THERMORACK 1201

The Ultimate Chiller for Plasma Etch

Product Manual

Solid State
COOLING SYSTEMS
*Temperature Control...***Precisely.**

Solid State COOLING SYSTEMS
*Temperature Control...***Precisely.**

CE Declaration of Conformity

We: Solid State Cooling Systems
167 Myers Corners Road
Wappingers Falls, NY 12590
USA

declare under our sole responsibility that the

ThermoRack 1201 (All models)

meets the provisions of the directives:

Emissions:
CFR Title 47 FCC Part 15 Subpart B, Class A
ICES-003, Issue 6, Class A
EN 61326-1: 2013 per EN 55011:2009 + A1: 2010 Group 1 Class A
ACMA AS/NZS CISPR 11:2009 + A1:2010

Immunity:
EN 61326-1: 2013 Electrical Equipment for Measurement, Control, and Laboratory Use - EMC
EN 61000-3-2 Harmonics Emissions
EN 61000-3-3 Voltage Fluctuations and Flicker
EN 61000-4-2 Electro-Static Discharge
EN 61000-4-3 Radiated Radio Frequency (RF) Immunity
EN 61000-4-4 Electrical Fast Transient/Burst Immunity
EN 61000-4-5 Surge Immunity
EN 61000-4-6 Conducted RF Disturbance Immunity
EN 61000-4-11 Voltage Dips, Interruptions and Short Variations
EN 61000-6-2 Electromagnetic Compatibility Part 6-2: Immunity for Industrial Environments

Safety:
EN 61010-1: 2010 3rd Edition Low Voltage Directive Safety requirements for electrical equipment for measurement, control, and laboratory use.

Lloyd F Wright Chief Technology Officer	
Date	5/12/23

TABLE OF CONTENTS

Symbols Used on the Product 5
Symbols Used in this manual 6
1.0 Introduction 7
2.0 Specifications 8
3.0 Hook-up 12
3.1 ELECTRICAL CONNECTIONS 12
FIGURE 3 THERMORACK 1201 FRONT AND REAR VIEWS 13
3.2 TOOL INTERFACE CARD 14
3.2.1 Lam Analog (L1) Interface Card 14
3.2.2 Lam Analog 2 (L2) Interface Card for LonWorks® Conversion 15
3.2.3 Applied CHX (A1) Interface Card 18
3.2.4 AMAT P5000 Analog (A3) Interface Card 20
3.2.5 AMAT J100 Analog (A4) Interface Card 21
3.2.6 AMAT J100 Analog with Resistivity (A5) Interface Card 23
3.2.7 TEL Unity II (T1) or Unity M (T2) Interface Card 25
3.2.8 TEL Telius (T3) Interface Card 26
3.2.9 TR1201/1801 RS-232 Communications 29
3.3 PLUMBING CONNECTIONS 32
3.4 AIR CONSIDERATIONS 32
3.5 WETTED MATERIAL COMPATIBILITY 32
4.0 Coolant Fill/Start-Up 33
4.1 COOLANT TYPE 33
4.2 FILL/START-UP 33
5.0 Operation 35
5.1 SIMPLE OPERATION 35
5.2 ADVANCED OPERATION 35
5.3 ALARMS/INTERLOCKS 39
5.3.1 Standard Interlocks 39
5.3.2 Coolant Resistivity Low Interlock for Water Based Coolants 39
5.4 DRAINING THE SYSTEM OF COOLANT 40
5.5 CHANGING COOLANTS 40
5.6 CLEANING THE THERMORACK 41
5.7 DRAINING THE FACILITY WATER (PLANT COOLING WATER) LINES 41
6.0 Lam Dual Channel Chiller Option 42
6.1 ELECTRICAL HOOK-UP OF DUAL CHANNEL OPTION TO A LAM ETCHER 42
6.2 PLUMBING HOOK-UP OF THE DUAL CHANNEL OPTION 44
6.3 COOLANT FILL/START-UP WITH THE DUAL CHANNEL OPTION 44
7.0 Other Options 45
7.1 -1W DI WATER/ETHYLENE OR PROPYLENE GLYCOL COOLANT OPTION 45
7.2 -WS RESISTIVITY SENSOR OPTION 45
7.3 -1EG 100% ETHYLENE GLYCOL COOLANT OPTION 46
7.4 -N2 N2/CDA PURGE OPTION 46
7.5 -RF FRONT RTD OPTION 46
7.6 -LT LOW TEMPERATURE OPTION 47
7.7 -HC AUXILIARY HEATER OPTION 47

8.0 System Alarms/Troubleshooting 48
8.1 WARNINGS 48
8.2 ALARMS 48
8.3 OTHER PROBLEMS 49
9.0 Safety 49
9.1 HAZARDS 49
9.1.1 Electrical Hazards 49
9.1.2 Chemical Hazards 49
9.1.3 Spill Hazards 49
9.2 LIFTING THE THERMORACK 1201 50
9.3 ELECTRICAL ENERGY ISOLATION 50
9.4 ELECTRICAL LOCK OUT/TAG OUT 50
9.4.1 Lock Out 50
9.4.2 Tag Out 50
9.5 ELECTRICAL DISCONNECT REQUIREMENTS 50
9.5.1-Unit Out of Service 50
9.5.2 Maintenance 50
9.6 LEAKS 51
9.6.1Coolant Leaks 51
9.6.2 Plant Cooling Water Leaks 52
9.7 DISCONNECTING PLANT COOLING WATER 53
9.7.1 Disconnecting plant cooling water using double-ended shut-off valves: 53
9.7.2 Disconnecting plant cooling water using single-ended shut-off valves: 53
9.7.3 Disconnecting plant cooling water using the facility's shut-off valves: 53
9.8 COOLANT DISPOSAL 53
9.9 SEISMIC PROTECTION 54
9.10 MINIMUM PERSONAL PROTECTIVE 54
9.10.1 Manual Operation Equipment 54
9.10.2 Handling Coolant 54
9.10.3 PCW Spills 54
9.10.4 Coolant Spills 54
10.0 Technical Support 54
11.0 System Schematics 54
12.0 Warranty Policy 55
13.0 Safety Data Sheets 56
13.1 3M™ FLUORINERT™ FC-3283 ELECTRONIC LIQUID SDS 56
13.2 3M™ NOVEC™ 7100 ENGINEERED FLUID SDS 64
12.3 SOLVAY GALDEN® HT SDS 74
12.4 ETHYLENE GLYCOL 83
12.5 SDS FOR OPTEON™ SF10 SPECIALTY FLUID 90

SYMBOLS USED ON THE PRODUCT

Read the SDS for the coolant used and follow all safety precautions listed in the SDS prior to removing coolant tubes or opening the fill cap as this could result in contact with the coolant inside.

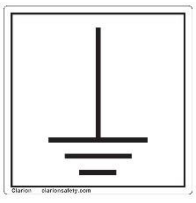
Caution! Risk of electric shock. Disconnect the power cord prior to servicing. This includes changing a fuse or opening the cover for any reason.

Note: The product manual must be consulted in all cases where this symbol is found in the product.

Caution! Heavy object. System weighs 70+ lbs (32kg) depending upon configuration. Two people are required to lift.

Earth ground connected to the external earth ground through the AC power cord. Safe operation of the ThermoRack requires that earth ground be connected to pin G of the Harting Plug #09200030620 supplied with the system.

Caution! Risk of entanglement – rotating machinery inside – exposed pump motor.



Earth ground connection used to ground internal components.

SYMBOLS USED IN THIS MANUAL

CAUTION

The red CAUTION equilateral triangle symbol appears throughout the manual. Please follow the important instructions accompanying this symbol to avoid significant damage to the chiller.

WARNING

The red WARNING equilateral triangle symbol appears throughout the manual accompanying certain maintenance and repair activities. Please follow the important instructions accompanying this symbol to avoid situations that could cause injury to the operator or other personnel.

DANGER

The red DANGER equilateral triangle symbol appears throughout the manual accompanying certain maintenance and repair activities. Please follow the important instructions accompanying this symbol to avoid injury to the operator. Only trained personnel should undertake any activity marked by the red DANGER triangle.

CAUTIONS

- Safe operation the ThermoRack requires earth ground be connected to Pin G of the Harting power input connector supplied with the system. Do Not Operate the ThermoRack without proper grounding!
- Operation of the ThermoRack in any manner not recommended in this manual could compromise the safety of operating personnel.
- Never disassemble the ThermoRack unit as irreparable damage may occur.
- Never store or operate the ThermoRack Chiller over 90 °C.
- Never operate the coolant within 5°C of its freezing point.
- If changing the coolant from Fluorinert/Galden to water/glycol, all coolant lines must be thoroughly flushed. See section 5.5 for details.
- Never ship the chiller with water inside the liquid cold plate as freezing temperatures may be encountered which would damage the unit. See Sections 5.4 & 5.7 for draining procedures.

Solid State COOLING SYSTEMS

PRODUCT MANUAL

THERMORACK 1201

1.0 INTRODUCTION

The ThermoRack 1201 is a 19” rack-mount thermoelectric recirculating chiller system with full PID control of both heating and cooling. It provides 3-4 gpm of constant temperature coolant for controlling the operating temperatures of semiconductor equipment, lasers, or any process requiring temperature control. In the ThermoRack 1201 "-1"model, all internal wetted materials and the pump are compatible with fluorinated heat transfer oils such as Solvay’s Galden or 3M’s Fluorinert products for temperature control of RF-powered electrodes. In the ThermoRack 1201 "-1W" model in the unit is configured for water-based coolants, such as water/glycol.

The ThermoRack does not use Freon or any other replacement gas. This chiller has been designed for long life and ease of use. The only moving parts are one pump and fans internal to a DC power supply. The internal thermoelectric modules have lifetimes greater than 200,000 hours.

2.0 SPECIFICATIONS

Operating Range	5°C to 80°C without N2 Purge Option -10°C to 80°C with N2 Purge Option LT Option required if operating below 0°C
Ambient Temperature	10°C to 40°C non-condensing, Indoor Use Only.
Maximum Altitude	2,000m (6,560ft)
Relative Humidity	20-70% non-condensing (coolant wetted parts excepted)
Stability / Repeatability	± 0.05°C at constant load (even near ambient)
Cooling Capacity[1]	Up to 1200 Watts @ 20°C with 20°C facility water
Heating Capacity[2]	Up to 2000 Watts @ 20°C with 20°C facility water
Coolant / Process Fluid	-1: Fluorinert / Galden, Opteon SF10 or other HFE -1W: Glycol / water mix -1EG 100% Ethylene Glycol
Process Fluid Fittings	1/2" Swagelok
Pump	Brushless DC magnetically driven high speed centrifugal pump
Process Flow Rate	14 to 18 lpm (3.7-4.8 gpm) @ 20 psig (process fluid dependent)
Tank Volume	5.7 liter (1.5 gal) with 2 level sensors
Facility Water	4-19 lpm (1-5 gpm) @ 10-35°C filtered, treated recirculating facility cooling water, pH 6.5 – 8.2
Facility Water Fittings	1/2" Swagelok (316 stainless steel)
N_2/CDA (Optional)	500 sccm -30°C dew point or lower CDA or N_2, 30-60 psig (2-4 bar) for low temperature operation
Wetted Materials	Process: Aluminum, stainless steel and polymers Facility: Sealed hard anodized aluminum and stainless steel
Size (W x D x H)	19" x 24" x 8.7" 5U (48.3 x 61.0 x 22.1 cm)
Weight	70 lbs (32 kg)
Power Input	200-240 VAC +/- 10% 1 phase, 50/60 Hz, 10 amps max Over Voltage Category OVC II per EN 60950 Pollution Degree 2
Circuit Breaker	16 amp 200-250 VAC 2-pole with 30 mA GFCI
Remote EMO	External dry contact
Communications	Lam Analog, Lam Analog 2 (for LonWorks® conversion), TEL Unity II & M, TEL Telius, AMAT CHX, AMAT Analog
Alarms	Temperature, fluid level, system or component failure (display, dry contact and machine interface)
Standards	Semi S2-0200, F47 compliant, CE, TUV listed to UL, CAN/CSA and EN 61010-1
Warranty	2 years

1) Cooling Capacity may vary with configuration, fluid type and facility water temperature / flow rates
2) Heating Capacity is very limited at 80°C. Contact SSCS to discuss our Auxiliary Heater.

FIGURE 1: COOLING CAPACITY

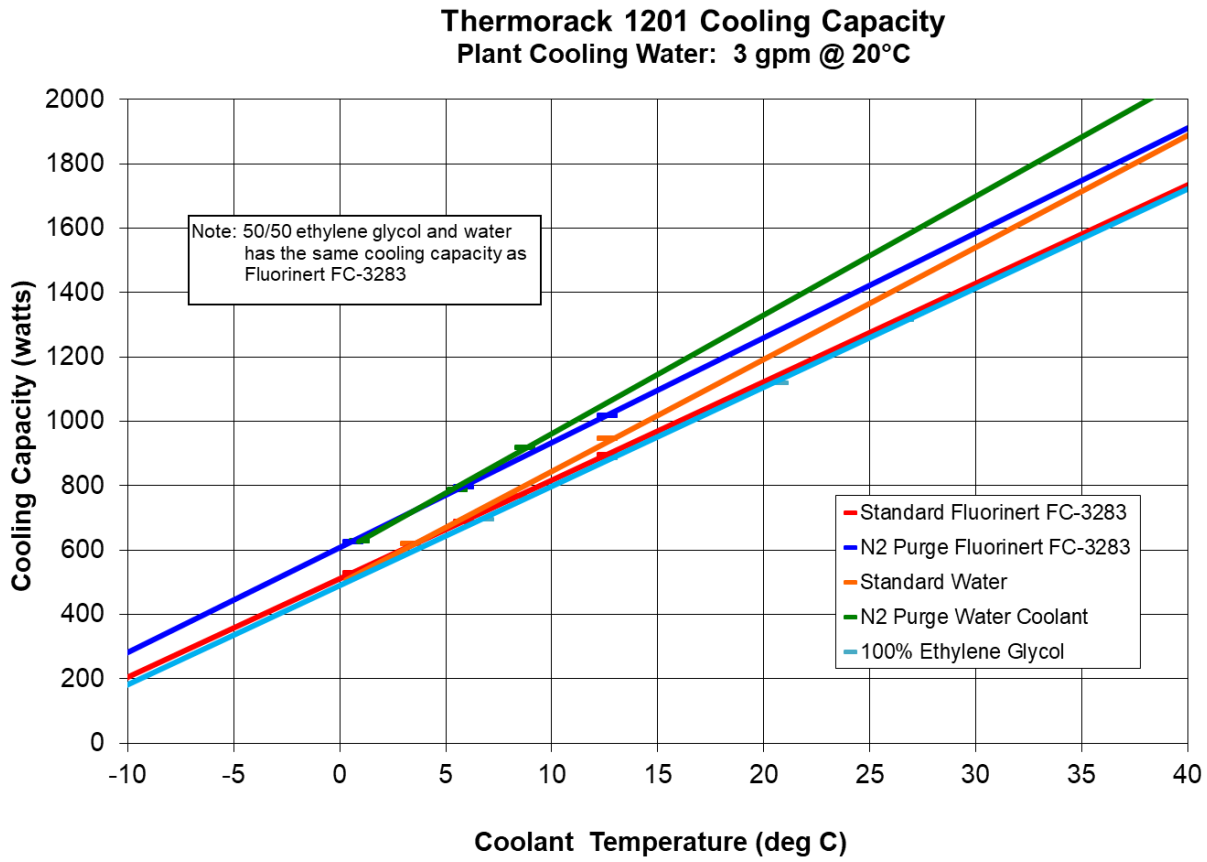
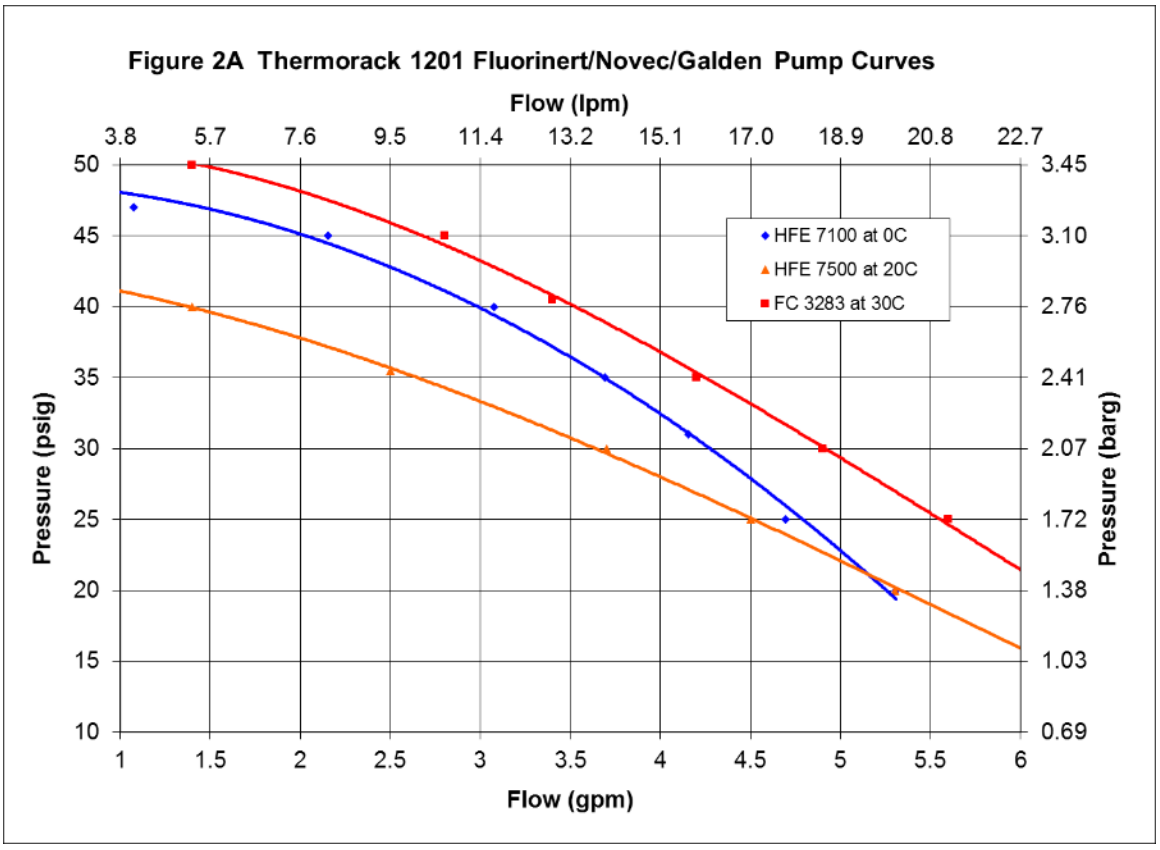
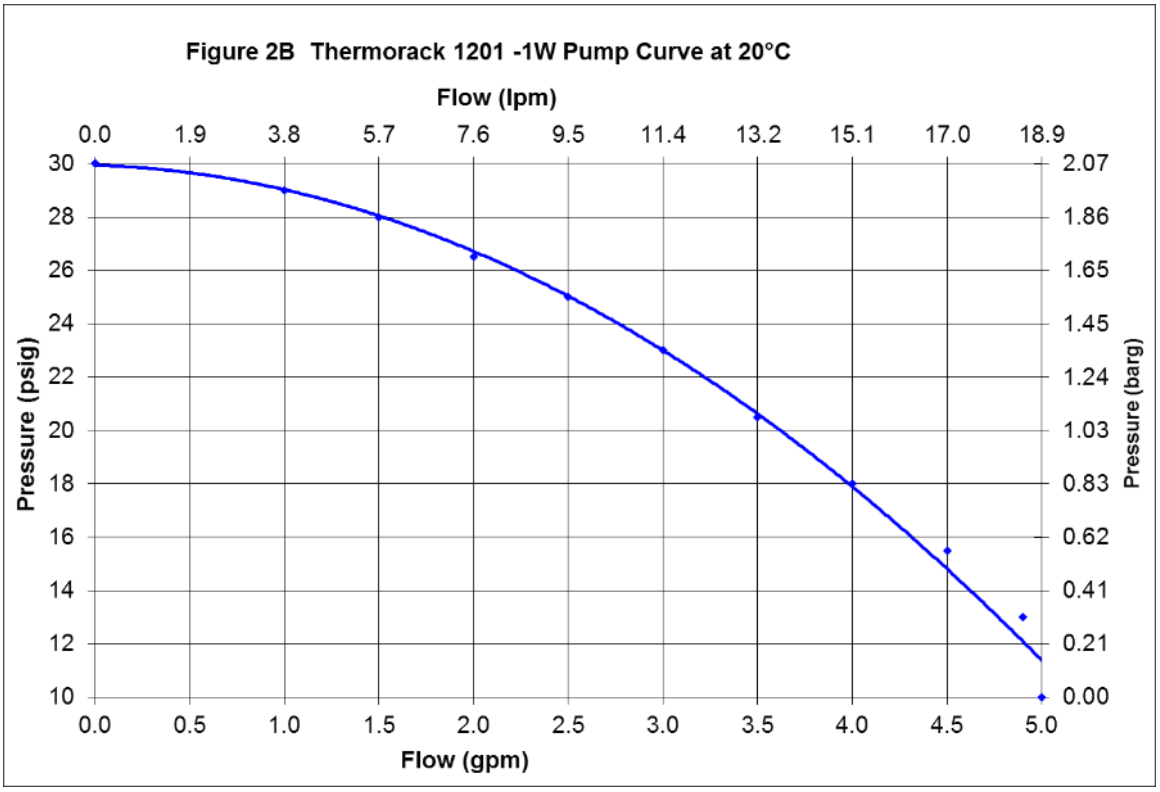
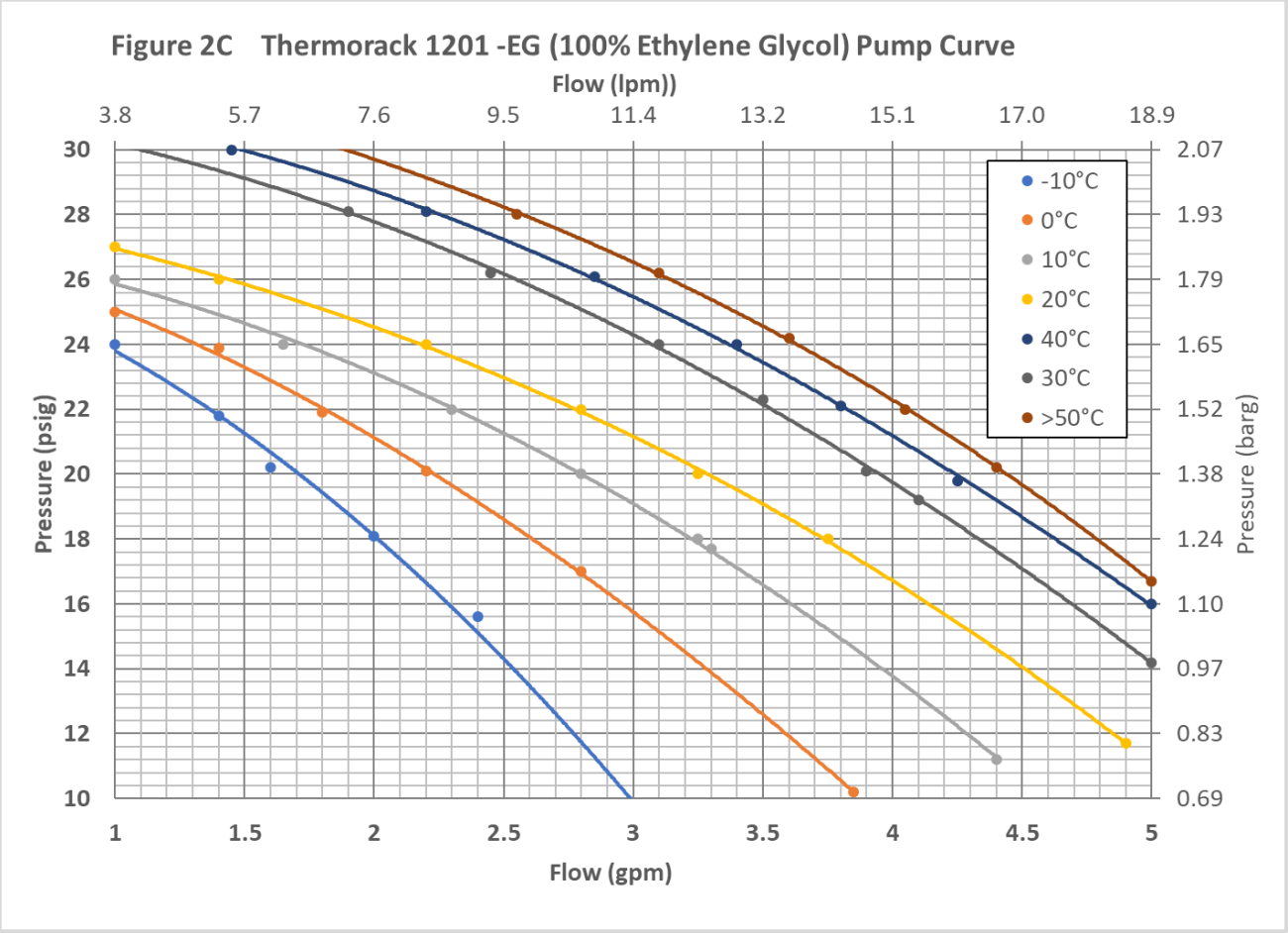


FIGURE 2: PUMP CURVES

Note: A pump fault will occur if the pump flow rate drops below 1 gpm.
As a result, the minimum recommended flow rate is 1.5 gpm (5.7 lpm).

