Scientific.

ThermoFlex1400

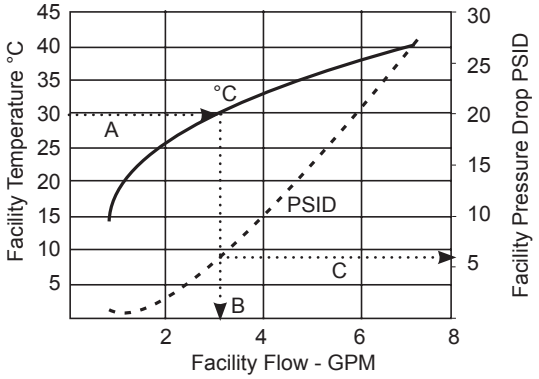
The facility water must meet the following conditions for the units to maintain their full rated capacity.



Example:
Follow the ·····► lines.
Start with a known, i.e. facility water temperature.
A - go across to temperature curve
B - drop down to determine the minimum required facility flow.
C - Where B crosses the PSID curve, go across to determine the minimum required PSID.

ThermoFlex2500

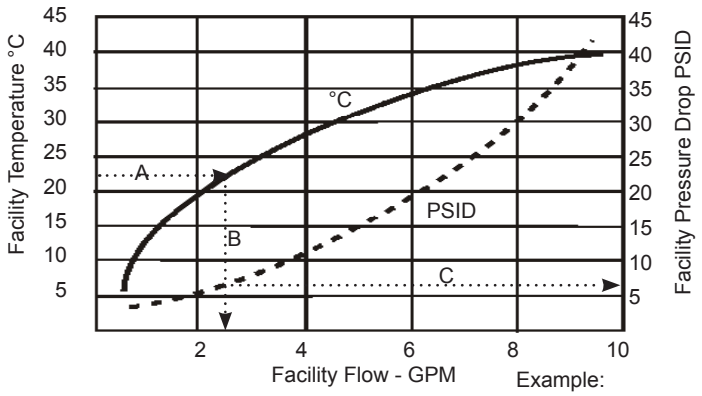
The facility water must meet the following conditions for the units to maintain their full rated capacity.



Example:
Follow the ·····► lines.
Start with a known, i.e. facility water temperature.
A - go across to temperature curve
B - drop down to determine the minimum required facility flow.
C - Where B crosses the PSID curve, go across to determine the minimum required PSID.

ThermoFlex3500/5000

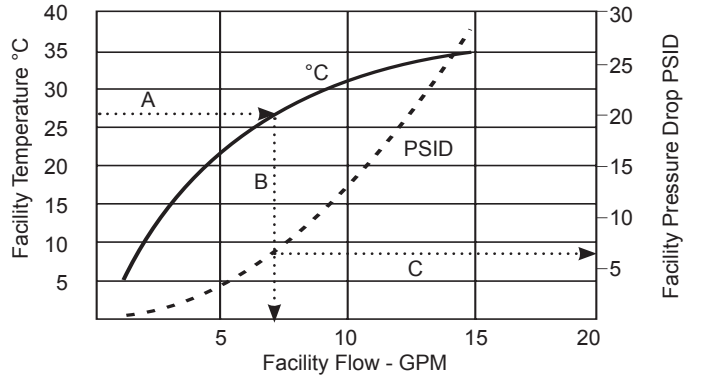
The facility water must meet the following conditions for the units to maintain their full rated capacity.



Example:
Follow the ·····► lines.
Start with a known, i.e. facility water temperature.
A - go across to temperature curve
B - drop down to determine the minimum required facility flow.
C - Where B crosses the PSID curve, go across to determine the minimum required PSID.

ThermoFlex7500/10000

The facility water must meet the following conditions for the units to maintain their full rated capacity.



Example:
Follow the ·····► lines.
Start with a known, i.e. facility water temperature.
A - go across to temperature curve
B - drop down to determine the minimum required facility flow.
C - Where B crosses the PSID curve, go across to determine the minimum required PSID.

Filling Requirements

Ensure the reservoir drain plug on the back of the unit is in place and that all plumbing connections are secure.

Before using any fluid refer to the manufacturer's MSDS for handling precautions. ▲

Locate and remove the reservoir cap by unscrewing it counterclockwise.

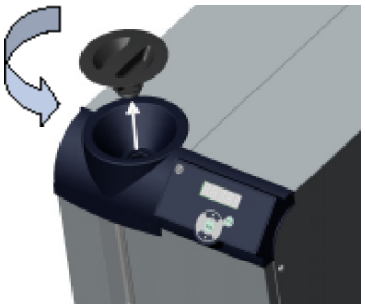


Figure 3-6 Reservoir Cap

To prevent the introduction of particulates into the system, fill the unit with the reservoir bag filter in place. Units are shipped with a bag filter in place. For information on changing the bag filter, see Section 6.

The reservoir has a sight tube and ball for easy fluid level monitoring. *Slowly* fill the reservoir with clean process fluid through the funnel only, failure to comply may result in internal spillage.

NOTE Filling the reservoir above MAX LEVEL fill line will result in a unit over flow error (**O FLO**)causing the unit to shut down. ▲

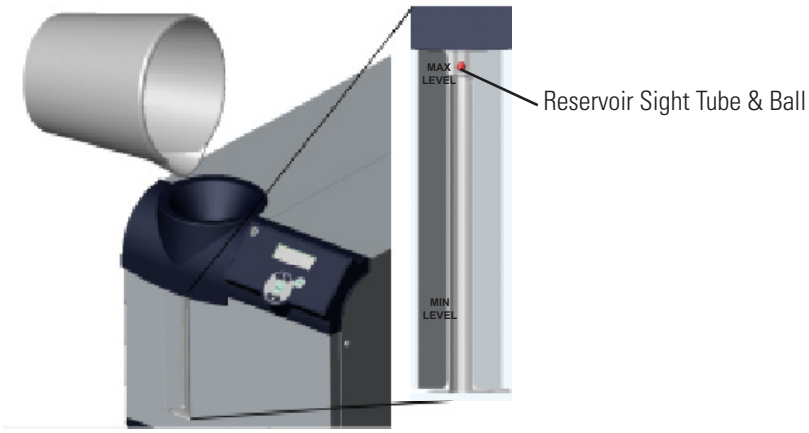


Figure 3-7 Reservoir Sight Tube & Ball

Since the reservoir capacity may be small compared to your application and air may need to be purged from the lines, have extra cooling fluid on hand to keep the system topped off when external circulation is started.

Replace the reservoir cap by screwing it clockwise. Cap should be hand tight.

Section 4 Operation

Basic Controller

The controller controls temperature using a Proportional-Integral-Derivative (PID) algorithm. It is designed with an easy to use operator interface.

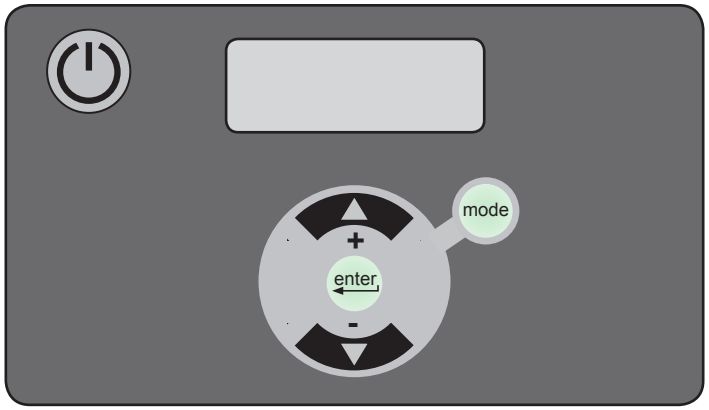


Figure 4-1 Basic Controller

This key is used to start and stop the unit.

This key is used to navigate through the controller displays, to make changes and to save changes once they are made. It is also used to clear error codes.

This key is also used to navigate through controller displays.

The up arrow key is used to navigate through the controller displays and to increase adjustable values.

The down arrow key is used to navigate through the controller displays and to decrease adjustable values.

Setup

NOTE For first time use, please refer to the quick start instructions included with your unit or the copy in this manual. The manual's version follows the Table of Contents. ▲

Before starting the unit, double check all electrical and plumbing connections. Have extra recirculating fluid on hand. If the unit will not start refer to Section 7 Troubleshooting.

If the unit is equipped with a deionization filter cartridge refer to Section 5 for installation.

Start Up

- Place the optional GFCI breaker located on the rear of the unit to the up position.
- Place the circuit protector located on the rear of the unit to the on (I) position. The display will indicate a series of upward scrolling bars (☰ ☰) .
- The bars will scroll upward indicating the controller is initializing the unit. The initialization takes approximately 15 seconds.
- When the bars disappear the controller display will go blank.
- Press the ⏻ key on the controller. The controller will show the process fluid temperature. The pump and refrigeration system will also start. **NOTE** You can press the ⏻ key anytime after placing the circuit protector to the on position. ▲

⚠ **If the auto restart is enabled and the unit shuts down as a result of a power failure, when power is restored the unit will automatically restart. Auto restart is enabled using the Setup Loop, see Setup Loop in this Section. ▲**

If desired, press the key to display the pump's discharge pressure - **P1**. The display will alternate between **P1** and the pump's discharge pressure value.

If the unit is equipped with an optional flow transducer, pressing again will display the flow rate - **FLo**. The display will alternate between **FLo** and the flow rate value.

After displaying **P1** or **FLo** for 60 seconds, if the key is not depressed the display will automatically revert to the process fluid temperature.

Press again to display the process fluid temperature.

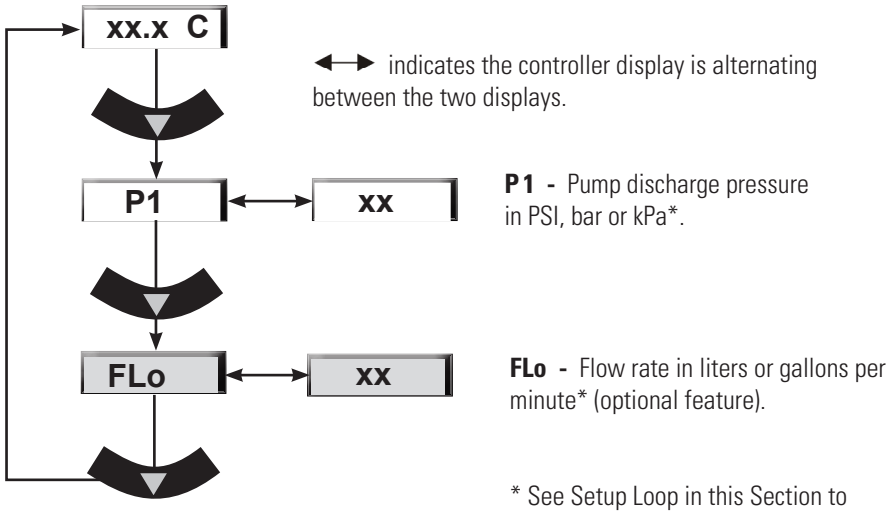


Figure 4-2 Main Loop

Controller Loops

The controller has the capability to display various loops which indicate operating conditions and parameters within the unit. The loops are selected and changed by pressing the appropriate keys.

When the controller is first powered up the unit goes through a short initialization (~15 seconds) and then displays the process fluid temperature. Use the key combination shown below to scroll through the loops.

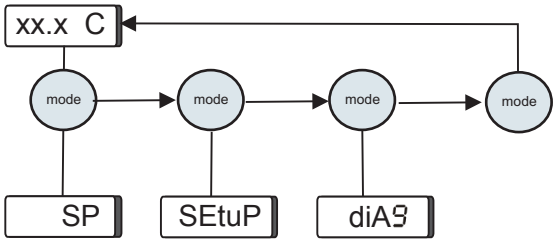


Figure 4-3 Controller Loops (Unit running)

SP is the Setpoint Loop and is used to display and change the setpoint. The setpoint is the desired process fluid temperature needed for your application. The Setpoint Loop is accessed by pressing the **mode** key, see next page.

SEtuP is the Setup Loop. The Setup Loop allows you to display and/or alter different parameters of the controller. The Setup Loop is accessed from the **SP** display by pressing the **mode** key.

diAg is the Diagnostic Loop. The Diagnostic Loop allows you to display the operating times for various components within the unit. The Diagnostic Loop is accessed from the **Setup** display by pressing the **mode** key, see Section VI for more details.

NOTE The loops can be accessed and changed without the unit running as long as the circuit protector is in the on (**I**) position. ▲

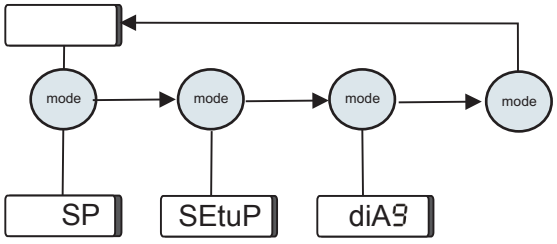


Figure 4-4 Controller Loops (Unit not running)

Setpoint Loop (SP)

- Ensure the controller is either a blank screen or displaying the process fluid temperature.
- Press the mode key and the controller display will alternate between **SP** and the setpoint value.
- If no change is required press the enter key to return the controller to the previous display.
- If a setpoint change is required, use the ▲▼ keys.

  The setpoint range is +5°C to +40°C (41°F to 104°F).

NOTE If the ▲▼ are not used within one minute the controller will time out and return to the previous display and any changes will not be accepted. ▲

- Once the desired value is displayed press the enter key to confirm the change.
- The controller will return to the process fluid temperature display or a blank screen.

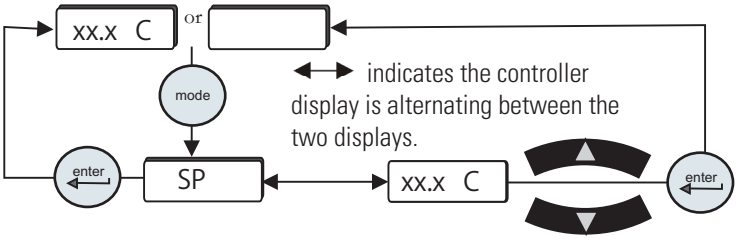


Figure 4-5 Setpoint Loop

Setup Loop (SEtuP)

Use the Setup Loop to adjust/verify the following controller settings.

- Scales: temperature in °C or °F, flow in liters per minute or gallons per minute (units with an optional flow transducer only), and pressure in PSI, bar or kPa
- High and low temperature alarm limits
- High and low pump discharge pressure alarm limits and time delays
- Fault reaction to a temperature, pressure or flow (optional) alarm limit (continue to run or shut down)
- Audible alarm enabled/disabled
- View/change the fan speed (ThermoFlex 2500 air-cooled units only)
- Auto restart feature enabled/disabled
- Preventive care cleaning frequency reminder for air and fluid filters

Optional Features:

- Global voltage
- Analog I/O
- Auto refill alarm
- DI filter cartridge preventive maintenance interval
- High/low flow alarm limits
- Serial communications
- Anti drainback valve position

- **Save or not save *all* changes**

To enter the Setup Loop ensure the controller display is either a blank screen (unit off) or displaying the process fluid temperature. Press the 

key and the display will indicate **SP**, press it again to display **SEtuP**.

Press the 

key to continue, or press 

twice to return to the process fluid temperature or blank display.

Use  to sequence down through the loop. Use  to sequence back through the loop up to the **Hi t** display, see next page.

To change any parameter:

- Press the 

key.
- Use the  keys to change a displayed value.
- Press 

key to confirm the change and bring up the next display.

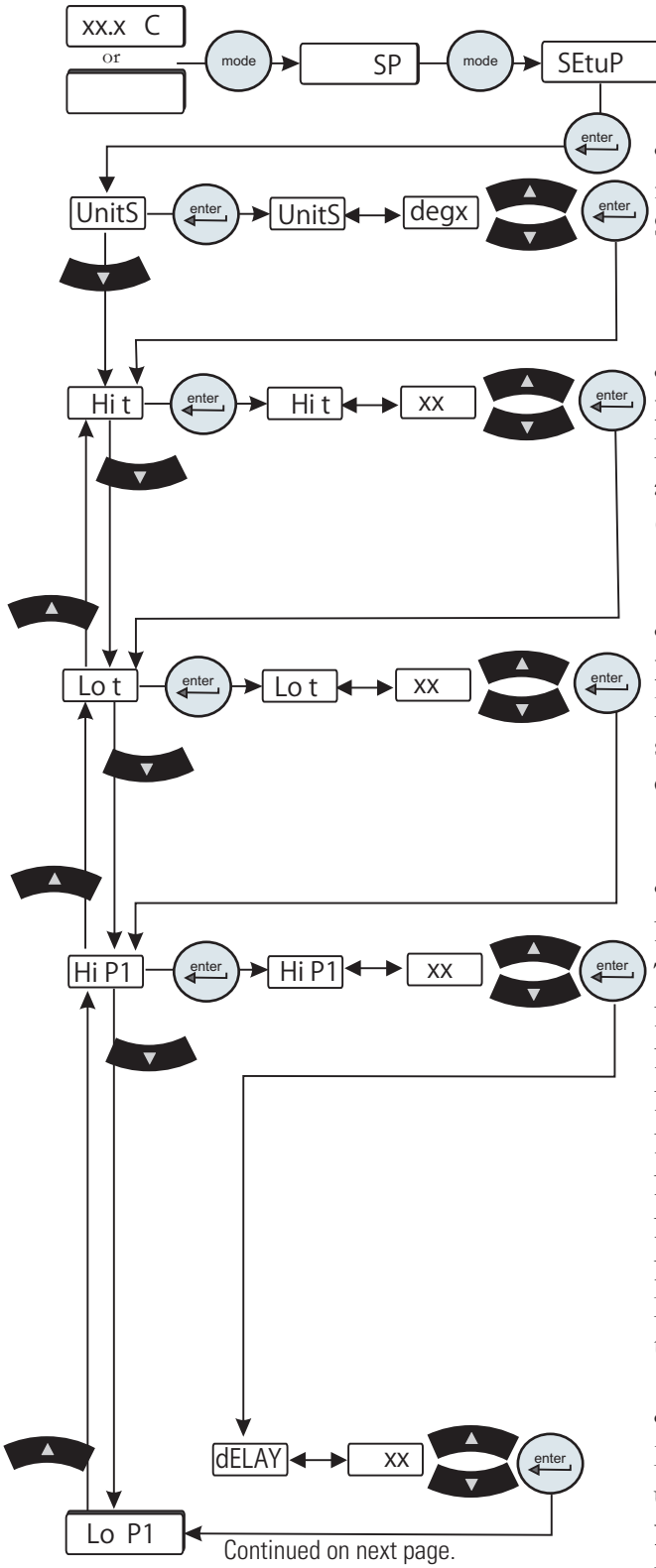


Figure 4-6 Setup Loop (All Units)

• **UnitS** are the temperature, fluid flow (units with an optional flow transducer only) and pressure display scales.

Scales: °C or °F	**Defaults:** °C
GPM or LPM	GPM
PSI, Bar or kPa	PSI

• **Hi t** is the fluid's High Temperature alarm limit.
Range: +3°C to +42°C **Default:** +42°C
Exceeding this limit flashes **Hi t** and, if enabled, sounds the alarm. The unit reaction depends on the alarm configuration (see **ALr** on next page).

• **Lo t** is the fluid's Low Temperature alarm limit.
Range: +3°C to +42°C **Default:** +3°C
Falling below this limit flashes **Lo t** and, if enabled, sounds the alarm. The unit reaction depends on the alarm configuration (see **ALr** on next page).

• **Hi P1** is the pump's High Pressure discharge alarm limit.

P1 Pump **Range:** 3 to 100 PSI	**Default:** 100 PSI
T1 Pump **Range:** 3 to 100 PSI	**Default:** 100 PSI
P2 Pump **Range:** 3 to 100 PSI	**Default:** 100 PSI
P3 Pump 60Hz **Range:** 3 to 48 PSI	**Default:** 48 PSI
P3 Pump 50Hz **Range:** 3 to 32 PSI	**Default:** 32 PSI
P4 Pump 60Hz **Range:** 3 to 85 PSI	**Default:** 85 PSI
P4 Pump 50Hz **Range:** 3 to 60 PSI	**Default:** 60 PSI
P5 Pump 60Hz **Range:** 3 to 87 PSI	**Default:** 87 PSI
P5 Pump 50Hz **Range:** 3 to 56 PSI	**Default:** 56 PSI

Exceeding this limit flashes **Hi P1** and, if enabled, sounds the alarm.

• **dELAY** is the length of time the pump can exceed the Hi P1 alarm limit. **NOTE** This feature is active only if the unit is configured to shut down with a pressure alarm. ▲
P1, **P2** and **T1 Range:** 0 to 30 seconds **Default:** 0 seconds
P3 - P5 Range: 0 to 60 seconds **Default:** 0 seconds
Exceeding this limit flashes **Hi P1** and, if enabled, sounds the alarm. The unit reaction depends on the alarm configuration (see **ALr** on next page).

