

THERMO CUBE 200/265/300/400 THERMOELECTRIC CHILLER MANUAL



Solid State
COOLING  SYSTEMS
Temperature Control...Precisely.

EC Declaration of Conformity

EC Declaration of Conformity

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

declare under sole responsibility that the

ThermoCube 400, 300, 265, and 200 (all models)

meet the intent of Directive 89/336/EEC and amendments 92/31/EEC, 93/68/EEC for Electromagnetic Compatibility and the Low Voltage Directive 73/23/EEC. Compliance was demonstrated to the following specifications as listed in the official Journal of the European Communities:

EN 50081-2: 1993 Emissions:

| | |
|--------------------|-----------------------------|
| EN 55011: 1998 | Radiated, Class A, Group 1 |
| EN 55011: 1998 | Conducted, Class A, Group 1 |
| EN 61000-3-2: 1995 | Harmonics |
| EN 61000-3-3: 1995 | Flicker Meter |

EN 61000-6-2: 1999 Immunity:

| | |
|------------------------|---|
| EN 61000-4-2: 1995 | Electrostatic Discharge (ESD) |
| EN 61000-4-3 +A1: 1998 | Radiated Susceptibility (RF) |
| EN 61000-4-5: 1995 | Surge Susceptibility |
| EN 61000-4-4: 1995 | Electrical Fast Transient (EFT) |
| EN 61000-4-6: 1996 | Conducted Disturbances Induced by RF Fields |
| EN 61000-4-8: 1994 | Power Frequency Magnetic Field Immunity |
| EN 61000-4-11:1995 | Voltage Dips and Interference (VDI) |

EN 61010-1 +A1+A2: 1995 Low Voltage Directive safety requirements for electrical equipment for measurement, control, and laboratory use.

| | |
|-----------------------------|--|
| Lloyd F Wright President |  |
| Date | February 22, 2002 |

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SYMBOLS USED ON THE THERMOCUBE 200/265/300/400



Read the MSDS for the coolant used and follow **all** safety precautions listed in the MSDS 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.

CAUTION

- * Never disassemble the ThermoCube unit as irreparable damage may occur.
 - * Never store or operate the ThermoCube Chiller over 100 °C.
 - * Never operate the coolant within 5°C of its freezing point.
 - * Never ship the chiller with water inside the liquid cold plate as freezing temperatures may be encountered which would damage the unit.
 - * The chiller should be located at approximately the same level or above the system it is cooling to avoid coolant draining back into the tank and overflowing after the ThermoCube is turned off.
-

Solid State

COOLING SYSTEMS

Temperature Control...Precisely.

THERMOCUBE 200/265/300/400 THERMOELECTRIC CHILLER

PRODUCT

Manual

SECTION 1 INTRODUCTION

The ThermoCube 200/265/300/400 is a thermoelectric temperature control system with full PID control of both heating and cooling. It provides 1-3 lpm of constant temperature coolant for controlling the operating temperatures of lasers, medical equipment, semiconductor equipment, or any process requiring temperature control. It also has a cycling feature where two different temperature set points may be entered with a soak time at each temperature and the number of cycles desired. It does not use Freon or any other replacement gas. From conception, this chiller has been designed for long life and ease of use. The internal thermoelectric modules have lifetimes greater than 200,000 hours.