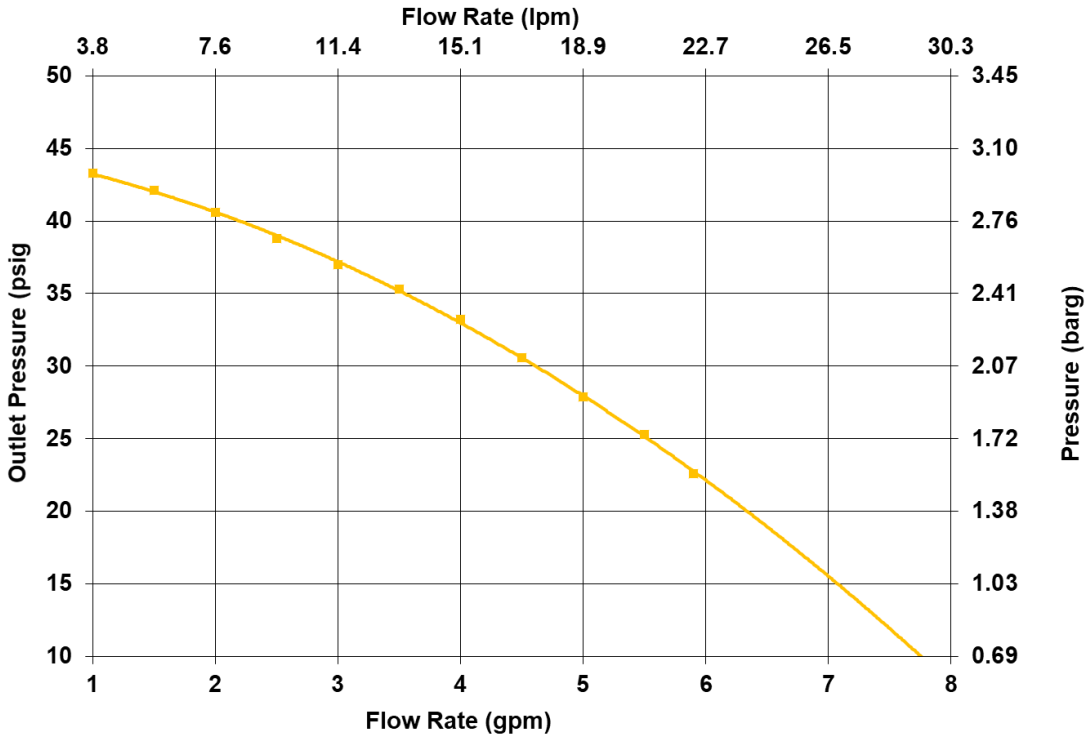






Note: The flow rate of 100% Ethylene Glycol changes with set point temperature due to its high viscosity until temperatures go above 50°C.

Figure 2D Thermorack 1201 Opteon SF10 Pump Curve at 10°C



3.0 HOOK-UP

3.1 ELECTRICAL CONNECTIONS

All electrical connections are made on the rear panel (Figure 3).

CAUTION

Mis-wiring the AC power can damage the Thermorack 1201

AC Power Connection: Connect 200-240 V~ power to the rear of the ThermoRack via the 20ft service cable provided. Connect bare end of service cable as follows:

Black: Line 1
White: Line 2 (or neutral)
Green: Earth ground

The service cable connects to the ThermoRack via a Harting Han Q 5/0 connector which has 5 contacts plus ground, Harting part number 09120153101. Connector pin out: (for reference).

Pin 1: Line 1
Pin 2: Line 2 (or Neutral)
Pin 3: Not Used
Pin 4: Not Used
Pin 5: Not Used
G: Earth Ground

WARNING

Failure to connect earth ground to the Green/Yellow stripe conductor will make the Thermorack chassis potential shock hazard

Note: Safe operation of the ThermoRack 1201 requires earth-ground be connected to the G terminal of this plug.

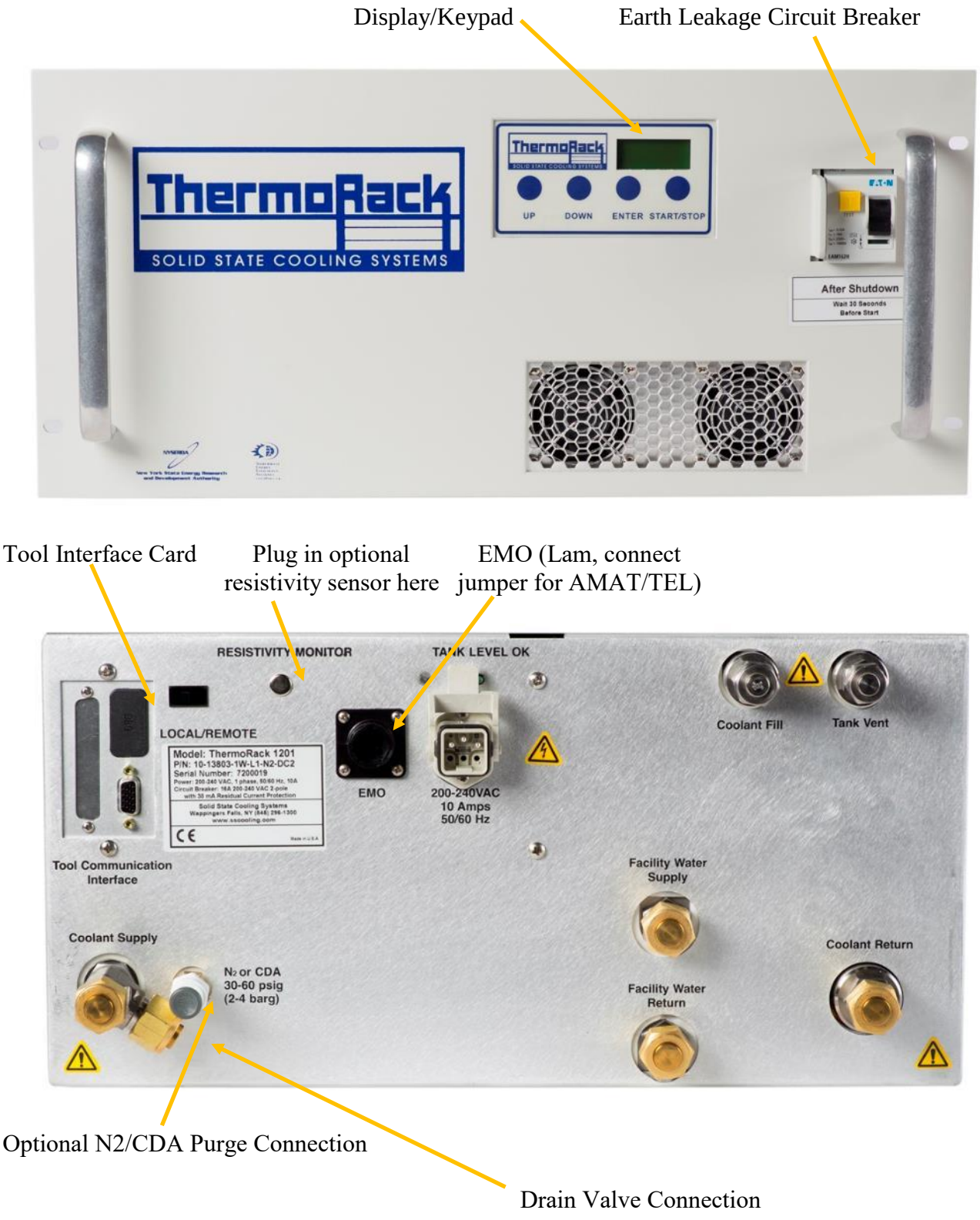
Remote EMO: A remote EMO circuit may be connected to pins 5 and 6 on the 9-pin CPC connector provided, AMP #206708-1, to the socket labeled 72J2. (See Table 1.) If no remote EMO circuit is available (AMAT and TEL tools) connect the jumper shipped with the Thermorack 1201.

Table 1 Connector 72J2 Pin Description

Pin Number	Signal Description
1	Jumpered to Pin 2 (tool EMO loop)
2	Jumpered to Pin 1 (tool EMO loop)
3	24 VAC Remote/Local Switch from etcher
4	24 VAC Remote/Local Switch from etcher return
5	Closed contact from etcher (remote EMO)
6	Closed contact from etcher return (remote EMO)
7	Spare
8	Spare
9	Spare

Local/Remote Switching: The chiller set-point temperature can be entered via keys on the front user interface or via a remote analog signal on the tool interface card. The method of switching from using a locally entered set-point to a remote one depends upon the type of tool interface card used. See section 3.2 for Details.

FIGURE 3 THERMORACK 1201 FRONT AND REAR VIEWS



Fuses: The ThermoRack 1201 has fuses on the main AC power, TE power, and 24VAC EMO transformer.

Table 2 Fuses

Fuse Protecting	Fuse Type/Mfg.	Mfg. PN	Rating	SSCS PN
Thermoelectric Modules	Automotive Blade Style Littelfuse	0287030.PXCN	30A	20-25134-30
24VAC Transformer	Slo-Blo 3AG Littelfuse	0313.500MXP	0.5A	20-22700-0.5
System Power	Class G, SC Type Bussmann	SC-15	15A	20-26610-15

3.2 TOOL INTERFACE CARD

The ThermoRack 1201 can communicate with several different types of semiconductor equipment via the tool interface card. The electrical hookup required and method of remote operation varies depending on the tool interface card purchased with the ThermoRack 1201. Tool interface cards may be changed should the ThermoRack be moved from one type of tool to another.

3.2.1 LAM ANALOG (L1) INTERFACE CARD

The Lam Analog tool interface card is designed to operate with Lam Research Corporation® plasma-etch tools. This interface card is the ThermoRack default standard. The Lam Analog tool interface is through a 37-pin D-subminiature Female connector labeled 72J1, as shown in Table 3.

Local/Remote Switching: Switching from local to remote operation is accomplished by applying 24 VAC across pins 3 & 4 on the 9-pin CPC connector labeled 72J2. (See Table 1.) Turning off 24 VAC returns to a locally entered set-point.

System Warning: The ThermoRack warning signal is available on the tool interface card. (See Table 3 "Warn" signal)

Temperature Alarm: The ThermoRack temperature alarm is available on the tool interface card. (See Table 3 "Warn" signal)

System Alarm: The ThermoRack system alarm is available on the tool interface. (See Table 3 "Fail" signal)

Table 3 Connector 72J1 Lam Analog Interface Card Pin Description

Pin Number	Signal Description All pins not identified are spares.
24	Set Point Temperature, 0-10VDC, 1V/10°C, 0VDC = 0°C 10VDC = 100°C
5	Set Point Temperature Return
20	Actual Coolant Exit Temperature, 0-10VDC, 1V/10°C, 0VDC = 0°C 10VDC = 100°C
1	Actual Coolant Exit Temperature Return
26	ThermoRack Fail, Normally Closed Opto-isolated transistor, Ic=125mA Vbce(off)=30V
7	ThermoRack Fail Return
28	ThermoRack Warn, Normally Closed Opto-isolated transistor, Ic=125mA Vbce(off)=30V
9	ThermoRack Warn Return

3.2.2 LAM ANALOG 2 (L2) INTERFACE CARD FOR LONWORKS® CONVERSION

Connecting to Lam Research Corporation plasma-etch tools that use LonWorks® requires the -L2 interface card PLUS a LonWorks® conversion box purchased from Lam Research Corporation: PN 853-224341-001 for a 2-channel box or 853-801876-015 for a 1-channel box. This interface card communicates all data required by LonWorks® through a 37-pin D-subminiature Female connector, as shown in Table 4A, and a 9-pin D-subminiature Female connector as shown in Table 4B. Drawings for the interconnecting cables are shown in Figures 4 and 5.

Table 4A: J2A Lam Analog to LonWorks® Converter 37-pin dsub connector

FUNCTION	PIN	SIGNAL NAME
Start / Stop Status	1	DI0
Remote / Local Status	2	DI1
Warning Status	3	DI2
Fail Status	4	DI3
Start / Stop Command	5	DO0
Remote / Local Command	6	DO1
Spare	7	DO2
Spare	8	DO3
Source Supply For Digital Inputs	9	24VDC
Source Supply For Digital Inputs	10	24VDC
Temperature Setpoint 1 Command	11	AOUT0
Temperature Setpoint 2 Command (For Dual Channel Only)	12	AOUT1
Spare	13	AOUT2
Spare	14	AOUT3
Temperature Setpoint 1 Readback	15	AIN0(+)
Temperature Setpoint 2 Readback (For Dual Channel Only)	16	AIN1(+)
Temperature Actual 1	17	AIN2(+)
Temperature Actual 2 (For Dual Channel Only)	18	AIN3(+)
Spare	19	AGND
Spare	20	24VRET
Spare	21	24VRET
Spare	22	24VRET
are	23	24VRET
Start / Stop Command Return	24	24VRET
Remote / Local Command Return	25	24VRET
Spare	26	24VRET
Spare	27	24VRET
Source Supply For Digital Inputs	28	24VDC
Not Used	29	NC
Temperature Setpoint 1 Command Return	30	AGND
Temperature Setpoint 2 Command Return (For Dual Channel Only)	31	AGND
Spare	32	AGND
Spare	33	AGND
Temperature Setpoint 1 Readback Return	34	AIN0(-)
Temperature Setpoint 2 Readback Return (For Dual Channel Only)	35	AIN1(-)
Temperature Actual 1 Return	36	AIN2(-)

Figure 4: J2A interconnect cable

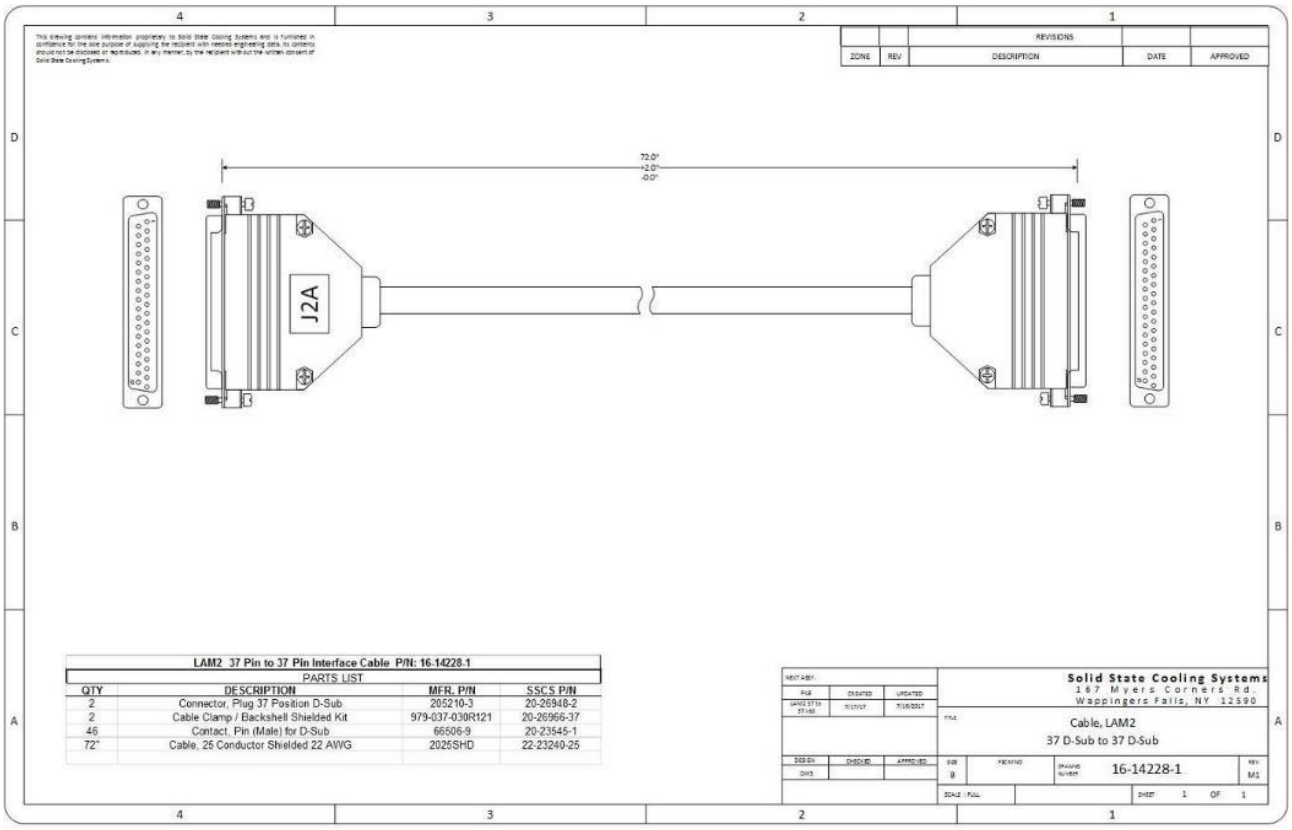
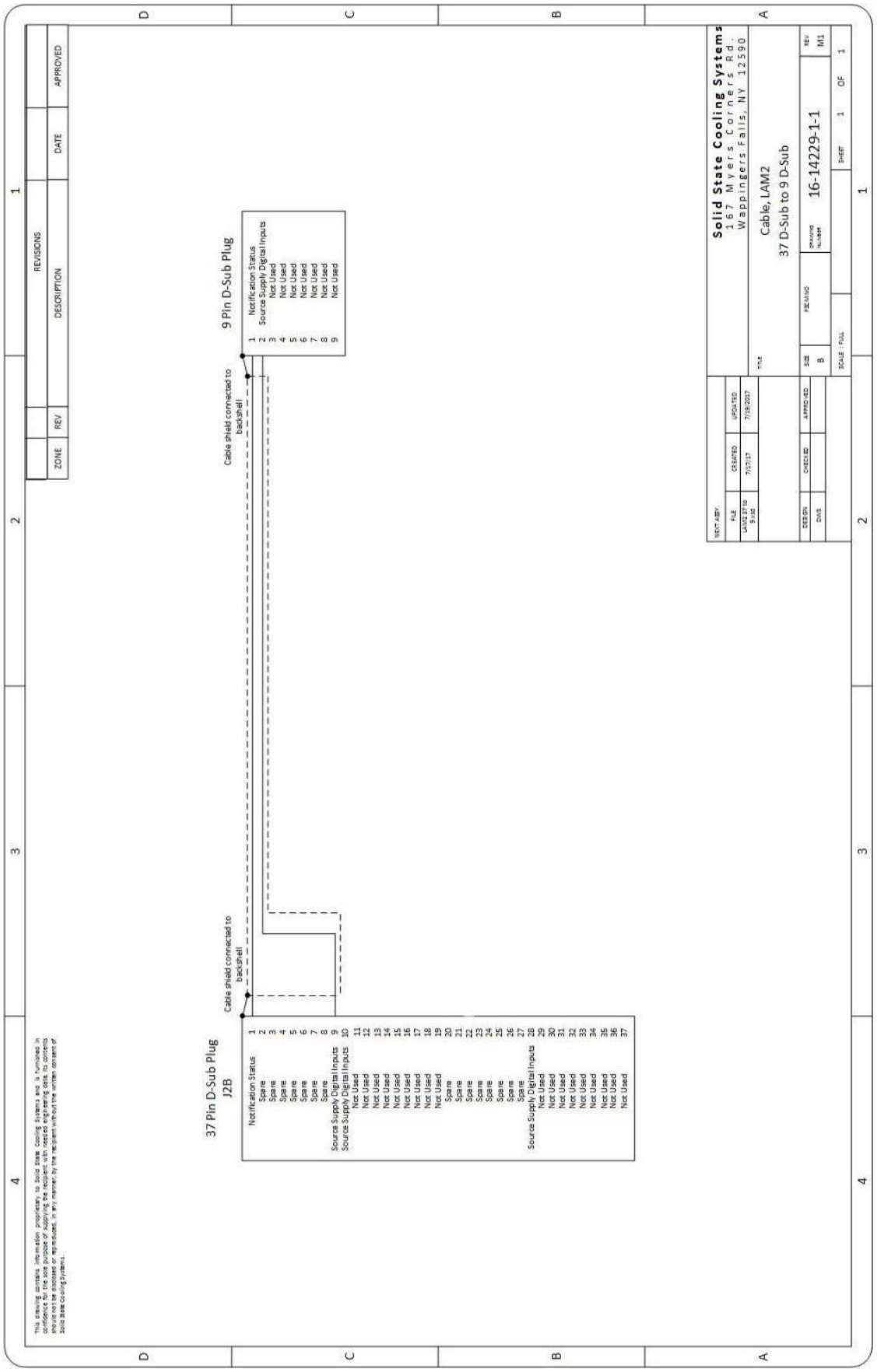


Table 4B J2B Lam Analog to LonWorks® Converter 9-pin dsub connector (ThermoRack 1201/1801 end)

FUNCTION	PIN	SIGNAL NAME
Notification Status	1	DI0
Source Supply For Digital Inputs	2	DI1
Spare	3	
Spare	4	
Spare	5	
Spare	6	
Spare	7	
Spare	8	
Spare	9	

Figure 5: J2B interconnect cable



3.2.3 APPLIED CHX (A1) INTERFACE CARD

The Applied CHX interface is designed to operate with Applied Materials® plasma etch and CVD tools with the CHX interface. Communication is made via an RS-485 connection on the upper 9-pin d-sub connector of the tool interface card. (See figure 3.) Table 5A shows the signal description for this connector.

Table 5A Applied CHX RS-485 Pin Description

Pin Number	Signal Description
1	A (-)
5	GND
9	B (+)

Local/Remote Switching: Switching from local to remote operation is accomplished as follows:

1) Disconnect AC power from the ThermoRack via the circuit breaker.
2) Locate the AMAT CHX interface card at the left rear (as viewed from the rear).
3) Enter the slave address for the ThermoRack using the red 4-position dipswitch. The ThermoRack address must match the chiller address on the Applied tool. The AMAT CHX bracket shows the dip switch values for each address (1-16). A dipswitch in the right position is ON, while the left position is OFF. Table 5B shows the dip switch setting for each address.
4) Find the Local/Remote toggle switch on the ThermoRack back panel. Flip the switch to Remote.
5) Restart the ThermoRack chiller.

Table 5B AMAT CHX Interface Card Dip Switch Settings

Dip Switch Position 1	Dip Switch Position 2	Dip Switch Position 3	Dip Switch Position 4	CHX Address
ON	ON	ON	ON	1
OFF	ON	ON	ON	2
ON	OFF	ON	ON	3*
OFF	OFF	ON	ON	4
ON	ON	OFF	ON	5
OFF	ON	OFF	ON	6
ON	OFF	OFF	ON	7
OFF	OFF	OFF	ON	8
ON	ON	ON	OFF	9
OFF	ON	ON	OFF	10
ON	OFF	ON	OFF	11
OFF	OFF	ON	OFF	12
ON	ON	OFF	OFF	13
OFF	ON	OFF	OFF	14
ON	OFF	OFF	OFF	15
OFF	OFF	OFF	OFF	16

Important Notes:

1) Do not use channel 3 as communications errors may occur.
2) The ThermoRack 1201 AMAT CHX interface card only transmits “Required Data” (as defined by the AMAT CHX specification PN 0250-35965 rev. C). “Optional data” as defined by the same specification.

Required CHX information transmitted:

- Fault Summary (digital input)
- Warning Summary (digital input)
- Actual Temperature (analog input)

Optional CHX information transmitted:

- Fluid Resistivity (analog input)
- Fluid Flow (analog input)
- Fluid Level Fault (digital input)

Optional CHX information not transmitted:

- Fluid Flow Fault (digital input)
- Facility Water Fault (digital input)

When installing the ThermoRack 1201, configure the Centura Controller to ignore optional data on the heat exchanger configuration screen, located as follows:

MISC: System Config: Config Heat Exchangers, page 3/3, sheet 2/3

Set all not transmitted values to NO.

3.2.4 AMAT P5000 ANALOG (A3) INTERFACE CARD

The AMAT Analog (-A3) interface allows the ThermoRack 1201 to communicate with an Applied Materials P5000 CVD or Etch tool. The ThermoRack 1201 may be connected as a Chiller or a Heat Exchanger. Table 5C shows the Signal Descriptions for each type.

Table 5C –A3 AMAT Analog Interface Signal Descriptions

AMAT Analog Chiller 25-Pin Dsub		AMAT Analog Heat Exchanger 15-Pin Dsub	
Pin	**Description**	**Pin**	**Description**
1	Ground	1	Flow alarm (Normally Open)
2	Chiller ON/OFF	2	Reservoir level alarm (Normally Open)
3	NC	3	NC
4	Chiller Setpoint return (-ve)	4	NC
5	NC	5	Heat exchanger ON/OFF (return)
6	Chiller Alarm (Normally Open)	6	NC
7	RTD Temperature +ve output	7	RTD output
8	Alarm relay daisy chain	8	NC
9	Chiller Alarm return (chiller alarm relay common)	9	24 Volt return (ground)
10	Chiller flow warning relay (B/C chamber normally open)	10	24 Volt input
11	Warning relay daisy chain	11	15 Volt common (NC)
12	Chiller flow warning relay (A/D chamber normally open)	12	+15 Volts (NC)
13	Chiller flow warning relay (A/D chamber common)	13	-15 Volts (NC)
14	Chiller ON/OFF return	14	NC
15	Chiller Setpoint analog input (ground referenced)	15	NC
16	NC		
17	15 Volts NC		
18	Chiller flow warning relay (B/C chamber common)		
19	Ground (daisy chain)		
20	15 Volts NC		
21	NC		
22	Chiller resistivity (shorted to pin 23)		
23	Chiller resistivity (shorted to pin 22)		
24	NC		
25	ON/OFF (daisy chain)		

3.2.5 AMAT J100 ANALOG (A4) INTERFACE CARD

The AMAT Analog (-A4) interface allows the ThermoRack 1201 to communicate with an Applied Materials P5000 tools with the J100 connector, either as a chiller or a heat exchanger. The ThermoRack 1201 may be connected as a Chiller or a Heat Exchanger. Tables 5D and 5E show the Signal Descriptions for each type.

Table 5D -A4 AMAT Analog Chiller (25-pin dsub) Interface Signal Description

Connector Pin	Direction	Signal Name	Usage
2	Input	Chiller ON	NO relay contact
14	Input	Chiller ON	Relay common
15	Input	Chiller Temperature Setpoint	Setpoint Voltage
4	Input	Chiller Temperature Setpoint	Ground
6	Output	Chiller Warnings - Level/Temp/Resistivity	NO relay contact
9	Output	Warnings - Level/Temp/Resistivity	Relay common
7	Output	Chiller Reservoir Temperature	RTD Voltage
19	Output	Chiller Reservoir Temperature	Ground
10	Output	Chiller Alarms - Level/Flow/RTD/PCW Flow	NO relay contact, B/C chamber
18	Output	Alarms - Level/Flow/RTD/PCW Flow	COM, B/C Chamber
12	Output	Alarms - Level/Flow/RTD/PCW Flow	NO relay contact, A/D chamber
13	Output	Alarms - Level/Flow/RTD/PCW Flow	COM, A/D chamber
20	Input	15VDC	NC
17	Input	15VDC	NC
22	Output	Chiller Resistivity Alarm	NO relay contact
23	Output	Chiller Resistivity Alarm	Relay common
1	Input	Ground	Ground
3, 5, 8, 11, 16, 21, 24, 25	---	NC	NC

Chiller Interlock Status Warning

- Pins 6, 9

Chiller Flow Alarm

- Pins 10, 18 (Channel BC)
- Pins 12, 13 (Channel AD)

Chiller RTD Output

- Pins 7, 19
- Voltage : -0.2 to 1 VDC
- -0.2VDC = -20°C
- 0VDC = 0°C
- 1VDC = 100°C

Chiller ON

- Pins 2, 14
- ON = pins shorted

Chiller Temperature Set-point

- Pins 4, 15
- Voltage : -0.2 to 1 VDC
- -0.2VDC = -20°C
- 0VDC = 0°C
- 1VDC = 100°C

Table 5E: -A4 AMAT Analog Heat Exchanger (15-pin dsub) Interface Signal Description

AMAT Analog Heat Exchanger 15-Pin Dsub			
Pin	**Direction**	**Signal Name**	**Usage**
1	Output	Warnings - Level/Temp/Resistivity	NO Relay Contact
2	Output	Alarms - Level/Flow/RTD/PCW Flow	NO Relay Contact
3		NC	
4		NC	
5	Input	Heat Exchanger ON/OFF (return)	Ground
6		NC	
7	Output	RTD – Coolant Temperature	RTD Voltage
8		NC	
9		24 Volt return (ground)	
10	Input	Heat Exchanger ON/OFF	+24 Volt input
11		15 Volt common	NC
12		+15 Volts	NC
13		-15 Volts	NC
14		NC	
15	Input	Coolant Set Point (°C)	Set Point Voltage

Heat Exchanger Flow Alarm

- Pins 1, 9

Heat Exchanger Level Alarm

- Pins 2, 9

Heat Exchanger RTD Output

- Pins 7, 11
- Voltage : 0-10 VDC
- 0VDC = 0°C
- 10VDC = 100°C

Heat Exchanger ON

- Pins 10, 5
- ON = +24VDC Pin 10

Heat Exchanger Temperature Set-point

- Pins 15, 9
- Voltage : 0-10 VDC
- 2VDC = 20°C
- 4VDC = 40°C
- <30mV = 21°C Set-point

3.2.6 AMAT J100 ANALOG WITH RESISTIVITY (A5) INTERFACE CARD

The AMAT Analog (-A5) interface allows the Thermorack 1201 to communicate with an Applied Materials P5000 tools with the J100 connector and an analog resistivity value on the Heat Exchanger (15-pin dsub) connector. The ThermoRack 1201 may be connected as a Chiller or a Heat Exchanger. Tables 5F and 5G shows the Signal Descriptions for each type.