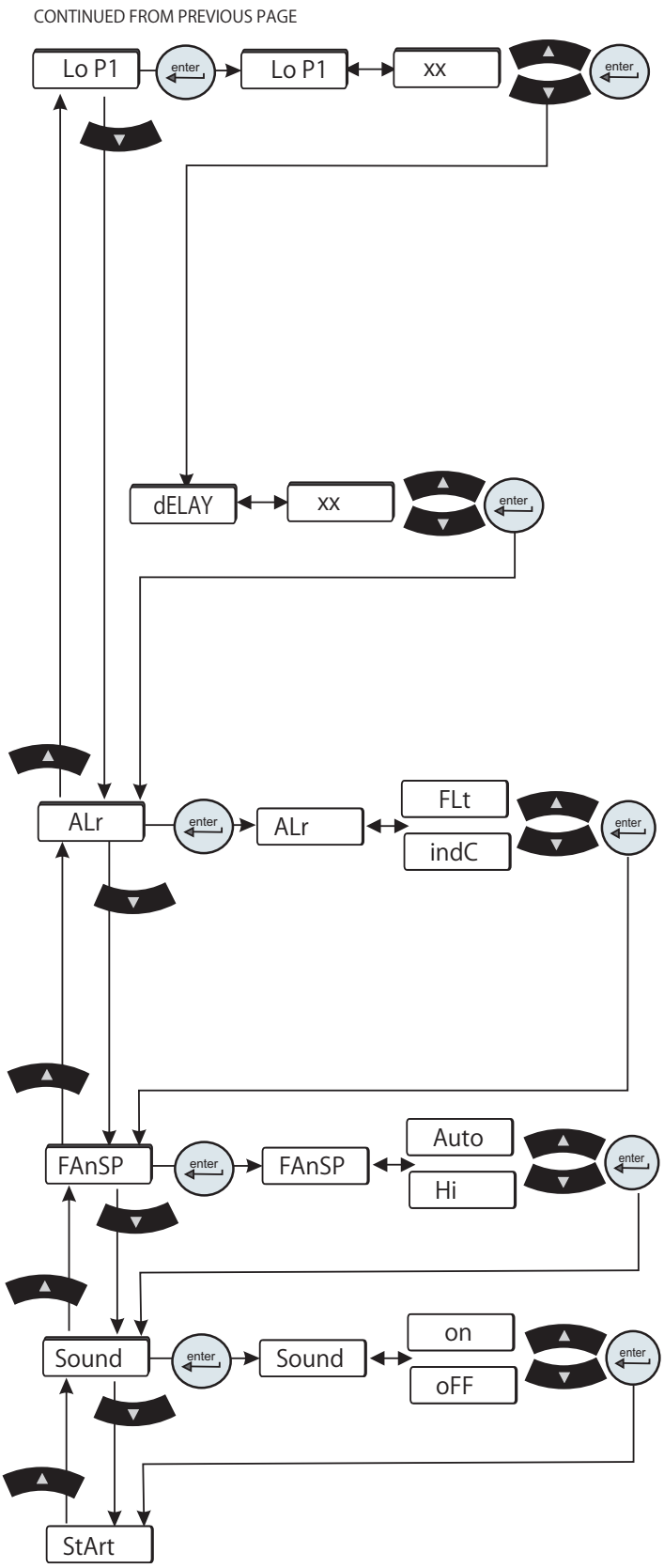


Figure 4-6 Setup Loop (All Units)

• **Lo P1** is the pump's Low Pressure discharge alarm limit.

P 1 Pump **Range:** 3 to 100 PSI **Default:** 4 PSI
T 1 Pump **Range:** 3 to 100 PSI **Default:** 4 PSI
P 2 Pump **Range:** 3 to 100 PSI **Default:** 4 PSI
P 3 Pump 60Hz **Range:** 3 to 48 PSI **Default:** 4 PSI
P 3 Pump 50Hz **Range:** 3 to 32 PSI **Default:** 4 PSI
P 4 Pump 60Hz **Range:** 3 to 85 PSI **Default:** 4 PSI
P 4 Pump 50Hz **Range:** 3 to 60 PSI **Default:** 4 PSI
P 5 Pump 60Hz **Range:** 3 to 87 PSI **Default:** 4 PSI
P 5 Pump 50Hz **Range:** 3 to 56 PSI **Default:** 4 PSI

Going below this limit flashes **Lo P1** and, if enabled, sounds the alarm.

• **dELAY** is the length of time the pump can exceed the Lo P1 alarm limit. **NOTE** This feature is active only if the unit is configured to shut down with a pressure alarm. ▲

Range: 0 to 30 seconds **Default:** 10 seconds

Exceeding this limit flashes **Lo P1** and, if enabled, sounds the alarm. The unit reaction depends on the **ALr** alarm configuration set below.

• **ALr** is used to configure the unit's reaction for exceeding an alarm limit (temperature, pressure and optional flow). The unit will either shut down (**FLt**) or continue to run (**indC**). In each configuration, the controller will display the error code and sound the audible alarm, if enabled.

Range: FLt or indC **Default:** FLt

• **FAnSP** is used to control the fan speed (air-cooled 2500 units only). **Auto** allows the fan to run under the conditions listed in Section 3. Selecting **Hi** allows the fan to run at high speed all the time. **NOTE Hi** is required for the unit to achieve its 2500 watt cooling capacity. ▲

Range: Auto or Hi **Default:** Auto

• **Sound** is used to enable/disable the audible alarm.

Range: on or oFF **Default:** on

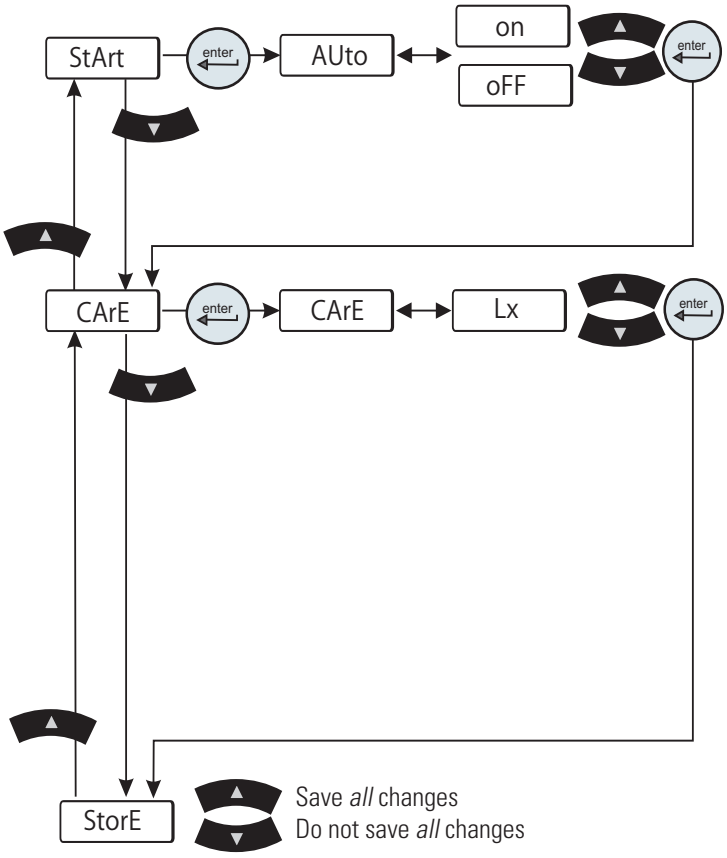


Figure 4-6 Setup Loop (All Units)

• **StArt** is used to enable/disable the auto restart function. When enabled the unit will automatically restart after a power failure or power interruption condition.

Range: on or oFF **Default:** oFF

• **CArE** is used to set the preventive care cleaning frequency reminder for the unit's air and fluid filters, in hours. The time selected is based on your operating environment, see Section 6.

Range: off **Default:** L1
L1 (1000 hours)
L2 (2000 hours)
L3 (3000 hours)

Off disables the reminder. Exceeding this limit flashes **FLtrS**, see Section 6.

NOTE If your unit is equipped with any of the **Optional Features** refer to the next page. ▲

When the display indicates **StorE** press ▲ to save *all* changes or press ▼ to not save *all* changes. The display will return either the process fluid temperature or, if the unit was off when you entered the loop, a blank screen.

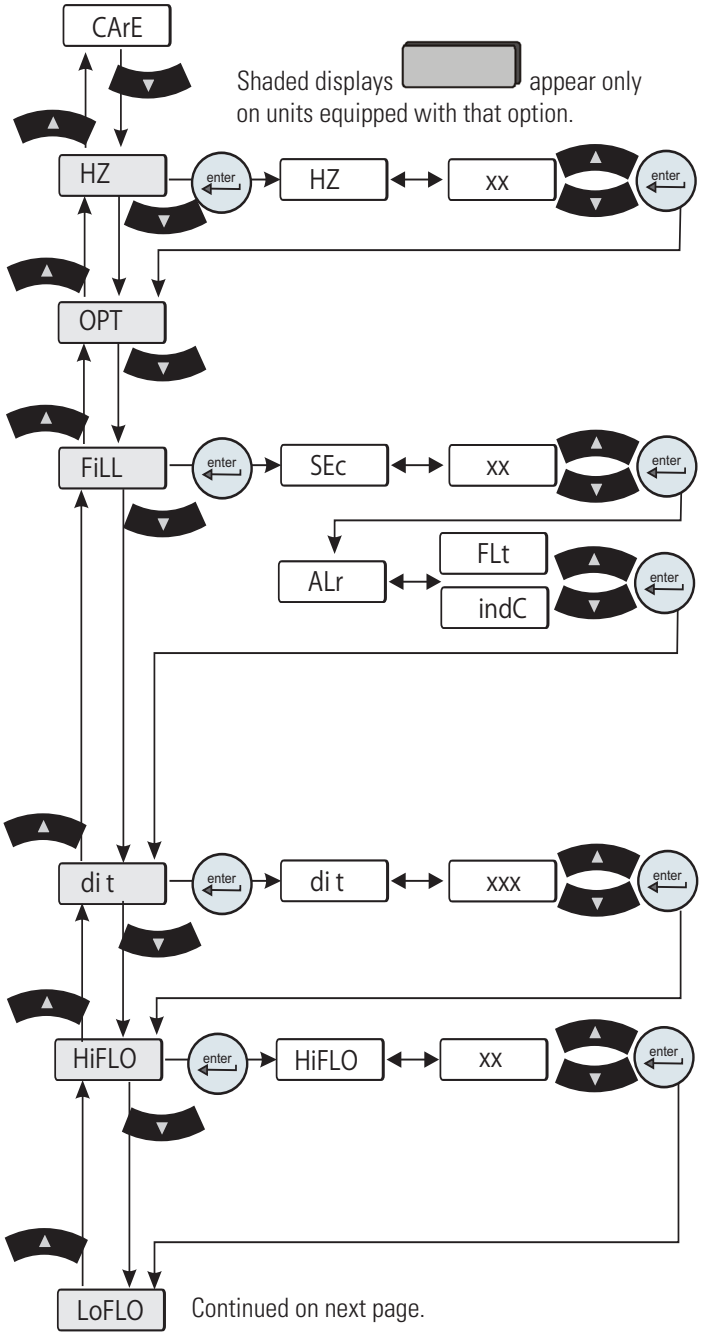


Figure 4-7 Setup Loop (Optional Features)

• **HZ** is used to identify the incoming frequency for units with P 3 - P 5 pumps *and* the capability to run on either 50 Hz or 60 Hz. The selected frequency automatically adjusts the firmware's *fixed* high pressure default setting.
Range: 50 Hz or 60 Hz **Default:** 60 Hz

• **OPt** is used to configure the analog in/out mode of operation. See Appendix C.

• **FiLL** is used to set the time limit the auto refill has for filling the unit's reservoir to the normal operating level.
Range: 0 to 900 seconds
Default: 45 seconds ThermoFlex900 - 5000
80 seconds ThermoFlex7500 - 10000
Exceeding the time limit flashes **rEFiL** and the auto refill will shut off. The unit's reaction depends on the alarm **ALr** setting, **Flt** is shut down, **indC** is continue to run.
NOTE Setting the time limit to 0 disables the auto refill option. ▲ See Section 5 for additional information.

• **di t** is used to set the preventive care cleaning frequency reminder for the unit's DI filter cartridge.
Range: 0 to 9999 hours **Default:** 448 hours
Exceeding the limit flashes **di**, see Section 6.

• **HiFLO** is used to set the high flow alarm limit.
P 1 Pump **Range:** 0.3 to 10.0 GPM **Default:** 5.0 GPM
T 1 Pump **Range:** 0.3 to 10.0 GPM **Default:** 5.0 GPM
P 2 Pump **Range:** 1.0 to 10.0 GPM **Default:** 5.0 GPM
P 3 Pump **Range:** 4.0 to 30.0 GPM **Default:** 15.0 GPM
P 4 Pump **Range:** 4.0 to 30.0 GPM **Default:** 20.0 GPM
P 5 Pump **Range:** 4.0 to 30.0 GPM **Default:** 25.0 GPM
Exceeding this limit flashes **HiFLO** and, if enabled, sounds the alarm. The unit's reaction depends on the alarm (**ALr**) setting.

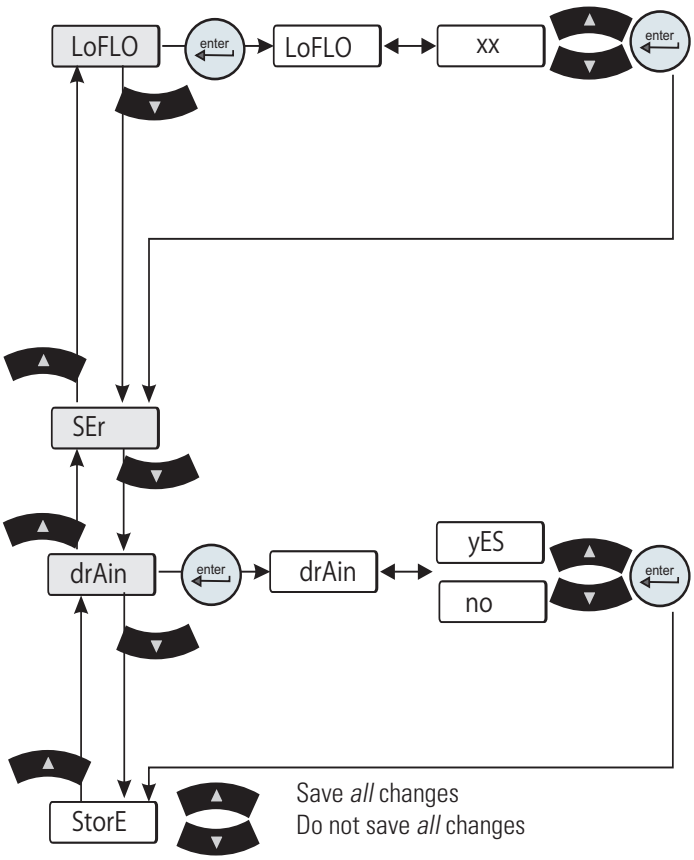


Figure 4-7 Setup Loop (Optional Features)

• **LoFLO** is used to set the low flow alarm limit.

P 1 Pump **Range:** 0.3 to 10.0 GPM **Default:** 0.3 GPM
T 1 Pump **Range:** 0.3 to 10.0 GPM **Default:** 0.3 GPM
P 2 Pump **Range:** 1.0 to 10.0 GPM **Default:** 1.0 GPM
P 3 Pump **Range:** 4.0 to 30.0 GPM **Default:** 4.0 GPM
P 4 Pump **Range:** 4.0 to 30.0 GPM **Default:** 4.0 GPM
P 5 Pump **Range:** 4.0 to 30.0 GPM **Default:** 4.0 GPM

Going below this limit flashes **LoFLO** and, if enabled, sounds the alarm. The unit's reaction depends on the alarm (**ALr**) setting.

• **SEr** is used to configure the serial communications mode of operation. See Appendix D.

• **drAin** is used to open and close the unit's anti drainback valve for draining, see Section 5.
Range: yes or no **Default:** no

NOTE The unit must be off to drain the valve. The valve automatically closes when you exit the **drAin** display. ▲

When the display indicates **StorE** press ▲ to save *all* changes or press ▼ to not save *all* changes. The display will return either the process fluid temperature or, if the unit was off when you entered the loop, a blank screen.

Shut Down

Press the  key on the controller.

NOTE To protect the unit's compressor, the unit will enter a 20 second shut down cycle before the refrigeration system and pump shut down. During this time the display will indicate OFF . The bars will scroll downward indicating the controller is in the shut down cycle. ▲

Using any other means to shut the unit down can reduce the life of the compressor.

When the display goes blank it is safe to place the circuit protector located on the rear of the unit to the off (**0**) position.

Always turn the unit off and disconnect it from its supply voltage before moving the unit. ▲

The circuit protector located on the rear of the unit is not intended to act as a disconnecting means. ▲

Section 5 Options/Accessories

Auto Refill

The Auto Refill provides makeup fluid to replace any fluid lost to evaporation, etc. It requires a pressurized fluid source connection to the ¼" Female Pipe Thread (FNPT) fitting on the rear of the unit. (If Teflon® tape is used, ensure the tape does not cover the connection's starting-end thread .)

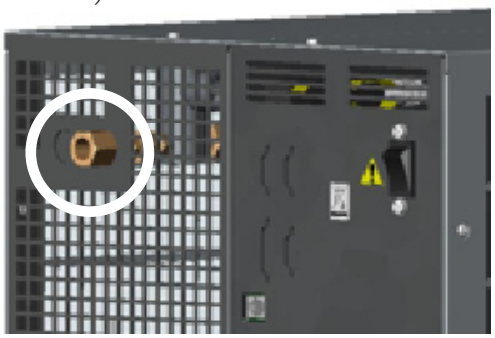


Figure 5-1 Auto Refill Fitting

The auto refill fluid must also meet water quality standards or the valve may fail to operate as designed, see Section 3.

The auto refill valve input pressure must be < 80 PSI to ensure the valve functions properly.

The auto refill operates when all of the following conditions are met:

- Fluid is available
- The unit is turned on
- The fluid reaches a low level condition.

The auto refill shuts off when:

- The fluid reaches the correct operating level.
- The delay timer exceeds user fill time entered in the Setup Loop, see Section 4. If **FLt** is selected in the Setup Loop the unit also shuts down. (If **indC** is selected the unit continues to run.) In either case the controller will display **rEFIL**.
- The unit shuts down for any reason.

Setting the fill time to 0 disables auto refill. If a low level condition occurs the unit will:

- If **Indc** is selected, continue to run and the controller displays **Add**.
- If **FLt** is selected, shut down and the controller displays **LLF**.

Internal DI Cartridge

A partial flow DI filter cartridge is designed to provide between 1 and 3 MΩ-cm water resistivity.

NOTE The DI option results in a 0.5 gpm reduction of available flow. ▲

Do not use a Deionization (DI) filter cartridge with Inhibited EG or Inhibited PG. A DI filter will remove inhibitors from the solution rendering the fluid ineffective against corrosion protection. Also, inhibitors increase fluid conductivity. ▲

The Puralite sensor on the back of the unit turns red when the cartridge needs changing (< 1 MΩ-cm), see Section 6. **NOTE** The Puralite sensor that comes with the DI cartridge requires a separate power source. ▲

Remove the two thumbscrews securing the DI access panel to the top of the unit. Remove the new cartridge from the shipping bag. The cartridge has a blue and a white connector. Lower the cartridge into the unit with the blue connector facing downward. Press down on the cartridge lightly to engage and then rotate it ¼ turn clockwise (do not over rotate) or until you feel the filter click into place.

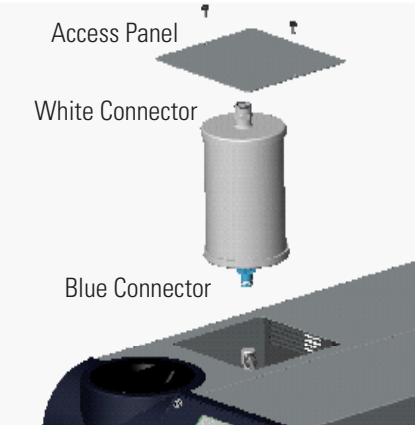


Figure 5-2 Internal DI Cartridge

If there is a cartridge in place, first undo the hose fitting by pressing on the quick disconnect located on the top white connection.

The DI Cartridge will overpressurize if it is removed from the unit before removing the hose fitting. ▲

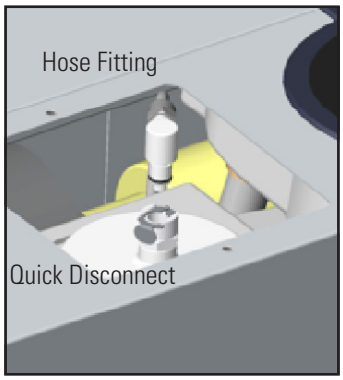


Figure 5-3 DI Fittings

Next rotate the cartridge ¼ turn counter-clockwise and then pull the cartridge straight up to remove it.

Push the hose fitting into the quick disconnect located on the white end of the cartridge.

Replace the access panel and thumbscrews.

NOTE The cartridge can be changed with the unit running, however, since the cartridge runs in a parallel arrangement, disconnecting the cartridge adds 0.5 gpm to the main flow. The additional flow will cause an increase in system pressure which may cause a high fluid pressure fault. ▲

P1 P2 T1 Pump Pressure Relief Valve (Internal Configuration)

Use the pressure relief valve, located on the top left rear of the unit, to set the desired system back pressure to your application. The valve is factory preset to 80 ± 5 psi (5.5 ± 0.4 bar).

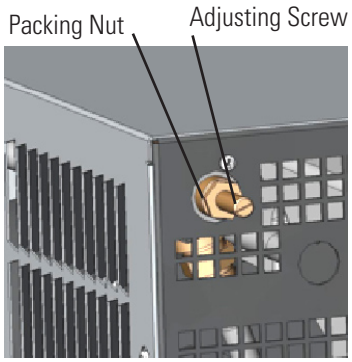


Figure 5-4 Nut and Screw

If the unit is not plumbed to an application, set the pressure by installing a loop of hose equipped with a shut-off valve between the supply and return fittings. Start the unit and allow it to prime, then close the valve.