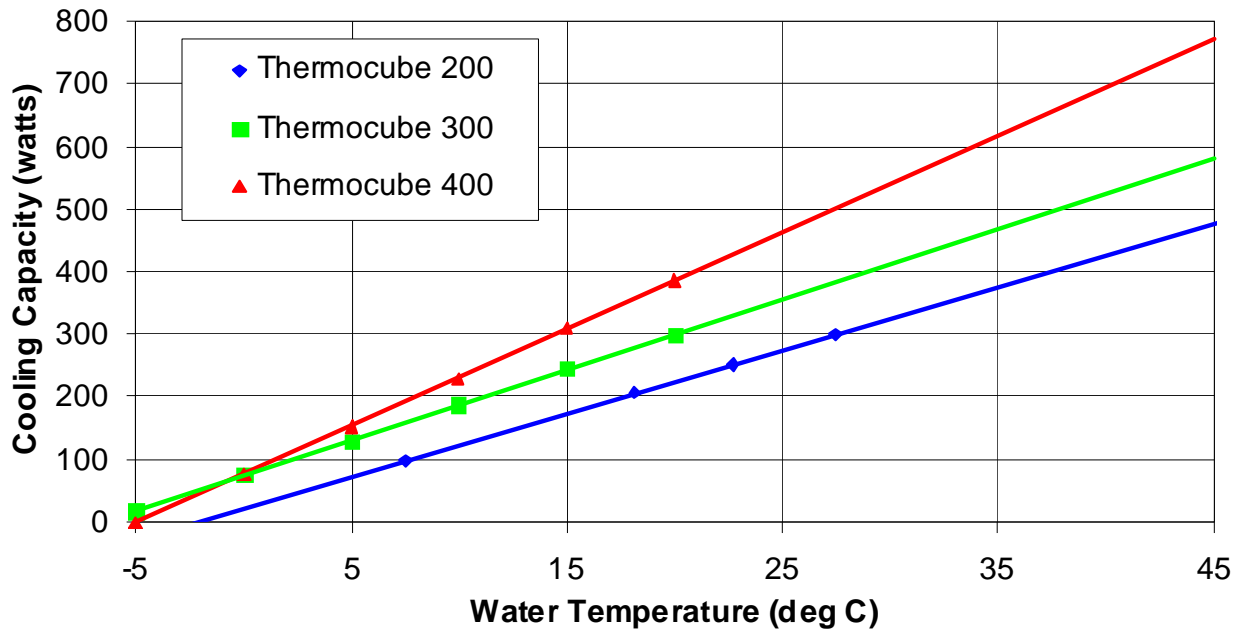
SECTION 2

SPECIFICATIONS

| | |
|--------------------------------------|---|
| Coolant Operating Temperature Range: | |
| Standard: | +5 to +50 °C |
| Low Option Temperature (-LT) | -5 to + 50°C |
| High Temperature Option (-HT) | +5 to + 65°C |
| Control Accuracy: | ± .05°C |
| Compatible Coolant Types: | Water, 20% ethanol and water, 20-50% ethylene or propylene glycol and water. Galden HT-110/Fluorinert FC 3283 and PAO options are available. |
| Recommended Coolant: | Koolance LIQ-702BU-B (blue) or LIQ-702CL-B (clear): 27% propylene glycol/water with corrosion inhibitors & algaecides. |
| Maximum Ambient Air Temperature: | 40 °C (104 °F), 50 °C (122 °F) for Thermocube 265 |
| Nominal Cooling Capacity: | <input type="checkbox"/> 200 Watts @ 25 °C <input type="checkbox"/> 265 Watts @ set point = ambient <input type="checkbox"/> 300 Watts @ 25 °C <input type="checkbox"/> 400 Watts @ 25 °C (See Figure 1 for chart.) |
| Operating Voltage: | <input type="checkbox"/> Universal Input 100-240 VAC, 7 amps max |
| Safety Certifications: | <input type="checkbox"/> CE Mark/NRTL (TUV) US & Canada |
| Cooling Fan: | <input type="checkbox"/> Standard <input type="checkbox"/> Quiet (Reduces cooling capacity by 25 Watts) <input type="checkbox"/> Variable speed |
| Coolant Pump: | <input type="checkbox"/> -1D 1 lpm @ 35 psig Diaphragm <input type="checkbox"/> -2D 1.7 lpm @ 35 psig Diaphragm <input type="checkbox"/> -3D 3 lpm @ 35 psig Diaphragm <input type="checkbox"/> -1G 1 lpm @ 35 psig Gear Pump <input type="checkbox"/> -2G 2 lpm @ 35 psig Gear Pump <input type="checkbox"/> -3G 3 lpm @ 32 psig Gear Pump <input type="checkbox"/> -1C 1 lpm @ 15 psig, 2 lpm @ 10 psig centrifugal pump |
| System Proof Pressure: | 100 psig |
| Coolant Fluid Connections: | 1/4" Push-in fitting, 3/8" for -3D or -1C pumps |
| Tank Volume: | 300 ml |
| Dimensions: | 12.75" x 11" x 12.75" (L x W x H, plus fittings) |
| Weight: | 28 lbs. |
| Standard Alarms | Two TTL Level Alarms, System Fail & Temperature out of Range |
| Other Options: | <input type="checkbox"/> -EF 5 micron External Filter <input type="checkbox"/> -RS 232 <input type="checkbox"/> -XX Preset Control Temperature: _____ <input type="checkbox"/> -SW 1/4" Swagelok Coolant Fittings <input type="checkbox"/> -HT High Temperature Operation (up to 65 °C set point) <input type="checkbox"/> -LT Low Temperature Operation (down to -5 °C set point) <input type="checkbox"/> -VD Vibration Dampening Material <input type="checkbox"/> -DC Dry Contact Alarm Outputs <input type="checkbox"/> -AR Auto restart <input type="checkbox"/> -DI DI water compatible |