Table 5F: -A5 AMAT Analog Chiller (25-pin dsub) Interface Signal Description

Connector Pin	Direction	Signal Name	Usage
2	Input	Chiller ON	NO relay contact
14	Input	Chiller ON	Relay common
15	Input	Chiller Temperature Setpoint	Setpoint Voltage
4	Input	Chiller Temperature Setpoint	Ground
6	Output	Chiller Warnings - Level/Temp/Resistivity	NO relay contact
9	Output	Chiller Warnings - Level/Temp/Resistivity	Relay common
7	Output	Chiller Reservoir Temperature	RTD Voltage
19	Output	Chiller Reservoir Temperature	Ground
10	Output	Chiller Alarms - Level/Flow/RTD/PCW Flow	NO relay contact, B/C chamber
18	Output	Chiller Alarms - Level/Flow/RTD/PCW Flow	COM, B/C Chamber
12	Output	Alarms - Level/Flow/RTD/PCW Flow	NO relay contact, A/D chamber
13	Output	Alarms - Level/Flow/RTD/PCW Flow	COM, A/D chamber
20	Input	15VDC	NC
17	Input	15VDC	NC
22	Output	Chiller Resistivity Alarm	NO relay contact
23	Output	Chiller Resistivity Alarm	Relay common
1	Input	Ground	Ground
3, 5, 8, 11, 16, 21, 24, 25	---	NC	NC

Chiller Interlock Status Warning

- Pins 6, 9

Chiller Flow Alarm

- Pins 10, 18 (Channel BC)
- Pins 12, 13 (Channel AD)

Chiller RTD Output

- Pins 7, 1
- Voltage : 0-1 VDC
- 0VDC = 0°C
- 1VDC = 100°C

Chiller ON

- Pins 2, 14
- ON = pins shorted

Chiller Temperature Setpoint

- Pins 4, 15
- Voltage : 0-1 VDC
- 0VDC = 0°C
- 1VDC = 100°C
- <30mV = 21°C Set-point

Table 5G: -A5 AMAT Analog Heat Exchanger (15-pin dsub) Interface Signal Description

AMAT Analog Heat Exchanger 15-Pin Dsub			
Pin	**Direction**	**Signal Name**	**Usage**
1	Output	Warnings - Level/Temp/Resistivity	NO Relay Contact
2	Output	Alarms - Level/Flow/RTD/PCW Flow	NO Relay Contact
3		NC	
4		NC	
5	Input	Heat Exchanger ON/OFF (return)	Ground
6		NC	
7	Output	RTD output	RTD Voltage
8	Output	Resistivity	Resistivity Voltage
9	Output	24 Volt return	Signal Ground
10	Input	Heat Exchanger ON/OFF	+24 Volt input
11		15 Volt common	NC
12		+15 Volts	NC
13		-15 Volts	NC
14		NC	
15	Input	Set Point (°C)	Set Point Voltage

Heat Exchanger Warnings

- Pins 1, 9

Heat Exchanger Alarms

- Pins 2, 9

Heat Exchanger RTD Output

- Pins 7, 11
- Voltage: 0-10 VDC
- 0VDC = 0°C
- 10VDC = 100°C

Heat Exchanger ON/OFF

- Pins 10, 5
- ON = +24VDC Pin 10

Heat Exchanger Temperature Set-point

- Pins 15, 9
- Voltage: 0-10 VDC
- 2VDC = 20°C
- 4VDC = 40°C
- <30mV = 21°C Set-point

Heat Exchanger Resistivity

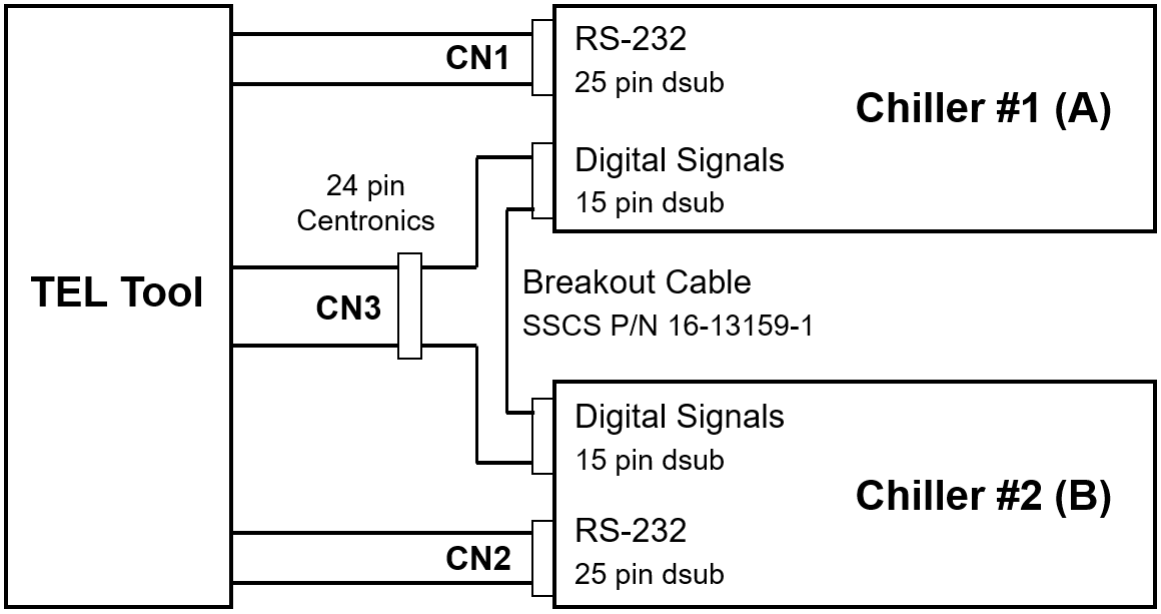
- 0-10VDC
- Pins 8, 9
- Resistivity (megΩ-cm) = 2*Voltage

3.2.7 TEL UNITY II (T1) OR UNITY M (T2) INTERFACE CARD

The TEL Unity II or Unity M Interface Card options allows communication between the ThermoRack 1201 and a TEL Unity II or Unity M plasma etch tool. Chiller communications from the TEL Unity II/M comprises two 25-pin dsub RS-232 communication cables (one per chiller channel) and one 24-pin Centronics digital signal cable that combines the two chiller channel's digital signals into one connector. The ThermoRack 1201 TEL interface includes a splitter cable that splits the 24-pin Centronics digital signals into two 15-pin dsub connectors feeding two separate ThermoRack 1201 chillers as shown in Figure 6.

Note: The ThermoRack 1201 TEL Unity II/M interface pre-sets the temperature alarm width to 5°C. This can only be changed via the TEL Unity II/M's RS-232 communications.

Figure 6 TEL Unity II/M Signal Hook-up



1) Connect the channel 1 (CN1) 25-pin dsub connector from the TEL tool to ThermoRack chiller #1's (A) rear panel RS-232 tool communications connector (see figure 6).
2) Connect the channel 2 (CN2) 25-pin dsub connector from the TEL tool to ThermoRack chiller #2's (B) rear panel RS-232 tool communications connector.
3) Connect the Centronics end of the Breakout Cable (SSCS #16-13159-1) to the 24-pin Centronics connector (CN3) from the TEL tool.
4) Connect the breakout cable's 15-pin dsub connector labeled Chiller #1 to ThermoRack #1's (A) rear panel Digital Signals tool communications connector.
5) Connect the breakout cable's 15-pin dsub connector labeled Chiller #2 to ThermoRack #2's (B) rear panel Digital Signals tool communications connector.

Table 5H: TEL UNITY II and UNITY M CN3 24-Pin Centronics Connector Pin-Out

Pin	Description	Pin	Description
1	Channel A Start/Stop	13	12VDC Return
2	Channel A Remote/Local	14	Channel A Common
3	Channel A Run LED	15	Channel A Ready LED
4	Channel A Alarm 1 LED	16	+12VDC
5	Channel A Alarm 2 LED	17	Channel A Remote/Local LED
6	Channel B Remote/Local	18	Channel B Common
7	Channel B Run LED	19	Channel B Ready LED
8	Channel B Alarm 1 LED	20	+12VDC
9	Channel B Alarm 2 LED	21	Channel B Remote/Local LED
10	Channel B Start/Stop	22	12VDC Return
11	Channel A Stop	23	Channel B Stop
12	EMO Connection	24	EMO Connection

Note: The difference between TEL Unity II and TEL Unity M is the Start/Stop Signals for Channel A&B. TEL Unity II tools use a continuous Start/Stop On signal to run the chiller (high=run, low=stop) while TEL Unity M uses a momentary Start/Stop signal to start and stop the chiller.

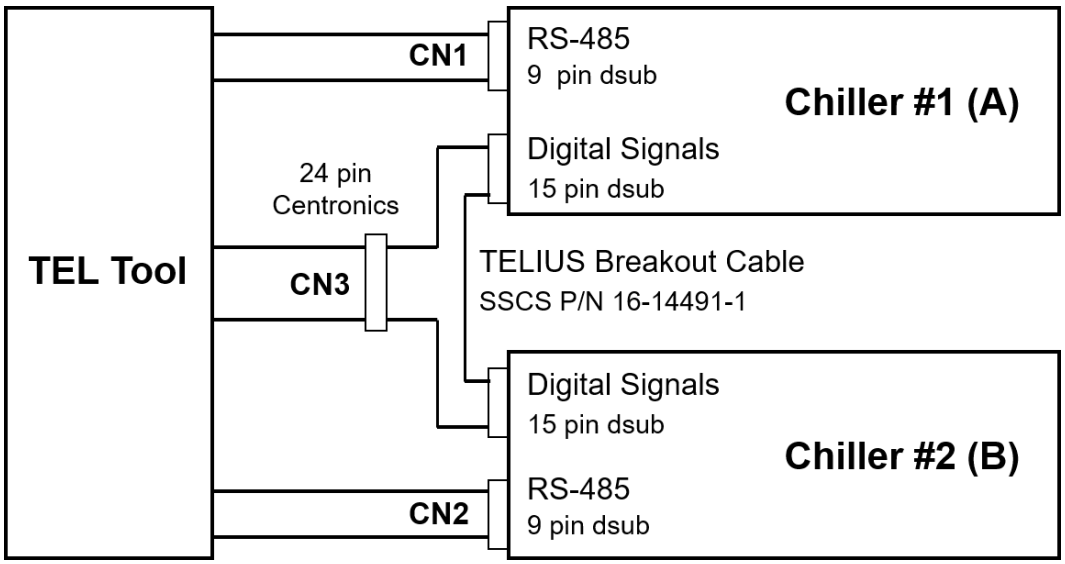
3.2.8 TEL TELIUS (T3) INTERFACE CARD

The TELIUS Interface Card option allows communication between the ThermoRack 1201/1801 and a TEL 300mm plasma etch tool. Chiller communications from the TELIUS tool comprises two 9-pin dsub RS-485 communication cables (one per chiller channel) and one 24-pin Centronics digital signal cable that combines the two chiller channel's digital signals into one connector. The ThermoRack 1201/1801 TELIUS interface includes a splitter cable that splits the 24-pin Centronics digital signals into two 15-pin dsub connectors feeding two separate ThermoRack 1201/1801 chillers or one ThermoRack 1801 and one Nikola 3K/5K chiller as shown in Figure 7.

Note: The ThermoRack 1201/1801 TELIUS interface pre-sets the temperature alarm width to 5°C. This can only be changed via the TELIUS RS-485 communications.

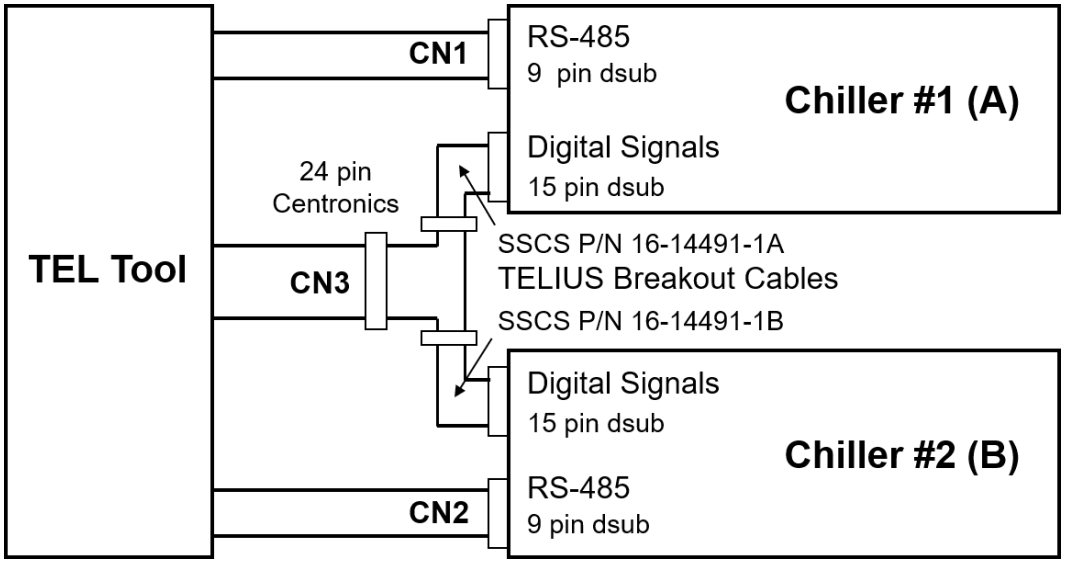
There are two possible TELIUS cable hook-ups:

Figure 7A: TELIUS Signal Hook-up #1 (Standard – T3 units ship with Cable P/N 16-14491-1)



- Connect the channel 1 (CN1) 9-pin dsub connector from the TELIUS tool to ThermoRack chiller #1's (A) rear panel RS-485 tool communications connector.
- Connect the channel 2 (CN2) 9-pin dsub connector from the TELIUS tool to ThermoRack chiller #2's (B) rear panel RS-485 tool communications connector.
- Connect the Centronics end of the Breakout Cable (SSCS #16-14491-1) to the 24-pin Centronics connector (CN3) from the TELIUS tool.
- Connect the breakout cable's 15-pin dsub connector labeled Chiller #1 (A) to ThermoRack #1's rear panel Digital Signals tool communications connector.
- Connect the breakout cable's 15-pin dsub connector labeled Chiller #2 (B) to ThermoRack #2's rear panel Digital Signals tool communications connector.

Figure 7B: TELIUS Signal Hook-up #2 (Optional: These cables must be ordered separately)



- Connect the channel 1 (CN1) 9-pin dsub connector from the TELIUS tool to ThermoRack chiller #1's (A) rear panel RS-485 tool communications connector.
- Connect the channel 2 (CN2) 9-pin dsub connector from the TELIUS tool to ThermoRack chiller #2's (B) rear panel RS-485 tool communications connector.
- Connect the Centronics end of the Breakout Cable (SSCS #16-13159-1A) to the 24-pin Centronics connector (CN3 for Channel A) from the TELIUS tool and the other end to the 15-pin dsub connector on Chiller #1 (A).
- Connect the Centronics end of the Breakout Cable (SSCS #16-13159-1B) to the 24-pin Centronics connector (CN3 for Channel B) from the TELIUS tool and the other end to the 15-pin dsub connector on Chiller #2 (B).

Table 5I: TELIUS CN3 24-Pin Centronics Connector Pin-Out

Pin	Channel	Application	Category	Pin	Channel	Application	Category
1	CH1	Run / Stop signal	IN	13	Common	input/output common (COM)	IN
2	CH1	RUN mode signal	OUT	14	CH1	operation mode output common	OUT
3	CH1	RUN signal	OUT	15	CH1	Temperature OK signal	OUT
4	CH1	Error-signal (Operation stop)	OUT	16	Common	RF matcher Power OFF	IN
5	CH1	Abnormal-signal (Operation continuation)	OUT	17	CH1	RUN mode signal	OUT
6	CH2	operation mode signal	OUT	18	CH2	operation mode output common	OUT
7	CH2	operation signal	OUT	19	CH2	Temperature OK signal	OUT
8	CH2	Error-signal (Operation stop)	OUT	20	Common	RF matcher Power OFF	IN
9	CH2	Abnormal-signal (Operation continuation)	OUT	21	CH2	RUN mode signal	OUT
10	CH2	Run / Stop signal	IN	22	Common	input/output common (COM)	IN
11	CH2	RUN mode signal	OUT	23	CH2	Stop signal	OUT
12	CH1	Brine collect	IN	24	CH2	Brine collect	IN

Notes:

1. When using a ThermoRack 1201 with a Nikola 3K/5K chiller, the Nikola 3K/5K should be channel #1 and the ThermoRack 1201 channel #2.
2. When the CN3 cable is split into two cables with 24-pin Centronics connectors, the pin-outs are the same as shown in Table 5I, except Channel A's signals are on one cable and Channel B's on the other.

3.2.9 TR1201/1801 RS-232 COMMUNICATIONS

The ThermoRack 1201/1801 has a RS-232 serial communications option that replaces the tool interface card. can receive a remote set point, return the current temperature, and signal an alarm has occurred.

Wiring: Proper wiring depends upon whether the equipment being cooled (the Host) is wired as Data Computer Equipment (DCE) or Data Terminal Equipment (DTE)

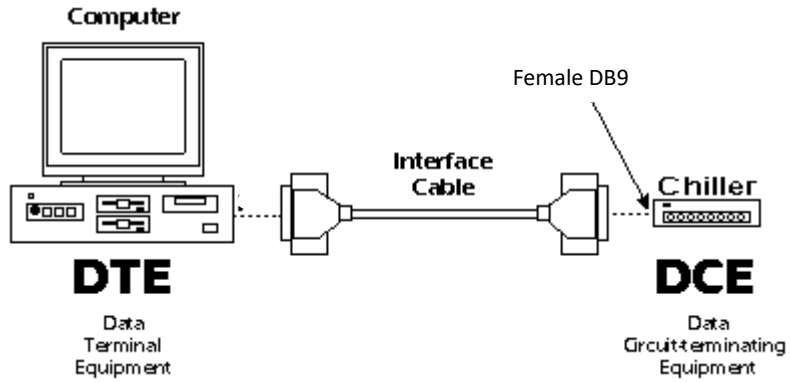


Table 1A: Signal definition and wiring for Host wired as DTE

Computer/Host/Master Male 9-Pin D-sub Pin #	**ThermoRack Chiller / Slave** Female 9-Pin D-sub Pin#
2 (Receive – RXD)	2 (Transmit – TXD)
3 (Transmit – TXD)	3 (Receive – RXD)
5 (Ground)	5 (Ground)

Note: Use a null modem cable if your RS-232 is set up as a DCE.

Communication Specification

Speed:	57,600 baud.
Data Flow Control:	None
Data Format:	8-bit serial
Number of Start bits	1
Number of Stop bits:	1
Parity:	None
Master/Slave:	The ThermoRack is always the SLAVE (DTE)
Interrupts Reported:	None, must be polled for status
Transmission Length:	$\leq$ 15 meters
Data Update Frequency:	Once per second
Maximum Polling Frequency:	One command every 200msec
Data Format:	ASCII Insert a carriage return ($0x0D_{hex}$) at the end of each command string.

A carriage return ($0x0D_{hex}$) is sent at the end of each response

A complete list of all TR1201/1801 parameters available are listed below. Sending an RS-232 Command other than LOCAL puts the ThermoRack 1201/1801 in remote mode.

PARAMETER	To GET Data	To PUT Data (or control)
mfr, model, ser#, sw version	IDN	-
puts chiller in LOCAL mode	-	LOCAL<Cr>
restarts the chiller	-	RESTART<Cr>
clear alarms	-	CLEARALARMS<Cr>
chiller: run	-	RUN<Cr>
chiller: stop	-	STOP<Cr>
RTD temp	TEMP? (+/- XX.X)	-
RTD offset	RTDOFFSET? (+/- XX.X)	RTDOFFSET XX.X<Cr>
setpoint	SETTEMP? (+/- XX.X)	SETTEMP XX.X<Cr>
ready width (	WIDTH? (+XX.X)	WIDTH XX.X<Cr>
backlight off	-	BLOFF<Cr>
backlight on	-	BLON<Cr>
coolant type	COOLANT? {WEG_5050, FLUORINERT_FC3283}	
coolant flowrate	FLOWRATE? (XX.X)	-
coolant fault threshold - low	LOWFLOWTHRESH? (XX.X)	LOWFLOWTHRESH XX.X<Cr>
coolant fault threshold - high	HIGHFLOWTHRESH? (XX.X)	HIGHFLOWTHRESH XX.X<Cr>
coolant resistivity	RESIS? (XX.X)	
coolant resistivity warning threshold - low	RESISMIN? (XX.X)	RESISMIN XX.X<Cr>
coolant resistivity warning threshold - high	RESISMAX? (XX.X)	RESISMIN XX.X<Cr>
actual TE PWM %	PWM? (+/- XX.X)	-
status word 1 (5 ASCII bytes)	STAT1A? (XXXXX) {0, 65535}	-
fault word 1 (5 ASCII bytes)	FLTS1A? (XXXXX) {0, 65535}	-
GET1201: returns the following stream:	• XX.X<Cr> (RTD Temp) • XX.X<Cr> (Set temp) • XX.X<Cr> (PWM%) • XXXX<Cr> (Pump Freq) • XX.X<Cr> (Flowrate) • XX.X<Cr> (Resistivity) • XXXXX<Cr> (Status word) • XXXXX<Cr> (Fault word 1) • XXXXX<Cr> (Fault word 2) • XXXXX<Cr> (# EEPROM Writes) • ETX (03hex) (End of transmission)	

PARAMETER	To GET Data	To PUT Data (or control)
status word 1 (5 ASCII bytes)	**STAT1A?**<Cr> (XXXXX = 0 to 65535) _ _ _ _ |_ _ _ _ |_ _ _ _ |_ _ _ _ | LSbit | | | | | | | | | | | | |_ STBY(0), RUN(1) | | | | | | | | | | | | |__ Local(0), Remote(1) | | | | | | | | | | | | |___ Ready(1) | | | | | | | | | | | | |_____ RTD < Alarm Width(1) | | | | | | | | | | | | |_____ RTD > Alarm Width(1) | | | | | | | | | | | | |_____ Cooling(0), Heating(1) | | | | | | | | | | | | |_____ Gen. Warning(1) | | | | | | | | | | | | |_____ Gen. Alarm(1) | | | | | | | | | | | | |_____ rsvd | |_____| _____ rsvd	N/A
faults word 1 (5 ASCII bytes)	**FLTS1A?**<Cr> (XXXXX = 0 to 65535) _ _ _ _ |_ _ _ _ |_ _ _ _ |_ _ _ _ | LSbit | | | | | | | | | | | | |_ RTD(1) | | | | | | | | | | | | |__ Tank Level Low(1) | | | | | | | | | | | | |___ Pump Temp(1) | | | | | | | | | | | | |____ rsvd | | | | | | | | | | | | |_____ Alarm Width Warning(1): | | | | | | | | | | | _____ STAT1A "ready" bit. (1) | | | | | | | | | | | |_____ Tank Empty(1) | | | | | | | | | | |_____ rsvd | | | | | | | | | |_____ Pump Frequency Low(1) | | | | | | | | |_____ Pump Frequency High(1) | | | | | | |_____ Pump Flow Low(1) | | | | | |_____ PCW Temp(1) | | | | |_____ Resistivity High(1) | | | |_____ Resistivity Low(1) | |_|_____ rsvd |_____ EEPROM Timing Error(1) - Setpoint changes too fast.	N/A

3.3 PLUMBING CONNECTIONS

All plumbing connections are made on the chiller rear panel (see figure 3).

Coolant Connections: The coolant supply and return connections are made via 1/2" stainless steel Swagelok fittings. Coolant supply (out) is located on the left side of the rear panel and coolant return (in) is located on the right side. The normal coolant flow rate is 3 - 4.5 gpm (see Figure 2). For optimal performance, minimize flow restrictions in the lines between the ThermoRack 1201 and the process tool. Flow restrictions typically occur in fittings, quick disconnect shut-offs (use the largest size possible), tubing kinks, and long lengths of tubing.

Facility Cooling Water: Facility (Plant) cooling water must be 10-35 ºC, filtered with a 75 micron or better filter, treated re-circulating water, pH 6.5 – 8.2, non-condensing. Facility cooling water connections are made via 1/2" stainless steel Swagelok fittings located on the left side of the rear panel. The facility cooling water supply (in) connection is above the return (out) connection. The required cooling water flow rate is 2-5 gpm.

Drain Valve: The system drain valve is a ¼" plug valve shipped in a separate bag inside the ThermoRack 1201 box. Use a 7/8" wrench to tighten the ½" Swagelok nut to the branch of the ½" Coolant Outlet tee located at the lower left of the ThermoRack rear panel (figure 3).

3.4 AIR CONSIDERATIONS

The ThermoRack 1201 has one 20 cfm fan, located on the right side, for cooling its electronics and pump. Do not block airflow into this fan or the perforations on the left side. Only 0.375" of clearance is required. Typical 19" rack enclosures provide plenty of clearance.

3.5 WETTED MATERIAL COMPATIBILITY

Plant Cooling Water (PCW): The ThermoRack 1201 PCW lines are made from stainless steel and hard-coat anodized aluminum. The chiller is compatible with filtered plant cooling water with a pH of 6.5-8.2 treated against calcium deposits.

Coolant: The ThermoRack 1201 PCW lines are made from stainless steel and aluminum. The chiller is compatible with any Fluorinated heat transfer oil made by 3M (Fluorinert or Novec Fluids) or San Gobain (Galden). In addition, the chiller is compatible with de-ionized water or any combination of de-ionized water and propylene or ethylene glycol with a resistivity between 1 meg-ohm and 10 meg-ohms.