Use the controller's  to display P1, it should display 80 ± 5 psi.

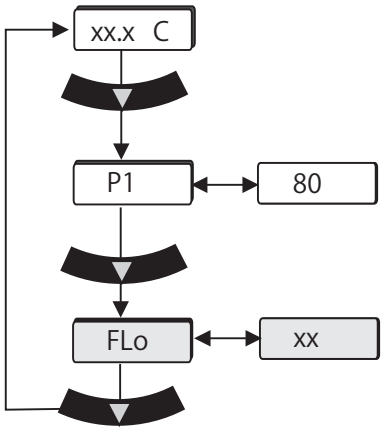


Figure 5-5 Main Loop

Use a screwdriver to turn the adjusting screw (counterclockwise to reduce pressure) until the controller displays the desired setting.

NOTE Due to internal back pressure, the minimum pressure setting for a deadheaded P2 pump is 32 psi (2.2 bar), and 8 psi (0.6 bar) for a P1 (these settings prohibit external flow from the unit). ▲

If the unit is plumbed to an application, ensure the unit is off. Then back out the adjusting screw counterclockwise to reduce pressure. Turn the unit on. Ensure that there is back pressure in the system. Turn the adjusting screw until the controller displays the desired setting.

Do not exceed 100 psi (6.9 bar). ▲

When complete, inspect the area around the $^{5}/_{8}$" packing nut for fluid leaks. If fluid is present, slightly tighten the nut and reinspect.

NOTE Should the unit start to vibrate the valve setting may be the cause. Changing the pressure setting ± 5 psi (0.3 bar) will eliminate the vibration. ▲

P1 P2 T1 Pump Pressure Relief Valve (External Con-

Use the pressure relief valve to set the desired system back pressure (P1) to your application. The valve is factory preset to 80 ± 5 psi (5.5 ± 0.4 bar).

The valve's inlet/outlet connections are ½"FNPT.

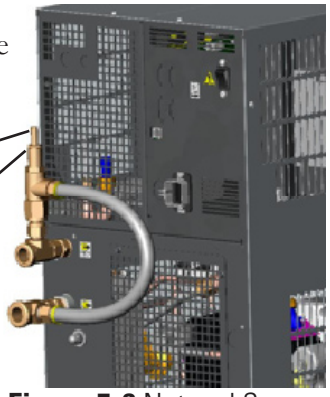


Figure 5-6 Nut and Screw

If the unit is not plumbed to an application, set the pressure by installing a loop of hose equipped with a shut-off valve between the supply and return fittings. Start the unit and allow it to prime, then close the valve.

Use the controller's  to display P1, it should display 80 ± 5 psi.

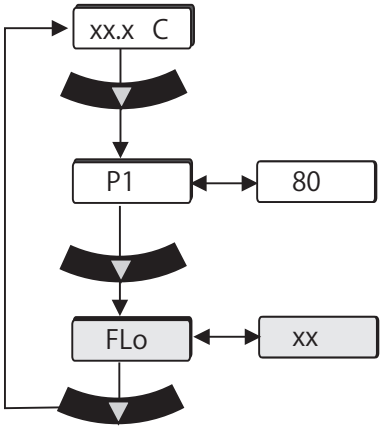


Figure 5-7 Main Loop

Use a screwdriver to turn the adjusting screw (counterclockwise to reduce pressure) until the controller displays the desired setting.

NOTE Due to internal back pressure, the minimum pressure setting for a deadheaded P2 pump is 40 psi (2.8 bar), and 22 psi (1.5 bar) for a P1 (these settings prohibit external flow from the unit). ▲

If the unit is plumbed to an application, ensure the unit is off. Then back out the adjusting screw counterclockwise to reduce pressure. Turn the unit on. Ensure that there is back pressure in the system. Turn the adjusting screw until the controller displays the desired setting.

Do not exceed 100 psi (6.9 bar). ▲

When complete, inspect the area around the $^{5}/_{8}$" packing nut for fluid leaks. If fluid is present, slightly tighten the nut and reinspect.

Flow Control with Flow Readout

Flow control for P1 and P2 pumps on ThermoFlex900 - 5000 units is achieved using a 3-way valve plumbed between the standard process outlet and the process inlet on the rear of the unit. Use the auxiliary process outlet at the top left of the rear of the unit as a connection point. The connections are ½" FNPT. See Figure 5-8.

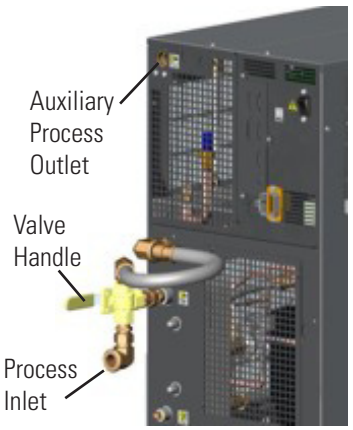


Figure 5-8 P1 P2 Flow Control

ThermoFlex3500 and 5000 units with P3 and P4 pumps use a 2-way valve located on the rear of the unit. The connections are 3/4" FNPT. See Figure 5-9.

ThermoFlex7500 and 10000 units with P2 - P5 pumps use a valve located on the rear of the unit. The connections are 1/2" for P2, 1" FNPT for P3 and P5. See Figure 5-9.

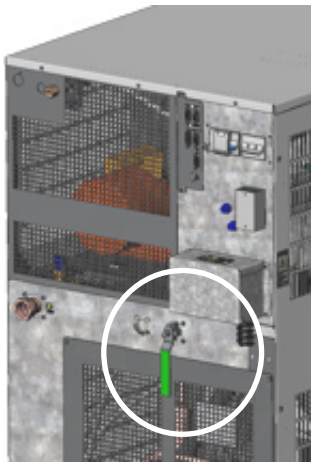


Figure 5-9 Flow Control Handle (Typical)

Press the controller's down arrow twice to display the controller's FLo display, see previous page. Turn the valve handle until the desired rate is displayed.

NOTE The valve is sensitive to slight adjustments. ▲

P1 P2 T1 Pump Pressure Relief with Flow Readout

The Pressure Relief with Flow Readout works just like the Pressure Relief Valve discussed on the previous page. It allows you to control the pressure going to your application.

This valve is plumbed between the standard process outlet and the process inlet on the rear of the unit. Use the auxiliary process outlet at the top left of the rear of the unit as a connection point, allowing you to also monitor the flow rate to your application using the controller's FLo display, see previous page.

The valve's outlet connection is ½" FNPT. See Figure 5-10.

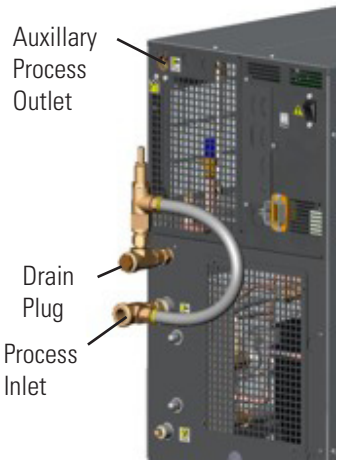


Figure 5-10 Pressure Relief

Anti Drainback

Units installed below the end-user application may allow system fluid to drain back into the chiller and cause spillage. The anti-drainback valve is designed to prevent any such spillage.

The valve opens just before the pump is turned on and it closes just after the pump shuts off.

This option is required if your unit is more than 24 feet below your application, or if there is a possibility of drain back due to the occasional opening of the process lines for either application swaps or unit servicing.

Semiconductor Equipment and Materials International (SEMI) Units

Compliance

SEMI units are compliant with:

SEMI S2-0703 Product Safety Assessment

SEMI S8-0705 Ergonomic Assessment

SEMI S14-0704 Fire Risk Assessment

SEMI F47-0706

Emergency Off (EMO)

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

NOTE The EMO is controlled by a safety circuit and is not influenced by the unit's firmware/software. ▲

Activation of the EMO button will remove power from the main contactor coil stopping operation of the unit. The controller will display **Er 48**.

Resetting the EMO button will not restart the unit. After all hazards have been removed reset the unit by pushing the enter key on the controller. In the local mode, the unit will restart by pressing the START STOP button again. In the serial communications mode, send the appropriate start command. In the analog I/O mode, the unit starts when the error is cleared.

Unit Circuit Breaker Interrupt Rating

The main power circuit breaker located on the rear of the unit has an Interrupting Capacity (AIC) of 10,000 amps.

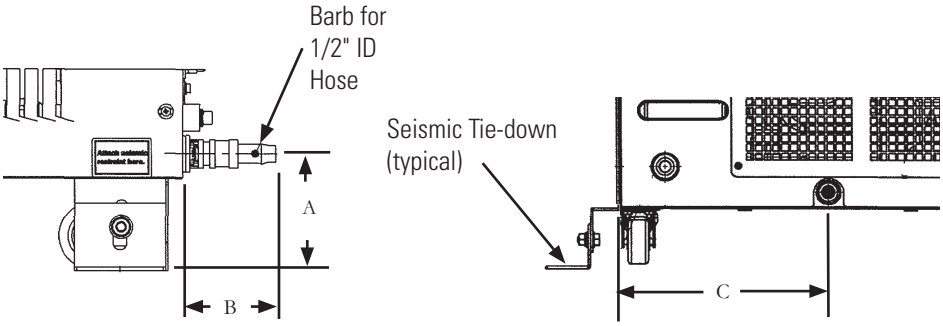
Lockout/Tagout (LOTO)
Before performing Chiller maintenance, the energy sources associated with the Chiller system must be lockedout and tagged out (LOTO). Hazard control features added to the system (e.g., safety interlocks, EMO) are not a substitute for turning off and locking out electrical or fluid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

For units rated 20 Amps or less, electrical LOTO is accomplished by removing the power cord on the rear of the unit then closing and locking the power receptacle locking device. For other units, electrical LOTO is the responsibility of the user and can be provided by:

- Using the main disconnect (knife switch at system control cabinet).
- Disconnecting main power at the facility power source prior to the system controller cabinet.
- In addition, follow all OSHA and local facility LOTO directives.

Drip Pan and Drain
The unit is equipped with a secondary containment (drip pan) in case there is a leak. The drip pan drain is located on the rear of the unit. Install the supplied nylon 1/4 turn quick disconnect (QD) fitting into the drain fitting. The QD is barbed for a 1/2" ID hose.

Since the drip pan will not hold more than 110% of the reservoir volume, connect the drain to guide the fluid to an appropriate spillage location.



1/4 Turn Quick Disconnect Drip Pan Drain Fitting

Figure 5-11 Drip Pan Drain

	900/1400		2500		3500/5000		7500/10000	
A	3 1/2"	8.8 cm	4"	10.1 cm	3 3/8"	11.3 cm	4 1/4"	10.8 cm
B	2 3/4"	7.0 cm	2 11/16"	6.8 cm	2 3/4"	7.1 cm	2 5/8"	6.6 cm
C	6 15/16"	17.7 cm	6 9/16"	16.7 cm	9 9/16"	24.3 cm	7 11/16"	19.5 cm

Seismic Tie-Downs

Install the seismic tie-downs to the unit as shown below. Then secure the unit to the floor with user-supplied hardware.

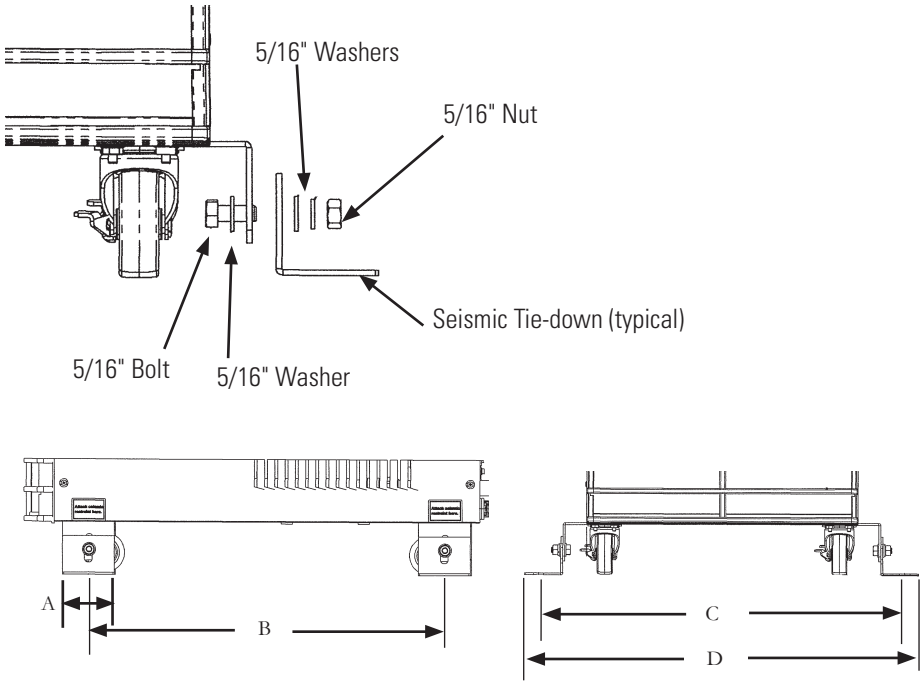


Figure 5-12 Seismic Tie-Downs

	900/1400		2500		3500/5000		7500/10000	
A	2 11/16"	6.8 cm	2 11/16"	6.8 cm	2 11/16"	6.8 cm	2"	5.1 cm
B*	18 ½ "	47.0 cm	20 1/16"	51.0 cm	24 ½"	62.2 cm	17"	43.1 cm
C*	19 1/16"	48.4 cm	22 1/16"	56.1 cm	24 1/8"	61.3 cm	27 7/16"	69.6
D	20 9/16"	52.2 cm	23 1/16"	59.9 cm	25 5/8"	65.1 cm	28 15/16"	73.4

* Distance between Ø.53 Seismic mounting holes

Center of Gravity ± ½", P2 pump (P3 for 7500/10000), air-cooled unit, no fluid in tank

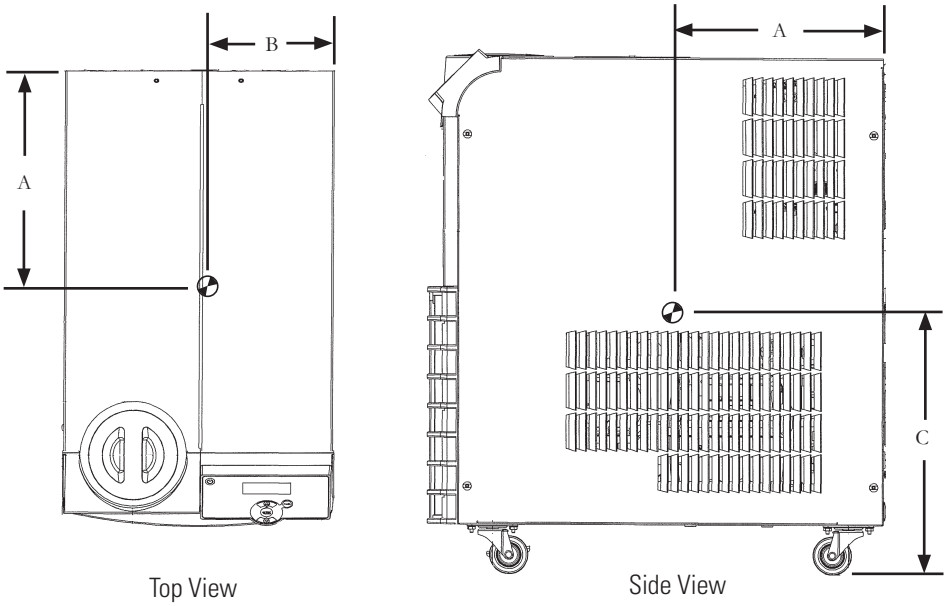


Figure 5-13 Center of Gravity

	900/1400		2500		3500/5000		7500/10000	
A	10 3/4"	27.3 cm	12"	30.5 cm	13 3/8"	34.0 cm	14 7/8"	37.8 cm
B	6 3/4"	17.2 cm	8 3/8"	21.3 cm	9"	22.9 cm	12 5/8"	32.1 cm
C	13 1/2"	34.3 cm	13 1/2"	34.3 cm	16"	40.6 cm	25 1/4"	64.1 cm

Weight Distribution

	900/1400		2500		3500/5000		7500/10000	
Left Front	29.5 lbs	13.4 kg	42.8 lbs	19.5 kg	56.6 lbs	25.7 kg	99.3 lbs	45.0 kg
Left Rear	28.8 lbs	13.1 kg	43.6 lbs	19.8 kg	66.4 lbs	30.1 kg	101.9 lbs	46.2 kg
Right Front	34.3 lbs	15.6 kg	46.9 lbs	21.3 kg	64.9 lbs	29.4 kg	98.2 lbs	44.5 kg
Right Rear	33.4 lbs	15.1 kg	47.7 lbs	21.6 kg	76.1 lbs	34.6 kg	100.7 lbs	45.7 kg

Other Accessories

Installation kit - includes replacement air and fluid filters

Maintenance kit - includes a set of hoses, adaptor fittings and Teflon® tape

Fluids

Fluid treatment kit

Please contact Thermo Fisher Scientific's Sales, Service and Customer Support to assist you with questions that you may have regarding accessories for your ThermoFlex, see inside front cover for contact information.

Section 6 Preventive Maintenance

Preventive Maintenance Timer (CAr-E)

The ThermoFlex chiller has an integrated preventive maintenance timer that will alert you when it is time to perform preventive maintenance. This unique feature will remind you to change your air and fluid filters.

Based on the environment in which your chiller is located, you can choose from four levels of preventive maintenance off, L1, L2, and L3:

- off – Disables the alert
- L1 – 1,000 hours - default setting
  - · Heavy manufacturing environment
  - · Airborne particulate created during manufacturing process
- L2 – 2,000 hours
  - · Typical production environment
- L3 – 3,000 hours
  - · Clean environment – filtered air
  - · Typically laboratory or research environment

Change/set the level using the Setup Loop, see Section 4. When the unit exceeds the chosen limit, the controller will flash Chng↔FLtS and, if enabled, an audible alarm will sound.

To clear this message press 

. This will automatically restart the preventive maintenance timer for your filters. Each time the unit exceeds the chosen time, the controller will remind you that it is time to change your filters.

If you change your filters before the preventive timer trips, you can clear the timer by using the Diagnostic Loop explained in this section.

NOTE For air-cooled units, both the air and fluid filters in the ThermoFlex can be changed while the unit is running. For water-cooled units, only the fluid filter can be changed while the unit is running. ▲

Fluid Filter Bag

The reservoir has a fluid bag filter designed to prevent the introduction of particulates into the system. Units are shipped with a bag filter in place.

NOTE The fluid bag filter can be removed with the unit operating. ▲

Before using any fluid or performing maintenance where contact with the fluid is likely refer to the manufacturer's MSDS for handling precautions. ▲

When it is time to replace the bag, gently pull up on the plastic funnel housing to remove it and simply pull the bag out of the unit. Replacement bags are available from Thermo Fisher Scientific.

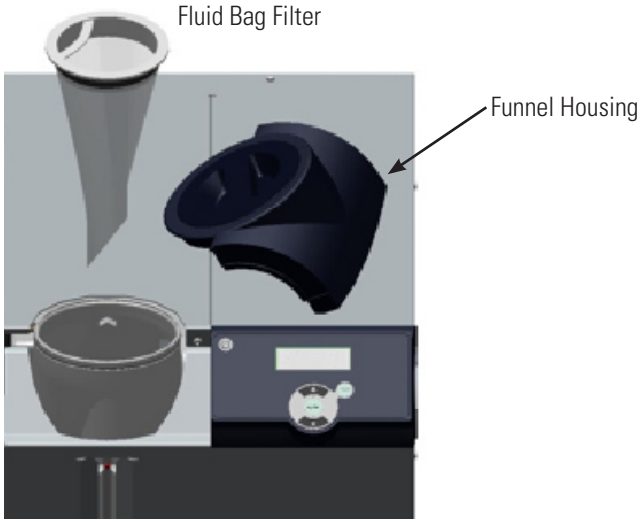


Figure 6-1 Fluid Filter Bag

Fluid Diffuser

On ThermoFlex900-5000 units, when you remove the bag you will notice a wire mesh fluid diffuser inside the reservoir supply line, see Figure 6-2. The diffuser is used to help streamline the flow into the reservoir. After several bag replacements turn the unit off and remove the diffuser to inspect it for debris/damage.

The fluid velocity into the reservoir will rapidly increase with the diffuser removed and cause splashing. Turn the unit off before removing the diffuser. This is especially critical when using ethylene or propylene glycol. ▲

NOTE To prevent particulates from entering the reservoir, ensure the fluid bag filter is in place before removing the diffuser. ▲

Do not operate the unit unless the diffuser is installed. ▲

Reservoir Cleaning

The user is responsible for maintaining reservoir fluid quality. Check the fluid on a regular interval. Start with frequent checks until a regular interval (based on your application) is established.

If cleaning is necessary, flush the reservoir with a fluid compatible with the process fluid and the unit's wetted parts, see Section 8.

Before using any fluid or performing maintenance where contact with the fluid is likely refer to the manufacturer's MSDS for handling precautions. ▲

Reservoir Sight Tube

Clean the sight tube by gently pulling up on the plastic funnel housing to remove it (see illustration on previous page) and then gently pulling out the black sight ball stopper from the tube. Use a long soft-bristle ¼" brush. Use caution not to scratch the glass.

For easier replacement, wet the stopper first and then use a twisting motion to install it in the sight tube.