This Unit Serial Number: _____

Figure 1 Thermocube Cooling Curves
Thermocube 200/300/400 20 C Ambient



Thermocube 265 Cooling Capacity

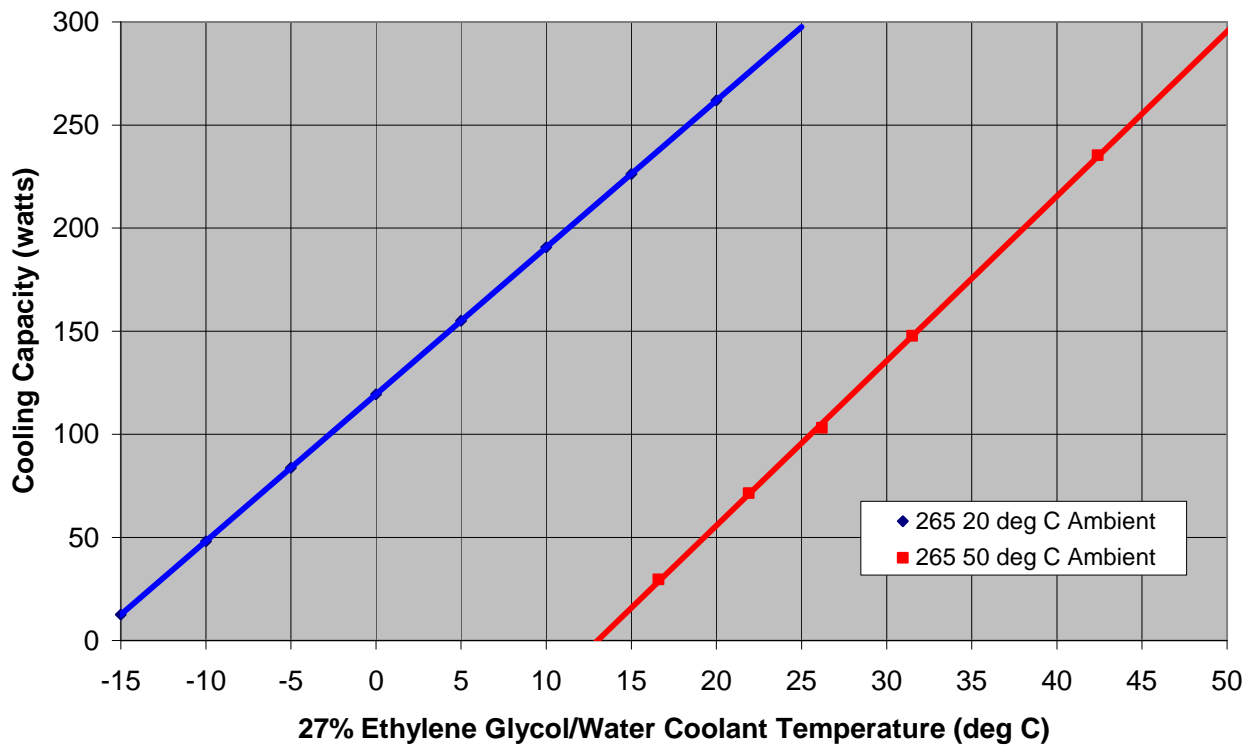
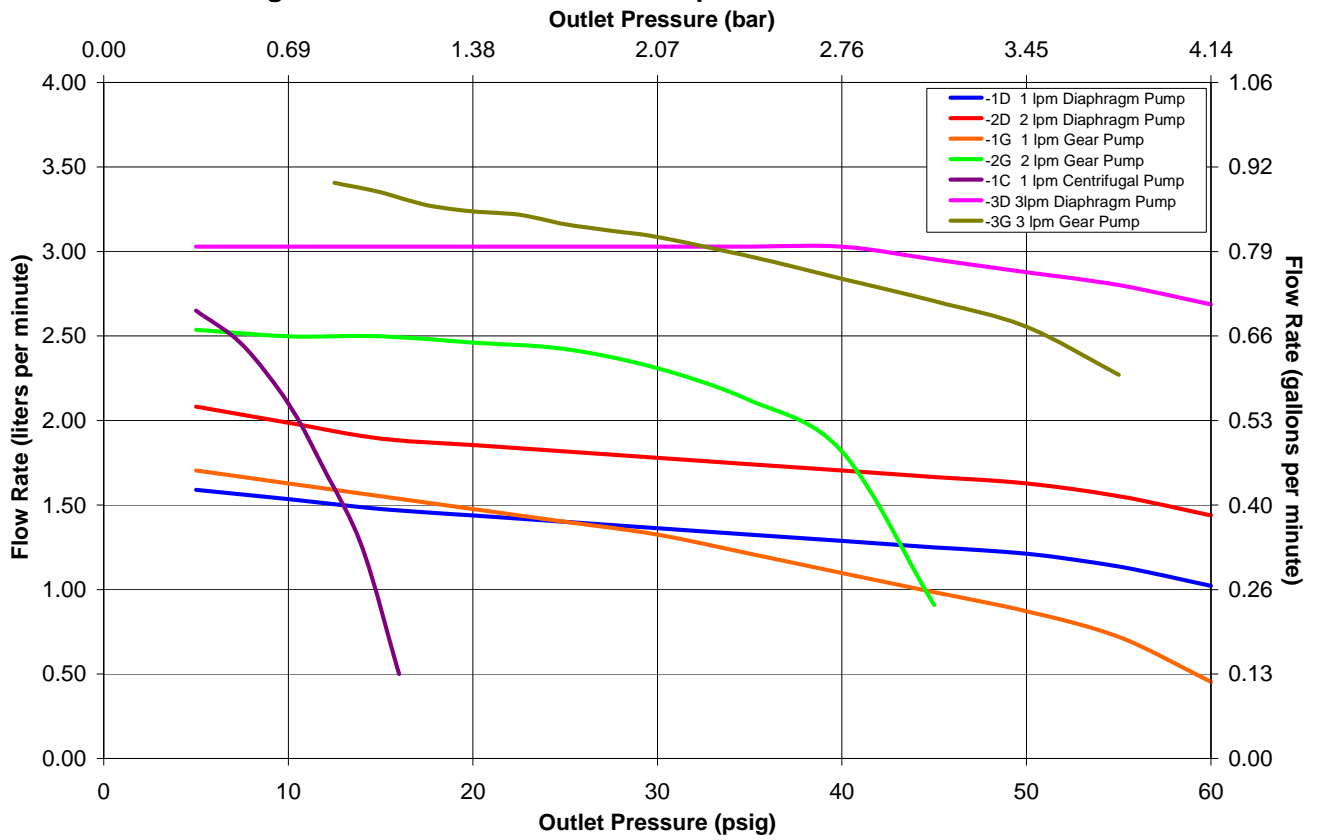


Figure 2 Thermocube Pump Curves



SECTION 3

HOOK UP

3.1 ELECTRICAL CONNECTIONS (SEE FIGURE 3)

Power: Plug line cord into 110 VAC or 230 VAC 50/60 Hz outlet (depending on voltage option chosen).