4.0 COOLANT FILL/START-UP

4.1 COOLANT TYPE

The ThermoRack 1201 is designed to run with a fluorinated heat transfer fluid or water/glycol mixtures as the coolant. Selection of the coolant type is important to the proper operation of the ThermoRack 1201 and is dependent upon the fluid set point desired. Operation with the wrong coolant can lead to cavitation in the pump and premature failure. Table 6 below lists the recommended coolant types:

Table 6 Recommended Coolant Types

Set Point Temperature	3M Fluorinert® Coolant	3M Novec® Coolant	Galden® Coolant	Opteon Coolant	Ethylene Glycol/Water
-10 to 20ºC	FC-72	HFE-7100, 7200, or 7500	None tested	SF10	50% Ethylene Glycol/Water 100% Ethylene Glycol
10 to 60 ºC	FC-77 or FC-777	HFE-7500	HT-110	SF10	25% Ethylene Glycol/Water
20 to 80 ºC	FC-3283	HFE-7500	HT-200	None	25% Ethylene Glycol/Water

4.2 FILL/START-UP

WARNING

Read coolant and PCW SDS before handling. Wear protective gear listed in SDS when filling the Thermorack 1201.

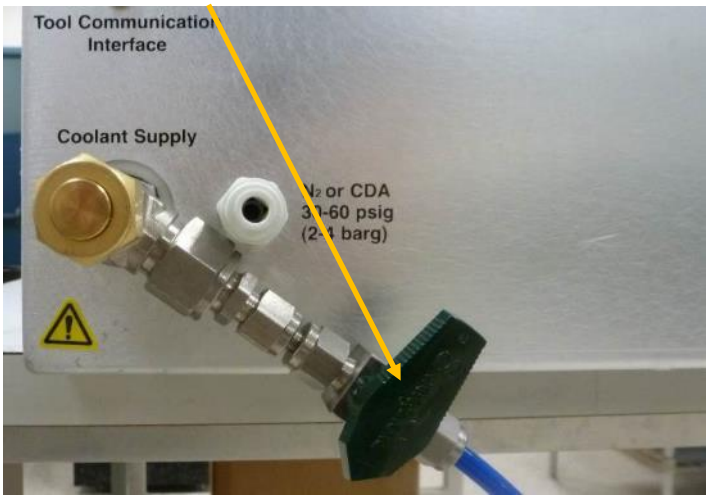
Once hook-up has been completed as per Section 3, follow the instructions below for filling the tank with coolant and starting the ThermoRack. Note: the ThermoRack has a 1.5-gallon (6 liter) tank.

1) Turn on the facility water flow to 1-2 gpm (more cooling water increases the cooling capacity).
2) Using a ⅝" open end wrench, remove Swagelok cap on the Tank Vent port.
3) Using an 11/16" open-ended wrench, remove the Swagelok cap on the Fill port.
4) Connect the funnel provided with the ThermoRack chiller to the Fill port, hand-tighten only.
5) Turn on power to the ThermoRack via the circuit breaker. (Do not press the start button.)
6) Fill the tank with one gallon of coolant. (The green Tank Level OK light will come on before one gallon is added, but add the entire gallon as it probably will be required to fill the lines to the tool at start-up.
7) Check that any exterior valves attached to the coolant lines are open.
8) Turn off the front circuit breaker, wait 30 seconds, and then turn the circuit breaker back on. If the ThermoRack is in remote mode it will start up automatically, otherwise press the START/STOP key to begin operation.

Note: On units with the system enable/disable option, the green enable button must be pressed prior to pressing the START/STOP key.

9) The ThermoRack will now enter its Pump-Prime sequence. If the Tank Level Low signal appears on the front display add more coolant through the funnel until Tank Level OK Light turns on.
10) The ThermoRack Pump Prime sequence will cycle the pump on and off up to ten times (30 seconds per cycle). If PUMP FLOW LOW appears after the sequence completes, turn off the ThermoRack via the circuit breaker, **wait 30 seconds**, and then turn the circuit breaker back on. Place a container under the drain valve and open the drain valve. When the pump turns on to allow coolant to flow out of the ThermoRack. This will help remove trapped gas bubbles.
11) Once the pump has primed, remove the coolant funnel and replace the Swagelok cap on the fill and vent ports. Tighten the caps ¼-turn past hand tight.
12) The ThermoRack will now control at the most recent set-point or at the initial factory set-point of 22 °C.

Drain Valve



Important Notes:

1) Operating the ThermoRack at a set point of 5°C or less requires the N2 Purge option. This option is recommended for operation at 10°C or less as it increases the ThermoRack's cooling capacity.
2) When operating the ThermoRack at a set point of 5ºC or lower, leave the tank vented during the initial cool down to set point. Tighten the caps 1/4 –turn past hand tight once set point has been reached.

When operating with a water/ethylene or propylene glycol mixture at temperatures over 70 °C, leave the tank vent open until the coolant temperature reaches set point. This allows dissolved gas to vent out of the system.

5.0 OPERATION

The ThermoRack is operated via the control panel located on the front panel. The control panel has a 16-character LCD display and four input keys: UP, DOWN, ENTER, and START/STOP. These keys work as follows:

Table 7 Using the Keypad

Key	Action
UP	Pressing the UP key raises the parameter value displayed.
DOWN	Pressing the DOWN key lowers the parameter value displayed
ENTER	Pressing the ENTER key momentarily enters the parameter changed.
ENTER	Pressing and holding the ENTER key for 3 seconds changes the LCD display menu.
START	Pressing the START key turns on temperature control.
START	Pressing the START key while the chiller is operating turns off temperature control.

5.1 SIMPLE OPERATION

The ThermoRack comes with preset operating parameters that will work well for most applications. If temperature control at one temperature is desired, follow the steps below.

1) Turn on ThermoRack and wait for display to read TEMP.
2) Press the UP or DOWN keys to change SETTEMP 1 to the desired set point.
3) Press the START key.

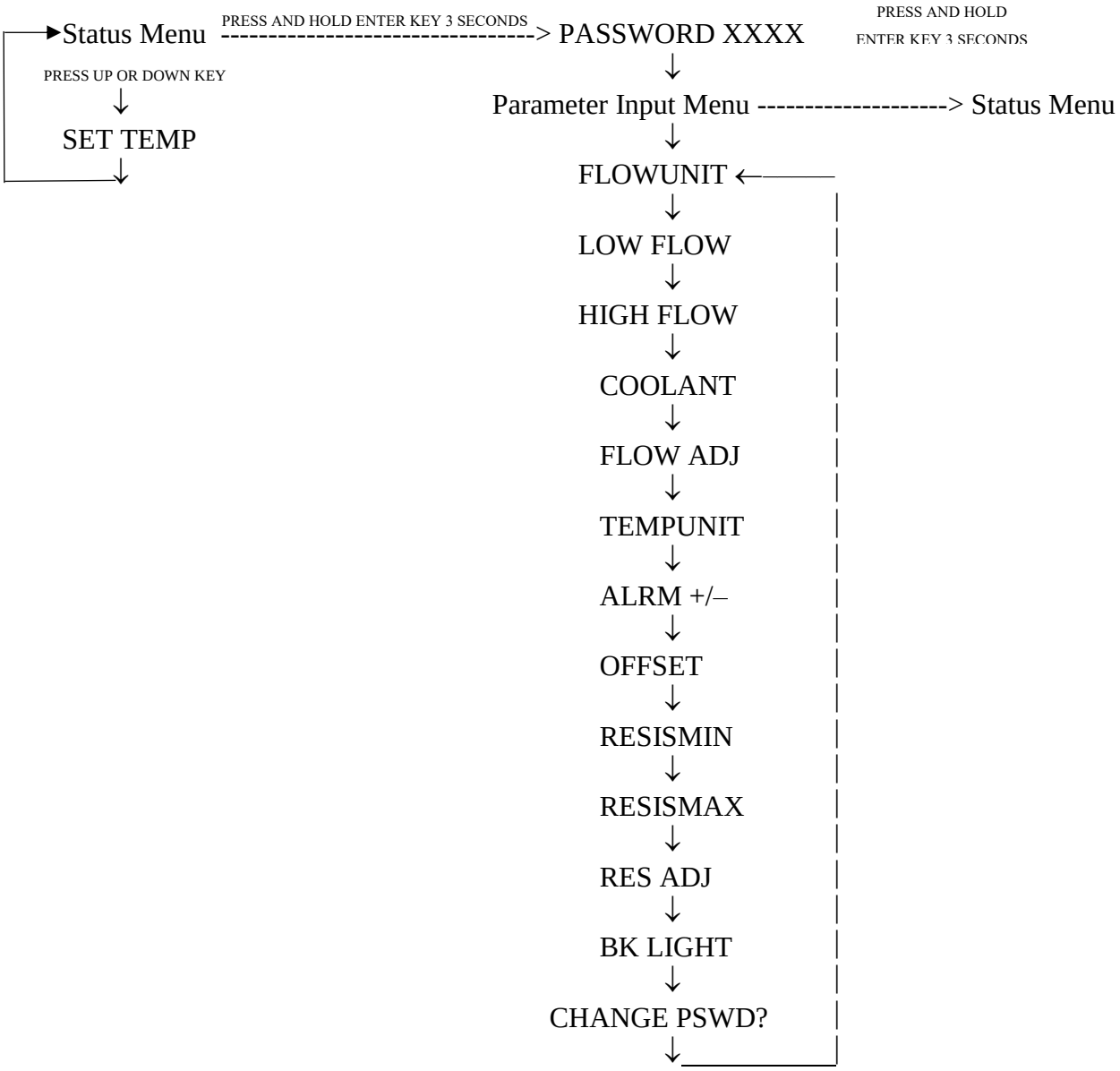
The ThermoRack will now control to the set point temperature. To change the set point temperatures just press the UP or DOWN keys again to change SETTEMP 1 to the new set point, followed by the START/STOP key.

Note on Dual Channel Start-up: Turn on the circuit breaker of ThermoRack #2 first, followed by ThermoRack #1. Both units will turn on upon start-up on ThermoRack #1.

5.2 ADVANCED OPERATION

The ThermoRack controller has two menus: the Status Menu and the Parameter Input Menu. The Status Menu shows the chiller operating status, current temperature of coolant leaving the chiller, and current coolant flow rate if the enter key is pressed momentarily. The Status Menu also allows input of new coolant temperature set points when the cycling feature is off. The Parameter Input Menu allows input of set point temperatures, soak times, number of cycles (if cycling between two temperatures), temperature alarm points, a temperature display offset, temperature units, coolant flow units, and the minimum coolant flow before triggering a pump flow low alarm.

Figure 8 Menu Structure



Press and release the ENTER key to scroll between the Parameter Menu items (↓).

Press the UP or DOWN keys followed by the ENTER key to change the set point locally in the Status Menu.

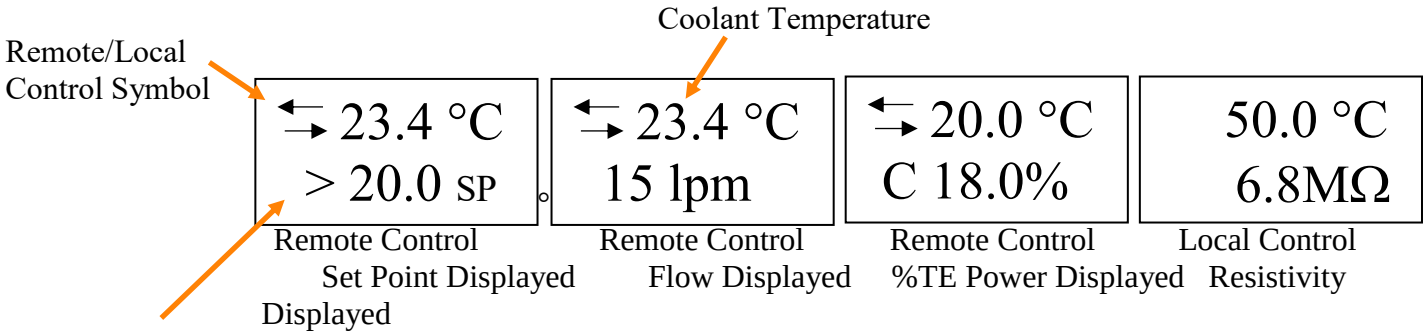
Press and hold ENTER key for 3 seconds to scroll between menus.
A 4-digit password is required to enter the Parameter Input Menu. **The Factory Default Password is 0000.** Use the UP or DOWN key to change individual numbers; use the ENTER key to enter each number and move to the next. If an incorrect password is entered the user is returned to the Status Menu. The password may be changed via the CHG PASSWORD command in the Parameter Menu.

Notes:
1) If the user enters the parameter input and does not press a key for 30 seconds the display will revert back to the Status menu.
2) Operating the ThermoRack 1201 remotely via the tool interface card locks out the front keypad.

Status Menu: The status menu displays the chiller control mode (remote or local) and coolant temperature on the top line, and the operating mode (heating, cooling, or above/below the temperature alarm range) plus the set point, coolant flow, %TE power, and resistivity (DI water units only) alternating on the lower line.

Operating Mode Symbols:
* = Standby mode, no temperature control
H = Heating mode with temperature control
C = Cooling mode with temperature control
> = Current temperature is above the set point + ALARM TEMP
< = Current temperature is below the set point – ALARM TEMP
⇐⇒ Indicates remote control through the tool interface card.

Figure 9 Operating Display



The coolant outlet temperature is shown on the top line in °C or °F.

Pressing the UP or DOWN keys in local mode allows the user to change the set point temperature upon pressing the ENTER key.

Parameter Input Menu: The parameter input menu allows input of all operating parameters. Use the UP or DOWN keys to change values. Press ENTER when complete.

FLOW UNIT = Flow units displayed when the enter key is pressed in the Status Menu, gpm or lpm. **Factory Default is gpm.**

LOW FLOW = Coolant low flow rate at which the ThermoRack will shut off the coolant pump and thermoelectric power triggering an alarm signal and displaying PUMP FLOW LOW on the screen. **Factory Default Value: 1.0 gpm.**

HIGH FLOW = Coolant high flow rate at which the ThermoRack will shut off the coolant pump and thermoelectric power triggering an alarm signal and displaying PUMP FLOW LOW on the screen. **Factory Default Value: 10.0 gpm.**

COOLANT = Type of coolant used. This is used to calculate flow and pressure. Options are: Fluorinert (calibrated to FC-3283) 50/50WEG (calibrated for 50% water/ethylene glycol) Galden (calibrated to HT200), and 100% Ethylene Glycol **Factory Default is Set by Model Configuration**

FLOW ADJ = Offsets the coolant flow measured by the amount entered to match an external flowmeter. Use the UP or DOWN keys to adjust the flow displayed. The ThermoRack will then scale its flow measurements based on this adjustment. **Factory Default is 0.0 gpm or lpm.**

TEMP UNIT = Temperature units used, °C or °F. **Factory Default is °C**

ALRM +/- = Deviation from set point that triggers a warning signal, displaying the < or > symbol on the screen. No interlock action is taken. Range: +/- 0-15°C from set point. **Factory Default Value 3.0°C**

OFFSET T = Offsets the temperature measured by the ThermoRack by the amount entered. Range: +/- 0-15°C. Used to equalize the ThermoRack temperature displayed with tool's measured temperature. Once the ThermoRack has stabilized at a set point, enter the following value: Tool Temperature – Set Point. **Factory Default Value: 0.0 °C**

RESISMIN = The DI water resistivity low level that trips a warning to the tool and the front display, units in megohm-cm. **Factory Default is 0.1M**

RESISMAX= The DI water resistivity high level that trips a warning to the tool and the front display, units in megohm-cm. **Factory Default is 20M**

RES ADJ = Adjust Resistivity to match an external resistivity meter. Display shows the current measured resistivity. Use the UP or DOWN keys to adjust the resistivity displayed. The ThermoRack will then scale its resistivity measurements based on this adjustment. **Factory default is 0megΩ-cm**

BK LIGHT = Turns the display light ON or OFF. **Factory Default is ON.**

CHANGE PSWD? = Allows user to change the four digit password. Change the password by toggling the N to a Y and then enter a new four-digit number.

5.3 ALARMS/INTERLOCKS

5.3.1 STANDARD INTERLOCKS

The ThermoRack 1201 has several interlocks and alarms to prevent hazardous operation in the event of system failures or operation outside of prescribed limits. The response of the ThermoRack to alarms and warnings is shown in Table 8. In the event of a system failure, the alarm type will be shown on the front display. A description of these alarms can be found in section 6.

Table 8 ThermoRack 1201 Interlock Chart

Sensor/Interlock	Trip Level	Display	Action		Alarm Type
			TE	Power Pump	
Tank Level Low	open	Tank Low	On	On	Warn[1]
Temp Alarm Out of Range	User Sets +/- alarm	> Or <	On	On	Warn
Water Resistivity Low (water units)	1 megΩcm		On	On	Warn[2]
Tank Level Empty	open	Tank Level Empty	Off	Off	Soft
Facility Water Flow Low	open	Water Flow Low	Off	On	Soft
Pump Flow	User Sets	Pump Flow Low	Off	Off	Soft
RTD Fault	open	RTD Open/RTD Fail	Off	On	Soft
Coolant Flow Low Measurement	½ gpm	Pump Flow Low	Off	Off	Hard
GFCI	> 30 mA	None	Off	Off	Hard[3]
Coolant Over-temp	100 °C	None	Off	Off	Hard[3]
External EMO	Open	None	Off	Off	Hard[3]

Notes:

1) Tank Low will also cause the green tank level OK LED on the rear panel to turn off.
2) The Resistivity Low warning is an alarm for DI water units only. See section 5.3.2.
3) These alarms will shut off power to the ThermoRack via the main contactor, turning off the front display.

5.3.2 COOLANT RESISTIVITY LOW INTERLOCK FOR WATER BASED COOLANTS

The ThermoRack 1201 has a remote resistivity sensor option available, –WS, for DI water based coolants. This sensor ties into the ThermoRack warning loop, sending a warning to the process tool and flashing Resistivity Low on the front display. See section 7.2 for more details.

5.4 DRAINING THE SYSTEM OF COOLANT

WARNING

Read coolant and PCW SDS before handling. Wear protective gear listed in SDS and follow local regulatory statues when disposing of coolants or PCW drained from the chiller

Draining the ThermoRack of coolant is accomplished by using the following procedure:

1) Unscrew the tank vent cap.
2) Connect a tube to the 1/4" drain valve located on the coolant supply line.
3) Place the tube into a suitable container and open the drain valve (turn the handle to point toward the drain tube).
4) Turn on the ThermoRack circuit breaker and press START.

Coolant will now drain from the ThermoRack. The ThermoRack will stop pumping when the tank empties. Turn off the circuit breaker when the pump stops. A small amount of coolant will still remain in the ThermoRack and external coolant lines when the coolant has stopped draining out. To recover the remaining coolant, close the drain valve and connect a nitrogen line up to the tank vent. Pressurize the tank with 10-15 psig of nitrogen. Shut off the nitrogen and re-open the drain valve. More coolant will drain out. Repeating this process three times will normally remove 95% of the coolant.

5.5 CHANGING COOLANTS

WARNING

Read coolant and PCW SDS before handling. Wear protective gear listed in SDS and follow local regulatory statues when disposing of coolants or PCW drained from the chiller

Changing coolant type requires changing the ThermoRack controller software (contact SSCS for details) and completely removing the original coolant prior to switching to the new coolant, especially when changing from Fluorinert/Galden to water/glycol. Failure to remove all fluorinated coolants prior to operating with water/glycol will result in a frothy mixture being produced that will reduce heat transfer rates. When changing coolants, use the following procedure:

1) Connect a ¼" tube to the drain valve, placing the other end into a 2 gallon or larger container.
2) Open the drain valve.
3) Turn on the ThermoRack in local mode and press start. The ThermoRack will pump out the coolant until tank level empty is reached.
4) Turn off the ThermoRack circuit breaker and allow coolant to continue to drain for 30 minutes. If compressed air or nitrogen at 50 psig or less is available, connect it to the 3/8" Tank Vent connection to facilitate coolant removal.
5) Remove the coolant lines to the tool and purge all coolant out with clean dry air or nitrogen.
6) Fill the ThermoRack and coolant lines with water and run the ThermoRack for 5 minutes. (See section 4.2.)
7) Drain the water as per steps 1-5.
8) Flush the system two more times as per steps 1-7.
9) Fill the ThermoRack with the new coolant.
10) Re-start the ThermoRack as per section 4.2.

5.6 CLEANING THE THERMORACK

The external surfaces of the ThermoRack may be cleaned with a clean, dry cloth or a clean dry cloth with isopropyl alcohol. Do not clean the internal surfaces.

5.7 DRAINING THE FACILITY WATER (PLANT COOLING WATER) LINES

WARNING

Read coolant and PCW SDS before handling. Wear protective gear listed in SDS and follow local regulatory statues when disposing of coolants or PCW drained from the chiller

Drain the ThermoRack 1201 internal facility water lines using the following procedure:

1) Turn off the facility water (plant cooling water or PCW).
2) Place a bucket under the facility water fittings.
3) Disconnect the facility water return fitting, placing the hose in the bucket.
4) Slowly disconnect the facility water supply fitting, letting the water flow into the bucket. Place the hose in the bucket.
5) Connect clean dry air (CDA) to the facility water supply fitting and blow out the remaining water into the bucket.
6) Turn off and disconnect the CDA once all water has been blown out of the ThermoRack.

6.0 LAM DUAL CHANNEL CHILLER OPTION

WARNING

Channel #2 alarms and warnings will not be communicated to Lam tools with a 10 or 12-pin communication cable unless the –DC1A option is chosen.

The dual channel chiller option allows control of two ThermoRack 1201's to via a single tool interface cable, as is typical in some etch tools where an upper and lower electrode are controlled at different temperatures. When this option is selected, the signals from the tool connect to the primary (Lower Electrode/Chuck) Chiller #1. A signal interconnect cable connects the primary Chiller #1 to the secondary (Upper Electrode/Chamber Walls) Chiller #2. The two ThermoRacks in a dual channel system are labeled as Chiller #1 and Chiller #2 and are not interchangeable.

Important note:

Lam Dual Channel Chiller 37-pin Analog/Digital communication cables come in two types, one with 16 pins and one with 10 or 12 pins. Those with 16 pins require the –DC1 option while those with 10 or 12 pins require the –DC1A option. (See table 10 for details.)

6.1 ELECTRICAL HOOK-UP OF DUAL CHANNEL OPTION TO A LAM ETCHER

All electrical connections are made on the rear panel of each Chiller (see Figure 3).

CAUTION

Mis-wiring the AC power can damage the Thermorack 1201

AC Power Connections: Two separate power cables are required for the Dual Channel Option. Connect 200-240 V~ power to the rear of both ThermoRacks via the 20ft service cables provided. Connect bare end of service cables as follows:

Black: Line 1
White: Line 2 (or neutral)
Green/Yellow stripe: Earth ground

The service cable connects to the ThermoRack via a Harting Han Q 5/0 connector which has 5 contacts plus ground plug number 09120153101. Connector pin out: (for reference).

Pin 1: Line 1
Pin 2: Line 2 (or Neutral)
Pin 3: Not Used
Pin 4: Not Used
Pin 5: Not Used
G: Earth Ground

Note: Safe operation of the ThermoRack 1201 requires earth-ground be connected to the G terminal of this plug.

WARNING

Failure to connect earth ground to the Green/Yellow stripe conductor will make the Thermorack chassis potential shock hazard

Remote EMO: Connect the remote EMO circuit to CHILLER #1 via pins 5 and 6 on the 9-pin CPC connector provided, AMP #206708-1, to the socket labeled 72J2. (See Table 3.) If no remote EMO circuit is available these two pins must be jumpered together or the ThermoRack 1201 will not turn on. Note: triggering the EMO circuit will shut down both Chiller #1 and Chiller #2. The remote EMO connection to Chiller #2 is not used.

Table 9 Lam Dual Channel Chiller #1 Connector 72J2 Pin Description

Pin Number	Signal Description
1	Jumpered to Pin 2 (tool EMO loop)
2	Jumpered to Pin 1 (tool EMO loop)
3	24 VAC Remote/Local Switch from etcher
4	24 VAC Remote/Local Switch from etcher return
5	Closed contact from etcher (remote EMO)
6	Closed contact from etcher return (remote EMO)
7	Spare
8	Spare
9	Spare

Analog Signal Interface: The Lam Analog tool interface card is designed to operate with Lam Research Corporation® plasma-etch tools. This interface card is the ThermoRack default standard. Connect the Lam Dual Channel Analog tool interface to Chiller #1 via the 37-pin D-subminiature Female connector labeled 72J1, as shown in Table 10.

Local/Remote Switching: Switching from local to remote operation on both is accomplished by applying 24 VAC across pins 3 & 4 on the 9-pin CPC connector labeled 72J2 on Chiller #1. (See Table 3.) This switches both Chiller #1 and Chiller #2 to remote operation. Turning off 24 VAC returns both Chillers to a locally entered set-point.

System Warning: System warning signals from both ThermoRack channels are available on the tool interface card. (See Table 10 “Warn” signal)

Temperature Alarm: Coolant temperature out of range warnings from both ThermoRack channels are available on the tool interface card. (See Table 10 “Warn” signal)

System Alarms: System alarm signals from both ThermoRack channels are available on the tool interface card. (See Table 10 “Warn” signal)

Table 10 Connector 72J1 Lam Dual Channel Chiller Analog Interface Card Pin Description

Pin Number	Signal Description
24	Chiller #1 Set Point Temperature, 0-10VDC, 0VDC = 0°C 10VDC = 100°C
5	Chiller #1 Set Point Temperature Return
20	Chiller #1 Coolant Exit Temperature, 0-10VDC, 0VDC = 0°C 10VDC = 100°C
1	Chiller #1 Coolant Exit Temperature Return
26	Chiller #1 Fail, Normally Closed Opto-isolated transistor, Ic=125mA Vbce(off)=30V
7	Chiller #1 Fail Return
28	Chiller #1 Warn, Normally Closed Opto-isolated transistor, Ic=125mA Vbce(off)=30V
9	Chiller #1 Warn Return
25	Chiller #2 Set Point Temperature, 0-10VDC, 0VDC = 0°C 10VDC = 100°C
2	Chiller #2 Set Point Temperature Return
21	Chiller #2 Coolant Exit Temperature, 0-10VDC, 0VDC = 0°C 10VDC = 100°C
6	Chiller #2 Coolant Exit Temperature Return
29	Chiller #2 Fail, Normally Closed Opto-isolated transistor, Ic=125mA Vbce(off)=30V
10	Chiller #2 Fail Return
30	Chiller #2 Warn, Normally Closed Opto-isolated transistor, Ic=125mA Vbce(off)=30V
11	Chiller #2 Warn Return

Notes: 1) All pins not identified above are spares.
2) The signals highlighted in yellow are combined into the Chiller #1 Fail Signal with the –DC1A option. All signals are used in –DC1 units

Dual Channel Chiller Interconnect cable: A 6 ft. interconnect cable is provided for connecting signals from Chiller #1 to Chiller #2. Connect this cable to the upper 9-pin dsub connector among the tool interface connectors at the rear of each chiller (see figure 3). Failure to install this cable will prevent Chiller #2 from powering up and will cause Chiller #1 to lock-up and not control temperature.