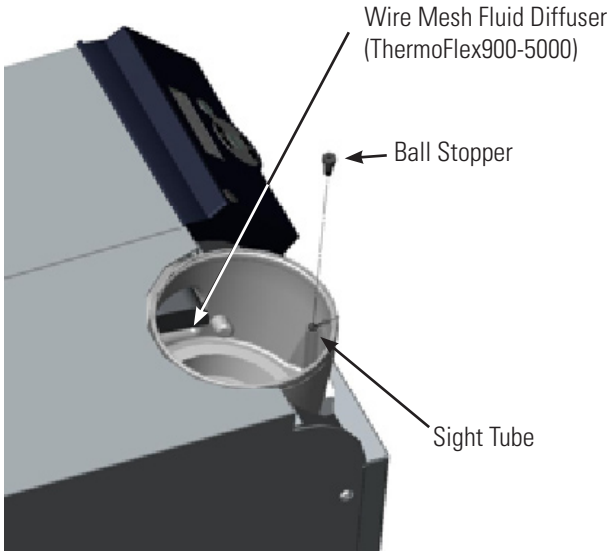


Figure 6-2 Reservoir Cleaning and Diffuser

Condenser Filter

Failure to clean/replace the condenser filter will cause a loss of cooling capacity and lead to premature failure of the cooling system. ▲

ThermoFlex900 - 5000
Clean the filter through the grill using a vacuum with a soft-bristle brush.

When it is time for a more thorough cleaning, remove the one-piece grill assembly by first pulling the bottom of the assembly away from the unit and then pulling it away from the top.

The condenser framing and fins located behind the grill assembly are very sharp. Use caution when removing the assembly. ▲

NOTE ThermoFlex900 - 5000 water-cooled units have an embedded screw(s) located at the top (and bottom) of the grill securing it to the unit. Loosen the screw(s) to remove the grill. ▲

Water-cooled units also have a fan with sharp blades, ensure the unit is off before removing the assembly. ▲

Shake off as much of the excess water as possible before reinstalling. Press the grill back into place.

For water-cooled units, tighten the screw(s) at the top (and bottom) of the grill.

Replacement grill assemblies are available from Thermo Fisher.

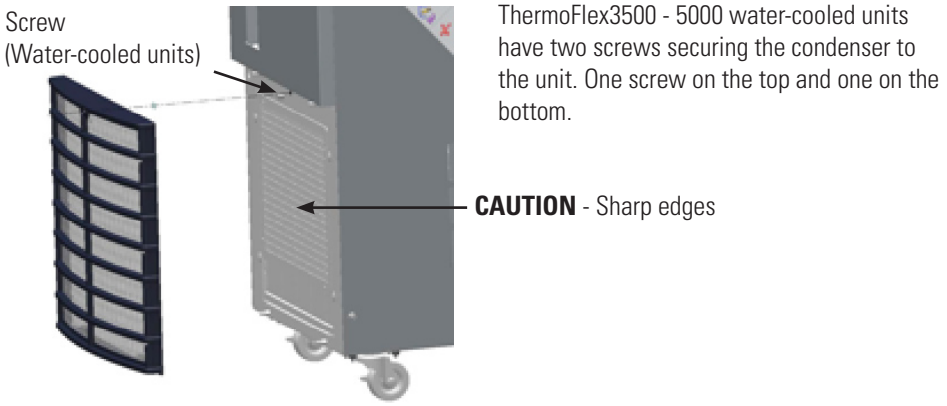


Figure 6-3 ThermoFlex900 - 5000 Condenser Grill Removal

ThermoFlex7500 - 10000
For air-cooled units, remove the one-piece grill assembly by pulling the assembly away from the unit.

Water-cooled units do not have a filter.

The filter goes over four studs and plastic "fast nuts" hold it in place.

Replace it or vacuum the old filter with a soft-bristle brush, or wash it. Shake off as much of the excess water as possible before reinstalling.

Tuck the filter around the perimeter of the grill and over the four studs, use the plastic "fast nuts" to hold it in place.

Replacement grills are available from Thermo Fisher.

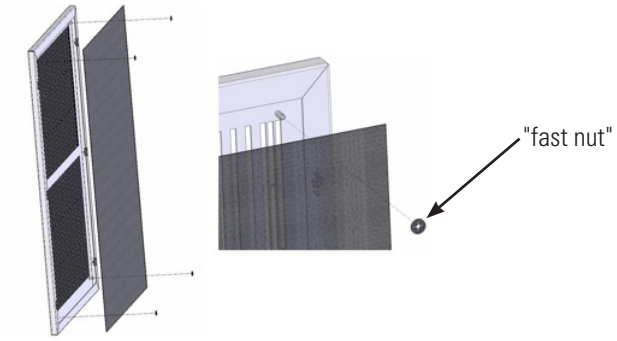


Figure 6-4 Filter Removal/Replacement ThermoFlex7500 - 10000 Air-Cooled

DI Filter (Optional)

Establish a preventive maintenance schedule for the DI filter cartridge based on your specific application.

The Puralite sensor located on the back of your chiller will illuminate red when it is time to change the DI filter cartridge (< 1 MΩ-cm).

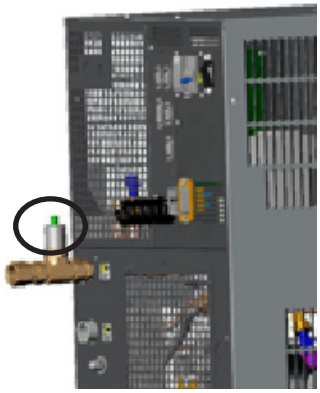


Figure 6-5 Puralite

NOTE When the unit is initially powered, or has been sitting idle for a period of time, the sensor may illuminate. The length of time it will be on varies with your application. ▲

Although the Puralite sensor is the primary indicator that the cartridge needs changing, the unit also has a *separate* integrated alarm that works independently of the Puralite. The alarm is based on unit run hours that will alert you when it is time to change your filter. The **di t** alarm is enabled using the Setup Loop, see Section 4.

If you already know how often your DI filter needs changing, you can input the number of hours into the Setup Loop's **di t** display. When the time is reached, the controller will flash **di** and the audible alarm, if enabled, will sound.

When alerted, check the Puralite sensor on the back of the unit to see if it is illuminated. If it is not illuminated reset the **di t** timer and then check the Puralite periodically.

To clear this message and stop the audible alarm press enter .

If the Puralite has turned red and the controller alarm has not gone off, access the Diagnostic Loop **di** display, see next page. Check the system run hours, this will give you an accurate DI replacement time. Adjust the **di t** filter alarm to match the time needed between filter cartridge changes.

This will automatically restart the preventive maintenance timer for your DI filter. If you change the filter before the preventive maintenance timer alerts you, you can clear the timer by again accessing the Diagnostic Loop **di** display, see next page.

NOTE It may be necessary to monitor the Puralite three or four times to establish an accurate changing schedule. Also, filter operating time is reduced every time new fluid is added. ▲

Diagnostic Loop (d iAG)

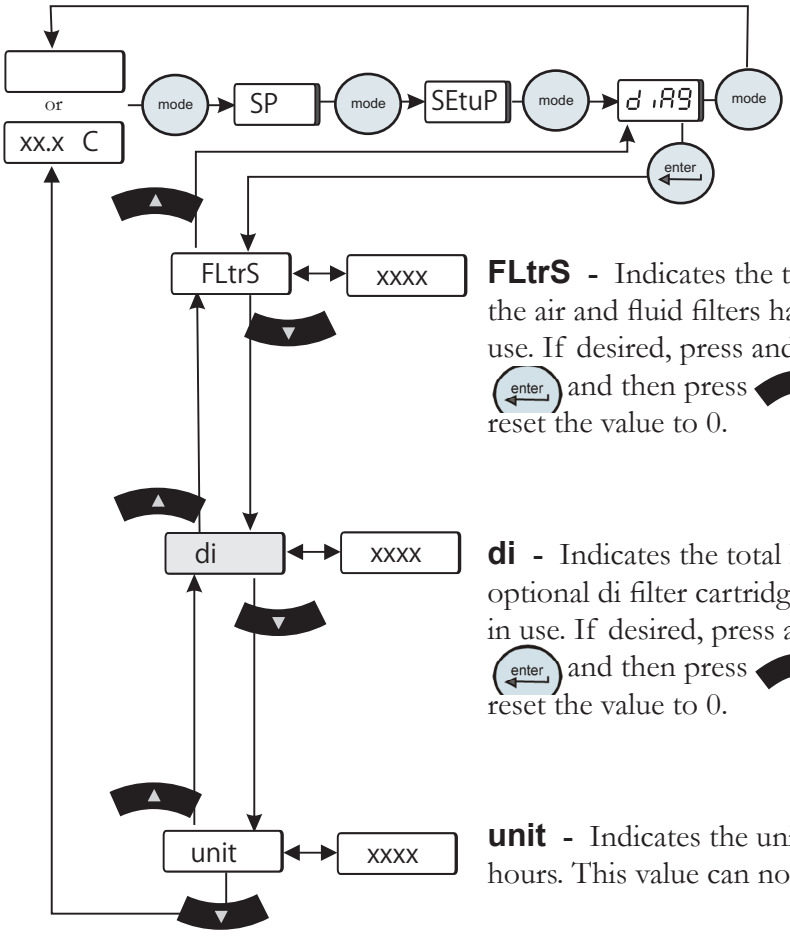
The Diagnostic Loop is used to view or reset the operating times of various unit components.

To enter the Diagnostic Loop ensure the controller display is either a blank screen (unit off) or displaying the process fluid temperature.

Press the mode key and the display will indicate **SP**, press mode again to display **SEtuP**, press mode again to display d iAG.

Press enter to enter the loop or press mode to return to the process fluid temperature or blank display.

Use the key to sequence down through the loop. Use the key to sequence up through the loop.



FLtrS - Indicates the total hours the air and fluid filters have been in use. If desired, press and hold enter and then press to reset the value to 0.

di - Indicates the total hours the optional di filter cartridge has been in use. If desired, press and hold enter and then press to reset the value to 0.

unit - Indicates the unit operating hours. This value can not be reset.

Figure 6-6 Diagnostic Loop

Section 7 Troubleshooting

Error Codes

The controller can display Error Codes. If the unit is still running press **enter** to see if the code clears, a limit may have been only temporarily exceeded. If the unit shut down, the controller will continue to flash the error code. Press **enter** to clear the display and silence any alarm. You can silence the alarm without clearing the code by pressing either the up or down arrow key. Once the cause of the shut down is identified and corrected, start the unit. If the cause was not corrected the error code will reappear.

Error Code	Reaction	Cause	Actions
8888 (or blank-screen)	Unit will not start.	Software communication error.	•Cycle circuit protector on the rear of the unit •Contact our Sales, Service and Customer Support.
Add	Unit continues to run. Auto refill, if installed, shuts off.	The auto refill time chosen for the customer adjustable *fill* setting in the Setup Loop is set to 0 and the unit is configured to keep running, see Section 4.	•Check for leaks. •Check **rEFil** settings and adjust if necessary, see Section 4. •Add fluid to the tank. •Contact our Sales, Service and Customer Support.
di	Unit continues to run. (Optional display)	The unit operating time exceeded Setup Loop di t alarm value. The optional DI cartridge *may* need replacing.	•Check the Puralite sensor on the rear of the unit, if the light is red change the cartridge. See Section 6. •If the Puralite sensor is green, see Section 4 to revise **di t** alarm value.
driP	Unit will shut down. (Optional display)	Fluid in drip pan (SEMI units only).	•Check for leaks. •Remove the fluid from the drip pan and reset the fault. •Contact our Sales, Service and Customer Support.
FLtrS	Unit continues to run.	Air and fluid filters require preventive maintenance/replacement.	•Check air and fluid filters. If required, clean/change air and fluid filters, see Section 6. •If your filters do not need cleaning, you may increase the number of hours between preventive care reminders. There are four levels, see Section 6.

Error Code	Reaction	Cause	Actions
HiFLo	Unit reaction depends on **ALr** setting chosen in the Setup Loop, see Section 4. (Units equipped with a flow transducer.)	The process fluid flow rate has exceeded the adjustable high flow setting's value.	•If the unit is still running press enter to see if the code clears, the limit may have been only temporarily exceeded. •Verify your **HiFLo** setting, see Section 4, and adjust setting if necessary. •Check all application and plumbing shut off valves for correct position. •Adjust flow if unit is equipped with a flow control valve (option), see Section 5. •If flow transducer was recently calibrated double check calibration, see Section 8. •Contact our Sales, Service and Customer Support.
Hi P1	Unit reaction depends on **ALr** setting chosen in the Setup Loop, see Section 4.	The pump's high discharge pressure exceeded Setup Loop high alarm value.	•If the unit is still running press enter to see if the code clears, the limit may have been only temporarily exceeded. •Verify your **Hi P1** setting, see Section 4. •Check application valves and ensure that they have not changed or been closed. **NOTE** If routine shut-off of the process flow is required then an external pressure relief valve should be added, see Section 5. ▲ •May occur as a result of changing the internal DI cartridge. Disconnecting the cartridge adds an additional 0.5 gpm to the main flow. See Section 5. •Check for debris in the application or external filters. •Double check fluid lines. Excessive bends, long tubing and diameter reductions can affect the pump's discharge pressure. **NOTE** If diameter reductions must be made, they should be made at the inlet and outlet of your application, not at the chiller. ▲ •Contact our Sales, Service and Customer Support.

Error Code	Reaction	Cause	Actions
Hi t	Unit reaction depends on **ALr** setting chosen in the Setup Loop, see Section 4. **NOTE** If the unit does shut down it can be restarted provided the temperature is still within the factory-set high fixed temperature limit. However, the error will reoccur if the temperature goes below the adjustable setting and then again exceeds it. ▲	The process fluid temperature exceeded Setup Loop alarm value.	•If the unit is still running press enter to see if the code clears, the limit may have been only temporarily exceeded. •Verify your **Hi t** setting, see Section 4. •Ensure the unit meets all environmental requirements, see Section 3. •Ensure unit has adequate ventilation, see Section 3. •Clean the air filter. Dirt and debris on the filter can prevent the unit from functioning at full capacity, see Section 6. •Ensure that the heat load being applied to the chiller is not too high. Contact Thermo Fisher for assistance on calculating heat loads. •Bring cooler air in from another area or exhaust the hot air into another location using an auxiliary fan. •Verify/adjust controller PID values, see the end of this section. •Contact our Sales, Service and Customer Support.
HPC	Unit will shut down.	High refrigeration pressure.	**Air-cooled units** •Ensure that the ambient temperature is not exceeding the recommended range, see Section 3. •Ensure unit has adequate ventilation, see Section 3. •Clean the air filter. Dirt and debris on the filter can prevent the filter from functioning at full capacity, see Section 6. •Bring cooler air in from another area or exhaust the hot air into another location using an auxiliary fan. •Contact our Sales, Service and Customer Support. **Water-cooled units** •Ensure the plastic plugs were removed from the facility connections. •Ensure facility water is on and connected. •Check facility water flow rate and pressure. •Contact our Sales, Service and Customer Support.

Error Code	Reaction	Cause	Actions
LLF	Unit will shut down. Optional auto refill shuts down.	Reservoir fluid level too low for normal operation. The auto refill time chosen for the customer adjustable *fill* setting in the Setup Loop is set to 0 and the unit is configured to shut down, see Section 4	•Excessive evaporation. Ensure the unit is operating with the funnel and cap in place. •Check for leaks. •Check **rEFil** settings and adjust if necessary, see Section 4. •Add fluid to the tank. •Contact our Sales, Service and Customer Support.
LoFLo	Unit reaction depends on **ALr** setting chosen in the Setup Loop, see Section 4. (Units equipped with a flow transducer.)	The process fluid flow rate has gone below the adjustable setting's value.	•If the unit is still running press enter to see if the code clears, the limit may have been only temporarily exceeded. •Verify your **LoFLo** setting, see Section 4. •Adjust flow if unit is equipped with a flow control valve (option), see Section 5. •Check all valves in your application and plumbing lines to ensure that they have not changed or closed. •If flow transducer has recently been calibrated, double check calibration to ensure it was done properly, see Section 8. •Contact our Sales, Service and Customer Support.
Lo P1	Unit reaction depends on **ALr** setting chosen in the Setup Loop, see Section 4.	Pump's low discharge pressure is below Setup Loop low alarm value.	•If the unit is still running press enter to see if the code clears, the limit may have been only temporarily exceeded. •Ensure that chiller reservoir level is not too low. •Verify your **LoP1** setting, see Section 4. •Unit requires >3 PSIG application pressure drop. If a bypass valve has been installed, some restriction may need to be added to the bypass line. •Contact our Sales, Service and Customer Support.

Error Code	Reaction	Cause	Actions
Lo t	Unit reaction depends on **ALr** setting chosen in the Setup Loop, see Section 4. **NOTE** If the unit does shut down it can be restarted provided the temperature is still above the factory-set low fixed temperature limit. However, the error will reoccur if the temperature goes above the adjustable setting and then again drops below it. ▲	Process fluid temperature is below Setup Loop alarm value.	• If the unit is still running press enter to see if the code clears, the limit may have been only temporarily exceeded. •Verify your **Lo t** setting, see Section 4. •Ensure that the ambient temperature is not below the recommended low-range, see Section 3. If your application load is constant and/ or the lower temperature can be temporarily tolerated, then continue operation. (The ThermoFlex will control setpoint when sufficient heat is added.) •Verify/adjust controller PID values. •Add insulation to external plumbing lines to reduce the heat-loss to the environment. •For water-cooled units check facility water temperature. •Contact our Sales, Service and Customer Support.
o FLo	Unit will shut down.	There is an overflow condition in the reservoir.	•Ensure the reservoir was not filled above the MAX LEVEL line. •Check for clogged reservoir filter. •Contact our Sales, Service and Customer Support.
oL	Unit will shut down. (Units equipped with 3-Φ pump motor overload.)	Pump motor overload activated. Pump motor exposed to excessive current due to high pressure, flow or ambient temperature.	•Allow pump to cool down. •Contact our Sales, Service and Customer Support.
oL 2	Unit will shut down. (Units equipped with 3-Φ fan.)	Fan motor overload activated.	•Allow unit to cool down. •For air-cooled units, clean the air filter •Contact our Sales, Service and Customer Support.
PHEr	Unit will shut down. (3-Φ units only)	Phase rotation is wrong.	•Disconnect unit from power source and reverse any two line conductors on the line side of the main circuit breaker. •Contact our Sales, Service and Customer Support.

Error Code	Reaction	Cause	Actions
rEFiL	Auto refill will shut off. Unit reaction depends on **ALr** setting chosen in the Setup Loop, see Section 4. Auto refill will shut off. Unit will continue to run. (Optional display.)	The fluid level did not reach the minimum operating level within the time chosen for the customer adjustable *fill* setting, chosen in the Setup Loop, see Section 4. The auto refill successfully filled within the time frame chosen for the customer adjustable *fill* setting, but the unit tried to refill 5 times in 40 hours.	•Check auto refill connection. •Check for leaks. •Check the supply pressure on the auto refill supply line. With low pressure the auto refill time span setting may be set too low and the reservoir does not have time to fill. •Check **rEFil** settings and adjust if necessary, see Section 4. •Contact our Sales, Service and Customer Support.
SEr X (x = 1 to 6)	Unit will continue to run.	Preventive maintenance reminder.	•Perform preventive maintenance, see Section 6. **NOTE** The reminder is based on component operating time. ▲ •Contact our Sales, Service and Customer Support.
Er 4	Unit will not start.	Normal if new software installed and all values in the Setup and Tune Loops were reset to factory defaults.	•Clear the error code. •If error remains, contact our Sales, Service and Customer Support.
Er 15	Unit will continue to run. (Units equipped with serial communications.)	Bad, communications connection.	•Check the serial communication connection. •See serial communication connections in Appendix D. •Contact our Sales, Service and Customer Support.
Er 16	Unit continues to run.	Bad sensor calibration detected several seconds after performing a calibration.	•Redo calibration, see Section 8. •Contact our Sales, Service and Customer Support.

Error Code	Reaction	Cause	Actions
Er 22	This error code has priority over **H iT**. Unit will shut down. **NOTE** Unit will not restart until process fluid temperature is below +43°C. ▲	Reservoir fluid temperature exceeded the *factory preset* value of +43°C.	•Ensure the unit meets all environmental requirements, see Section 3. •Ensure unit has adequate ventilation, see Section 3. •Clean the air filter. Dirt and debris on the filter can prevent the unit from functioning at full capacity, see Section 6. •Ensure that the heat load being applied to the chiller is not too high. Contact Thermo Fisher for assistance on calculating heat loads. •Bring cooler air in from another area or exhaust the hot air into another location using an auxiliary fan. •Verify/adjust controller PID values, see the end of this section. •Contact our Sales, Service and Customer Support.
Er 23	Unit will shut down.	Refrigeration temperature sensor shorted.	•Contact our Sales, Service and Customer Support.
Er 24	Unit will shut down.	Refrigeration temperature sensor open.	•Contact our Sales, Service and Customer Support.
Er 25	Unit will shut down.	Internal temperature sensor shorted.	•Contact our Sales, Service and Customer Support.
Er 26	Unit will shut down.	Internal temperature sensor open.	•Contact our Sales, Service and Customer Support.
Er 32	Unit will shut down.	Refrigeration suction gas temperature exceeded 50°C.	•Contact our Sales, Service and Customer Support.