Fuse: 10 amp (5mm x 20mm) GDB quick acting glass, meets IEC 127-2

Replacement Fuse: SSCS#20-22332-10, Allied Electronics #740-0543

Alarms: Alarm signals are TTL signals, normally high (>4 VDC), located on the 9-pin d-subminiature connector as follows:

| | |
|----------------------|-------|
| System Alarm: | Pin 7 |
| Alarm Signal Return: | Pin 8 |
| Temperature Alarm: | Pin 9 |

3.2 PLUMBING CONNECTIONS (SEE FIGURE 3)

The process fluid inlet (coolant return) and outlet (coolant supply) connections, located on the left side, are ¼” John Guest “push-in” style fittings. (See Figure 5 on page 22 for directions on use.) Also available as fitting options are Colder Products ¼” or 3/8” valved quick-disconnect fittings and ¼” or 3/8” Swagelok fittings.

Important Note: The ThermoCube chiller should be located at approximately the same level or above the system it is cooling to avoid coolant draining back into the tank and overflowing after the ThermoCube is turned off.

3.3 AIR CONSIDERATIONS

The air inlet and outlet are located on the left and right sides respectively. Restricting airflow into or out of the unit will impair performance. At least 3 inches of clearance is required on each side to ensure adequate airflow.

3.4 COOLANT FILL

The water fill cap is located at the top rear of the unit. Twist off the cap counter-clockwise to open. Fill reservoir prior to starting unit. Close cap before operating.

Recommended coolant: Koolance LIQ-702BU-B (blue) or LIQ-702CL-B (clear): 27% propylene glycol/water with corrosion inhibitors & algacides.

Other Acceptable Coolants: Water, 20-50% Ethylene or Propylene Glycol/water, 25% Ethanol or Isopropanol/water.

Note: Algae growth may occur when 100% water is the coolant.