6.2 PLUMBING HOOK-UP OF THE DUAL CHANNEL OPTION

Plumb each chiller independently to their respective electrodes as described in section 3.3

6.3 COOLANT FILL/START-UP WITH THE DUAL CHANNEL OPTION

WARNING

Read coolant and PCW SDS before handling. Wear protective gear listed in SDS when filling.

The coolant fill and start-up of the dual channel ThermoRack chillers is identical to starting up two individual chillers as per section 4.1 with one exception: The circuit breaker of Chiller #2 must be turned on first, followed by the circuit breaker of Chiller #1. Due to the EMO loop, Chiller #2 will not power up until Chiller #1 powers up. Turning on Chiller #1 first can result in a communications lock-up between the two Chillers. Should this occur, turn off the circuit breakers of both Chillers, wait at least 10 seconds, the turn on Chiller #2 first.

7.0 OTHER OPTIONS

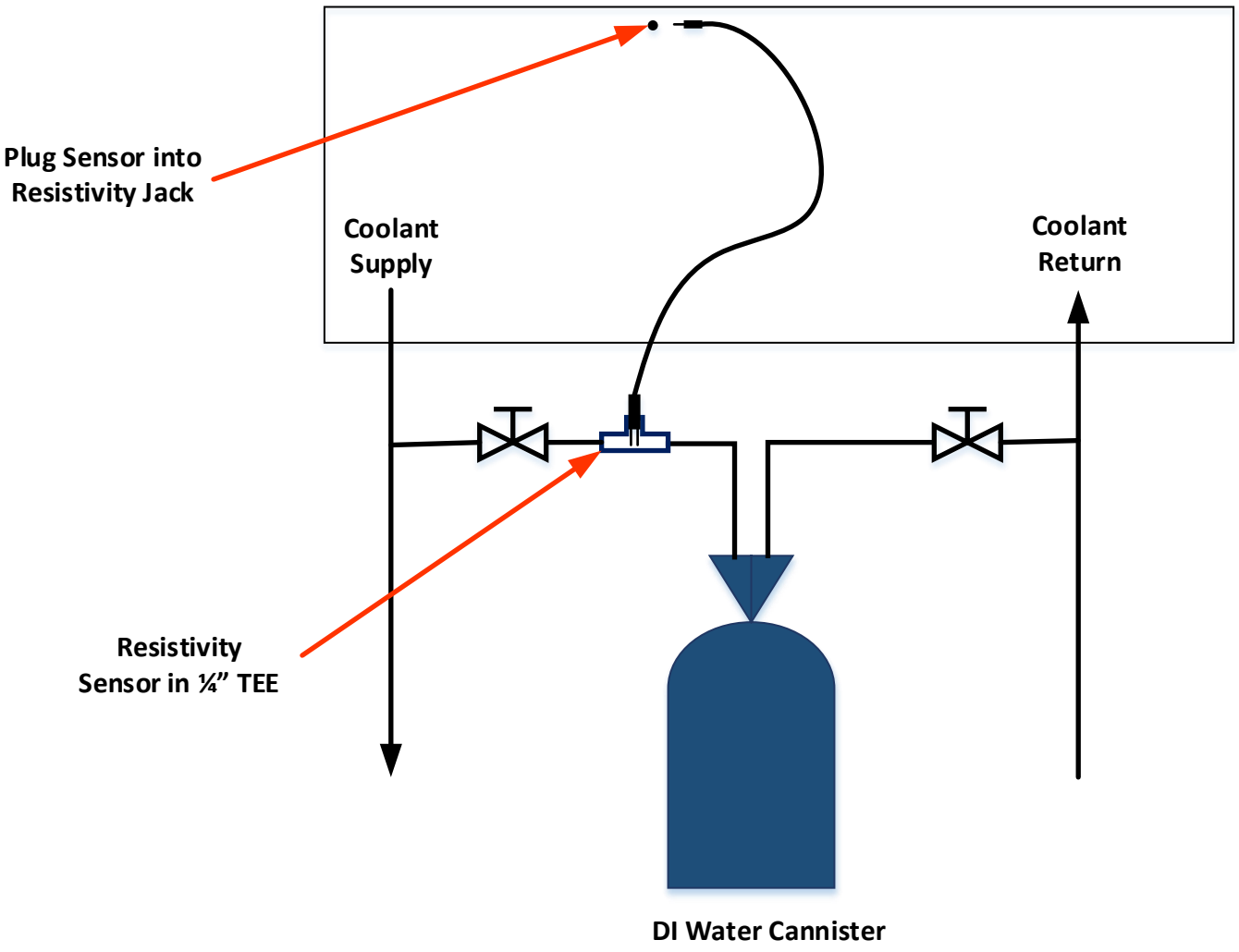
7.1 -1W DI WATER/ETHYLENE OR PROPYLENE GLYCOL COOLANT OPTION

When this option is chosen, SSCS will configure for and test the unit with water/glycol. The ThermoRack will not measure the coolant resistivity unless the –WS resistivity option is purchased.

7.2 -WS RESISTIVITY SENSOR OPTION

The –WS resistivity sensor option provides an external DI water resistivity sensor and two ¼" valved TEE's for plumbing the DI water canister in parallel to the ThermoRack 1201 coolant loop as shown in figure 10 below. This sensor will measure the DI water/Ethylene Glycol resistivity and signal a warning if the measured resistivity falls below 1 megohm-cm or if it reads above 20 megohm-cm.

Figure 10 DI Water Sensor Hook-up



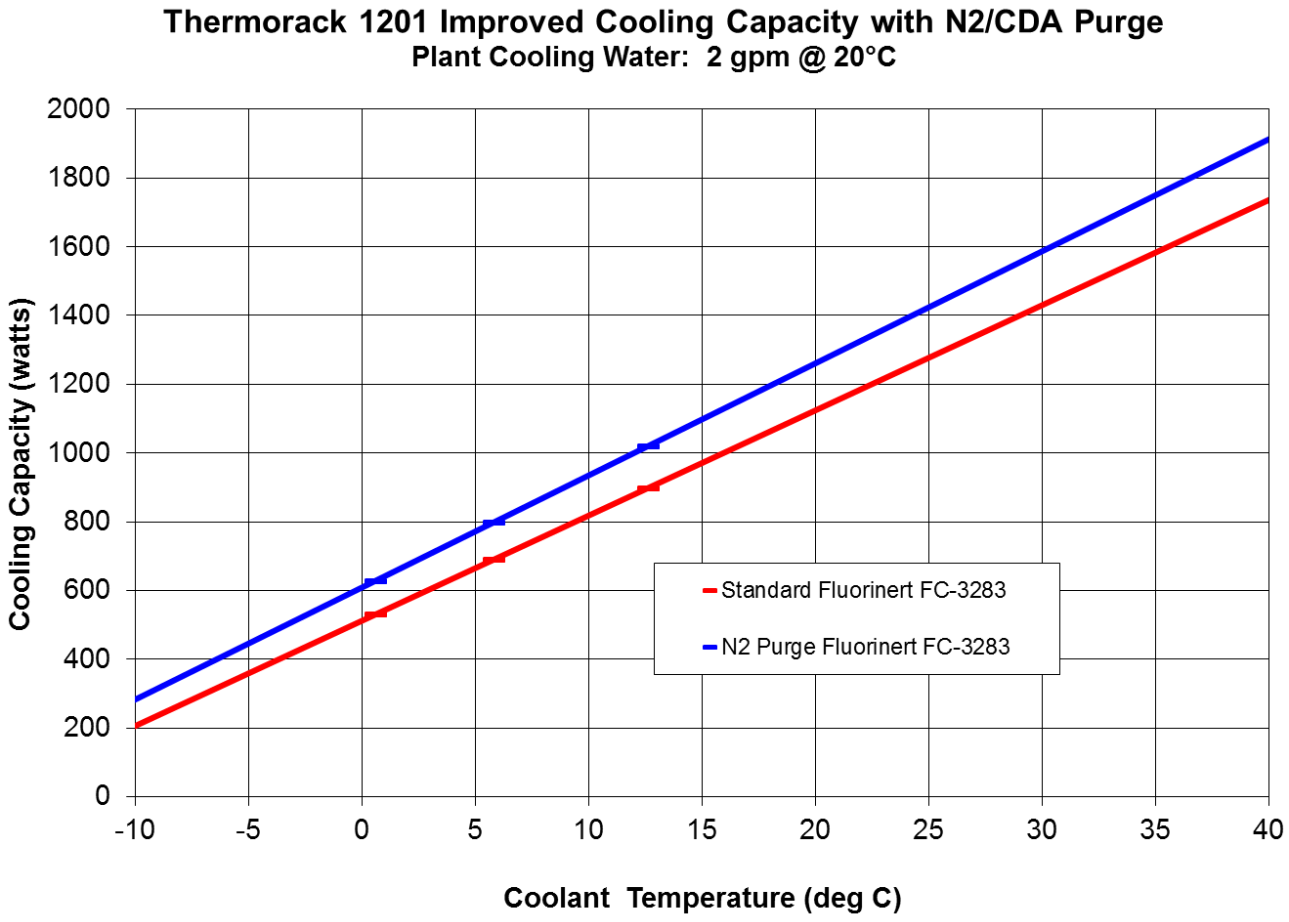
7.3 -1EG 100% ETHYLENE GLYCOL COOLANT OPTION

When this option is chosen, SSCS will configure for and test the unit with 100% Ethylene Glycol.

7.4 -N2 N2/CDA PURGE OPTION

This option purges the thermoelectric modules with nitrogen (N_2) or clean dry air (CDA). The dew point of the purge stream must be -30 °C or lower. This improves the ThermoRack 1201's low temperature cooling capacity by up to 25%, as shown in figure 11 below. A supply of 500 sccm of 30 psig nitrogen or CDA is required. A ¼" John Guest® Speed-fit connection is provided on the rear panel for this purge. Just push a ¼" O.D. N_2 or CDA tube into the fitting.

Figure 11



7.5 -RF FRONT RTD OPTION

This option moves the temperature control RTD from the ThermoRack coolant outlet to a location at the front of the ThermoRack, between the pump and thermoelectric heat exchanger. This alternative RTD location improves process control in some applications.

7.6 -LT LOW TEMPERATURE OPTION

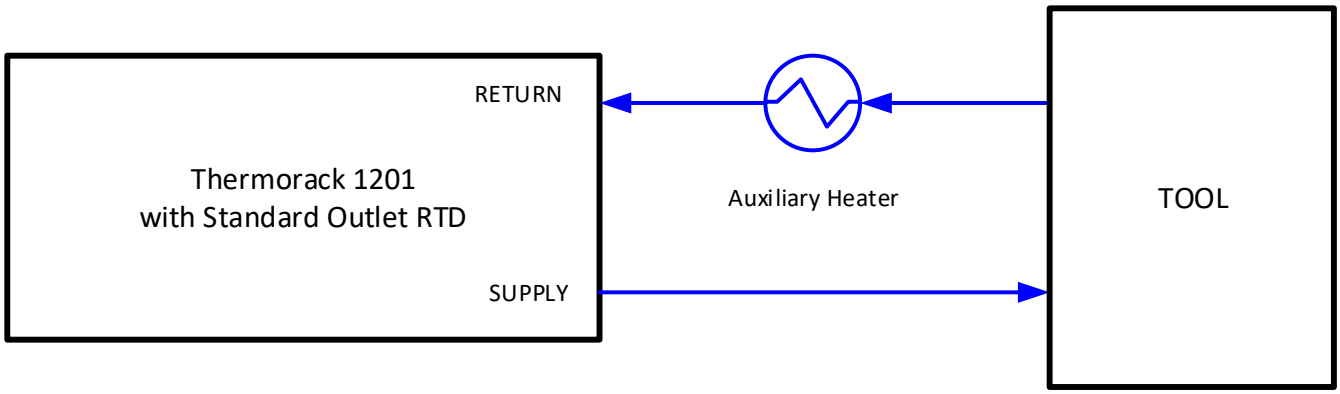
This option is required for any units operating below 0°C. With this option the pump is fully insulated with an added N2 fitting to prevent condensation and ice formation.

7.7 -HC AUXILIARY HEATER OPTION

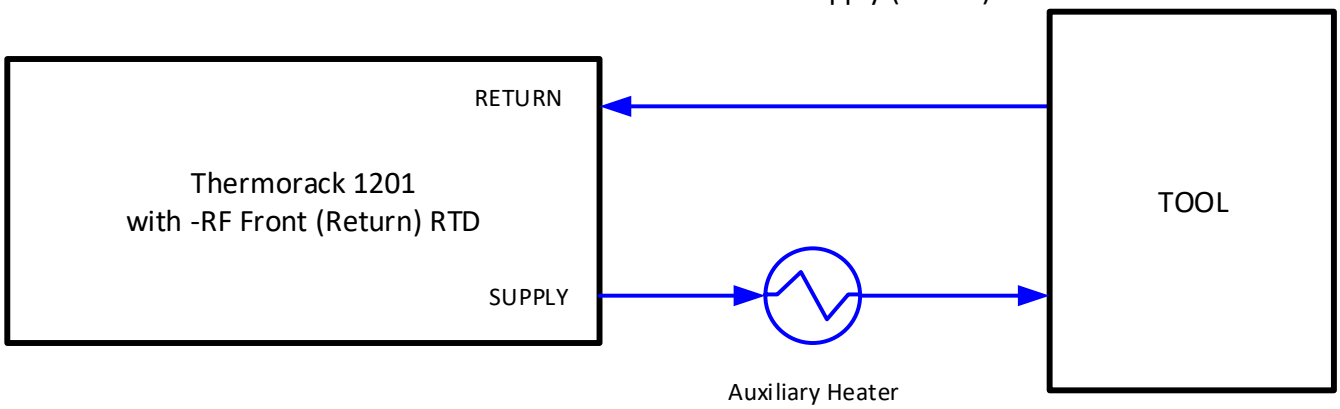
This option is recommended for process set points at or above 65°C. This option allows the ThermoRack 1201 to control a 1500 watt external heating unit, SSCS Part Number 10-14354-1, to boost the heating capacity of the ThermoRack 1201. This auxiliary heater is powered by a separate 200-240VAC power source and connects in series with the ThermoRack 1201 to boost the heating capacity of the ThermoRack 1201. This auxiliary heater is powered by a separate 200-240VAC power source and is plumbed in series with the ThermoRack 1201 as shown in figure 12 below depending upon the ThermoRack 1201 RTD location:

Figure 12 Optional Auxiliary Heater Plumbing

Thermorack 1201 with Standard Outlet RTD – Plumb Heater to Chiller Return



Thermorack 1201 with Front RTD -RF – Plumb Heater to Chiller Supply (Outlet)



8.0 SYSTEM ALARMS/TROUBLESHOOTING

The ThermoRack 1201 has two warnings and four system alarms that when triggered will show on the display. When an alarm is displayed the system will not attempt to heat or cool the coolant.

8.1 WARNINGS

Tank Low: Warning only. The front display will read Tank Low and the rear panel green Tank Level Ok light will go dark. The tank needs refilling at the earliest convenience. The ThermoRack 1201 coolant loop is a sealed system. A tank level low warning indicates the presence of a leak. See section 9.6 of this manual.

Resistivity Low/High: If the Resistivity Low or High warning is displayed and the -WS option has been purchased, then the DI water resistivity has fallen below the low or high limits. The factory default values are 1 megohm-cm on the low end and 20 megohm-cm on the high end. This indicates that the DI canisters are spent and require replacement (low) or a sensor fail/disconnection has occurred at the high end. If the ThermoRack does not include the DI option, then contact SSCS technical support.

Temp out of Range: (< or > Symbol at left edge of display): Warning only. The coolant temperature leaving the chiller is outside the maximum deviation range set in the parameter input menu.

8.2 ALARMS

DANGER

Always disconnect the AC power cord before opening the ThermoRack 1201 cover as electrical shock hazards exist

Tank Level Empty: The level of coolant in the tank has become so low that it endangers the operation of the coolant pump. The coolant pump and thermoelectric power is shut off.

RTD Open or RTD Fail: The temperature sensor has failed or its connector has come loose. Thermoelectric power is shut off.

Turn off the ThermoRack and disconnect the AC power cord. Open the cover and check if the 5-pin connector is firmly attached to the controller board located inside the front panel. If the connector is firmly attached, contact SSCS for a replacement RTD, or for an RMA number to return the unit for RTD replacement.

Water Flow Low: Facility cooling water flow is insufficient, causing the liquid heat exchanger plate cooling the thermoelectrics to become too hot or too cold. Thermoelectric power is shut off.

Pump Flow Low: The flow rate of coolant has dropped below the low flow limit set in the parameter menu. The coolant pump and thermoelectric power is shut off.

Coolant Flow Low: The pump flow low measurement detected a coolant flow below the user set minimum flow rate. (Factory Default is 1 gpm). The coolant pump and thermoelectric power are shut off.

Important:
The Tank Level Low, Resistivity Low, and Temp Out of Range warnings will automatically reset when corrected (see table 2). All other alarms will not clear until the system is power cycled via the circuit breaker.

8.3 OTHER PROBLEMS

Temperature Control Poor:
If no other alarms are present, poor temperature control indicates the heat load is too great for the chiller, the TE cooling/heating engine is not receiving power or has failed, or the PID constants have been corrupted. *Contact SSCS for technical support.*

9.0 SAFETY

9.1 HAZARDS

9.1.1 ELECTRICAL HAZARDS

DANGER

The ThermoRack 1201 operates on 200-240 VAC single power. As a result, it has hazardous voltage present inside its covers. Only qualified personnel should work on the unit with the covers removed.

9.1.2 CHEMICAL HAZARDS

WARNING

The ThermoRack 1201 contains no hazardous chemicals except for the coolant chosen by the customer. SDS's for coolants recommended by SSCS are included in section 12 of this manual. The user should thoroughly read the SDS of any coolant chosen prior to filling and operating the ThermoRack 1201. Only qualified personnel should handle coolants used in the ThermoRack 1201.

The user should contact SSCS prior to using any coolant not recommended in this manual.

9.1.3 SPILL HAZARDS

WARNING

The ThermoRack 1201's recommended coolants present a slip hazard if spilled on the floor. All coolant spills should be immediately wiped from the floor and disposed of in accordance with local and national regulations and the guidelines found in the coolant SDS's in section 12 of this manual.

9.2 LIFTING THE THERMORACK 1201

WARNING

The ThermoRack 1201 weighs 70lbs (32 kg) and is designed to be installed into a 19" EIA standard electronics rack. Two people are required for lifting the ThermoRack 1201 into this rack.

9.3 ELECTRICAL ENERGY ISOLATION

For installations requiring adherence to SEMI S2 guidelines, the customer must install a circuit breaker rated in accordance with local AJH (authorities having jurisdiction) and NEC requirements.

9.4 ELECTRICAL LOCK OUT/TAG OUT

9.4.1 LOCK OUT

DANGER

Lock out the main AC power via the following procedure:

1) Disconnect AC power by turning off the customer supplied electrical disconnect device (see section 9.3).
2) Unlatch the main AC power plug (on the rear panel) and remove the plug.
3) Place a safety padlock through the ThermoRack 1201's main AC power connector latch. AC power cannot be plugged into the ThermoRack AC power receptacle with the padlock in place.

9.4.2 TAG OUT

When locking out the main AC power receptacle, place a lockout tag through the main AC power connector latch to identify contact person/phone number. Never attach a lockout tag without first locking out the connector latch with a padlock.

9.5 ELECTRICAL DISCONNECT REQUIREMENTS

9.5.1-UNIT OUT OF SERVICE

When the ThermoRack 1201 is out of service, disconnect the main AC power via the customer installed circuit breaker described in manual section 9.3. SSCS recommends leaving the AC power cord connected unless the system's covers are to be removed.

9.5.2 MAINTENANCE

DANGER

When performing repairs or maintenance on the ThermoRack 1201 that require removing one or more of the system's covers, disconnect electrical power as follows:

1) Open the user installed main AC power circuit breaker described in section 9.3.
2) Disconnect the main AC power plug.
3) Lockout main AC power as per section 9.4.

9.6 LEAKS

9.6.1 COOLANT LEAKS

WARNING

Read coolant and PCW SDS before handling. Wear protective gear listed in SDS and follow local regulatory statues when disposing of coolants or PCW drained from the chiller

Two types of coolant leaks can occur when operating the ThermoRack 1201: internal and external leaks. Internally, the ThermoRack 1201 utilizes stainless steel plumbing with SAE-style o-ring sealed fittings to minimize the likelihood of leaks. Should a coolant leak occur, it should be immediately wiped up and properly disposed of as per sections 9.1.2 and 9.1.3 of this manual. The ThermoRack 1201 has an optional leak detection alarm that notifies the user and the tool being cooled that a leak has occurred, even a very small leak. The leak detect system can also be used to shut down the chiller, if desired. Contact SSCS for details.

The ThermoRack 1201 plumbing area chassis serves as secondary containment for the coolant tank and holds up to 2.5 gallons, or 180% of the 1.375 gallon tank volume. If the leak detection option is not chosen, the operator can use the Tank Level Low warning, which display's a warning on the front screen and notifies the etch tool controller via the tool interface card, to indicate the presence of a leak somewhere in the coolant loop. A Tank Level Low occurs when the coolant volume in the tank falls to 1.2 gallons, indicating a leak of up to 0.175 gallons (1.9 liters) has occurred. The chiller will continue to run normally when a Tank Level Low warning is present. If the leak continues without action from the operator, the next alarm is Tank Level Empty.
A Tank Level Empty alarm occurs when the tank level drops to 0.67 gallons, indicating a leak of up to 0.70 gallons. A Tank Level Empty alarm will shut down the ThermoRack 1201.

DANGER

Should a Tank Level Low warning or Tank Level Empty alarm occur, the operator should immediately check for leaks. If the coolant is a fluorinated heat transfer fluid, such as Fluorinert, Galden, or Novec, a halogen leak detector works well for finding leaks. For water based coolants, visual inspection must suffice. First check the external plumbing lines for leaks. If no leaks are found in the external plumbing, then the open the ThermoRack 1201's cover and inspect the plumbing section (on the left as viewed from the front. Only trained maintenance personnel should remove the cover as hazardous voltages are present inside. If coolant is found in the chassis, schedule maintenance on the chiller. Follow the safety guidelines in section 7.4. prior to performing maintenance.

9.6.2 PLANT COOLING WATER LEAKS

WARNING

Read coolant and PCW SDS before handling. Wear protective gear listed in SDS and follow local regulatory statues when disposing of coolants or PCW drained from the chiller

Two types of plant cooling water (PCW) leaks can occur when operating the ThermoRack 1201: internal and external leaks. Internally, the ThermoRack 1201 utilizes stainless steel plumbing with SAE-style o-ring sealed fittings to minimize the likelihood of leaks. Should a PCW leak occur, it may contain treatment chemicals and should be immediately wiped up as per sections 9.1.2 and 9.1.3 of this manual. The ThermoRack 1201 has an optional leak detection alarm that notifies the user and the tool being cooled that a leak has occurred, even a very small leak. The leak detect system can also be used to shut down the chiller, if desired. Contact SSCS for details. If this option is not chosen, the ThermoRack has no means of detecting PCW leaks. As a result, the leak will fill the ThermoRack 1201's secondary containment until the total volume reaches 2.5 gallons. Once the leak has reached 2.5 gallons, PCW will flow out of the ThermoRack onto the surrounding floor, creating a slip hazard.

The ThermoRack 1201's main circuit breaker does have a ground fault circuit interrupt feature. Should a water leak come in contact with electrically live components, this circuit breaker will disconnect the main AC power.

To identify the source of an internal PCW leak, first disconnect main AC power as per section 9.4.2 of this manual. (Leave the PCW flow on.) Open the ThermoRack 1201 cover and look for water. The only PCW plumbing line is located under the tank. If a leak is present, disconnect the PCW as per section 9.6 and return the ThermoRack 1201 to SSCS for repair.

External water leaks will also not be contained nor detected by the ThermoRack 1201.

9.7 DISCONNECTING PLANT COOLING WATER

Plant cooling water (PCW) is often under high pressures on both the supply and return sides, typically 100 psig (7 bar) on the supply side and 80 psig (5.5 bar) on the return side. As a result, maintenance personnel should take care in disconnecting (PCW) lines. SSCS recommends the use of single or double ended shut off valves on PCW lines for easy and safe disconnection of plant cooling water. See section 3.3 of this manual for details. If quick disconnect valves are not employed, then prior to disconnecting PCW lines from the chiller, the user must shut off and tag the factory's cooling water shut-off valves.

9.7.1 DISCONNECTING PLANT COOLING WATER USING DOUBLE-ENDED SHUT-OFF VALVES:

1) Unplug the supply side PCW quick-disconnect fitting.
2) Unplug the return side PCW quick disconnect fitting.

9.7.2 DISCONNECTING PLANT COOLING WATER USING SINGLE-ENDED SHUT-OFF VALVES:

1) Place a drip pan under the PCW quick-disconnect fittings.
2) Unplug the supply side PCW quick-disconnect fitting.
3) Unplug the return side PCW quick disconnect fitting.

9.7.3 DISCONNECTING PLANT COOLING WATER USING THE FACILITY'S SHUT-OFF VALVES:

1) Shut-off and tag the factory's plant cooling water valves to the chiller.
2) Place a drip pan under the PCW fittings at the rear of the chiller.
3) Using a 7/8" wrench, disconnect the supply side PCW Swagelok® fitting.
4) Using a 7/8" wrench, disconnect the return side PCW Swagelok® fitting.

Note: Since PCW may contain hazardous treatment chemicals, dispose of any spilled or drained PCW in accordance with sections 9.1.2 and 9.1.3 of this manual.

9.8 COOLANT DISPOSAL

Dispose of any coolants spilled or drained from the ThermoRack 1201 in accordance with national and local guidelines and the coolant's SDS found in section 11 of this manual.

9.9 SEISMIC PROTECTION

The ThermoRack 1201 may be anchored to seismically rated EIA standard electronics racks by placing support rails under the ThermoRack and clamping bars across the top.

For reference, the center of gravity of the ThermoRack 1201 is located as follows:
9.0 inches (228 mm) right from the left side
12.75 inches (324 mm) back from the front face
3.75 inches (95 mm) above the chassis base.

9.10 MINIMUM PERSONAL PROTECTIVE

9.10.1 MANUAL OPERATION EQUIPMENT

No personal protective equipment is required for normal operation of the ThermoRack 1201.

9.10.2 HANDLING COOLANT

WARNING

When filling the tank with coolant, the operator should wear the proper protective equipment recommended by the SDS of the coolant used. See section 12 of this manual.