Error Code	Reaction	Cause	Actions
Er 33	This error code has priority over **L oT**. Unit will shut down. **NOTE** Unit will not restart until process fluid temperature exceeds +2°C. ▲	Reservoir fluid temperature below the *factory preset* value of +2°C.	•Check ambient temperature. Unit may not to be able to reach setpoint at low ambient temperatures. •Ensure that the ambient temperature is not exceeding the recommended range, see Section 3. •Verify/adjust controller PID values, see Section 7. •Add insulation to external plumbing lines to reduce the heat-loss to the environment. •For water-cooled units check facility water temperature. •Contact our Sales, Service and Customer Support.
Er 35	This error code has priority over **Hi P1**. Unit will shut down.	Process pressure (P1) exceeded *factory preset* value for greater than 30 seconds. Preset Values: P1, P2 and T1- 105 psi P3 60 Hz - 48 psi P3 50 Hz - 32 psi P4 60 Hz - 85 psi P4 50 Hz - 60 psi P5 60 Hz - 87 psi P5 50 Hz - 56 psi	•Check application valves and ensure that they have not changed or been closed. **NOTE** If routine shut-off of the process flow is required then an external pressure regulator accessory should be added - contact Thermo Fisher. ▲ •May occur as a result of changing the internal DI cartridge. Disconnecting the cartridge adds an additional 0.5 GPM to the main flow, see Section 5. •Check for debris in the application or clogged external filters. •Double check fluid lines. Excessive bends, long tubing and diameter reductions can affect the pump's discharge pressure. **NOTE** If diameter reductions must be made, they should be made at the inlet and outlet of your application, not the chiller. ▲ •Contact our Sales, Service and Customer Support.
Er 36	This error code has priority over **Lo P1**. Unit will shut down.	Process pressure (P1) below *factory preset* limit of 3 psi (all pumps) for greater than 15 seconds. Possible pump motor overload.	•Ensure that the chiller reservoir is not too low. •Unit requires >3 PSIG application pressure drop. If a bypass valve has been installed, some restriction may need to be added to the bypass line. •Allow unit to cool down •Contact our Sales, Service and Customer Support.

Error Code	Reaction	Cause	Actions
Er 41	Unit continues to run.	Communication error between display and main control board.	•Cycle circuit protector on rear of unit off and on. •Contact our Sales, Service and Customer Support.
Er 42	Unit continues to run.	Internal communications error.	•Contact our Sales, Service and Customer Support.
Er 48	Unit will shut down. (Optional display.)	Unit's optional EMO button depressed.	•When able, reset the EMO.
Er 59	Unit will shut down.	Invalid level fault. Unit sensed both a high level and low level reservoir fluid level.	•Contact our Sales, Service and Customer Support.
Er 62	Unit will not start. (Units equipped with optional Analog I/O.)	Probe not properly connected. Shorted remote temperature probe.	•Check connection. •Contact our Sales, Service and Customer Support.
Er 63	Unit will not start. (Units equipped with optional Analog I/O.)	Probe not properly connected. Open remote temperature probe.	•Check connection. •Contact our Sales, Service and Customer Support.
Er 64	Unit will continue to run using the last valid setpoint received. (Units equipped with optional Analog I/O.)	Analog remote setpoint is enabled and the unit receives a voltage or current level that is outside the unit's set point range.	•The error can be cleared only after a valid set point is received, or the remote analog setpoint is turned off.

Checklist

Unit will not start

For first time use, please refer to the quick start instructions included with your unit or the copy in this manual. The manual's copy follows the Table of Contents.

Check the controller for error codes, see Error Codes in this section.

Ensure the optional GFCI breaker located on the rear of the unit is in the up position.

Ensure the circuit protector is in the on (**I**) position.

For ThermoFlex900 - 5000 Global Voltage units ensure the unit is properly configured, see Appendix B.

Make sure supply voltage is connected and matches the unit's nameplate rating ±10%

NOTE Once RS232 or RS485 is activated, all keypad operations are disabled except for turning the unit off and changing serial communication settings. ▲

No display on controller or display is 8888

Recycle the circuit protector on the rear of the unit.

Clearing Error Codes

Note the code in case it clears before you are done troubleshooting.

If desired, silence the audible alarm by pressing the up or down arrow key.

If the unit shut down, the controller will continue to flash the error code. Press **enter** to clear the display and silence any alarm. Refer to Error Codes in this section. Once the cause of the shut down is identified and corrected, start the unit. If the cause was not corrected the error code will reappear.

If the unit is still running, press **enter** to see if the code clears, a limit may have been only temporarily exceeded. If the error code does not clear press  until the display flashes between the error code and the temperature and then press **enter.** If the code still does not clear refer to Error Codes in this section.

Unit will not circulate process fluid

Check the reservoir level. Fill, if necessary.

Ensure the reservoir bag filter is not clogged.

Check the application for restrictions in the cooling lines.

Unit requires >3 PSIG application pressure drop. If a bypass valve has been installed add some restriction to the bypass line.

The pump motor overloaded. The pump's internal overtemperature overcurrent device will shut off the pump causing the flow to stop. This can be caused by low fluid, debris in system, operating unit in a high ambient temperature condition or excessively confined space. Allow time for the motor to cool down.

Make sure supply voltage matches the unit's nameplate rating ±10%.

Inadequate temperature control

Verify the setpoint.

Make sure the condenser/air filter is free of dust and debris.

Check the fluid concentration, see Section 3.

Ensure unit installation complies with the site requirements in Section 3.

Make sure supply voltage matches unit nameplate rating ±10%.

If the temperature continues to rise, make sure your application's heat load does not exceed the rated specifications.

Check for high thermal gradients (i.e., the application load is being turned on and off or rapidly changing).

Verify/adjust controller PID values, see next page.

Unit vibration

The optional pressure relief valve setting may be the cause. Change the pressure setting ± 5 psi to eliminate the vibration.

Unit shuts down

Ensure  button wasn't accidently pressed.

Ensure the optional GFCI breaker located on the rear of the unit is in the up position.

Ensure the circuit protector is in the on (**I**) position.

Check the controller for error codes, see Error Codes in this section.

Make sure supply voltage is connected and matches the unit's nameplate rating ±10%.

Restart the unit.

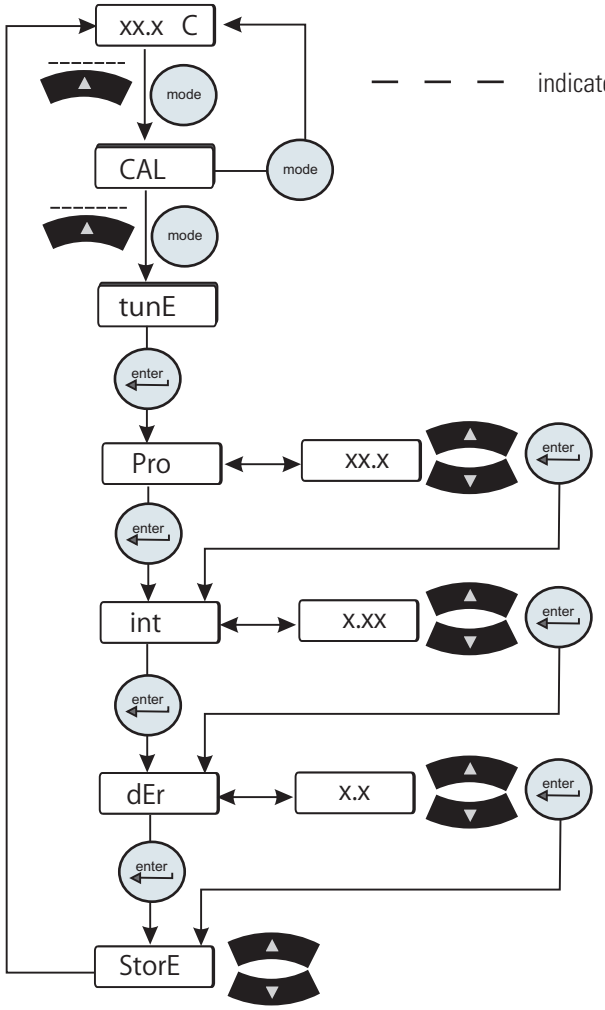
Please contact Thermo Fisher Scientific Sales Service and Customer Support if you need any additional information, see inside cover for contact instructions.

Verifying/ Adjusting the Controller PID Values

(Tune Loop)

The controller controls temperature using a Proportional-Integral-Derivative (PID) algorithm. Should your unit experience temperature control issues, verifying/adjusting the controller's PID values may correct the condition.

NOTE Thermo Fisher recommends that only a qualified technician adjust the PID values. Incorrect values will hamper unit performance. ▲



• Pro
proportional value
P = % of span (100°C)
Range: 0.0 to 99.9
Factory Preset:
ThermoFlex900-5000
10.0
ThermoFlex7500-10000
15.0

• int
integral value
I = repeats/minute
Range: 0.00 to 9.99
Factory Preset: 0.50

• dEr
derivative value
D = minutes
Range: 0.0 to 9.9
Factory Preset: 0.0

Figure 7-1 Verifying/Adjusting PID Values

Section 8 Additional Information

Draining

Before using any fluid or performing maintenance where contact with the fluid is likely refer to the manufacturer's MSDS for handling precautions. ▲

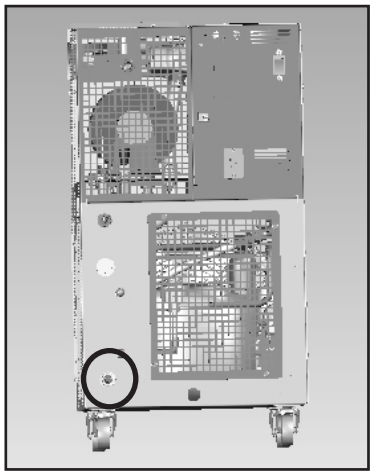
Position a suitable pan beneath the drain port at the rear of the unit. The drain pan must be shallow (under 3½" in height) and have a volume of approximately 3 gallons (6 gallons for ThermoFlex7500 - 10000). Remove ¼" Male NPT pipe plug from drain port. This will drain the return line, reservoir, plate exchanger, and the suction side of the pump.

To drain the discharge side of the pump disconnect the Female NPT outlet connection on the rear of the unit.

NOTE Internally the unit does not contain a large quantity of fluid on the discharge side however take care to contain what fluid does drain, a wet-vac can be employed to minimize the potential for spillage. ▲

If the unit is equipped with the flow control or pressure relief with flow control option, open the valve or remove the drain plug in order to drain the discharge line, see Section 5.

If the unit is equipped with the anti drainback option, enter the Setup Loop and utilize the **drAin** display to open the valve, see Section 4. Opening the valve allows the fluid to drain out of the unit.



Reinstall ¼" Male NPT pipe plug using a sealant suitable for the wetted materials prior to refilling the unit.

Figure 8-1 1/4" Male NPT Reservoir Drain Plug

Water-Cooled

Draining ThermoFlex900 - 2500 water-cooled units is accomplished by removing the right side panel. Use a Philips head screwdriver to remove the five screws indicated in the illustration below. Slide the panel back approximately one inch, then lift slightly from the rear to disengage the panel's two tabs from their slots.

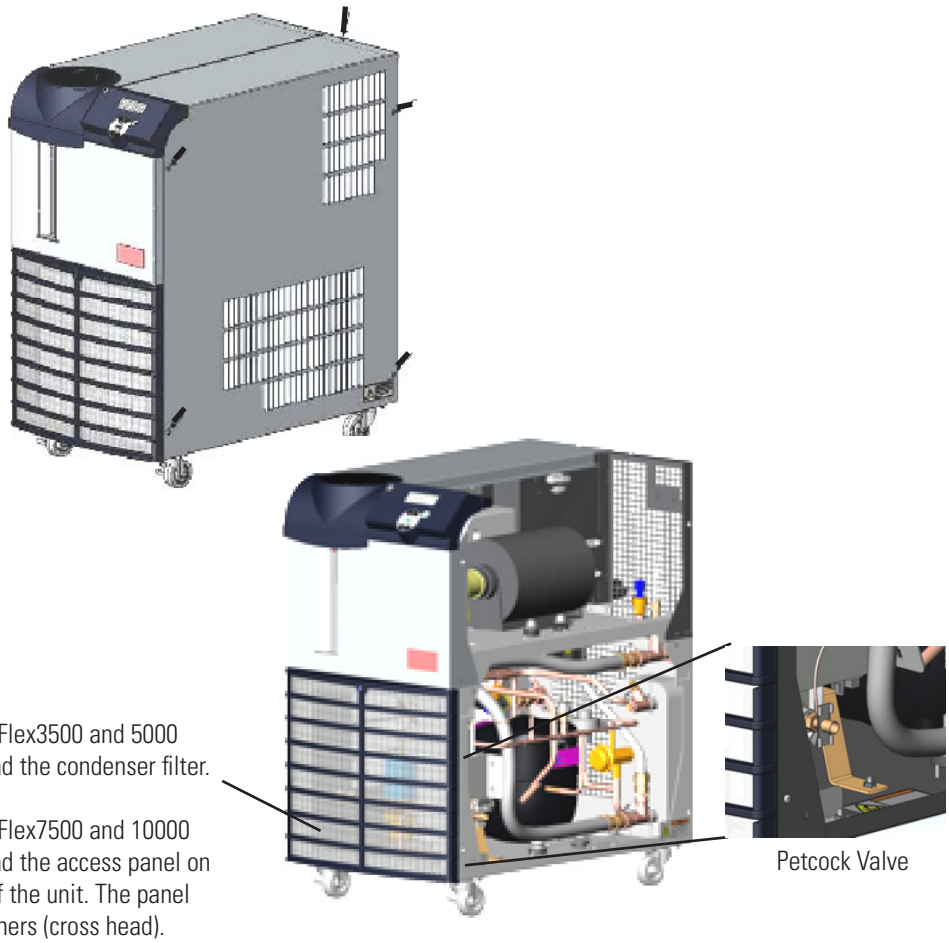


Figure 8-2 Water-Cooled

Install a $^{7}/_{16}$" ID tube on the drain petcock valve located on the lower end of the exchanger. Open the valve to allow fluid to drain into an external device. When draining is complete close the valve and replace the panel.

A wet-vac is needed on the facility water inlet connection to thoroughly drain any remaining fluid from the lines.

Wetted Materials

P1 and P2 Pumps

300 Series Stainless Steel
Bronze
Carbon Graphite
Ceramic
Fluorocarbon (Viton®)
Polysulfone

Tank

Polyethylene
Brass
EPDM
Pyrex®

Plumbing

300 Series Stainless Steel
Bronze
Fluorocarbon (Viton®)
Nickel
Polypropylene
EPDM
Brass
Copper
Teflon®
PPS (flow transducer)
Nitrile (Buna-n®)

Filter bag

Polypropylene
Mono-filament nylon

Funnel

Acetal Copolymer

P3, P4 and P5 Pumps

316 Series Stainless Steel
Carbon
Silicon Carbide
Fluorocarbon (Viton®)

T1 Pumps

Stainless Steel AISI 304
Bronze ASTM B62
Bronze ASTM B16
Buna N
Buna/Ceramic
Buna/Carbon

Internal Fluid Temperature Sensor (rdt1) Calibration

The ThermoFlex has been designed to minimize the need for calibration. However, if calibration is desired or recommended by our Sales, Service and Customer Support, please use the following procedure.

This procedure requires a running unit and a calibrated reference thermometer.

NOTE Uninsulated applications may cause the internal temperature and an external reference temperature to differ and to fluctuate. If inaccurate calibration is suspected, place the reference thermometer as close to the ThermoFlex process outlet as possible. ▲

NOTE If it is more convenient, perform the low-end calibration before doing the high-end. ▲

Do not pick calibration points that are outside the safe operating limits of the fluid in your application. For example with water, 40°C and 5°C are typical high and low calibration points.

Run the unit to a suitable high-end calibration point. Place a calibrated reference thermometer in the reservoir. Ensure the fluid temperature is stabilized.

To enter the Calibration Loop ensure the controller display is displaying the process fluid temperature, see the diagram on next page. Press and hold the  and then press the 

key. The display will indicate **CAL**. Press the 

key and the controller will display **rtd1**. Press 

again and the controller will display **r1 H** (high-end calibration). Press 

again and the controller will flash between **r1 H** and the temperature. Use  to adjust the temperature to match the reference thermometer. Press the 

key again to accept the value.

Press the  key until **StorE** is displayed, press  to save the new value, press  to not save it.

NOTE After pressing the  button at the **StorE** prompt wait several seconds before proceeding to ensure that a bad calibration message (**Er 16**) does not appear. Premature use of the keypad after pressing  may cancel the bad calibration error message. ▲

Run the unit to a suitable low-end calibration point. At the **r1 L** (low-end calibration) display repeat the procedure.

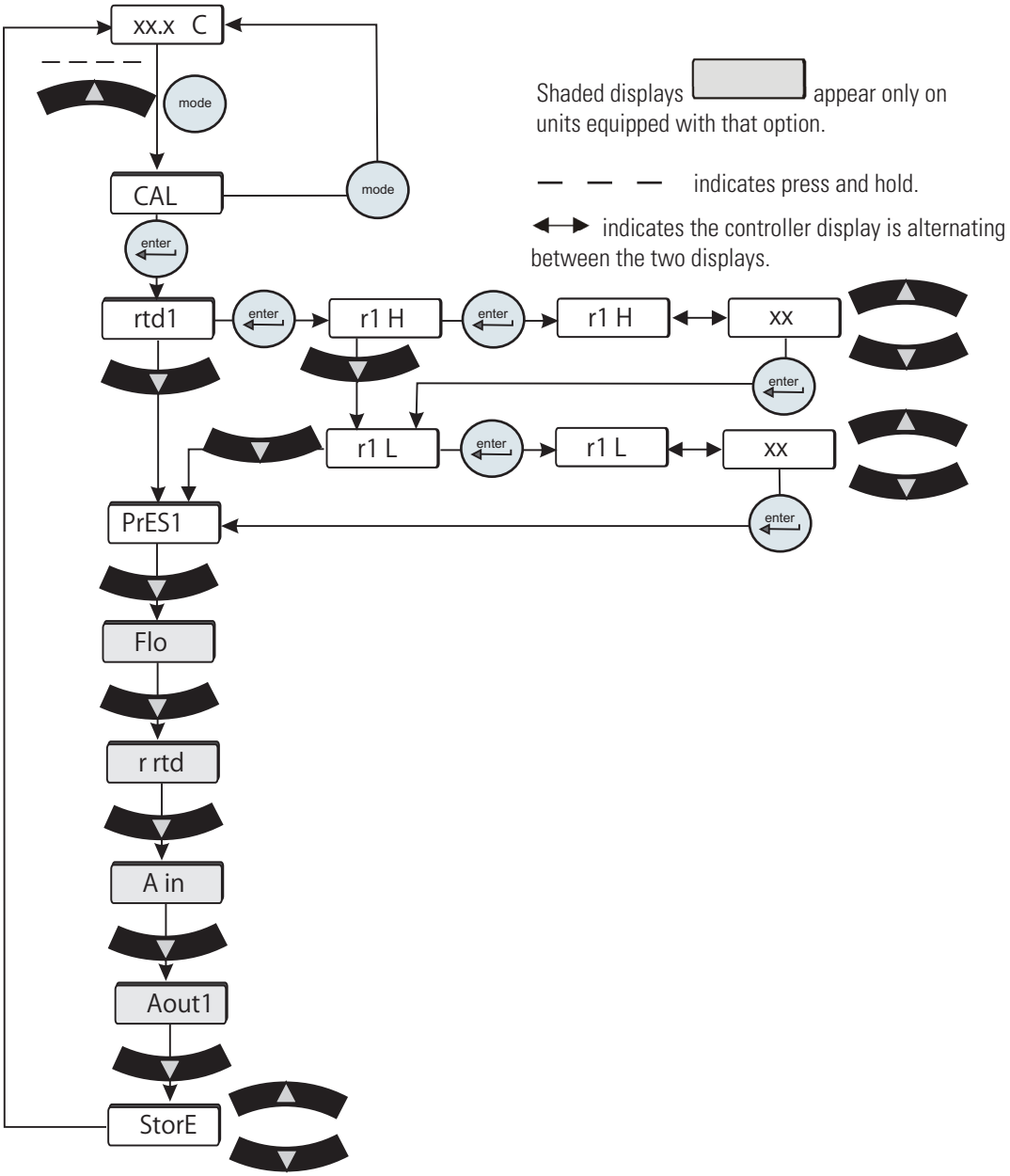


Figure 8-3 Internal Temperature Sensor Calibration

If you have any questions please contact Thermo Fisher Scientific's Sales, Service and Customer Support.

Process Fluid Pressure (P1) Transducer Calibration

The ThermoFlex has been designed to minimize the need for calibration. However, if calibration is desired or recommended by our Sales, Service and Customer Support, please use the following procedure.

This procedure requires a running unit, a calibrated reference pressure gauge and an external flow control valve.

Connect a calibrated reference pressure gauge to the outlet line. Using an external flow control valve, increase the pressure to a suitable high-end calibration point by closing the valve. Ensure the pressure is stabilized.

To enter the Calibration Loop ensure the controller display is displaying the process fluid temperature, see the diagram on the next page. Press and hold the  and then press the  key. The display will indicate **CAL**.

Press the  key and the controller will display **rtd1**. Press  until the controller displays **PrES1**. Press  and the controller will flash between **P1H** and the pressure.

Use  to adjust the rate to match the reference pressure gauge.

Press the  key to accept the value.

Decrease the pressure to a suitable low-end calibration point (avoid a zero pressure). Ensure the pressure is stable.

The controller will flash between **P1L** and the pressure. Use  to adjust the rate to match the reference pressure gauge.

Press the  key and **StorE** is displayed, press  to save both values, press  to not save them.