9.10.3 PCW SPILLS

When handling PCW spills, always follow your factory spill handling procedures.

9.10.4 COOLANT SPILLS

WARNING

When handling coolant spills, the operator must wear the personal protective equipment recommended in the SDS of the coolant spilled. See section 12 of this manual.

10.0 TECHNICAL SUPPORT

Delighting our customers is our highest priority. Please contact us immediately for technical assistance whenever you have questions or concerns.
Hours: 8 a.m. to 5 p.m. E.S.T., weekdays
Telephone: (845) 296-1300, E-mail: info1@sscooling.com

11.0 SYSTEM SCHEMATICS

System and electrical schematics are available on request by sending an email to info1@sscooling.com or contacting Technical Support.

12.0 WARRANTY POLICY

This ThermoRack 1201 chiller is covered under a two-year parts and labor warranty. The length of a warranty is product-specific, depending on the type and planned usage of the product, but will be specified in the quotation upon which a purchase order is made. Prototypes are not covered under warrantee, but will be repaired/adjusted after original shipment until they meet the agreed-upon specifications.
Malfunctioning products should be returned to Solid State Cooling Systems by the method described below. Solid State Cooling Systems will provide a Failure Analysis Report to the customer and will determine if the problem is covered under the warranty.

Warranty Coverage:

Products with defects in components or manufacturing which are reported to Solid State Cooling Systems before the end of the warranty period will be repaired or replaced at no cost (see below for reporting requirements). The warranty period begins on the date the product was initially shipped from Solid State Cooling System's factory.

Excluded from Warranty:

Excluded from warranty is any damage caused to the product occurring during, but not limited to, such events as shipment, installation, storage, or usage occurring during a situation specifically cautioned against or noted in the product manual.

Specific situations, which invalidate the warranty, include (but are not limited to):

- Removing the serial number label.
- Any disassembly (partial or complete) of a heat exchanger, which includes removing the tape on the sides, loosening or removing the bolts, or separating the heat sinks.
- Subjecting a heat exchanger to temperatures below the freezing point of the heat transfer fluid contained inside the unit.
- Subjecting a heat exchanger to unfiltered water.
- Subjecting any product to temperature, voltage, current, or pressure (internal or external) greater than that specified in the product manual.
- Any actions prohibited in the "Caution" section of the product manual.

Returned Goods Procedure and Reporting Requirements

Before a failed product is returned to the factory, a Returned Materials Authorization (RMA) number must be obtained from Customer Service at (845) 296-1300. The date the RMA is requested will be the reporting date noted and relevant to the warranty. Products, which have received an RMA, must be received at Solid State Cooling System's factory within 30 days or the reporting date will be moved ahead 30 days and a new 30-day waiting period will begin.
All out of warranty returned goods will require a $450 evaluation purchase order prior to receipt at SSCS. The evaluation costs will be deducted from the cost of any repairs required.

13.0 SAFETY DATA SHEETS

13.1 3M™ FLUORINERT™ FC-3283 ELECTRONIC LIQUID SDS

SAFETY DATA SHEET

Copyright,2018,3M Company.
All rights reserved. Copying and/or downloading of this information for the purpose of properly utilizing 3M products is allowed provided that: (1) the information is copied in full with no changes unless prior written agreement is obtained from 3M, and (2) neither the copy nor the original is resold or otherwise distributed with the intention of earning a profit thereon.

Document Group:	06-4521-8	**Version Number:**	31.06
Issue Date:	01/18/18	**Supercedes Date:**	06/26/17

SECTION 1: Identification

1.1. Product identifier
3M™ Fluorinert™ FC-3283 Electronic Liquid

Product Identification Numbers

ID Number	UPC	ID Number	UPC
98-0212-2908-7	00-51135-70349-6	98-0212-4878-0	000 51138 99254 5
98-0212-4879-8	000 51138 99255 2	98-0212-4880-6	000 51138 99256 9
HB-0042-0654-4		ZF-0002-1344-5	
ZF-0002-1345-2		ZF-0002-1356-9	

1.2. Recommended use and restrictions on use

Recommended use
For Industrial Use Only. Not Intended for Use as a Medical Device or Drug., Testing Fluid or Heat Transfer Fluid for Electronics
Restrictions on use
Fluorinert™ Electronic Liquids are used in a wide variety of applications, including but not limited to precision cleaning of medical devices and as lubricant deposition solvents for medical devices. When the product is used for applications where the finished device is implanted into the human body, no residual Fluorinert solvent may remain on the parts. It is highly recommended that the supporting test results and protocol be cited during FDA registration.

3M Electronics Markets Materials Division (EMMD) will not knowingly sample, support, or sell its products for incorporation in medical and pharmaceutical products and applications in which the 3M product will be temporarily or permanently implanted into humans or animals. The customer is responsible for evaluating and determining that a 3M EMMD product is suitable and appropriate for its particular use and intended application. The conditions of evaluation, selection, and use of a 3M product can vary widely and affect the use and intended application of a 3M product. Because many of these conditions are uniquely within the user's knowledge and control, it is essential that the user evaluate and determine whether the 3M product is suitable and appropriate for a particular use and intended application, and complies with all local applicable laws, regulations, standards, and guidance.

1.3. Supplier's details

MANUFACTURER:	3M
DIVISION:	Electronics Materials Solutions Division
ADDRESS:	3M Center, St. Paul, MN 55144-1000, USA
Telephone:	1-888-3M HELPS (1-888-364-3577)

1.4. Emergency telephone number: 1-800-364-3577 or (651) 737-6501 (24 hours)

SECTION 2: Hazard identification

2.1. Hazard classification
Not classified as hazardous according to OSHA Hazard Communication Standard, 29 CFR 1910.1200.

2.2. Label elements
Signal word
Not applicable.

Symbols
Not applicable.

Pictograms
Not applicable.

SECTION 3: Composition/information on ingredients

Ingredient	C.A.S. No.	% by Wt
PERFLUORO COMPOUNDS, C5-18	86508-42-1	100 (typically 100)

SECTION 4: First aid measures

4.1. Description of first aid measures

Inhalation:
No need for first aid is anticipated.

Skin Contact:
Wash with soap and water. If signs/symptoms develop, get medical attention.

Eye Contact:
Flush with large amounts of water. Remove contact lenses if easy to do. Continue rinsing. If signs/symptoms persist, get medical attention.

If Swallowed:
Rinse mouth. If you feel unwell, get medical attention.

4.2. Most important symptoms and effects, both acute and delayed
See Section 11.1. Information on toxicological effects.

4.3. Indication of any immediate medical attention and special treatment required
Not applicable

SECTION 5: Fire-fighting measures

5.1. Suitable extinguishing media
Material will not burn. Use a fire fighting agent suitable for the surrounding fire.

5.2. Special hazards arising from the substance or mixture
Exposure to extreme heat can give rise to thermal decomposition.

Hazardous Decomposition or By-Products

Substance	Condition
Carbon monoxide	During Combustion
Carbon dioxide	During Combustion

5.3. Special protective actions for fire-fighters
When fire fighting conditions are severe and total thermal decomposition of the product is possible, wear full protective clothing, including helmet, self-contained, positive pressure or pressure demand breathing apparatus, bunker coat and pants, bands around arms, waist and legs, face mask, and protective covering for exposed areas of the head.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures
Evacuate area. Ventilate the area with fresh air. For large spill, or spills in confined spaces, provide mechanical ventilation to disperse or exhaust vapors, in accordance with good industrial hygiene practice. Refer to other sections of this SDS for information regarding physical and health hazards, respiratory protection, ventilation, and personal protective equipment.

6.2. Environmental precautions
Avoid release to the environment. For larger spills, cover drains and build dikes to prevent entry into sewer systems or bodies of water.

6.3. Methods and material for containment and cleaning up
Contain spill. Working from around the edges of the spill inward, cover with bentonite, vermiculite, or commercially available inorganic absorbent material. Mix in sufficient absorbent until it appears dry. Remember, adding an absorbent material does not remove a physical, health, or environmental hazard. Collect as much of the spilled material as possible. Place in a closed container approved for transportation by appropriate authorities. Clean up residue with an appropriate solvent selected by a qualified and authorized person. Ventilate the area with fresh air. Read and follow safety precautions on the solvent label and SDS. Seal the container. Dispose of collected material as soon as possible in accordance with applicable local/regional/national/international regulations.

SECTION 7: Handling and storage

7.1. Precautions for safe handling
Do not breathe thermal decomposition products. Avoid skin contact with hot material. For industrial or professional use only. Store work clothes separately from other clothing, food and tobacco products. Do not eat, drink or smoke when using this product. Wash thoroughly after handling. Avoid release to the environment. No smoking: Smoking while using this product can result in contamination of the tobacco and/or smoke and lead to the formation of hazardous decomposition products.

7.2. Conditions for safe storage including any incompatibilities
Store away from heat.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational exposure limits
No occupational exposure limit values exist for any of the components listed in Section 3 of this SDS.

8.2. Exposure controls

8.2.1. Engineering controls
Provide appropriate local exhaust when product is heated.

8.2.2. Personal protective equipment (PPE)

Eye/face protection
None required.

Skin/hand protection

Select and use gloves and/or protective clothing approved to relevant local standards to prevent skin contact based on the results of an exposure assessment. Selection should be based on use factors such as exposure levels, concentration of the substance or mixture, frequency and duration, physical challenges such as temperature extremes, and other use conditions. Consult with your glove and/or protective clothing manufacturer for selection of appropriate compatible gloves/protective clothing. Note: Nitrile gloves may be worn over polymer laminate gloves to improve dexterity. Gloves made from the following material(s) are recommended: Polymer laminate

Respiratory protection

During heating:

Use a positive pressure supplied-air respirator if there is a potential for over exposure from an uncontrolled release, exposure levels are not known, or under any other circumstances where air-purifying respirators may not provide adequate protection.

Thermal hazards

Wear heat insulating gloves when handling hot material to prevent thermal burns.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

General Physical Form:	Liquid
Specific Physical Form:	Liquid
Odor, Color, Grade:	Colorless, odorless liquid.
Odor threshold	*No Data Available*
pH	*Not Applicable*
Melting point	*Not Applicable*
Boiling Point	123 - 133 ºC
Flash Point	No flash point
Evaporation rate	< 1 [*Ref Std:*BUOAC=1]
Flammability (solid, gas)	Not Applicable
Flammable Limits(LEL)	None detected
Flammable Limits(UEL)	None detected
Vapor Pressure	14 mmHg [@ 23 ºC]
Vapor Density	18 [@ 23 ºC] [*Ref Std:*AIR=1]
Density	1.8 g/ml
Specific Gravity	1.8 [*Ref Std:*WATER=1]
Solubility in Water	Nil
Solubility- non-water	*No Data Available*
Partition coefficient: n-octanol/ water	*No Data Available*
Autoignition temperature	*No Data Available*
Decomposition temperature	*Not Applicable*
Viscosity	0.7 centistoke [@ 25 ºC]
Molecular weight	*No Data Available*
Volatile Organic Compounds	[*Details:*Exempt]
Percent volatile	100 %
VOC Less H2O & Exempt Solvents	[*Details:*Exempt]

SECTION 10: Stability and reactivity

10.1. Reactivity

This material may be reactive with certain agents under certain conditions - see the remaining headings in this section.

10.2. Chemical stability

Stable.

10.3. Possibility of hazardous reactions
Hazardous polymerization will not occur.

10.4. Conditions to avoid
Heat

10.5. Incompatible materials
Finely divided active metals
Alkali and alkaline earth metals

10.6. Hazardous decomposition products

Substance	Condition
Hydrogen Fluoride	At Elevated Temperatures - greater than 200 ºC
Perfluoroisobutylene (PFIB)	At Elevated Temperatures - greater than 200 ºC

Refer to section 5.2 for hazardous decomposition products during combustion.

If the product is exposed to extreme condition of heat from misuse or equipment failure, toxic decomposition products that include hydrogen fluoride and perfluoroisobutylene can occur.

SECTION 11: Toxicological information

The information below may not be consistent with the material classification in Section 2 if specific ingredient classifications are mandated by a competent authority. In addition, toxicological data on ingredients may not be reflected in the material classification and/or the signs and symptoms of exposure, because an ingredient may be present below the threshold for labeling, an ingredient may not be available for exposure, or the data may not be relevant to the material as a whole.

11.1. Information on Toxicological effects

Signs and Symptoms of Exposure

Based on test data and/or information on the components, this material may produce the following health effects:

Inhalation:
No known health effects.

Skin Contact:
Contact with the skin during product use is not expected to result in significant irritation.

Eye Contact:
Contact with the eyes during product use is not expected to result in significant irritation.
Ingestion:

Ingestion:
May be harmful if swallowed.

Additional Information:
A Material Toxicity Summary Sheet (MTSS) has been developed for this product. Please contact the address listed on the first page of this SDS to obtain a copy of the MTSS for this product.

Toxicological Data
If a component is disclosed in section 3 but does not appear in a table below, either no data are available for that endpoint or the data are not sufficient for classification.

Acute Toxicity

Name	Route	Species	Value
PERFLUORO COMPOUNDS, C5-18	Dermal		LD50 estimated to be > 5,000 mg/kg
PERFLUORO COMPOUNDS, C5-18	Inhalation-Vapor (4 hours)	Rat	LC50 > 41 mg/l
PERFLUORO COMPOUNDS, C5-18	Ingestion	Rat	

ATE = acute toxicity estimate

Skin Corrosion/Irritation

Name	Species	Value
PERFLUORO COMPOUNDS, C5-18	Rabbit	No significant irritation

Serious Eye Damage/Irritation

Name	Species	Value
PERFLUORO COMPOUNDS, C5-18	Rabbit	No significant irritation

Skin Sensitization

For the component/components, either no data are currently available or the data are not sufficient for classification.

Respiratory Sensitization

For the component/components, either no data are currently available or the data are not sufficient for classification.

Germ Cell Mutagenicity

Name	Species	Value
PERFLUORO COMPOUNDS, C5-18	In Vitro	Not mutagenic

Carcinogenicity

For the component/components, either no data are currently available or the data are not sufficient for classification.

Reproductive Toxicity

Reproductive and/or Developmental Effects

For the component/components, either no data are currently available or the data are not sufficient for classification.

Target Organ(s)

Specific Target Organ Toxicity - single exposure

For the component/components, either no data are currently available or the data are not sufficient for classification.

Specific Target Organ Toxicity - repeated exposure

Name	Route	Target Organ(s)	Value	Species	Test Result	Exposure Duration
PERFLUORO	Inhalation	heart | endocrine	Not classified	Rat	NOAEL	13 weeks
COMPOUNDS, C5-18		system | bone, teeth, nails, and/or hair | hematopoietic system | liver | immune system | nervous system | eyes | kidney and/or bladder | respiratory system			49,821 ppm	
PERFLUORO COMPOUNDS, C5-18	Ingestion	heart | endocrine system | hematopoietic system | liver | nervous system | kidney and/or bladder | respiratory system	Not classified		NOAEL 2,000 mg/kg/day	28 days

Aspiration Hazard

For the component/components, either no data are currently available or the data are not sufficient for classification.

Please contact the address or phone number listed on the first page of the SDS for additional toxicological information on this material and/or its components.

SECTION 12: Ecological information

Ecotoxicological information
Please contact the address or phone number listed on the first page of the SDS for additional ecotoxicological information on this material and/or its components.

Chemical fate information
Please contact the address or phone number listed on the first page of the SDS for additional chemical fate information on this material and/or its components.

SECTION 13: Disposal considerations

13.1. Disposal methods
Dispose of contents/ container in accordance with the local/regional/national/international regulations.

Dispose of waste product in a permitted industrial waste facility. Combustion products will include HF. Facility must be capable of handling halogenated materials. Empty drums/barrels/containers used for transporting and handling hazardous chemicals (chemical substances/mixtures/preparations classified as Hazardous as per applicable regulations) shall be considered, stored, treated & disposed of as hazardous wastes unless otherwise defined by applicable waste regulations. Consult with the respective regulating authorities to determine the available treatment and disposal facilities.

EPA Hazardous Waste Number (RCRA): Not regulated

SECTION 14: Transport Information

Not regulated per U.S. DOT, IATA or IMO.

These transportation classifications are provided as a customer service. As the shipper YOU remain responsible for complying with all applicable laws and regulations, including proper transportation classification and packaging. 3M transportation classifications are based on product formulation, packaging, 3M policies and 3M understanding of applicable current regulations. 3M does not guarantee the accuracy of this classification information. This information applies only to transportation classification and not the packaging, labeling, or marking requirements. The original 3M package is certified for U.S. ground shipment only. If you are shipping by air or ocean, the package may not meet applicable regulatory requirements.

SECTION 15: Regulatory Information

15.1. US Federal Regulations
Contact 3M for more information.

Physical Hazards
Not applicable

Health Hazards
Not applicable

15.2. State Regulations
Contact 3M for more information.

15.3. Chemical Inventories

The components of this material are in compliance with the provisions of Australia National Industrial Chemical Notification and Assessment Scheme (NICNAS). Certain restrictions may apply. Contact the selling division for additional information.

The components of this product are in compliance with the new substance notification requirements of CEPA.

The components of this material are in compliance with the China "Measures on Environmental Management of New Chemical Substance". Certain restrictions may apply. Contact the selling division for additional information.

The components of this material are in compliance with the provisions of the Korean Toxic Chemical Control Law. Certain restrictions may apply. Contact the selling division for additional information.

The components of this material are in compliance with the provisions of Japan Chemical Substance Control Law. Certain restrictions may apply. Contact the selling division for additional information.

The components of this material are in compliance with the provisions of Philippines RA 6969 requirements. Certain restrictions may apply. Contact the selling division for additional information.

The components of this product are in compliance with the chemical notification requirements of TSCA.

Contact 3M for more information.

15.4. International Regulations
Contact 3M for more information.

This SDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: Other Information

NFPA Hazard Classification
Health: 3 **Flammability:** 0 **Instability:** 0 **Special Hazards:** None

National Fire Protection Association (NFPA) hazard ratings are designed for use by emergency response personnel to address the hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. Hazard ratings are primarily based on the inherent physical and toxic properties of the material but also include the toxic properties of combustion or decomposition products that are known to be generated in significant quantities.

HMIS Hazard Classification
Health: 0 **Flammability:** 0 **Physical Hazard:** 0 **Personal Protection:** X - See PPE section.

Hazardous Material Identification System (HMIS® IV) hazard ratings are designed to inform employees of chemical hazards in the workplace. These ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS® IV ratings are to be used with a fully implemented HMIS® IV program. HMIS® is a registered mark of the American Coatings Association (ACA).

Document Group:	06-4521-8	**Version Number:**	31.06
Issue Date:	01/18/18	**Supercedes Date:**	06/26/17

Reason for Reissue
Conversion to GHS format SDS.

DISCLAIMER: The information in this Safety Data Sheet (SDS) is believed to be correct as of the date issued.3MMAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR COURSE OF PERFORMANCE OR USAGE OF TRADE. User is responsible for determining whether the3Mproduct is fit for a particular purpose and suitable for user's method of use or application. Given the variety of factors that can affect the use and application of a3Mproduct, some of which are uniquely within the user's knowledge and control, it is essential that the user evaluate the3Mproduct to determine whether it is fit for a particular purpose and suitable for user's method of use or application.

3M provides information in electronic form as a service to its customers. Due to the remote possibility that electronic transfer may have resulted in errors, omissions or alterations in this information,3Mmakes no representations as to its completeness or accuracy. In addition, information obtained from a database may not be as current as the information in the SDS available directly from 3M

3M USA SDSs are available at www.3M.com

End of SDS

13.2 3M™ NOVEC™ 7100 ENGINEERED FLUID SDS

SAFETY DATA SHEET

Copyright,2018,3M Company.
All rights reserved. Copying and/or downloading of this information for the purpose of properly utilizing 3M products is allowed provided that: (1) the information is copied in full with no changes unless prior written agreement is obtained from 3M, and (2) neither the copy nor the original is resold or otherwise distributed with the intention of earning a profit thereon.

Document Group:	07-6378-9	**Version Number:**	69.03
Issue Date:	01/18/18	**Supercedes Date:**	09/06/16

SECTION 1: Identification

1.1. Product identifier
3M™ Novec™ 7100 Engineered Fluid

Product Identification Numbers

ID Number	UPC	ID Number	UPC
98-0211-8940-6	00-51135-11037-9	98-0211-8941-4	00-51135-11038-6
98-0211-8946-3	00-51135-11043-0	98-0212-1011-1	00-51135-45035-2
98-0212-1102-8	00-51135-45124-3	98-0212-1128-3	00-51135-45146-5
98-0212-1148-1	00-51135-63012-9	98-0212-3554-8	
98-0212-3635-5			

1.2. Recommended use and restrictions on use

Recommended use
For Industrial Use Only. Not Intended for Use as a Medical Device or Drug.,

Restrictions on use
Novec™ Engineered Fluids are used in a wide variety of applications, including but not limited to precision cleaning of medical devices and as lubricant deposition solvents for medical devices. When the product is used for applications where the finished device is implanted into the human body, no residual Novec solvent may remain on the parts. It is highly recommended that the supporting test results and protocol be cited during FDA registration.

3M Electronics Markets Materials Division (EMMD) will not knowingly sample, support, or sell its products for incorporation in medical and pharmaceutical products and applications in which the 3M product will be temporarily or permanently implanted into humans or animals. The customer is responsible for evaluating and determining that a 3M EMMD product is suitable and appropriate for its particular use and intended application. The conditions of evaluation, selection, and use of a 3M product can vary widely and affect the use and intended application of a 3M product. Because many of these conditions are uniquely within the user's knowledge and control, it is essential that the user evaluate and determine whether the 3M product is suitable and appropriate for a particular use and intended application, and complies with all local applicable laws, regulations, standards, and guidance.

1.3. Supplier's details

MANUFACTURER:	3M
DIVISION:	Electronics Materials Solutions Division
ADDRESS:	3M Center, St. Paul, MN 55144-1000, USA
Telephone:	1-888-3M HELPS (1-888-364-3577)

1.4. Emergency telephone number: 1-800-364-3577 or (651) 737-6501 (24 hours)

SECTION 2: Hazard identification

2.1. Hazard classification
Not classified as hazardous according to OSHA Hazard Communication Standard, 29 CFR 1910.1200.

2.2. Label elements
Signal word
Not applicable.

Symbols
Not applicable.

Pictograms
Not applicable.

SECTION 3: Composition/information on ingredients

Ingredient	C.A.S. No.	% by Wt
Methyl nonafluorobutyl ether	163702-07-6	20 - 80
Methyl nonafluoroisobutyl ether	163702-08-7	20 - 80

SECTION 4: First aid measures

4.1. Description of first aid measures

Inhalation:
Remove person to fresh air. If you feel unwell, get medical attention.

Skin Contact:
Wash with soap and water. If signs/symptoms develop, get medical attention.

Eye Contact:
Flush with large amounts of water. Remove contact lenses if easy to do. Continue rinsing. If signs/symptoms persist, get medical attention.

If Swallowed:
Rinse mouth. If you feel unwell, get medical attention.

4.2. Most important symptoms and effects, both acute and delayed
See Section 11.1. Information on toxicological effects.

4.3. Indication of any immediate medical attention and special treatment required
Not applicable

SECTION 5: Fire-fighting measures

5.1. Suitable extinguishing media
Non-combustible. Use a fire fighting agent suitable for surrounding fire.

5.2. Special hazards arising from the substance or mixture
Exposure to extreme heat can give rise to thermal decomposition.

Hazardous Decomposition or By-Products

Substance	Condition
Carbon monoxide	During Combustion
Carbon dioxide	During Combustion
Hydrogen Fluoride	During Composition - at elevated temperatures

5.3. Special protective actions for fire-fighters
When fire fighting conditions are severe and total thermal decomposition of the product is possible, wear full protective clothing, including helmet, self-contained, positive pressure or pressure demand breathing apparatus, bunker coat and pants, bands around arms, waist and legs, face mask, and protective covering for exposed areas of the head.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures
Ventilate the area with fresh air. For large spill, or spills in confined spaces, provide mechanical ventilation to disperse or exhaust vapors, in accordance with good industrial hygiene practice. Refer to other sections of this SDS for information regarding physical and health hazards, respiratory protection, ventilation, and personal protective equipment.

6.2. Environmental precautions
Avoid release to the environment. For larger spills, cover drains and build dikes to prevent entry into sewer systems or bodies of water.

6.3. Methods and material for containment and cleaning up
Contain spill. Working from around the edges of the spill inward, cover with bentonite, vermiculite, or commercially available inorganic absorbent material. Mix in sufficient absorbent until it appears dry. Remember, adding an absorbent material does not remove a physical, health, or environmental hazard. Collect as much of the spilled material as possible. Place in a closed container approved for transportation by appropriate authorities. Clean up residue with an appropriate solvent selected by a qualified and authorized person. Ventilate the area with fresh air. Read and follow safety precautions on the solvent label and SDS. Seal the container. Dispose of collected material as soon as possible in accordance with applicable local/regional/national/international regulations.

SECTION 7: Handling and storage

7.1. Precautions for safe handling
Do not breathe thermal decomposition products. Avoid skin contact with hot material. For industrial or professional use only. Store work clothes separately from other clothing, food and tobacco products. Avoid release to the environment. Avoid contact with oxidizing agents (eg. chlorine, chromic acid etc.) No smoking: Smoking while using this product can result in contamination of the tobacco and/or smoke and lead to the formation of hazardous decomposition products.

7.2. Conditions for safe storage including any incompatibilities
Keep container tightly closed. Store away from heat. Store away from acids. Store away from strong bases. Store away from oxidizing agents.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational exposure limits
If a component is disclosed in section 3 but does not appear in the table below, an occupational exposure limit is not available for the component.

Ingredient	C.A.S. No.	Agency	Limit Type	Additional Comments
Methyl nonafluorobutyl ether	163702-07-6	AIHA	TWA: 750 ppm	
Methyl nonafluoroisobutyl ether	163702-08-7	AIHA	TWA: 750 ppm	

ACGIH : American Conference of Governmental Industrial Hygienists
AIHA : American Industrial Hygiene Association
CMRG : Chemical Manufacturer's Recommended Guidelines
OSHA : United States Department of Labor - Occupational Safety and Health Administration
TWA: Time-Weighted-Average
STEL: Short Term Exposure Limit
CEIL: Ceiling

8.2. Exposure controls

8.2.1. Engineering controls
Provide appropriate local exhaust when product is heated. Use general dilution ventilation and/or local exhaust ventilation to control airborne exposures to below relevant Exposure Limits and/or control dust/fume/gas/mist/vapors/spray. If ventilation is not adequate, use respiratory protection equipment.

8.2.2. Personal protective equipment (PPE)

Eye/face protection
Select and use eye/face protection to prevent contact based on the results of an exposure assessment. The following eye/face protection(s) are recommended:
Safety Glasses with side shields

Skin/hand protection
No chemical protective gloves are required.

Respiratory protection

During heating:

Use a positive pressure supplied-air respirator if there is a potential for over exposure from an uncontrolled release, exposure levels are not known, or under any other circumstances where air-purifying respirators may not provide adequate protection.

Thermal hazards
Wear heat insulating gloves when handling hot material to prevent thermal burns.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

General Physical Form:	Liquid
Specific Physical Form:	Liquid
Odor, Color, Grade:	Clear colorless, odorless liquid with slight ether odor
Odor threshold	*No Data Available*
pH	*Not Applicable*
Melting point	-135 ºC
Boiling Point	61 ºC [@ 760 mmHg]
Flash Point	No flash point
Evaporation rate	49 [*Ref Std:*BUOAC=1]
Flammability (solid, gas)	Not Applicable
Flammable Limits(LEL)	None detected
Flammable Limits(UEL)	None detected
Vapor Pressure	202 mmHg [@ 25 ºC]
Vapor Density	8.6 [*Ref Std:*AIR=1]
Density	1.5 g/ml
Specific Gravity	1.5 [*Ref Std:*WATER=1]
Solubility in Water	, 12 ppm
Solubility- non-water	*No Data Available*
Partition coefficient: n-octanol/ water	3.9 [*Details*:30 °C]
Autoignition temperature	405 ºC [*Details*:(ASTM E659-84)]
Decomposition temperature	*Not Applicable*
Viscosity	0.6 centistoke [@ 23 ºC]
Molecular weight	*No Data Available*
Percent volatile	100 %

SECTION 10: Stability and reactivity

10.1. Reactivity
This material may be reactive with certain agents under certain conditions - see the remaining headings in this section.

10.2. Chemical stability
Stable.

10.3. Possibility of hazardous reactions
Hazardous polymerization will not occur.

10.4. Conditions to avoid
None known.

10.5. Incompatible materials
Strong acids
Strong bases
Strong oxidizing agents

10.6. Hazardous decomposition products

Substance	**Condition**
Perfluoroisobutylene (PFIB)	At Elevated Temperatures - extreme conditions of heat
Toxic Vapor, Gas, Particulate	At Elevated Temperatures - extreme conditions of heat

Refer to section 5.2 for hazardous decomposition products during combustion.

If the product is exposed to extreme condition of heat from misuse or equipment failure, toxic decomposition products that include hydrogen fluoride and perfluoroisobutylene can occur.

SECTION 11: Toxicological information

The information below may not be consistent with the material classification in Section 2 if specific ingredient classifications are mandated by a competent authority. In addition, toxicological data on ingredients may not be reflected in the material classification and/or the signs and symptoms of exposure, because an ingredient may be

present below the threshold for labeling, an ingredient may not be available for exposure, or the data may not be relevant to the material as a whole.

11.1. Information on Toxicological effects

Signs and Symptoms of Exposure

Based on test data and/or information on the components, this material may produce the following health effects:

Inhalation:
No known health effects.

Skin Contact:
Contact with the skin during product use is not expected to result in significant irritation.

Eye Contact:
Contact with the eyes during product use is not expected to result in significant irritation.
Ingestion:

Ingestion:
No known health effects.

Toxicological Data
If a component is disclosed in section 3 but does not appear in a table below, either no data are available for that endpoint or the data are not sufficient for classification.

Acute Toxicity

Name	Route	Species	Value
Methyl nonafluoroisobutyl ether	Dermal		LD50 estimated to be > 5,000 mg/kg
Methyl nonafluoroisobutyl ether	Inhalation-Vapor (4 hours)	Rat	LC50 > 1,000 mg/l
Methyl nonafluoroisobutyl ether	Ingestion	Rat	LD50 > 5,000 mg/kg
Methyl nonafluorobutyl ether	Dermal		LD50 estimated to be > 5,000 mg/kg
Methyl nonafluorobutyl ether	Inhalation-Vapor (4 hours)	Rat	LC50 > 1,000 mg/l
Methyl nonafluorobutyl ether	Ingestion	Rat	LD50 > 5,000 mg/kg

ATE = acute toxicity estimate

Skin Corrosion/Irritation

Name	Species	Value
Methyl nonafluoroisobutyl ether	Rabbit	No significant irritation
Methyl nonafluorobutyl ether	Rabbit	No significant irritation

Serious Eye Damage/Irritation

Name	Species	Value
Methyl nonafluoroisobutyl ether	Rabbit	No significant irritation
Methyl nonafluorobutyl ether	Rabbit	No significant irritation

Skin Sensitization

Name	Species	Value
Methyl nonafluoroisobutyl ether	Guinea Pig	No significant irritation
Methyl nonafluorobutyl ether	Guinea Pig	No significant irritation

Respiratory Sensitization
For the component/components, either no data are currently available or the data are not sufficient for classification.

Germ Cell Mutagenicity

Name	Species	Value
Methyl nonafluoroisobutyl ether	In Vitro	Not mutagenic
Methyl nonafluoroisobutyl ether	In vivo	Not mutagenic
Methyl nonafluorobutyl ether	In Vitro	Not mutagenic

Methyl nonafluorobutyl ether	In vivo	Not mutagenic

Carcinogenicity
For the component/components, either no data are currently available or the data are not sufficient for classification.

Reproductive Toxicity

Reproductive and/or Developmental Effects

Name	Route	Value	Species	Test Result	Exposure Duration
Methyl nonafluoroisobutyl ether	Inhalation	Not classified for female reproduction	Rat	NOAEL 129 mg/1	1 generation
Methyl nonafluoroisobutyl ether	Inhalation	Not classified for male reproduction	Rat	NOAEL 129 mg/1	1 generation
Methyl nonafluoroisobutyl ether	Inhalation	Not classified for development	Rat	NOAEL 307 mg/1	during gestation
Methyl nonafluorobutyl ether	Inhalation	Not classified for female reproduction	Rat	NOAEL 129 mg/1	1 generation
Methyl nonafluorobutyl ether	Inhalation	Not classified for male reproduction	Rat	NOAEL 129 mg/1	1 generation
Methyl nonafluorobutyl ether	Inhalation	Not classified for development	Rat	NOAEL 307 mg/1	during gestation

Target Organ(s)

Specific Target Organ Toxicity - single exposure

Name	Route	Target Organ(s)	Value	Species	Test Result	Exposure Duration
Methyl nonafluoroisobutyl ether	Inhalation	nervous system	Not classified	Dog	NOAEL 913 mg/l	10 minutes
Methyl nonafluoroisobutyl ether	Inhalation	cardiac sensitization	Not classified	Dog	NOAEL 913 mg/l	10 minutes
Methyl nonafluorobutyl ether	Inhalation	nervous system	Not classified	Dog	NOAEL 913 mg/l	10 minutes
Methyl nonafluorobutyl ether	Inhalation	cardiac sensitization	Not classified	Dog	NOAEL 913 mg/l	10 minutes

Specific Target Organ Toxicity - repeated exposure

Name	Route	Target Organ(s)	Value	Species	Test Result	Exposure Duration
Methyl nonafluoroisobutyl ether	Inhalation	liver	Not classified	Rat	NOAEL 155 mg/l	13 weeks
Methyl nonafluoroisobutyl ether	Inhalation	bone, teeth, nails, and/or hair	Not classified	Rat	NOAEL 129 mg/l	11 weeks
Methyl nonafluoroisobutyl ether	Inhalation	heart | skin | endocrine system | hematopoietic system | immune system | muscles | nervous system | eyes | kidney and/or bladder | respiratory system	Not classified	Rat	NOAEL 155 mg/l	13 weeks
Methyl nonafluoroisobutyl ether	Ingestion	endocrine system | hematopoietic system | immune system | muscles | nervous system | eyes | kidney and/or bladder | respiratory system	Not classified	Rat	NOAEL 1,000 mg/kg/day	28 days

Methyl nonafluorobutyl ether	Inhalation	liver	Not classified	Rat	NOAEL 155 mg/l	13 weeks
Methyl nonafluorobutyl ether	Inhalation	bone, teeth, nails, and/or hair	Not classified	Rat	NOAEL 129 mg/l	11 weeks
Methyl nonafluorobutyl ether	Inhalation	heart | skin | endocrine system | hematopoietic system | immune system | muscles | nervous system | eyes | kidney and/or bladder | respiratory system	Not classified	Rat	NOAEL 155 mg/l	13 weeks
Methyl nonafluorobutyl ether	Ingestion	endocrine system | hematopoietic system | immune system | muscles | nervous system | eyes | kidney and/or bladder | respiratory system	Not classified	Rat	NOAEL 1,000 mg/kg/day	28 days

Aspiration Hazard
For the component/components, either no data are currently available or the data are not sufficient for classification.

Please contact the address or phone number listed on the first page of the SDS for additional toxicological information on this material and/or its components.

SECTION 12: Ecological information

Ecotoxicological information
Please contact the address or phone number listed on the first page of the SDS for additional ecotoxicological information on this material and/or its components.

Chemical fate information
Please contact the address or phone number listed on the first page of the SDS for additional chemical fate information on this material and/or its components.

SECTION 13: Disposal considerations

13.1. Disposal methods
Dispose of contents/ container in accordance with the local/regional/national/international regulations.

Dispose of waste product in a permitted industrial waste facility. Combustion products will include HF. Facility must be capable of handling halogenated materials. Empty drums/barrels/containers used for transporting and handling hazardous chemicals (chemical substances/mixtures/preparations classified as Hazardous as per applicable regulations) shall be considered, stored, treated & disposed of as hazardous wastes unless otherwise defined by applicable waste regulations. Consult with the respective regulating authorities to determine the available treatment and disposal facilities.

EPA Hazardous Waste Number (RCRA): Not regulated

SECTION 14: Transport Information

Not regulated per U.S. DOT, IATA or IMO.

These transportation classifications are provided as a customer service. As the shipper YOU remain responsible for complying with all applicable laws and regulations, including proper transportation classification and packaging. 3M transportation classifications are based on product formulation, packaging, 3M policies and 3M understanding of applicable current regulations. 3M does not guarantee the accuracy of this classification information. This information applies only to transportation classification and not the packaging, labeling, or marking requirements. The original 3M package is certified for U.S. ground shipment only. If you are shipping by air or ocean, the package may not meet applicable regulatory requirements.

SECTION 15: Regulatory Information

15.1. US Federal Regulations
Contact 3M for more information.

Physical Hazards
Not applicable

Health Hazards
Not applicable

15.2. State Regulations
Contact 3M for more information.

15.3. Chemical Inventories
The components of this material are in compliance with the provisions of Australia National Industrial Chemical Notification and Assessment Scheme (NICNAS). Certain restrictions may apply. Contact the selling division for additional information.

The components of this product are in compliance with the new substance notification requirements of CEPA.

The components of this material are in compliance with the China "Measures on Environmental Management of New Chemical Substance". Certain restrictions may apply. Contact the selling division for additional information.

The components of this material are in compliance with the provisions of the Korean Toxic Chemical Control Law. Certain restrictions may apply. Contact the selling division for additional information.

The components of this material are in compliance with the provisions of Japan Chemical Substance Control Law. Certain restrictions may apply. Contact the selling division for additional information.

The components of this material are in compliance with the provisions of Philippines RA 6969 requirements. Certain restrictions may apply. Contact the selling division for additional information.

The components of this product are in compliance with the chemical notification requirements of TSCA.

Contact 3M for more information.

15.4. International Regulations
Contact 3M for more information.

This SDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: Other Information

NFPA Hazard Classification
Health: 3 **Flammability:** 0 **Instability:** 0 **Special Hazards:** None

National Fire Protection Association (NFPA) hazard ratings are designed for use by emergency response personnel to address the hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. Hazard ratings are primarily based on the inherent physical and toxic properties of the material but also include the toxic properties of combustion or decomposition products that are known to be generated in significant quantities.

HMIS Hazard Classification
Health: 0 **Flammability:** 0 **Physical Hazard:** 0 **Personal Protection:** X - See PPE section.

Hazardous Material Identification System (HMIS® IV) hazard ratings are designed to inform employees of chemical hazards in the workplace. These ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS® IV ratings are to be used with a fully implemented HMIS® IV program. HMIS® is a registered mark of the American Coatings Association (ACA).

Document Group:	07-6378-9	**Version Number:**	69.03
Issue Date:	01/18/18	**Supercedes Date:**	09/06/16

Reason for Reissue
Conversion to GHS format SDS.

DISCLAIMER: The information in this Safety Data Sheet (SDS) is believed to be correct as of the date issued.3MMAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR COURSE OF PERFORMANCE OR USAGE OF TRADE. User is responsible for determining whether the3Mproduct is fit for a particular purpose and suitable for user's method of use or application. Given the variety of factors that can affect the use and application of a3Mproduct, some of which are uniquely within the user's knowledge and control, it is essential that the user evaluate the3Mproduct to determine whether it is fit for a particular purpose and suitable for user's method of use or application.

3M provides information in electronic form as a service to its customers. Due to the remote possibility that electronic transfer may have resulted in errors, omissions or alterations in this information,3Mmakes no representations as to its completeness or accuracy. In addition, information obtained from a database may not be as current as the information in the SDS available directly from 3M

3M USA SDSs are available at www.3M.com

End of SDS

12.3 SOLVAY GALDEN® HT SDS

SOLVAY

SAFETY DATA SHEET

Revision Date 25.02.2014

SECTION 1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identifier

- Product name	:	**GALDEN® HT LOW-BOILING (2)**
- Product grade(s)	:	HT80; HT110; HT135
- Chemical characterization	:	Perfluorinated polyethers

1.2. Relevant identified uses of the substance or mixture and uses advised against

- Identified uses	:	- Heat transfer medium
	:	- For industrial use only.

1.3. Details of the supplier of the safety data sheet

- Company	:	SOLVAY
	:	SPECIALTY POLYMERS JAPAN K.K.
- Address	:	7TH FL,ATAGO GREEN HILLS MORI TOWER ATAGO 2-5-1, MINATO-KU J- 105-6207 TOKYO
- Telephone	:	+81354254330/4300
- Fax	:	+81354254321
- E-mail address	:	sds.solvay@solvay.com

1.4. Emergency telephone number

- Emergency telephone number **+44(0)1235 239 670 [CareChem 24] (Europe)**

SECTION 2. HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

2.1.1. European regulation (EC) 1272/2008, as amended

Not classified as hazardous according to the European regulation (EC) 1272/2008, as amended

2.1.2. European Directive 67/548/EEC or 1999/45/EC, as amended

Not classified as hazardous according to European Directive 67/548/EEC or 1999/45/EC, as amended

2.2. Label elements

No labelling

2.3. Other hazards

- Thermal decomposition can lead to release of toxic and corrosive gases.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1. Substances
3.1.1. Concentration

Substance name:	Concentration
1-Propene, 1,1,2,3,3,3-hexafluoro-, oxidized, polymd. CAS-No.: 69991-67-9 / EC-No.: - / Index-No.:-	> 99.9 %

SECTION 4. FIRST AID MEASURES

4.1. Description of first aid measures

4.1.1. If inhaled
- Move to fresh air in case of accidental inhalation of fumes from overheating or combustion.
- Oxygen or artificial respiration if needed.

4.1.2. In case of eye contact
- Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.
- If eye irritation persists, consult a specialist.

4.1.3. In case of skin contact
- Wash off with soap and water.

4.1.4. If swallowed
- Drink 1 or 2 glasses of water.
- Do NOT induce vomiting.
- If symptoms persist, call a physician.

4.2. Most important symptoms and effects, both acute and delayed

4.2.1. Inhalation
- No known effect.

4.2.2. Skin contact
- Symptoms: Redness, Irritation

4.2.3. Eye contact
- Contact with eyes may cause irritation.
- Redness

4.2.4. Ingestion
- Ingestion may provoke the following symptoms:
- Symptoms: Nausea, Vomiting, Diarrhoea

4.3. Indication of any immediate medical attention and special treatment needed

SECTION 5. FIREFIGHTING MEASURES

5.1. Extinguishing media

5.1.1. Suitable extinguishing media
- Water
- powder
- Foam
- Dry chemical
- Carbon dioxide (CO2)

5.1.2. Unsuitable extinguishing media
- None.

5.2. Special hazards arising from the substance or mixture

- The product is not flammable.
- Not explosive
- In case of fire hazardous decomposition products may be produced such as: Gaseous hydrogen fluoride (HF), Fluorophosgene

5.3. Advice for firefighters

- Wear self-contained breathing apparatus and protective suit.
- When intervention in close proximity wear acid resistant over suit.
- Evacuate personnel to safe areas.
- Approach from upwind.
- Protect intervention team with a water spray as they approach the fire.
- Keep containers and surroundings cool with water spray.
- Keep product and empty container away from heat and sources of ignition.

SECTION 6. ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. Advice for non-emergency personnel

- Prevent further leakage or spillage if safe to do so.

6.1.2. Advice for emergency responders

- Ensure adequate ventilation.
- Material can create slippery conditions.
- Sweep up to prevent slipping hazard.
- Keep away from open flames, hot surfaces and sources of ignition.

6.2. Environmental precautions

- Should not be released into the environment.
- Do not flush into surface water or sanitary sewer system.

6.3. Methods and materials for containment and cleaning up

- Soak up with inert absorbent material.
- Suitable material for picking up
- Dry sand
- Earth
- Shovel into suitable container for disposal.

6.4. Reference to other sections

- Refer to protective measures listed in sections 7 and 8.

SECTION 7. HANDLING AND STORAGE

7.1. Precautions for safe handling

- Ensure adequate ventilation.
- Use personal protective equipment.
- Keep away from heat and sources of ignition.
- To avoid thermal decomposition, do not overheat.
- Take measures to prevent the build up of electrostatic charge.
- Clean and dry piping circuits and equipment before any operations.
- Ensure all equipment is electrically grounded before beginning transfer operations.

7.2. Conditions for storage, including incompatibilities

7.2.1. Storage

- Keep away from heat and sources of ignition.
- Keep in properly labelled containers.
- Keep away from combustible material.
- Keep away from incompatible products
- Provide tight electrical equipment well protected against corrosion.
- Refer to protective measures listed in sections 7 and 8.

7.2.2. Packaging material

7.2.2.1. *Suitable material*

- glass
- Plastic material

7.3. Specific end use(s)

- For further information, please contact: Supplier

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters

8.1.1. Exposure Limit Values

Remarks:

- Threshold limit values of by-products from thermal decomposition

Hydrogen fluoride anhydrous

- UK. EH40 Workplace Exposure Limits (WELs) 12 2011
  time weighted average = 1.8 ppm
  time weighted average = 1.5 mg/m3
  Remarks: as F
- UK. EH40 Workplace Exposure Limits (WELs) 12 2011
  Short term exposure limit = 3 ppm
  Short term exposure limit = 2.5 mg/m3
  Remarks: as F
- US. ACGIH Threshold Limit Values 03 2013
  time weighted average = 0.5 ppm
  Remarks: as F
- US. ACGIH Threshold Limit Values 03 2013
  Ceiling Limit Value = 2 ppm
  Remarks: as F
- EU. Indicative Exposure Limit Values in Directives 91/322/EEC, 2000/39/EC, 2006/15/EC, 2009/161/EU 12 2009
  time weighted average = 1.8 ppm
  time weighted average = 1.5 mg/m3
  Remarks: Indicative
- EU. Indicative Exposure Limit Values in Directives 91/322/EEC, 2000/39/EC, 2006/15/EC, 2009/161/EU 12 2009
  Short term exposure limit = 3 ppm
  Short term exposure limit = 2.5 mg/m3
  Remarks: Indicative
- US. ACGIH Threshold Limit Values 03 2013
  Remarks: as F, Can be absorbed through skin.
  Carbonyl difluoride
- US. ACGIH Threshold Limit Values 03 2013
  time weighted average = 2 ppm
- US. ACGIH Threshold Limit Values 03 2013
  Short term exposure limit = 5 ppm
- UK. EH40 Workplace Exposure Limits (WELs) 12 2011
  time weighted average = 2.5 mg/m3
  Remarks: as F

- EU. Indicative Exposure Limit Values in Directives 91/322/EEC, 2000/39/EC, 2006/15/EC, 2009/161/EU 12 2009
  time weighted average = 2.5 mg/m3
  Remarks: Indicative

8.2. Exposure controls

8.2.1. Appropriate engineering controls
- Provide local ventilation appropriate to the product decomposition risk (see section 10).
- Refer to protective measures listed in sections 7 and 8.
- Apply technical measures to comply with the occupational exposure limits.

8.2.2. Individual protection measures
8.2.2.1. Respiratory protection
- In case of decomposition (see section 10), use an air breathing apparatus with face mask.
- Use only respiratory protection that conforms to international/ national standards.

8.2.2.2. Hand protection
- Wear protective gloves.
- Suitable material: Nitrile rubber, PVC, Neoprene gloves, butyl-rubber
- Take note of the information given by the producer concerning permeability and break through times, and of special workplace conditions (mechanical strain, duration of contact).

8.2.2.3. Eye protection
- Tightly fitting safety goggles

8.2.2.4. Skin and body protection
- Wear work overall and safety shoes.

8.2.2.5. Hygiene measures
- Ensure that eyewash stations and safety showers are close to the workstation location.
- When using, do not eat, drink or smoke.
- Wash hands before breaks and at the end of workday.
- Handle in accordance with good industrial hygiene and safety practice.

8.2.3. Environmental exposure controls
- Dispose of rinse water in accordance with local and national regulations.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

9.1.1. General Information

Appearance	liquid
Colour	colourless
Odour	odourless
Odour Threshold	No data
Molecular weight	Range of values: 430 - 610

9.1.2. Important health safety and environmental information

pH	No data
pKa	No data
Melting point/freezing point	not applicable
Boiling point/boiling range	80 - 135 °C
Flash point	The product is not flammable.
Evaporation rate	No data
Flammability (solid, gas)	No data
Flammability	The product is not flammable.
Explosive properties	Not explosive
Vapour pressure	ca. 10.5 - 140 hPa

▪ **Vapour density**	No data
▪ **Density**	1.69 - 1.72 g/cm3 Temperature: 25 °C
▪ **Relative density**	No data
▪ **Bulk density**	No data
▪ **Solubility(ies)**	insoluble, Water insoluble, fluorinated solvents
▪ **Solubility/qualitative**	No data
▪ **Partition coefficient: n-**	No data **octanol/water**
▪ **Auto-ignition temperature**	No data
▪ **Decomposition temperature**	> 290 °C
▪ **Viscosity**	ca. 0.95 - 1.7 mPa.s
▪ **Oxidizing properties**	Non oxidizer

9.2. Other information

Remarks	No data

SECTION 10. STABILITY AND REACTIVITY

10.1. Reactivity

- No dangerous reaction known under conditions of normal use.

10.2. Chemical stability

- Stable under recommended storage conditions.
- Metals promote and lower decomposition temperature
- In presence of titanium and its alloys the decomposition temperature decreases to 260°C.

10.3. Possibility of hazardous reactions

- No dangerous reaction known under conditions of normal use.

10.4. Conditions to avoid

- Avoid to use in presence of high voltage electric arc and in absence of oxygen.
- Keep away from flames.
- To avoid thermal decomposition, do not overheat.

10.5. Incompatible materials

- non-aqueous alkalis, Lewis acids (Friedel-Crafts) above 100°C, Aluminum and magnesium in powder form above 200°C

10.6. Hazardous decomposition products

- Gaseous hydrogen fluoride (HF)., Fluorophosgene

SECTION 11. TOXICOLOGICAL INFORMATION

11.1. Acute toxicity

11.1.1. Acute oral toxicity

- LD50, rat, > 5,000 mg/kg

11.1.2. Acute inhalation toxicity

- LC50, rat , > 1,826 mg/l

11.1.3. Acute dermal toxicity

- LD50, rat, > 2,000 mg/kg

11.2. Skin corrosion/irritation

- rabbit, No skin irritation

11.3. Serious eye damage/eye irritation

- rabbit, No eye irritation

11.4. Respiratory or skin sensitisation

- guinea pig, Did not cause sensitisation on laboratory animals., Dermal

11.5. Germ cell mutagenicity

- Not mutagenic in Ames Test.
- Chromosome aberration test in vitro, negative

11.6. Carcinogenicity

- no data available

11.7. Reproductive toxicity

- no data available

11.8. Specific target organ toxicity - single exposure

- Remarks: no data available

11.9. Specific target organ toxicity - repeated exposure

- Oral, 28 d, rats, > 1000 mg/kg, Remarks: NOEL
- Remarks: Subacute toxicity

11.10. Aspiration hazard

- no data available

11.11. Other information

- Description of possible hazardous to health effects is based on experience and/or toxicological characteristics of several components.
- The product is biologically inert.
- Thermal decomposition can lead to release of toxic and corrosive gases.
- Exposure to decomposition products
- Causes severe irritation of eyes, skin and mucous membranes.

SECTION 12. ECOLOGICAL INFORMATION

12.1. Toxicity

- no data available

12.2. Persistence and degradability

12.2.1. Abiotic degradation

- Result: no data available

12.2.2. Biodegradation

- no data available

12.3. Bioaccumulative potential

- Result: no data available

12.4. Mobility in soil

- no data available

12.5. Results of PBT and vPvB assessment

- no data available

12.6. Other adverse effects

- Ecological injuries are not known or expected under normal use.

SECTION 13. DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

- Can be incinerated, when in compliance with local regulations.
- The incinerator must be equipped with a system for the neutralisation or recovery of HF.
- Dispose of in accordance with local regulations.

13.2. Contaminated packaging

- Empty containers can be landfilled, when in accordance with the local regulations.

SECTION 14. TRANSPORT INFORMATION

International transport regulations

- Sea (IMO/IMDG)
- not regulated
- Air (ICAO/IATA)
- not regulated
- European Road/Rail (ADR/RID)
- not regulated
- Inland waterway transport
- not regulated

SECTION 15. REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

- Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, as amended
- Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), as amended
- European Waste Catalogue
- Waste codes should be assigned by the user based on the application for which the product was used.

15.1.1. Notification status

Inventory Information	Status
USA. Toxic Substances Control Act (TSCA)	- Listed on inventory
Australia. Inventory of Chemical Substances (AICS)	- Listed on inventory
Canada. Domestic Substances List (DSL)	- Listed on inventory
Korea. Existing Chemicals Inventory (KECI (KR))	- Listed on inventory
China. Inventory of Existing Chemical Substances (IECSC)	- Listed on inventory
Japan. Industrial Safety & Health Law Inventory (ISHL (JP))	- Listed on inventory
Japan. Inventory of Existing & New Chemical Substances (ENCS)	- Listed on inventory
Philippine. Inventory of Chemicals and Chemical Substances (PICCS)	- Listed on inventory
New Zealand. Inventory of Chemicals (NZIOC)	- Listed on inventory
Taiwan. National Existing Chemical Substance Inventory (NECSI)	- Listed on inventory
EU. European Registration, Evaluation, Authorisation and Restriction of Chemical (REACH)	- If product is purchased from Solvay in Europe it is in compliance with REACH, if not please contact the supplier.

15.2. Chemical Safety Assessment

- A Chemical Safety Assessment is not required for this substance.