NOTE After pressing the  button at the **StorE** prompt wait several seconds before proceeding to ensure that a bad calibration message (**Er 16**) does not appear. Premature use of the keypad after pressing  may cancel the bad calibration error message. ▲

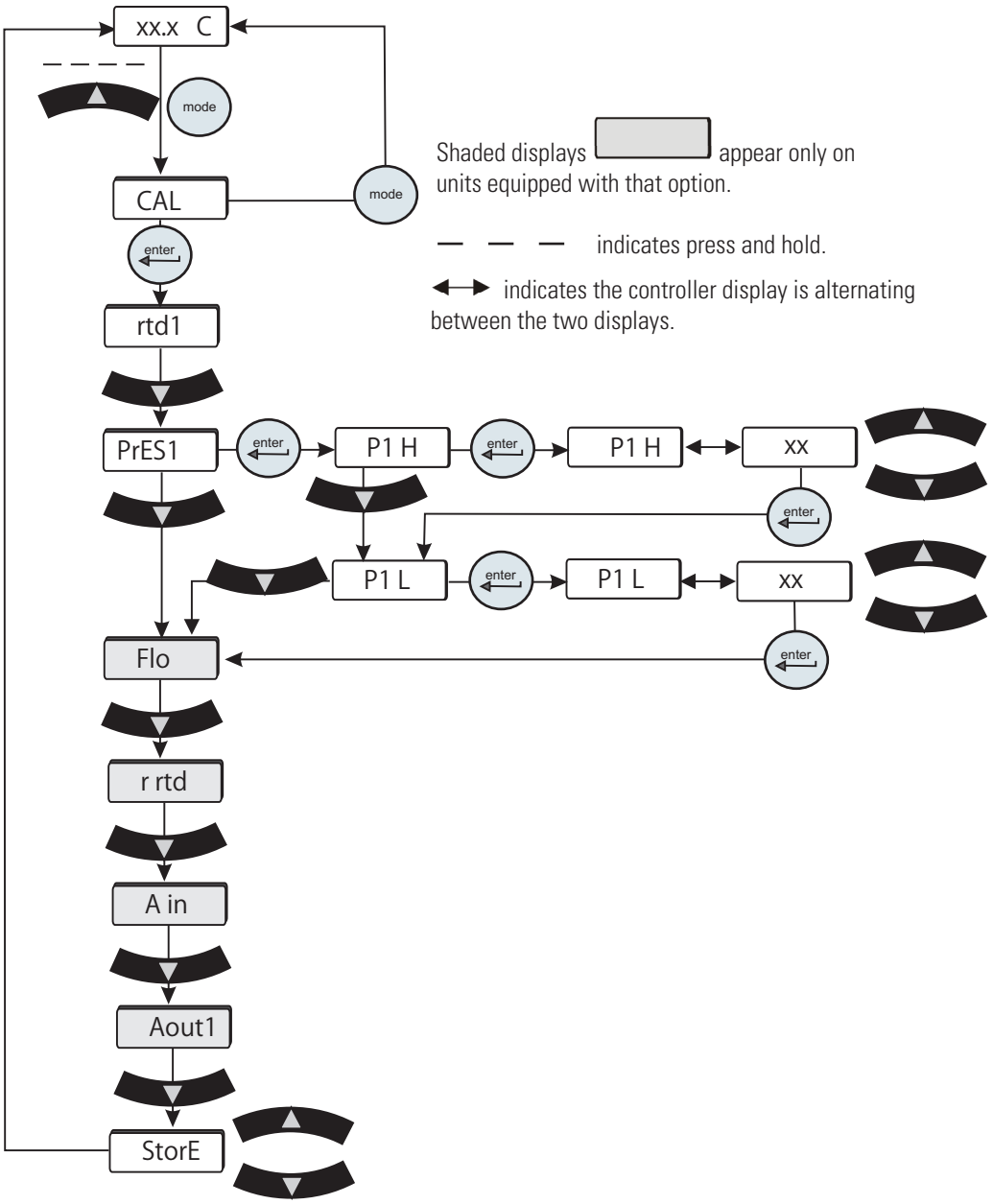


Figure 8-4 Pressure (P1) Calibration

If you have any questions please contact Thermo Fisher Scientific's Sales, Service and Customer Support.

Optional Process Fluid Flow Transducer (FLo) Calibration

The ThermoFlex has been designed to minimize the need for calibration. However, if calibration is desired or recommended by our Sales, Service and Customer Support, please use the following procedure.

This procedure requires a running unit, a calibrated reference flowmeter and an external flow control valve.

Connect a calibrated reference flowmeter to the outlet line. Using an external flow control valve, increase the flow to a suitable high-end calibration point. Ensure the flow is stabilized.

To enter the Calibration Loop ensure the controller display is displaying the process fluid temperature, see the diagram on the next page. Press and hold the  and then press the  key. The display will indicate **CAL**. Press the  key and the controller will display **rtd1**. Press  until the controller displays **FLo**. Press  and the controller will flash between **HiFLo** and the flow rate.

Use  to adjust the rate to match the reference flowmeter.

Press the  key to accept the value.

Decrease the flow to a suitable low-end calibration point (avoid a zero flow rate). Ensure the flow is stable.

The controller will flash between **LoFLo** and the flow rate. Use  to adjust the rate to match the reference flowmeter.

Press the  key and **StorE** is displayed, press  to save both values, press  to not save them.

NOTE After pressing the  button at the **StorE** prompt wait several seconds before proceeding to ensure that a bad calibration message (**Er 16**) does not appear. Premature use of the keypad after pressing  may cancel the bad calibration error message. ▲

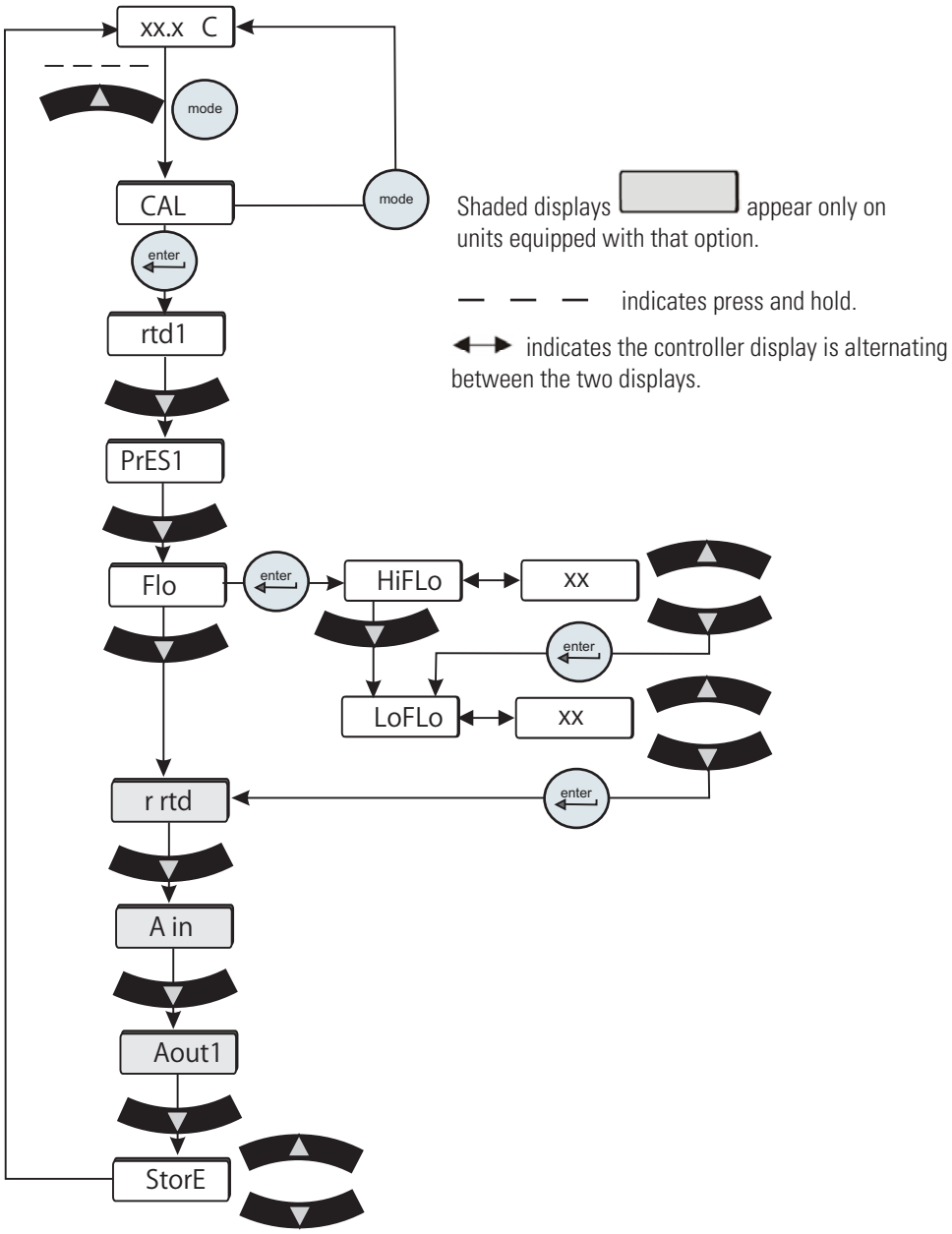


Figure 8-5 Flow Transducer (FLo) Calibration

If you have any questions please contact Thermo Fisher Scientific's Sales, Service and Customer Support.

Shipment/Storage

Transporting and/or storing the unit in near or below freezing temperatures requires draining, see Draining in this Section. Store the unit in the temperature range of -25°C to 60°C (with packaging), and <80% relative humidity. ▲

Do not store the unit for more than 90 days. ▲

Appendix A Country Specific 230 VAC, 50 Hz, 1Ø Requirements

Refer to the nameplate label located on the rear of the unit for specific electrical requirements.

1. Units shipped to the following locations require a **16 Amp service**:

Afghanistan, Albania, Algeria, Andorra, Angola, Argentina, Armenia, Austria, Azerbaijan, Belarus, Belgium, Benin, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Chile, Comoros, Congo, Croatia, Czech Republic, Denmark, Djibouti, DR Congo, Ecuador, Egypt, Eritrea, Estonia, Ethiopia, Finland, France, French Guiana, Gabon, Georgia, Germany, Greece, Guinea, Hungary, Iceland, Indonesia, Iran, Iraq, Israel, Italy, Ivory Coast, Jordan, Kazakhstan, Kyrgyzstan, Latvia, Lebanon, Liberia, Libya, Liechtenstein, Lithuania, Luxembourg, Madagascar, Mali, Mauritania, Moldova, Monaco, Mongolia, Morocco, Mozambique, Namibia, Nepal, Netherlands, Niger, North Korea, Norway, Paraguay, Peru, Poland, Portugal, Romania, Russia, Rwanda, Saint Vincent and the Grenadines, San Marino, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Slovakia, Slovenia, Somalia, South Africa, South Korea, Spain, Sweden, Switzerland, Syria, Tajikistan, Thailand, Togo, Tunisia, Turkey, Turkmenistan, Ukraine, Uruguay, Uzbekistan, Vanuatu, Vatican City, Vietnam.

2. Units shipped to the following locations require a **15 Amp service**:

Australia, China, Fiji Islands, Nauru, New Zealand, Papua New Guinea, Solomon Island, Tonga, Tuvalu.

3. Units shipped to the following locations require a **13 Amp service**:

Abu Dhabi, Bahrain, Bangladesh, Botswana, Brunei, Cyprus, Dominica, Gambia, Ghana, Gibraltar, Grenada, Hong Kong, India, Ireland, Kenya, Kiribati, Kuwait, Lesotho, Malawi, Malaysia, Maldives, Malta, Mauritius, Myanmar, Nigeria, Oman, Pakistan, Qatar, Saint Lucia, Seychelles, Sierra Leone, Singapore, Sri Lanka, Sudan, Swaziland, Tanzania, Uganda, United Arab Emirates, United Kingdom Yemen, Zambia, Zimbabwe.

Appendix B Voltage Configuration Instructions

ThermoFlex900 to 5000 units configured to operate at either 115V 60Hz or 100V 50/60Hz, or units with the Global Voltage option, have a voltage configuration panel located behind the access panel on the rear of the unit.

- Use a 1/4" socket to remove the four screws securing the access panel to the unit.
- The configuration panel has two 3-position toggle switches, one for voltage and one for frequency. All units are shipped with the toggle switch in the center **SHIP** position. Place each switch to the settings that match the voltage/frequency supplied to the unit.
- Reinstall the access panel.

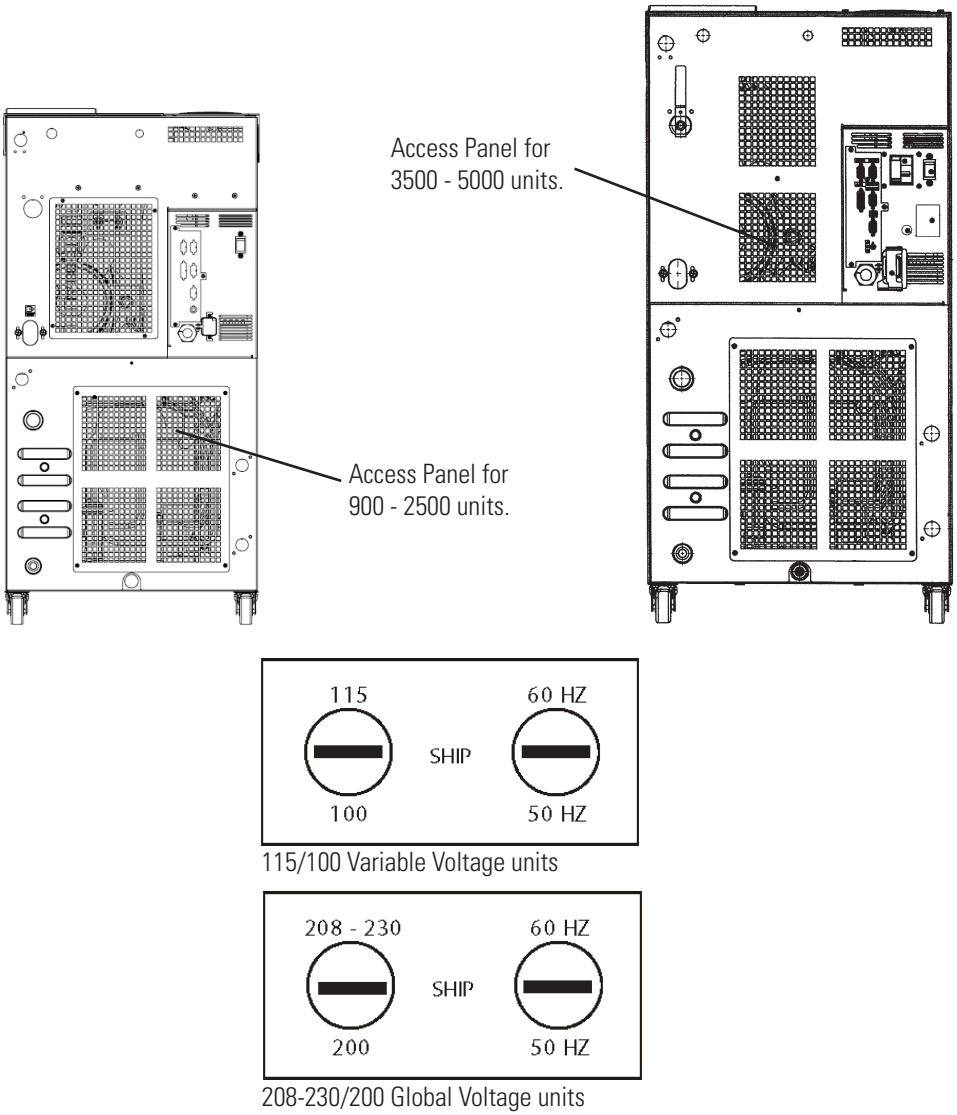
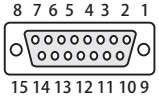


Figure B-1 Variable/Global Voltage Units

Appendix C Analog I/O and Remote Sensor

Analog I/O Connector Pinout ♀



Install your analog input/output device to the 15-pin female connector on the rear of the unit. Analog I/O is activated using the Setup Loop, see page C-3.

PIN	NAME	NOTES	DEFINITION
1	DIGITAL INPUT COMMON		Common for digital inputs (pins 12, 13 and 14)
2	Not Used		
3	LOW LEVEL (Only if option chosen)	Note 1	Dry Relay Contact: Reference to pin 11. Closes if either level switch is in the "low" position for more than 1 second.
4	CONFIGURABLE RELAY 2	Note 1	Dry Relay Contact: Reference to pin 11. Closes when any configured fault or warning occurs, see Table 2.
5	PUMP ON	Note 1	Dry Relay Contact: Reference to pin 11. Closes when pump is turned on. Opens when pump is turned off.
6	ANALOG GROUND		Common for analog signals (pins 2, 7 and 15)
7	RESERVOIR TEMP OUT **OR** EXTERNAL SENSOR TEMPERATURE IF EXTERNAL SENSOR ENABLED	Note 2	Analog Voltage Output 0-10VDC, 10mV/°C, or 4-20mA: Reference to pin 6. This voltage output is proportional to the reservoir fluid temperature: Default scale= 0–10V (where: 0V = Low Temp Span, 10V = Hi Temp Span) Optional Range = 10mV/ ^{0}C. (Ex: 200mV = 20°C) (Max Load @ 10V = 5mA) or 4-20mA, 4mA = low temp span, 20 mA = high temp span (maximum output current = 5mA @10VDC. Contact us for details.
8	LOW FLOW (Only if option chosen)	Note 1	Dry Relay Contact: Reference to pin 11. Closes when a low flow occurs while the pump is on. Note: To allow the pump to get up to speed at startup, the pump runs for 3 - 5 seconds before the low flow sensor is read.
9	CONFIGURABLE RELAY 1 (Normally Open)	Note 1	Dry Relay Contact: Reference to pin 11. Closes when any of the configured faults occur, see Table 1.
10	CONFIGURABLE RELAY 1 (Normally Closed)	Note 1	Dry Relay Contact: Reference to pin 11. Complement of pin 9 (open when pin 9 is closed).
11	RELAY COMMON		Common for all relay contacts (pins 3, 4, 5, 8, 9, 10).
12	REMOTE START ENABLE	Note 3	Digital Input (Isolated): Reference to pin 1. Connect to pin 1 to allow unit to be remotely turned on/off through pin 14 REMOTE START.

Note 1: All relay contacts (except for Pin 10) are normally OPEN when power is off. Pin 10 contacts are normally CLOSED when power is off. Relay contacts are rated: 24V AC/DC, 2A, <= 0.08 Ohm maximum each or 5A total for all relays combined, 1mA minimum, switching capacity: 48VA/48W (Resistive load only).

Note 2: Jumper Configurable (Default = 10mV/°C)

Note 3: Sink 0.5mA @ 5VDC (Rated for signal level gold contact or TTL device)

PIN	NAME	NOTES	DEFINITION
13	REMOTE SETPOINT ENABLE	Note 3	Digital Input (Isolated): Reference to pin 1. Connect to pin 1 to allow the setpoint to be changed remotely through pin 15 REMOTE SETPOINT.
14	REMOTE START	Note 3	Digital Input (Isolated): Reference to pin 1. Connect to pin 1 to turn unit on. Disconnect to turn unit off. Note: Pins 1 and 12 must be connected to allow operation from this pin.
15	REMOTE SETPOINT	Note 2	Analog Voltage Input 0-10VDC, 10mV/°C, or 4-20mA: Reference to pin 6. Apply a DC voltage to this pin to adjust the unit's setpoint: Default Range = 0 – 10V (where: 0V = Low Temp Span, 10V = Hi Temp Span) (Input Impedance > 600K) Optional Range = 10mV/ ^{0}C. (Ex: 200mV = 20°C) (Max Input Voltage = 10VDC, or 4-20mA, 4mA = low temp span, 20 mA = high temp span. Contact us for details.

Note 1: All relay contacts (except for Pin 10) are normally OPEN when power is off. Pin 10 contacts are normally CLOSED when power is off. Relay contacts are rated: 24V AC/DC, 2A, <= 0.08 Ohm maximum each or 5A total for all relays combined, 1mA minimum, switching capacity: 48VA/48W (Resistive load only).

Note 2: Jumper configurable (default = 10mV/°C)

Note 3: Sink 0.5mA @ 5VDC (rated for signal level gold contact or TTL device)

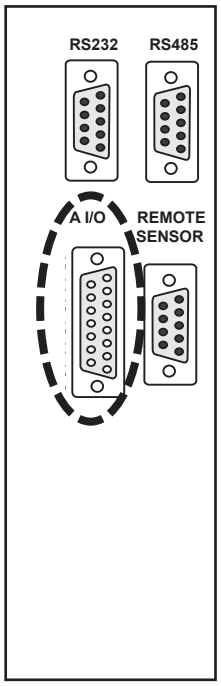
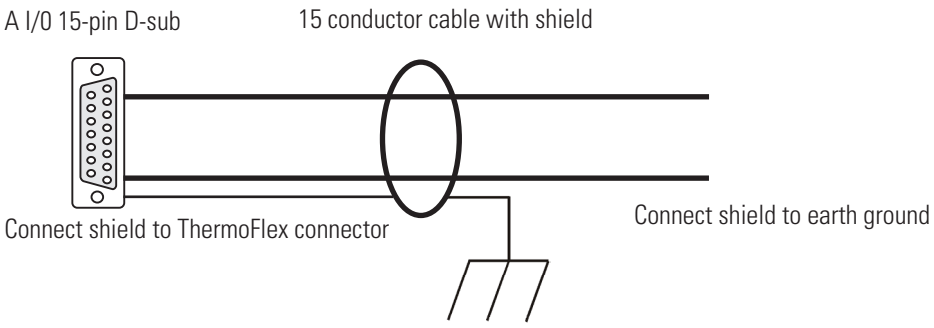


Figure C-1 Analog I/0 Connector

NOTE When making your connection to the ThermoFlex Analog I/0 connector, in order to comply with the EMC directive:

- Use a shielded I/0 cable
- Connect the remote end of the cable shield to earth ground.
- Connect cable shield to ThermoFlex end connector. ▲



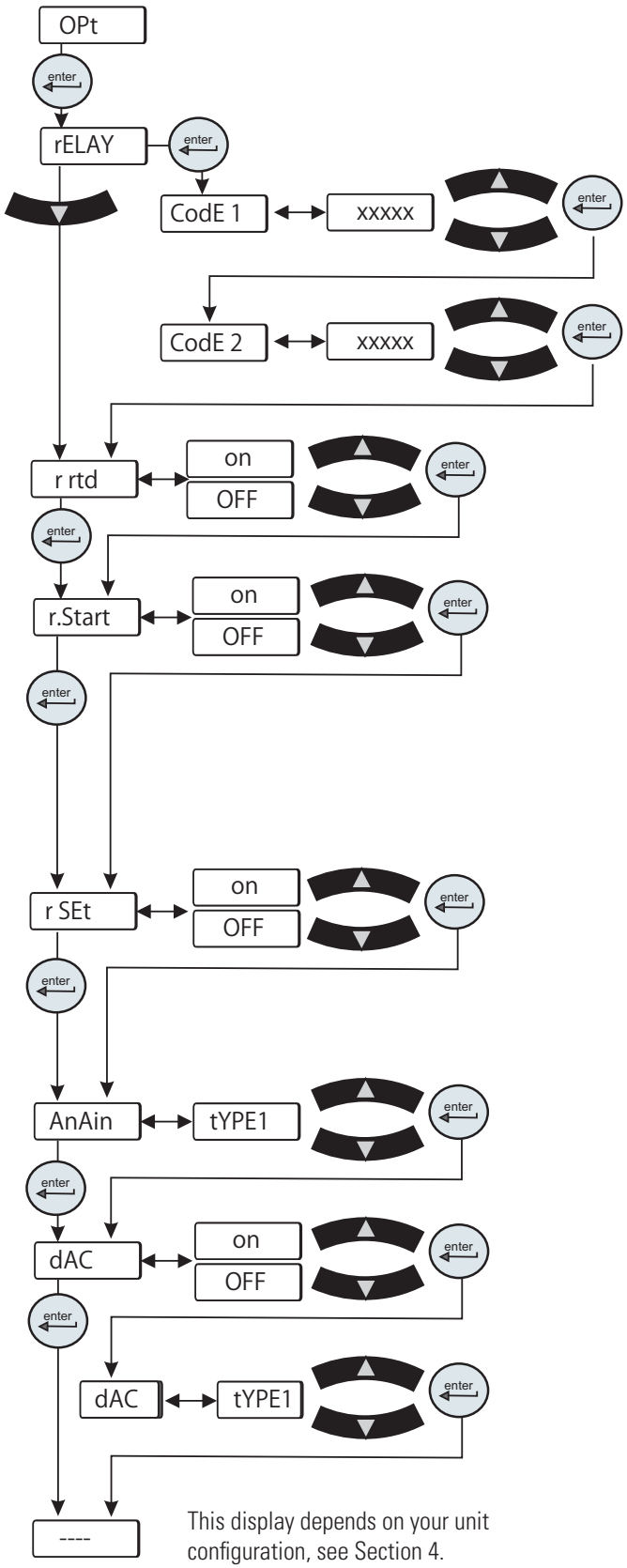


Figure C-2 Analog I/O Loop

• **rELAY** is used to configure the code for relays 1 and 2, see Tables 1 and 2 on the next page.

(Example: To have just the tank overflow **or** drip pan error fault activated for either relay you would enter code 6.)

• **r rtd** is used to enable/disable the remote temperature sensor. See Table 3 for pin out information.

NOTE There is no other indication on the unit that the remote sensor is enabled. ▲

• **r.Start** is used to enable/disable the remote start/stop.

NOTE The analog I/O remote start/stop capability has priority over the controller's start/stop, as well as any serial communications start/stop message. ▲

• **r SEt** is used to enable/disable the remote setpoint.

NOTE When remote setpoint is enabled a flashing dot will appear on the controller's display as shown below. ▲

• **AnAin** is used to configure the analog voltage input type.

Type 1: 0 - 10 VDC (Default)

Type 2: 10 mV/°C

Type 3: 4 - 20 mA

• **dAC** is used to enable/disable the digital to analog converter. Once enabled, the desired output type can be selected.

NOTE The **Type** display appears only if **dAC** is set to **on**. ▲

Type 1: 0 - 10 VDC (Default)

Type 2: 10 mV/°C

Type 3: 4 - 20 mA

Table 1	**Configurable Relay #1**		
Error	Error Number	Factory Default	Code 1
Low Level (option)	31	Enable	1 (Default)
Tank Overflow	44	Disable	2
Drip Pan Full (option)	57	Disable	4
Low Temp	19*	Disable	8
High Temp	21*	Disable	16
Low Flow (option)	27*	Enable	32 (Default)
High Flow (option)	29*	Disable	64
Low Resistivity (option)	28*	Disable	128
High Resistivity (option)	30*	Disable	256
High Pressure	60*	Disable	512
Low Pressure	61*	Disable	1024
Unit Fault	Any Fault	Enable	2048 (Default)
Pump/Unit Shut Off	Status bit(s)	Disable	4096
Refrigeration Shut Off	Status Bit	Disable	8192
Limit Fault (option)	39, 40, 45, 46, 47, 48	Enable	16384 (Default)
Sensor Fault	17, 18, 23, 24, 25, 26+ external sensor opened or shorted	Disable	32768 Default Relay Code 1 = 18465

*Regardless of alarm setting - fault or indicator

Table 2	**Configurable Relay #2**		
Error	Error Number	Factory Default	Code 2
Low Level (option)	20	Disable	1
Tank Overflow	44	Disable	2
Drip Pan Full (option)	57	Disable	4
Auto Refill Error (option)	43	Disable	8
Low Temp	19*	Enable	16 (Default)
High Temp	21*	Enable	32 (Default)
Low Flow (option)	27*	Disable	64
High Flow (option)	29*	Disable	128
Low Resistivity (option)	28*	Disable	256
High Resistivity (option)	30*	Enable	512(Default)
High Pressure	60*	Disable	1024
Low Pressure	61*	Disable	2048
Indicator (warning)	Any Indicator	Disable	4096
PM Timer (option)	50 - 56	Disable	8192
Comm Error	15, 41, 42	Disable	16384
Sensor Fault	17, 18, 23, 24, 25, 26+ external sensor opened or shorted	Enable	32768 (Default) Default Relay Code 2 = 33328

*Regardless of alarm setting - fault or indicator

Analog Input Calibration

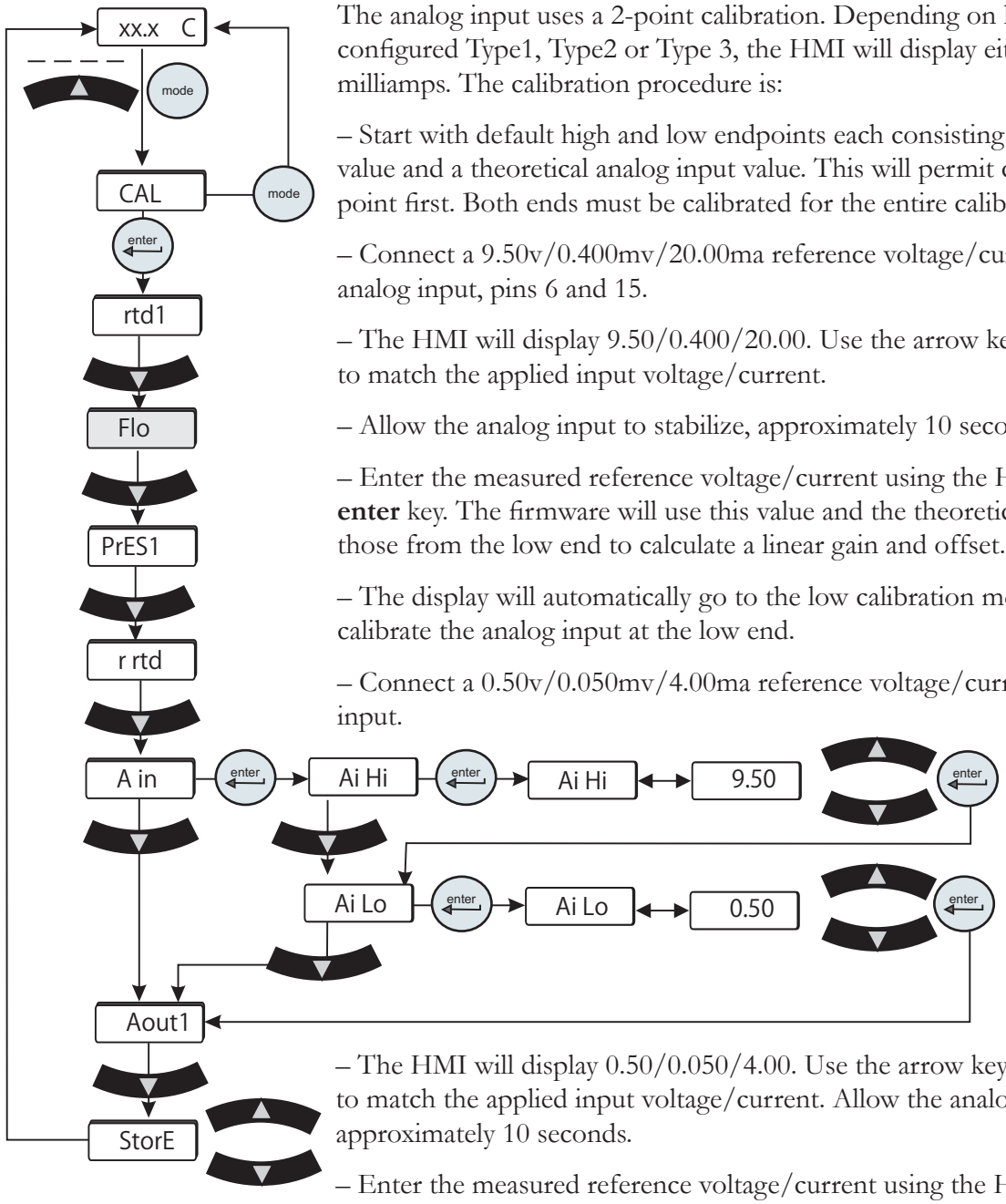


Figure C-3 Analog Input Calibration Loop

The analog input uses a 2-point calibration. Depending on how the analog input is configured Type1, Type2 or Type 3, the HMI will display either volts, millivolts or milliamps. The calibration procedure is:

– Start with default high and low endpoints each consisting of a voltage/current value and a theoretical analog input value. This will permit calibration of either point first. Both ends must be calibrated for the entire calibration to be valid.

– Connect a 9.50v/0.400mv/20.00ma reference voltage/current source to the analog input, pins 6 and 15.

– The HMI will display 9.50/0.400/20.00. Use the arrow keys to adjust the display to match the applied input voltage/current.

– Allow the analog input to stabilize, approximately 10 seconds.

– Enter the measured reference voltage/current using the HMI by pressing the **enter** key. The firmware will use this value and the theoretical analog value and those from the low end to calculate a linear gain and offset.

– The display will automatically go to the low calibration message. Press **enter** to calibrate the analog input at the low end.

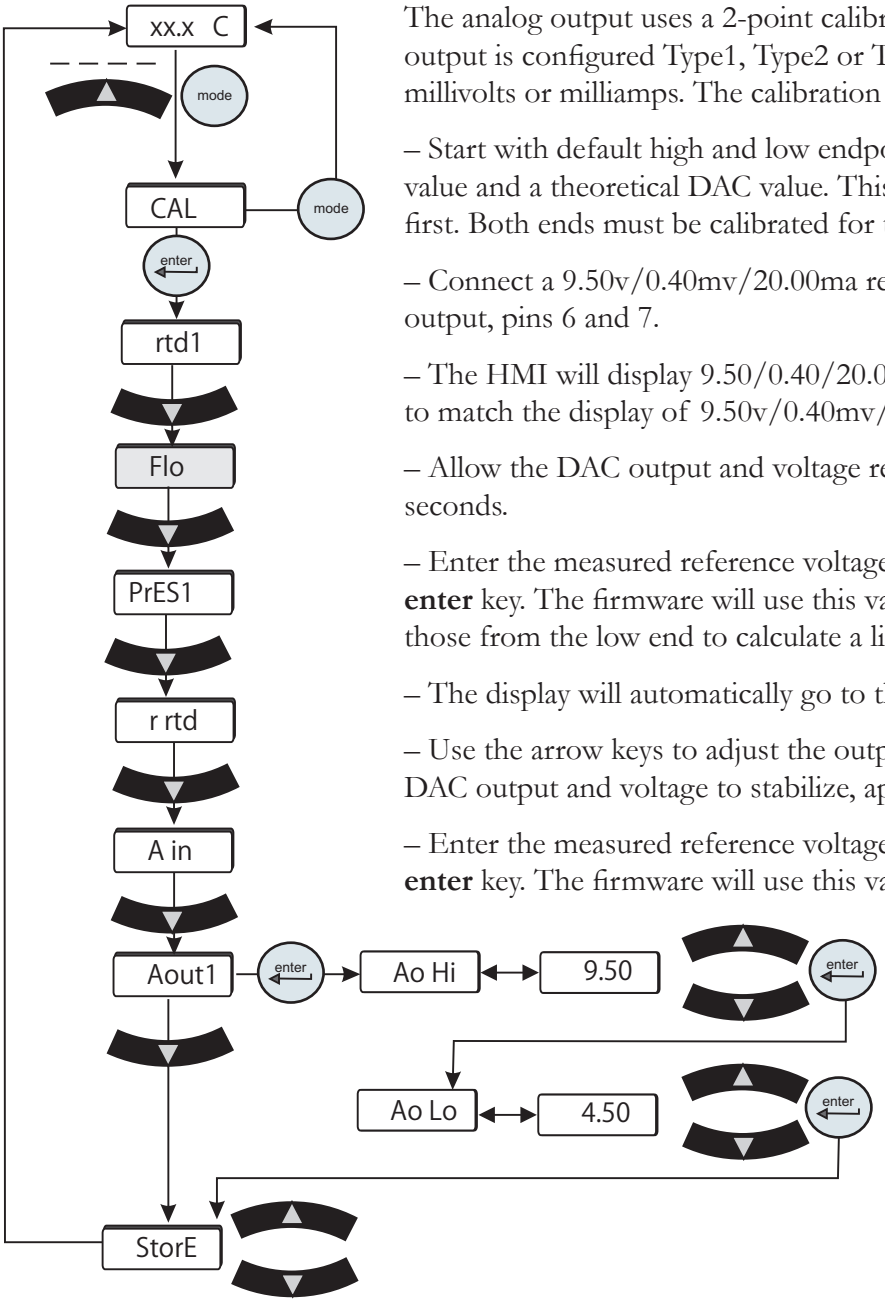
– Connect a 0.50v/0.050mv/4.00ma reference voltage/current source to the analog input.

– The HMI will display 0.50/0.050/4.00. Use the arrow keys to adjust the display to match the applied input voltage/current. Allow the analog input to stabilize, approximately 10 seconds.

– Enter the measured reference voltage/current using the HMI by pressing the **enter** key. The firmware will use this value and the theoretical analog input value and those from the high end to calculate a linear gain and offset.

– If the gain and offset are acceptable, the calibration is accepted and the calibration is now valid at the low end. Otherwise, the calibration is rejected and a bad calibration error message (**Er 16**) is displayed.

Analog Output Calibration



The analog output uses a 2-point calibration. Depending on how the analog output is configured Type1, Type2 or Type 3, the HMI will display either volts, millivolts or milliamps. The calibration procedure is:

– Start with default high and low endpoints each consisting of a voltage/current value and a theoretical DAC value. This will permit calibration of either point first. Both ends must be calibrated for the entire calibration to be valid.

– Connect a 9.50v/0.40mv/20.00ma reference voltage/current meter to the DAC output, pins 6 and 7.

– The HMI will display 9.50/0.40/20.00. Use the arrow keys to adjust the output to match the display of 9.50v/0.40mv/20.00ma.

– Allow the DAC output and voltage reading to stabilize, approximately 10 seconds.

– Enter the measured reference voltage/current using the HMI by pressing the **enter** key. The firmware will use this value and the theoretical DAC value and those from the low end to calculate a linear gain and offset.

– The display will automatically go to the low calibration point.

– Use the arrow keys to adjust the output to match the displayed value. Allow the DAC output and voltage to stabilize, approximately 10 seconds .

– Enter the measured reference voltage/current using the HMI by pressing the **enter** key. The firmware will use this value and the theoretical DAC value and those from the high end to calculate a linear gain and offset.

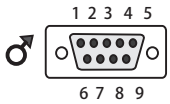
– If the gain and offset are acceptable, the calibration is accepted and the calibration is now valid at the low end. Otherwise, the calibration is rejected and a bad calibration error message (**Er 16**) is displayed.

Figure C-4 Analog Output Calibration Loop

Remote Sensor Connector Pinout

Table 3

Pin	
1	White
2	NA
3	NA
4	White
5	NA
6	NA
7	Red
8	NA
9	Red (4th wire not connected to the control board)



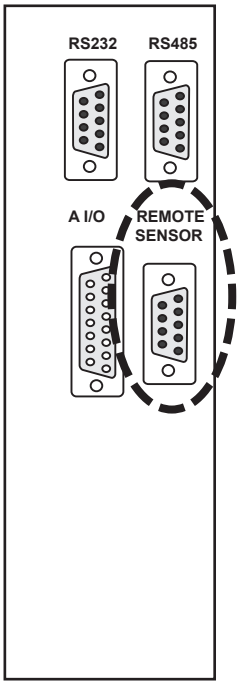


Figure C-5 Remote Sensor Connector

Remote Sensor Calibration

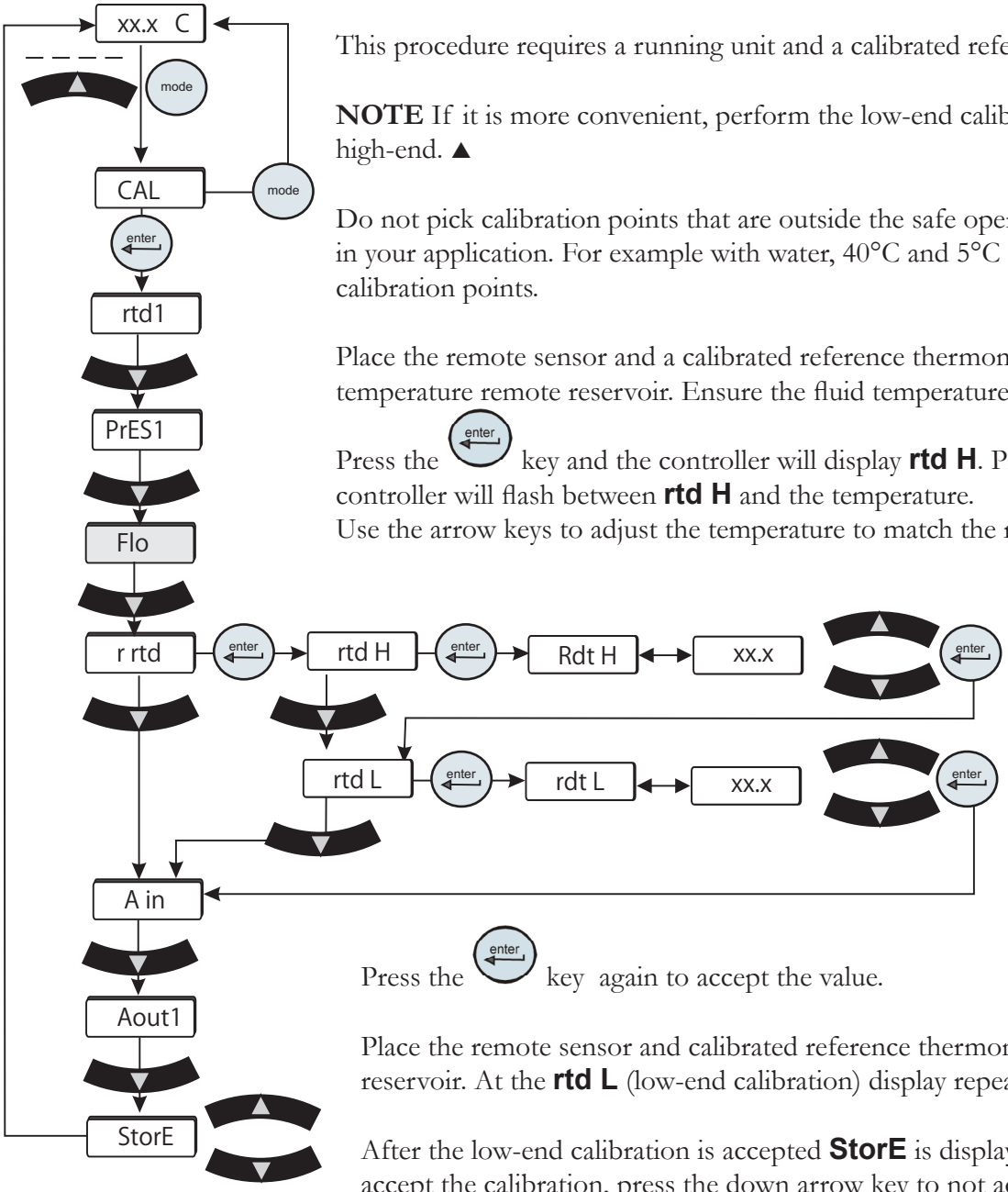


Figure C-6 Remote Sensor Calibration Loop

This procedure requires a running unit and a calibrated reference thermometer.