SECTION 16. OTHER INFORMATION

16.1. Other information

- New (SDS)
- Distribute new edition to clients

This SDS is only intended for the indicated country to which it is applicable. The European SDS format compliant with the applicable European legislation is not intended for use nor distribution in countries outside the European Union with the exception of Norway and Switzerland. Safety datasheets applicable in other countries/regions are available upon request.
The information given corresponds to the current state of our knowledge and experience of the product, and is not exhaustive. This applies to product which conforms to the specification, unless otherwise stated. In this case of combinations and mixtures one must make sure that no new dangers can arise. In any case, the user is not exempt from observing all legal, administrative and regulatory procedures relating to the product, personal hygiene, and protection of human welfare and the environment.

Print Date: 28.10.2014

End of SDS

12.4 ETHYLENE GLYCOL

ThermoFisher SCIENTIFIC

SAFETY DATA SHEET

Creation Date: 02-Feb-2010 **Revision Date:** 17-Jan-2018 **Revision Number** 4

1. Identification

Product Name **Ethylene glycol**

Cat No. : **E177-4; E177-20**

CAS-No 107-21-1
Synonyms Monoethylene glycol; 1,2-Ethanediol

Recommended Use Laboratory chemicals.
Uses advised against Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTRECÒ, Inside the USA: 800-424-9300
CHEMTRECÒ, Outside the USA: 001-703-527-3887

2. Hazard(s) Identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Acute oral toxicity	Category 4
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2

Label Elements

Signal Word
Warning

Hazard Statements
Harmful if swallowed
May cause drowsiness or dizziness
May cause damage to organs through prolonged or repeated exposure

Precautionary Statements
Prevention
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Response
Get medical attention/advice if you feel unwell
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor/physician if you feel unwell
Ingestion
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth
Storage
Store in a well-ventilated place. Keep container tightly closed
Store locked up
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)

WARNING. Reproductive Harm - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Ethylene Glycol	107-21-1	>95

4. First-aid measures

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Get medical attention immediately if symptoms occur.
Inhalation	Move to fresh air. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention immediately if symptoms occur. If not breathing, give artificial respiration.
Ingestion	Do not induce vomiting. Call a physician or Poison Control Center immediately.
Most important symptoms and effects	Breathing difficulties.
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Unsuitable Extinguishing Media No information available
Flash Point 111 °C / 231.8 °F
Method - DIN 51758

Autoignition Temperature 413 °C / 775.4 °F

Explosion Limits
Upper 15.30 vol %
Lower 3.20 vol %
Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products
Carbon monoxide (CO) Carbon dioxide (CO2)

Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	1	1	N/A

6. Accidental release measures

Personal Precautions Ensure adequate ventilation. Use personal protective equipment.

Environmental Precautions Should not be released into the environment. See Section 12 for additional ecological information.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling Wear personal protective equipment. Ensure adequate ventilation. Do not breathe vapors or spray mist. Avoid contact with skin, eyes and clothing.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
ethylene glycol	TWA: 25 ppm STEL: 50 ppm STEL: 10 mg/m^3	(vacated) Ceiling: 50 ppm (Vacated) Ceiling: 125 mg/m^3		Ceiling: 100 mg/m^3

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration

Engineering Measures	Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Viscous liquid
Appearance	Colorless
Odor	Odorless
Odor Threshold	No information available
pH	5.5-7.5 50% aq. sol
Melting Point/Range	-13 °C / 8.6 °F
Boiling Point/Range	196 - 198 °C / 384.8 - 388.4 °F @ 760 mmHg
Flash Point	111 °C / 231.8 °F
Method -	DIN 51758
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	15.30 vol %
Lower	3.20 vol %
Vapor Pressure	0.12 mmHg @ 20 °C
Vapor Density	2.14 (Air = 1.0)
Specific Gravity	1.113
Solubility	miscible
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	413 °C / 775.4 °F
Decomposition Temperature	> 500°C
Viscosity	21 cP (20°C)
Molecular Formula	C2 H6 O2
Molecular Weight	62.06

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Hygroscopic.
Conditions to Avoid	Incompatible products. Excess heat. Exposure to moist air or water.
Incompatible Materials	Strong oxidizing agents, Strong acids, Strong bases, Aldehydes
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO2)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological Information

Acute Toxicity

Product Information
Component Information

Component	LD50 Oral	LD50 Dermal	LD50 Inhalation
Ethylene glycol	7712 mg/kg (Rat)	9530 µL/kg (Rabbit) 10600 mg.kg (Rat)	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation May cause eye, skin, and respiratory tract irritation

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Ethylene glycol	107-21-1	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Central nervous system (CNS)
STOT - repeated exposure Kidney Liver

Aspiration hazard No information available

Symptoms/effects, both acute & delayed No information available

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological Information

Ecotoxicity
Do not empty into drains.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Ethylene glycol	EC50: 6500 - 13000 mg/L, 96h (Pseudokirchneriella subcapitata)	LC50: = 16000 mg/L, 96h static (Poecilia reticulata) LC50: 40000 - 60000 mg/L, 96h static (Pimephales promelas) LC50: = 40761 mg/L, 96h static (Oncorhynchus mykiss) LC50: = 41000 mg/L, 96h (Oncorhynchus mykiss) LC50: 14 - 18 mL/L, 96h static (Oncorhynchus mykiss) LC50: = 27540 mg/L, 96h static (Lepomis macrochirus)	Not listed	EC50: = 46300 mg/L, 48h (Daphnia magna)

Persistence and Degradability Persistence is unlikely

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

Component	log Pow
Ethylene glycol	-1.93

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT Not regulated
TDG Not regulated
IATA Not regulated
IMDG/IMO Not regulated

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Ethylene glycol	X	X	-	203-473-3	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 Threshold Values %
Ethylene glycol	107-21-1	>95	1.0

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act) Not applicable

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Ethylene glycol	X		-

OSHA Occupational Safety and Health Administration Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Ethylene glycol	5000 lb	-

California Proposition 65 This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Ethylene glycol	X	X	X	X	-

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade Slight risk, Grade 1

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 02-Feb-2010
Revision Date 17-Jan-2018
Print Date 17-Jan-2018
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

12.5 SDS FOR OPTEON™ SF10 SPECIALTY FLUID

SAFETY DATA SHEET

According to REACH Regulation (EC) No 1907/2006, as amended by UK REACH Regulations SI 2019/758

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name	:	Opteon™ SF10 Specialty Fluid
SDS-Identcode	:	130000143912
REACH Registration Number	:	01-2119943760-37-0000
Substance name	:	Methoxytridecafluoroheptene isomers

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture	:	Cleaning agent, Carrier fluid, Heat transfer fluids
Recommended restrictions on use	:	For professional users only., Do not use product for Anything outside of the above specified uses

1.3 Details of the supplier of the safety data sheet

Company	:	Chemours Netherlands B.V. Baanhoekweg 22 3313 LA Dordrecht Netherlands
Telephone	:	+31-(0)-78-630-1011
Telefax	:	+31-78-6163737
E-mail address of person responsible for the SDS	:	sds-support@chemours.com

1.4 Emergency telephone number

+(44)-870-8200418 (CHEMTREC - Recommended)

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008) as amended by GB-CLP Regulation, UK SI 2019/720, and UK SI 2020/1567)

Long-term (chronic) aquatic hazard, Category 4	H413: May cause long lasting harmful effects to aquatic life.

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008) as amended by GB-CLP Regulation, UK SI 2019/720, and UK SI 2020/1567)

Hazard statements : H413 May cause long lasting harmful effects to aquatic life.

Precautionary statements : **Prevention:**
P273 Avoid release to the environment.

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.

Misuse or intentional inhalation abuse may cause death without warning symptoms, due to cardiac effects.

Rapid evaporation of the product may cause frostbite.

SECTION 3: Composition/information on ingredients

3.1 Substances

Substance name : Methoxytridecafluoroheptene isomers

Components

Chemical Name	CAS-No. EC-No.	Concentration (% w/w)
Methoxytridecafluoroheptene isomers	Not assigned	>= 90 - <= 100

SECTION 4: First aid measures

4.1 Description of first aid measures

Protection of first-aiders : No special precautions are necessary for first aid responders.

If inhaled : If inhaled, remove to fresh air.
Get medical attention if symptoms occur.

In case of skin contact : Wash with water and soap as a precaution.
Get medical attention if symptoms occur.

In case of eye contact : Flush eyes with water as a precaution.
Get medical attention if irritation develops and persists.

If swallowed : If swallowed, DO NOT induce vomiting.
Get medical attention if symptoms occur.
Rinse mouth thoroughly with water.

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

4.2 Most important symptoms and effects, both acute and delayed

Symptoms	:	Inhalation may provoke the following symptoms: Dizziness May cause cardiac arrhythmia.

4.3 Indication of any immediate medical attention and special treatment needed

Treatment	:	Because of possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, that may be used in situations of emergency life support should be used with special caution.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media	:	Not applicable Will not burn
Unsuitable extinguishing media	:	Not applicable Will not burn

5.2 Special hazards arising from the substance or mixture

Specific hazards during firefighting to health.	:	Exposure to combustion products may be a hazard
Hazardous combustion products	:	Hydrogen fluoride carbonyl fluoride Carbon oxides

5.3 Advice for firefighters

Special protective equipment firefighting if for firefighters	:	Wear self-contained breathing apparatus for necessary. Use personal protective equipment.
Specific extinguishing methods	:	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. Use water spray to cool unopened containers. Remove undamaged containers from fire area if it is safe to do so. Evacuate area.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions	:	Follow safe handling advice (see section 7) and personal protective equipment recommendations (see section 8).

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

6.2 Environmental precautions

Environmental precautions : Avoid release to the environment.
Prevent further leakage or spillage if safe to do so. Prevent spreading over a wide area (e.g. by containment or Oil barriers).
Retain and dispose of contaminated wash water.
Local authorities should be advised if significant spillages cannot be contained.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Soak up with inert absorbent material. For large spills, provide dyking or other appropriate containment to keep material from spreading. If dyked material can be pumped, store recovered material in appropriate container.
Clean up remaining materials from spill with suitable absorbent.
Local or national regulations may apply to releases and disposal of this material, as well as those materials and items employed in the cleanup of releases. You will need to determine which regulations are applicable. Sections 13 and 15 of this SDS provide information regarding certain local or national requirements.

6.4 Reference to other sections

See sections: 7, 8, 11, 12 and 13

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Technical measures : See Engineering measures under EXPOSURE CONTROLS / PERSONAL PROTECTION section.

Local/Total ventilation : Use only with adequate ventilation.

Advice on safe handling : Handle in accordance with good industrial hygiene and safety practice, based on the results of the workplace exposure assessment. Take care to prevent spills, waste and minimize release to the environment.

Hygiene measures : If exposure to chemical is likely during typical use, provide eye flushing systems and safety showers close to the working place. When using do not eat, drink or smoke. Wash contaminated clothing before re-use.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage : Do not expose drums to direct heat or temperature above 46°C (115°F) areas and containers to avoid pressurizing and possibly distorting the drums. Material should not be dispensed by pouring from pail/drum shipping containers containing 5 gallons or more.

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

The use of a drum pump is recommended for dispensing from pail/drum shipping containers with 5 gallons or more, except for smaller containers where adequate ventilation can be used to manage the exposure. Keep in properly labelled containers. Store in accordance with the particular national regulations. Advice on common storage : No special restrictions on storage with other products.

Recommended storage temperature : < 46 °C

Further information on storage stability : Keep away from direct sunlight.

7.3 Specific end use(s)

Specific use(s) : No data available

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational Exposure Limits

Components	CAS-No.	Value type (Form of exposure)	Control Parameters	Basis
Methoxytride-cafluoroheptene isomers	Not assigned	TWA	200 ppm	US WEEL

Predicted No Effect Concentration (PNEC):

Substance name	Environmental Compartment	Value
Methoxytridecafluoroheptene isomers	Fresh water	0.002 mg/l
	Intermittent use/release	0.002 mg/l
	Marine water	0.000214 mg/l
	Fresh water sediment	6.3 mg/kg dry weight (d.w.)
	Marine sediment	0.6 mg/kg dry weight (d.w.)
	Sewage treatment plant	10 mg/l
	Soil	1 mg/kg dry weight (d.w.)

8.2 Exposure controls

Engineering measures

Ensure adequate ventilation, especially in confined areas.
Minimize workplace exposure concentrations.

Personal protective equipment

Eye/face protection : Wear the following personal protective equipment:
Safety glasses. Equipment should conform to BS EN 166

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

Hand protection		
Remarks	:	Wash hands before breaks and at the end of workday.
Skin and body protection	:	Skin should be washed after contact.
Respiratory protection	:	If adequate local exhaust ventilation is not available or exposure assessment demonstrates exposures outside the recommended guidelines, use respiratory protection. Equipment should conform to BS EN 14387
Filter type	:	Organic vapour type (A)

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	:	liquid
Colour	:	clear, colourless
Odour	:	mild
Odour Threshold	:	No data available
pH	:	No data available
Melting point/freezing point	:	< -85 °C
Initial boiling point and boiling range	:	110.5 °C
Flash point	:	does not flash
Evaporation rate	:	2.2 (Butyl Acetate=1.0)
Flammability (solid, gas)	:	Not applicable
Upper explosion limit / Upper flammability limit	:	Upper flammability limit Method: ASTM E681 None
Lower explosion limit / Lower flammability limit	:	Lower flammability limit Method: ASTM E681 None
Vapour pressure	:	21.5 hPa (20 °C) 28.8 hPa (25 °C)

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

Relative vapour density	:	12.1 (Air = 1.0)
Relative density	:	1.59 (25 °C)
Solubility(ies) Water solubility	:	0.00015 g/l slightly soluble (24 °C)
Partition coefficient: noctanol/water	:	log Pow: 4.4 - 4.9 (25 °C)
Auto-ignition temperature	:	348 - 351 °C
Decomposition temperature	:	No data available
Viscosity Viscosity, kinematic	:	0.74 mm2/s (25 °C)
Explosive properties	:	Not explosive
Oxidizing properties	:	The substance or mixture is not classified as oxidizing.

9.2 Other information

Flammability (liquids)	:	Will not burn
Particle size	:	Not applicable

SECTION 10: Stability and reactivity

10.1 Reactivity
Not classified as a reactivity hazard.

10.2 Chemical stability
Stable under normal conditions.

10.3 Possibility of hazardous reactions
Hazardous reactions : None known.

10.4 Conditions to avoid
Conditions to avoid : None known.

10.5 Incompatible materials
Materials to avoid : None.

10.6 Hazardous decomposition products
No hazardous decomposition products are known.

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Information on likely routes of exposure : Inhalation
Skin contact
Ingestion
Eye contact

Acute toxicity
Not classified based on available information.

Components:

Methoxytridecafluoroheptene isomers:

Acute oral toxicity	:	LD50 (Rat): > 5,000 mg/kg Method: OECD Test Guideline 420
Acute inhalation toxicity	:	LC50 (Rat): > 222.15 mg/l Exposure time: 4 h Test atmosphere: vapour Method: OECD Test Guideline 403
Acute dermal toxicity	:	LD50 (Rat): > 5,000 mg/kg Method: OECD Test Guideline 402

Skin corrosion/irritation
Not classified based on available information.

Components:

Methoxytridecafluoroheptene isomers:

Species	:	Rabbit
Method	:	OECD Test Guideline 404
Result	:	No skin irritation

Serious eye damage/eye irritation
Not classified based on available information.

Components:

Methoxytridecafluoroheptene isomers:

Species	:	Rabbit
Method	:	OECD Test Guideline 405
Result	:	No eye irritation

Respiratory or skin sensitisation

Skin sensitisation
Not classified based on available information.

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

Respiratory sensitisation
Not classified based on available information.

Components:

Methoxytridecafluoroheptene isomers:

Test Type	:	Local lymph node assay (LLNA)
Exposure routes	:	Skin contact
Species	:	Mouse
Method	:	OECD Test Guideline 429
Result	:	negative

Germ cell mutagenicity
Not classified based on available information.

Components:

Methoxytridecafluoroheptene isomers:

Genotoxicity in vitro	:	Test Type: Bacterial reverse mutation assay (AMES) Method: OECD Test Guideline 471 Result: negative Test Type: Chromosome aberration test in vitro Method: OECD Test Guideline 473 Result: negative Test Type: In vitro mammalian cell gene mutation test Method: OECD Test Guideline 476 Result: negative
Genotoxicity in vivo	:	Test Type: Mammalian erythrocyte micronucleus test (in vivo cytogenetic assay) Species: Rat Application Route: Ingestion Method: OECD Test Guideline 474 Result: negative Test Type: Mammalian erythrocyte micronucleus test (in vivo cytogenetic assay) Species: Rat Application Route: Inhalation Method: OECD Test Guideline 474 Result: negative
Germ cell mutagenicity Assessment	:	Weight of evidence does not support classification as a Germ cell mutagen.

Carcinogenicity
Not classified based on available information.

Reproductive toxicity
Not classified based on available information.

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

Components:

Methoxytridecafluoroheptene isomers:

Effects on foetal development	:	Test Type: Prenatal development toxicity study (teratogenicity) Species: Rat Application Route: Ingestion Method: OECD Test Guideline 414 Result: negative

STOT - single exposure

Not classified based on available information.

Components:

Methoxytridecafluoroheptene isomers:

Exposure routes	:	Ingestion
Assessment	:	No significant health effects observed in animals at concentrations of 2000 mg/kg bw or less
Exposure routes	:	Skin contact
Assessment	:	No significant health effects observed in animals at concentrations of 2000 mg/kg bw or less
Exposure routes	:	inhalation (vapour)
Assessment	:	No significant health effects observed in animals at concentrations of 20 mg/l/4h or less

STOT - repeated exposure

Not classified based on available information.

Components:

Methoxytridecafluoroheptene isomers:

Exposure routes	:	Ingestion
Assessment	:	No significant health effects observed in animals at concentrations of 100 mg/kg bw or less.
Exposure routes	:	inhalation (vapour)
Assessment	:	No significant health effects observed in animals at concentrations of 1 mg/l/6h/d or less.

Repeated dose toxicity

Components:

Methoxytridecafluoroheptene isomers:

Species	:	Rat, male and female
NOAEL	:	1,000 mg/kg
LOAEL	:	> 1,000 mg/kg
Application Route	:	Ingestion
Exposure time	:	90 d
Method	:	OECD Test Guideline 408

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

Species	:	Rat, male and female
NOAEL	:	37.025 mg/l
LOAEL	:	75.531 mg/l
Application Route	:	inhalation (vapour)
Exposure time	:	28 d
Method	:	OECD Test Guideline 412

Aspiration toxicity
Not classified based on available information.

Components:

Methoxytridecafluoroheptene isomers:
No aspiration toxicity classification

SECTION 12: Ecological information

12.1 Toxicity

Components:

Methoxytridecafluoroheptene isomers:

Toxicity to fish	:	LC50 (Oryzias latipes (Japanese medaka)): > 0.096 mg/l Exposure time: 96 h Method: OECD Test Guideline 203 Remarks: No toxicity at the limit of solubility
Toxicity to daphnia and other aquatic invertebrates	:	EC50 (Daphnia magna (Water flea)): > 0.157 mg/l Exposure time: 48 h Method: OECD Test Guideline 202 Remarks: No toxicity at the limit of solubility
Toxicity to algae/aquatic plants	:	ErC50 (Pseudokirchneriella subcapitata (green algae)): > 0.000477 mg/l Exposure time: 72 h Method: OECD Test Guideline 201 Remarks: No toxicity at the limit of solubility NOEC (Pseudokirchneriella subcapitata (green algae)): 0.000477 mg/l Exposure time: 72 h Method: OECD Test Guideline 201 Remarks: No toxicity at the limit of solubility
Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity)	:	NOEC: 0.107 mg/l Exposure time: 21 d Species: Daphnia magna (Water flea) Method: OECD Test Guideline 211 Remarks: No toxicity at the limit of solubility

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

Ecotoxicology Assessment

Chronic aquatic toxicity : May cause long lasting harmful effects to aquatic life.

12.2 Persistence and degradability

Components:

Methoxytridecafluoroheptene isomers:

Biodegradability : Result: Not inherently biodegradable.
Method: OECD Test Guideline 302C

12.3 Bioaccumulative potential

Components:

Methoxytridecafluoroheptene isomers:

Bioaccumulation : Species: Cyprinus carpio (Carp)
Bioconcentration factor (BCF): 1,990
Method: OECD Test Guideline 305

12.4 Mobility in soil

Components:

Methoxytridecafluoroheptene isomers:

Distribution among environmental Compartments : log Koc: 4.5
Remarks: immobile

12.5 Results of PBT and vPvB assessment

Product:

Assessment : This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Endocrine disrupting properties

Product:

Assessment : The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

12.7 Other adverse effects

No data available

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product	:	Dispose of in accordance with local regulations. According to the European Waste Catalogue, Waste Codes are not product specific, but application specific. Waste codes should be assigned by the user, preferably in discussion with the waste disposal authorities.
Contaminated packaging	:	Empty containers should be taken to an approved waste handling site for recycling or disposal. If not otherwise specified: Dispose of as unused product.

SECTION 14: Transport information

14.1 UN number

ADN	:	Not regulated as a dangerous good
ADR	:	Not regulated as a dangerous good
RID	:	Not regulated as a dangerous good
IMDG	:	Not regulated as a dangerous good
IATA	:	Not regulated as a dangerous good

14.2 UN proper shipping name

ADN	:	Not regulated as a dangerous good
ADR	:	Not regulated as a dangerous good
RID	:	Not regulated as a dangerous good
IMDG	:	Not regulated as a dangerous good
IATA	:	Not regulated as a dangerous good

14.3 Transport hazard class(es)

ADN	:	Not regulated as a dangerous good
ADR	:	Not regulated as a dangerous good
RID	:	Not regulated as a dangerous good
IMDG	:	Not regulated as a dangerous good
IATA	:	Not regulated as a dangerous good

14.4 Packing group

ADN	:	Not regulated as a dangerous good
ADR	:	Not regulated as a dangerous good
RID	:	Not regulated as a dangerous good
IMDG	:	Not regulated as a dangerous good
IATA (Cargo)	:	Not regulated as a dangerous good
IATA (Passenger)	:	Not regulated as a dangerous good

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

14.5 Environmental hazards

Not regulated as a dangerous good

14.6 Special precautions for user

Not applicable

14.7 Transport in bulk according to Annex II of Marpol and the IBC Code

Remarks : Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Relevant EU provisions transposed through retained EU law

UK REACH List of restrictions (Annex 17)	:	Conditions of restriction for the following entries should be considered: Number on list 3
UK REACH Candidate list of substances of very high concern (SVHC) for Authorisation	:	Not applicable
The Persistent Organic Pollutants Regulations (retained	:	Not applicable
Regulation (EU) 2019/1021 as amended for Great Britain)	:	Not applicable
Regulation (EC) No 1005/2009 on substances that deplete the ozone layer	:	Not applicable
UK REACH List of substances subject to authorization (Annex XIV)	:	Not applicable
GB Export and import of hazardous chemicals – Prior Informed Consent (PIC) Regulation	:	Not applicable
Control of Major Accident Hazards Regulations 2015 (COMAH)	:	Not applicable

15.2 Chemical safety assessment

A Chemical Safety Assessment has been carried out for this substance.

SECTION 16: Other information

Other information : Opteon™ and any associated logos are trademarks or copyrights of The Chemours Company FC, LLC. Chemours™ and the Chemours Logo are trademarks of The Chemours Company. Before use read Chemours safety information. For further information contact the local Chemours office or nominated distributors

Items where changes have been made to the previous version are highlighted in the body of this document by two vertical lines.

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

Full text of other abbreviations

US WEEL	:	USA. Workplace Environmental Exposure Levels (WEEL)
US WEEL / TWA	:	8-hr TWA

ADN - European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways; ADR - Agreement concerning the International Carriage of Dangerous Goods by Road; AIIC - Australian Inventory of Industrial Chemicals; ASTM - American Society for the Testing of Materials; bw - Body weight; CLP - Classification Labelling Packaging Regulation; Regulation (EC) No 1272/2008; CMR - Carcinogen, Mutagen or Reproductive Toxicant; DIN – Standard of the German Institute for Standardisation; DSL - Domestic Substances List (Canada); ECHA - European Chemicals Agency; EC-Number - European Community number; ECx – Concentration associated with x% response; ELx - Loading rate associated with x% response; EmS - Emergency Schedule; ENCS - Existing and New Chemical Substances (Japan); ErCx - Concentration associated with x% growth rate response; GHS - Globally Harmonized System; GLP - Good Laboratory Practice; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; IBC - International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk; IC50 - Half maximal inhibitory concentration; ICAO - International Civil Aviation Organization; IECSC - Inventory of Existing Chemical Substances in China; IMDG - International Maritime Dangerous Goods; IMO - International Maritime Organization; ISHL - Industrial Safety and Health Law (Japan); ISO - International Organisation for Standardization; KECI - Korea Existing Chemicals Inventory; LC50 - Lethal Concentration to 50 % of a test population; LD50 - Lethal Dose to 50% of a test population (Median Lethal Dose); MARPOL - International Convention for the Prevention of Pollution from Ships; n.o.s. - Not Otherwise Specified; NO(A)EC - No Observed (Adverse) Effect Concentration; NO(A)EL - No Observed (Adverse) Effect Level; NOELR - No Observable Effect Loading Rate; NZIoC - New Zealand Inventory of Chemicals; OECD - Organization for Economic Co-operation and Development; OPPTS – Office of Chemical Safety and Pollution Prevention; PBT - Persistent, Bioaccumulative and Toxic substance; PICCS - Philippines Inventory of Chemicals and Chemical Substances; (Q)SAR - (Quantitative) Structure Activity Relationship; REACH - Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals; RID - Regulations concerning the International Carriage of Dangerous Goods by Rail; SADT - Self-Accelerating Decomposition Temperature; SDS - Safety Data Sheet; SVHC - Substance of very high concern; TCSI - Taiwan Chemical Substance Inventory; TECI - Thailand Existing Chemicals Inventory; TSCA - Toxic Substances Control Act (United States); UN - United Nations; UNRTDG - United Nations Recommendations on the Transport of Dangerous Goods; vPvB - Very Persistent and Very Bioaccumulative

Further information

Sources of key data used to compile the Safety Data Sheet	:	Internal technical data, data from raw material SDSs, OECD eChem Portal search results and European Chemicals Agency, http://echa.europa.eu/

Items where changes have been made to the previous version are highlighted in the body of this document by two vertical lines.

Opteon™ SF10 Specialty Fluid

Version	Revision Date	SDS Number	Date of last issue: 23.06.2022
6.0	18.10.2022	9534008-00006	Date of first issue: 07.09.2021

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and shall not be considered a warranty or quality specification of any type. The information provided relates only to the specific material identified at the top of this SDS and may not be valid when the SDS material is used in combination with any other materials or in any process, unless specified in the text. Material users should review the information and recommendations in the specific context of their intended manner of handling, use, processing and storage, including an assessment of the appropriateness of the SDS material in the user's end product, if applicable.

GB / EN

End of SDS