NOTE If it is more convenient, perform the low-end calibration before doing the high-end. ▲

Do not pick calibration points that are outside the safe operating limits of the fluid in your application. For example with water, 40°C and 5°C are typical high and low calibration points.

Place the remote sensor and a calibrated reference thermometer in the high temperature remote reservoir. Ensure the fluid temperature is stabilized.

Press the enter key and the controller will display **rtd H**. Press enter again and the controller will flash between **rtd H** and the temperature.
Use the arrow keys to adjust the temperature to match the reference thermometer.

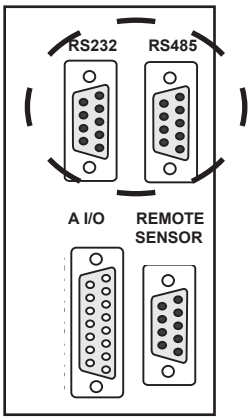
Press the enter key again to accept the value.

Place the remote sensor and calibrated reference thermometer in a low temperature reservoir. At the **rtd L** (low-end calibration) display repeat the procedure.

After the low-end calibration is accepted **StorE** is displayed. Press the up arrow to accept the calibration, press the down arrow key to not accept it.

NOTE After pressing the up arrow button at the **StorE** prompt wait several seconds before proceeding to ensure that a bad calibration message (**Er 16**) does not appear. Premature use of the keypad after pressing the up arrow may cancel the bad calibration error message. ▲

Appendix D NC Serial Communications Protocol

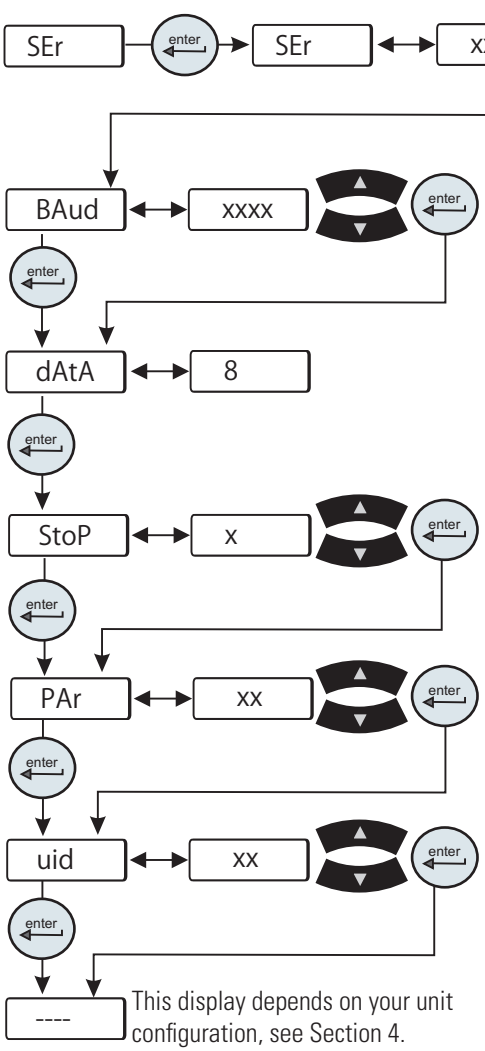


NOTE Appendix D assumes you have a basic understanding of communications protocols. ▲

Connect your PC to the applicable connector on the rear of the unit. Use the Setup Loop, see Section 4, to enable serial communications.

NOTE Once RS232 or RS485 is activated, all keypad operations are disabled except for turning the unit off and changing the serial communication's settings. ▲

Figure D-1 Connectors



• **SEr** is used to enable/disable and to configure serial communications.
Range: oFF, rS232, rS485 **Default:** oFF

• **BAud** is used to select the baud rate (speed) for serial communications.
Range: 9600, 4800, 2400, 1200, 600, or 300 bits per second
Default: 9600

• **dAtA** is used to display the number of data bits.
Range: Fixed at 8

• **StoP** is used to indicate the number of stop bits.
Range: 2 or 1 **Default:** 1

• **PAr** is used as a means to check for communication errors.
Range: even, odd, or none **Default:** none

• **u id** (unit id) is used in RS485 only. Identifies devices connected to the RS 485 port.
Range: 1 to 99 **Default:** 1

NOTE: To prevent data errors limit the number of units to 32. ▲

Figure D-2 Serial Communications Loop

All data is sent and received in binary form, do not use ASCII. In the following pages the binary data is represented in hexadecimal (hex) format.

The NC Serial Communications Protocol is based on a master-slave model. The master is a host computer, while the slave is the chiller's controller. Only the master can initiate a communications transaction (half-duplex). The slave ends the transaction by responding to the master's query. The protocol uses RS-232/RS-485 serial interface with the default parameters: 9600 baud, 8 data bits, 1 stop bit, and no parity. RS-485 offers a slave address selection, default parameter: 1.

The unit can be controlled through your computer's serial port by using the unit's standard female 9-pin connection.

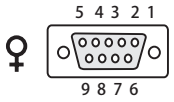
RS-232 COMM

Pin #	Function
1	No connection
2	TX
3	RX
4	No connection
5	GND = Signal ground
6 - 9	No connection

TX = Transmitted data from controller
RX = Received data to controller.

RS-485 COMM

Pin #	Function
1-7	No connection
8	T+
9	T-



Hardware **Mating Connector**
AMP Part# 745492-2 or equivalent

Communication cables are available from Thermo Fisher. Contact us for additional information.

All commands must be entered in the exact format shown in the tables on the following pages. The tables show all commands available, their format and responses. Controller responses are either the requested data or an error message. The controller response *must* be received before the host sends the next command.

The host sends a command embedded in a single communications packet, then waits for the controller's response. If the command is not understood or the checksums do not agree, the controller responds with an error command. Otherwise, the controller responds with the requested data. If the controller fails to respond within 1 second, the host should resend the command.

NOTE All byte values are shown in hex, hex represents the binary values that must be sent to the chiller. **Do not use ASCII.**

The framing of the communications packet in both directions is:

	Checksum region							
Lead char OxCA/OxCC	Addr-MSB	Addr-LSB	Command	n d-bytes	d-byte 1	...	d-byte n	Checksum

Lead char	**0xCA (RS-232) 0xCC (RS-485)**
	Device address is 1 (RS-232)
Addr-msb	Most significant byte of slave address (RS-232: 0)
Addr-lsb	Least significant byte of slave address (RS-232: 1)
Command	Command byte (see Table of Commands)
n d-bytes	Number of data bytes to follow
d-byte 1	1st data byte (the qualifier byte is considered a data byte)
...	...
d-byte n	nth data byte.
Checksum	Bitwise inversion of the 1 byte sum of bytes beginning with the most significant address byte and ending with the byte preceding the checksum. (To perform a bitwise inversion, "exclusive OR" the one byte sum with FF hex.)

When a command has no value associated with it (e.g. REQ ACK), "n d-bytes" will be set to 0. Values such as temperature and flow are sent as either 2 or 4 byte signed integers, depending on how they are stored in the controller RAM.

When the controller sends a value, a qualifier byte is sent first, followed by a 2 or 4 byte integer (the least significant byte is sent last). The qualifier indicates the precision and units of the value. The host does not send the qualifier byte; it must send the value using the correct precision, units and number of bytes. The host first inquires about a value it wants to change, then uses the number of data bytes and the qualifier byte it receives to generate the proper integer to send.

Analog Values

Qualifier Byte	
b.7 b.6 b.5 b.4	Precision of measurement
b.3 b.2 b.1 b.0	Unit of measure index

	Unit of Measure
Index	Unit
0	NONE
1	Temperature in °C
2	Temperature in °F
3	Flow liters per minute
4	Flow in gallons per minute
5	Time in seconds
6	Pressure in PSI
7	Pressure in bars
8	Resistivity in MΩ-cm
9	%
10	Volts
11	Pressure in kPa

E.g., A qualifier byte of 0x12 indicated that the value contains one decimal point and the units are °F , i.e. 98.6°F.

Examples to set setpoint to 25°C:

A. The precision and units are 1°C; a 2 byte integer is used. If you already know this, skip to step 3.

1. Master sends:	CA 00 01 70 00 8E	(Request Setpoint 1)
2. Slave responds:	CA 00 01 70 03 01 00 14 76	Precision =1, units =°C, value=20 (20 x 1°C=20°C)
Response indicates:		
uses a 2 byte integer		(nn=03)
precision and units are 1°C		(d1=01)
3. Master sends:	CA 00 01 F0 02 00 19 F3	(Set Setpoint 1 to 25°C)
4. Slave responds:	CA 00 01 F0 03 01 00 19 F1	Precision =1, units =°C, value=25 (25 x 1°C=25°C)

B. The precision and units are 0.1°C; a 2 byte integer is used. If you already know this, skip to step 3.

1. Master sends:	CA 00 01 70 00 8E	(REQ SETPOINT1)
2. Slave responds:	CA 00 01 70 03 11 00 C8 B2	Precision =0.1, units =°C, value=200 (200 x 0.1°C=20.0°C)
Response indicates:		
uses a 2 byte integer		(nn=03)
precision and units are 0.1°C		(d1=11)
3. Master sends:	CA 00 01 F0 02 00 FA 12	(Set Setpoint 1 to 25.0°C)
4. Slave responds:	CA 00 01 F0 03 11 00 FA 00	Precision =0.1, units =°C, value=250 (250 x 0.1°=25.0.0°C)

See Additional Command Examples in this Appendix.

Table of Commands

Command	M: Master Sends S: Slave Responds	Notes
Request Status		
REQ ACK	M: lc a1 a2 **00** 00 cs S: lc a1 a2 **00** 02 v1 v2 cs	protocol version v1=0; v2=1
REQ UNIT SW VER or FIRMWARE CHECKSUM	M: lc a1 a2 **02** 00 cs S: lc a1 a2 **02** nn d1 … dn cs	Unit SW version in ASCII

Example: Request SW version, unit returns 084992.2N
1. Master sends: lc a1 a2 **02** 00 cs
2. Slave responds: lc a1 a2 **02** 0A 30 38 34 39 39 32 2E 32 4E 20 E4

Example: Request unit checksum, unit returns 20FA
1. Master sends: CA 00 01 **02** 01 01 FA
2. Slave responds: CA 00 01 **02** 04 32 30 46 41 0F

REQ DISPLAY MSG	M: lc a1 a2 **07** 00 cs S: lc a1 a2 **07** nn d1 … dn cs	Display message in ASCII
REQ STATUS	M: lc a1 a2 **09** 00 cs S: lc a1 a2 **09** nn d1 … dn cs	see Request Status Table in this Appendix
ERROR	M: S: lc a1 a2 **0F** 02 en ed cs	Response Only! ed = Error Data en = Error Number 1: Bad Command 2: Bad Data 3: Bad Checksum See Error in this Appendix

Request Low Alarm Values		
REQ LO FLOW1	M: lc a1 a2 **30** 00 cs S: lc a1 a2 **30** 03 d1 d2 d3 cs	Process Alarm
REQ LO TEMP1	M: lc a1 a2 **40** 00 cs S: lc a1 a2 **40** 03 d1 d2 d3 cs	Process Alarm
REQ LO ANALOG1	M: lc a1 a2 **48** 00 cs S: lc a1 a2 **48** 03 d1 d2 d3 cs	Pressure Process Supply Alarm
Request High Alarm Values		
REQ HI FLOW1	M: lc a1 a2 **50** 00 cs S: lc a1 a2 **50** 03 d1 d2 d3 cs	Process Alarm
REQ HI TEMP1	M: lc a1 a2 **60** 00 cs S: lc a1 a2 **60** 03 d1 d2 d3 cs	Process Alarm
REQ HI ANALOG1	M: lc a1 a2 **68** 00 cs S: lc a1 a2 **68** 03 d1 d2 d3 cs	Pressure Process Supply Alarm
Request Measurements		
REQ FLOW1	M: lc a1 a2 **10** 00 cs S: lc a1 a2 **10** 03 d1 d2 d3 cs	Process Fluid Flow
REQ TEMP1	M: lc a1 a2 **20** 00 cs S: lc a1 a2 **20** 03 d1 d2 d3 cs	Process Fluid Supply Temperature (RTD1)
REQ TEMP2	M: lc a1 a2 **21** 00 cs S: lc a1 a2 **21** 03 d1 d2 d3 cs	Refrigeration Suction Temperature (RTD2)
REQ TEMP3	M: lc a1 a2 **22** 00 cs S: lc a1 a2 **22** 03 d1 d2 d3 cs	Refrigeration Ambient Temperature (RTD3)
REQ ANALOG1	M: lc a1 a2 **28** 00 cs S: lc a1 a2 **28** 03 d1 d2 d3 cs	Process Fluid Supply Pressure (P1)
REQ ANALOG2	M: lc a1 a2 **29** 00 cs S: lc a1 a2 **29** 03 d1 d2 d3 cs	Refrigeration Suction Pressure (P2)
Request PID Settings		
REQ SETPT1	M: lc a1 a2 **70** 00 cs S: lc a1 a2 **70** 03 d1 d2 d3 cs	Process Fluid Setpoint
REQ COOL P TERM1	M: lc a1 a2 **74** 00 cs S: lc a1 a2 **74** 03 d1 d2 d3 cs	
REQ COOL I TERM1	M: lc a1 a2 **75** 00 cs S: lc a1 a2 **75** 03 d1 d2 d3 cs	
REQ COOL D TERM1	M: lc a1 a2 **76** 00 cs S: lc a1 a2 **76** 03 d1 d2 d3 cs	

Set Status Settings		
SET KEYSTROKE	M: lc a1 a2 **80** 02 d1 d2 cs S: lc a1 a2 **80** 02 d1 d2 cs	See Keystroke in this Appendix
SET ON/OFF ARRAY	M: lc a1 a2 **81** nn d1 … dn cs S: lc a1 a2 **81** nn d1 … dn cs	See Set On/Off Array in this Appendix di: 0 = OFF, 1 = ON, 2 = no change
SET CALIBRATION	M: lc a1 a2 **82** 05 d1 … d5 cs S: lc a1 a2 **82** 07 d1 … d7 cs	See Calibration in this Appendix
SET SAVE UNIT CALIBRATION	M: lc a1 a2 **8B** 02 d1 d2 cs S: lc a1 a2 **8B** 02 d1 d2 cs	Save unit calibration data to reset or backup See Save Unit Calibration in this Appendix. d1 calibration id d2 reset = 0/backup = 1
Set Low Alarm Values		
SET LO FLOW1	M: lc a1 a2 **B0** 02 d1 d2 cs S: lc a1 a2 **B0** 03 d1 d2 d3 cs	Process Alarm
SET LO TEMP1	M: lc a1 a2 **C0** 02 d1 d2 cs S: lc a1 a2 **C0** 03 d1 d2 d3 cs	Process Alarm
SET LO ANALOG1	M: lc a1 a2 **C8** 02 d1 d2 cs S: lc a1 a2 **C8** 03 d1 d2 d3 cs	Pressure Process Supply Alarm
SET High Alarm Values		
SET HI FLOW1	M: lc a1 a2 **D0** 02 d1 d2 cs S: lc a1 a2 **D0** 03 d1 d2 d3 cs	Process Alarm
SET HI TEMP1	M: lc a1 a2 **E0** 02 d1 d2 cs S: lc a1 a2 **E0** 03 d1 d2 d3 cs	Process Alarm
SET HI ANALOG1	M: lc a1 a2 **E8** 02 d1 d2 cs S: lc a1 a2 **E8** 03 d1 d2 d3 cs	Pressure Process Supply Alarm
SET PID Settings		
SET SETPT1	M: lc a1 a2 **F0** 02 d1 d2 cs S: lc a1 a2 **F0** 03 d1 d2 d3 cs	Process Fluid Setpoint
SET COOL P TERM1	M: lc a1 a2 **F4** 02 d1 d2 cs S: lc a1 a2 **F4** 03 d1 d2 d3 cs	Cool P Term
SET COOL I TERM1	M: lc a1 a2 **F5** 02 d1 d2 cs S: lc a1 a2 **F5** 03 d1 d2 d3 cs	Cool I Term
SET COOL D TERM1	M: lc a1 a2 **F6** 02 d1 d2 cs S: lc a1 a2 **F6** 03 d1 d2 d3 cs	Cool D term

Request Status Table

Basic

nn	4	
	b0	Unit Running
	b1	RTD1 open or shorted
	b2	RTD2 open or shorted
d1	b3	RTD3 open or shorted
	b4	High Temp fixed fault
	b5	Low Temp fixed fault
	b6	High Temp fault or warn
	b7	Low Temp fault or warn
	b0	High Pressure fault or warn
	b1	Low Pressure fault or warn
	b2	Drip Pan fault
d2	b3	High Level fault
	b4	Phase Monitor fault
	b5	Motor Overload fault
	b6	LPC fault
	b7	HPC fault
	b0	External EMO fault
	b1	Local EMO fault
	b2	Low Flow fault
d3	b3	AutoRefill fault
	b4	Sense 5V fault
	b5	Invalid level fault
	b6	Low fixed flow warn
	b7	High pressure fault (set at factory)
	b0	Low pressure fault (set at factory
d4	b1	Unit powering up
	b2	Unit powering down

Error

The slave detected an error in the message it received from the master, so it returns this command instead of echoing the command sent by the master. The slave returns the command it received from the master in the ed byte, and an error code in the en byte.

en	Error
1	Bad command – not recognized by slave
2	Bad data
3	Bad checksum

Some errors may not result in any response. The slave ignores incoming bytes until it sees the valid lead character and its slave address. Then it must receive the correct number of bytes (determined by the length byte) before it can respond. If an incomplete frame is received, the slave will timeout and clear its input buffer without responding.

Set On/Off Array

This command is used to set the state of the unit, on or off. Sending a 0 in the array turns off the unit while sending a 1 turns it on. Sending a 2 does not change the state. The array is returned showing the state after the command has been carried out. Sending all 2's effectively turns this command into a request status command.

nn	1
d1	Unit On/Off

Set Keystroke

This command is used to effect a keystroke remotely as if someone pressed the key on the HMI.

Value	
0	Null
1	Enter
2	Up/Yes
3	Down/No
4	Mode
5	On/Off

Set Special Commands

These commands are product specific.

Master Sends: lc a1 a2 **8D** nn d1 d2 d3 d4 d5 d6 cs

Slave Returns: lc a1 a2 **8D** nn d1 d2 d3 d4 d5 d6 cs

Byte	Master	Slave
d1	Command byte	
d2	Entered Value MSB	
d3	Entered Value	
d4	Entered Value	
d5	Entered Value	
d6	Entered Value LSB	

Command	Unit sends	Description	Slave returns
0x00	CA 00 01 8D 02 d1 d2 cs d1 = command byte = 00 d2 = analog option byte	Set analog option	CA 00 01 8D 03 00 d2 d3 cs
0x80	CA 00 01 8D 01 80 cs	Request PM ststus	CA 00 01 8D 03 80 d2 d3 cs

Set analog option command

d2 analog option byte

b.6 - b.7 = unused	b.4 - b.5 = DAC enable	b.2 - b.3 = DAC out	b.0 - b.1 = analog in
	0 = voltage	0 = voltage	0 = voltage
	1 = milivolt	1 = milivolt	1 = milivolt
	2 = current	2 = current	2 = current
	3 = no change	3 = no change	3 = no change

Eg. Command to enable DAC, set DAC out to Voltage and set Analog in to millivolt

Unit sends	Slave returns
CA 00 01 8D 02 00 11 5E	CA 00 01 8D 02 00 11 5E

Eg. Command to set DAC out to current without changing DAC enable or analog in

Unit sends	Slave returns
CA 00 01 8D 02 00 3B 34	CA 00 01 8D 02 00 19 56

WARRANTY

Thermo Fisher Scientific warrants for 24 months from date of shipment the Thermo Scientific NESLAB ThermoFlex unit according to the following terms.

Any part of the unit manufactured or supplied by Thermo Fisher Scientific and found in the reasonable judgment of Thermo Fisher to be defective in material or workmanship will be repaired at an authorized Thermo Fisher Repair Depot without charge for parts or labor. The unit, including any defective part must be returned to an authorized Thermo Fisher Repair Depot within the warranty period. The expense of returning the unit to the authorized Thermo Fisher Repair Depot for warranty service will be paid for by the buyer. Our responsibility in respect to warranty claims is limited to performing the required repairs or replacements, and no claim of breach of warranty shall be cause for cancellation or recision of the contract of sales of any unit. With respect to units that qualify for field service repairs, Thermo Fisher Scientific's responsibility is limited to the component parts necessary for the repair and the labor that is required on site to perform the repair. Any travel labor or mileage charges are the financial responsibility of the buyer.

The buyer shall be responsible for any evaluation or warranty service call (including labor charges) if no defects are found with the Thermo Scientific product.

This warranty does not cover any unit that has been subject to misuse, neglect, or accident. This warranty does not apply to any damage to the unit that is the result of improper installation or maintenance, or to any unit that has been operated or maintained in any way contrary to the operating or maintenance instructions specified in this Instruction and Operation Manual. This warranty does not cover any unit that has been altered or modified so as to change its intended use.

In addition, this warranty does not extend to repairs made by the use of parts, accessories, or fluids which are either incompatible with the unit or adversely affect its operation, performance, or durability.

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