Figure 3A

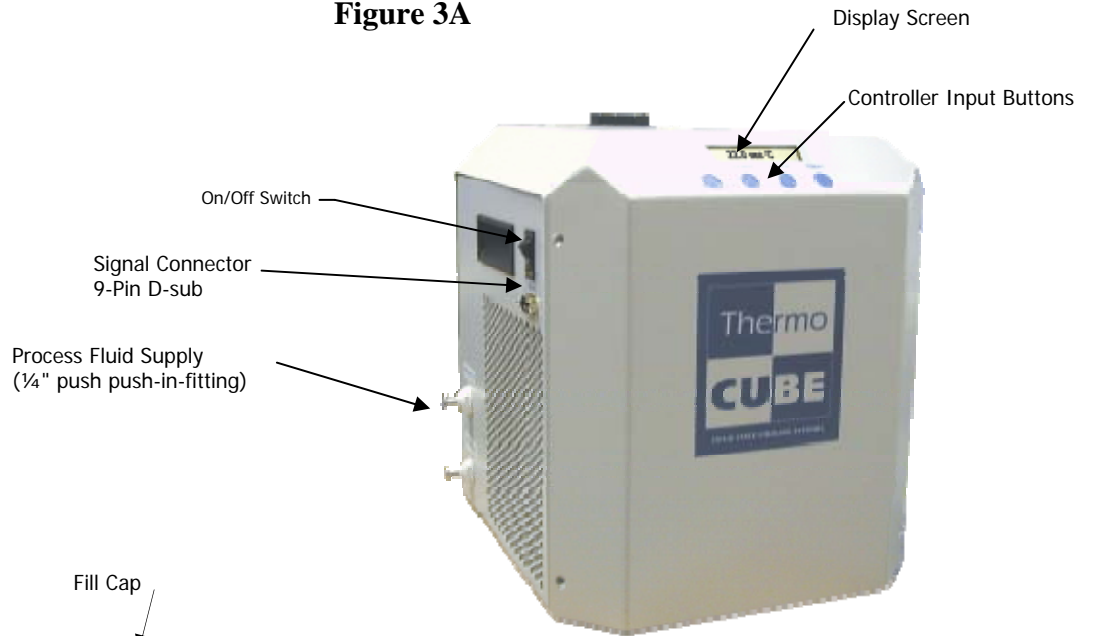
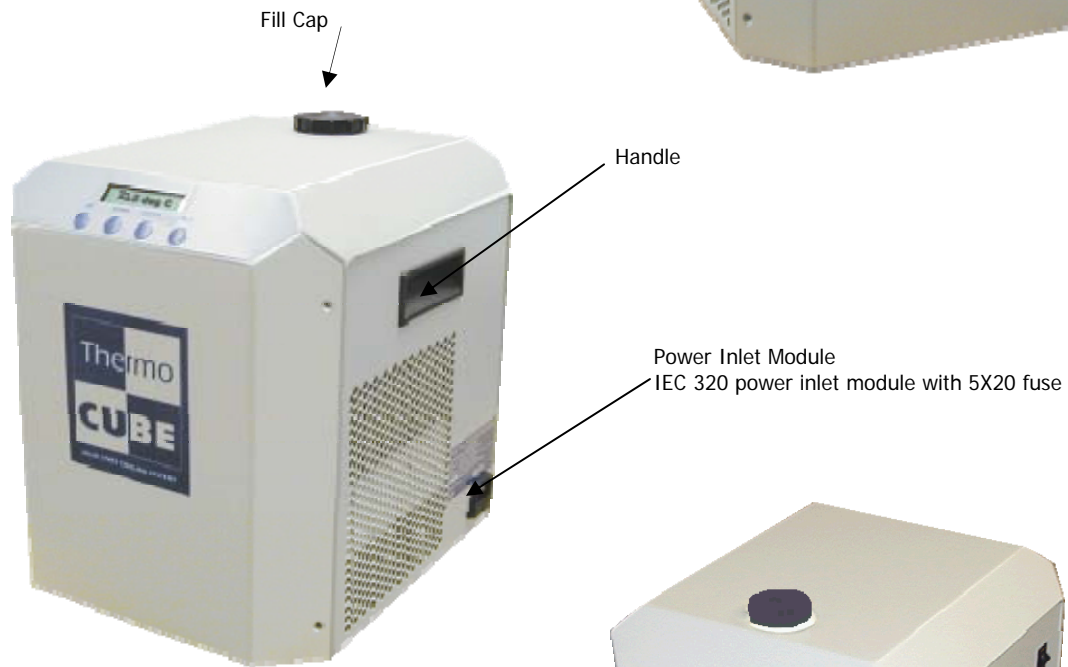


Figure 3B



Fasten the filter-mounting bracket via the four screws located here

Optional 5-micron particle filter

Figure 3C



SECTION 4

START UP

Start-up the ThermoCube using the following steps:

- 1) Connect ¼" tubing to fluid connections located on the left side, labeled Process Out (supply) and Process In (return).
- 2) Connect Alarm Signal connector (if option chosen).
- 3) Remove the reservoir cap on top and fill the reservoir to just below the bottom of its neck with coolant. Replace cap.
- 4) Plug line cord into 110 VAC or 230 VAC, 50/60 Hz.
- 5) Turn on switch located on the left side. The front display should read the current coolant temperature. If the front display reads "TANK LEVEL LOW", add water to the reservoir until the display changes to read the coolant temperature.

Important Notes:

- 1) If using an alcohol/water mixture, do not exceed 25% alcohol or the reservoir level float may not rise sufficiently when filled to turn off the tank level low alarm.
- 2) If the tank level low alarm persists, or if another alarm is displayed, consult section 6.0 of this manual.

SECTION 5

OPERATION

The ThermoCube 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. These keys work as follows:

| 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 ThermoCube 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 ThermoCube and wait for display to read TEMP.
- 2) Press the UP or DOWN keys to change SET TEMP 1 to the desired set point.
- 3) Press the START key.

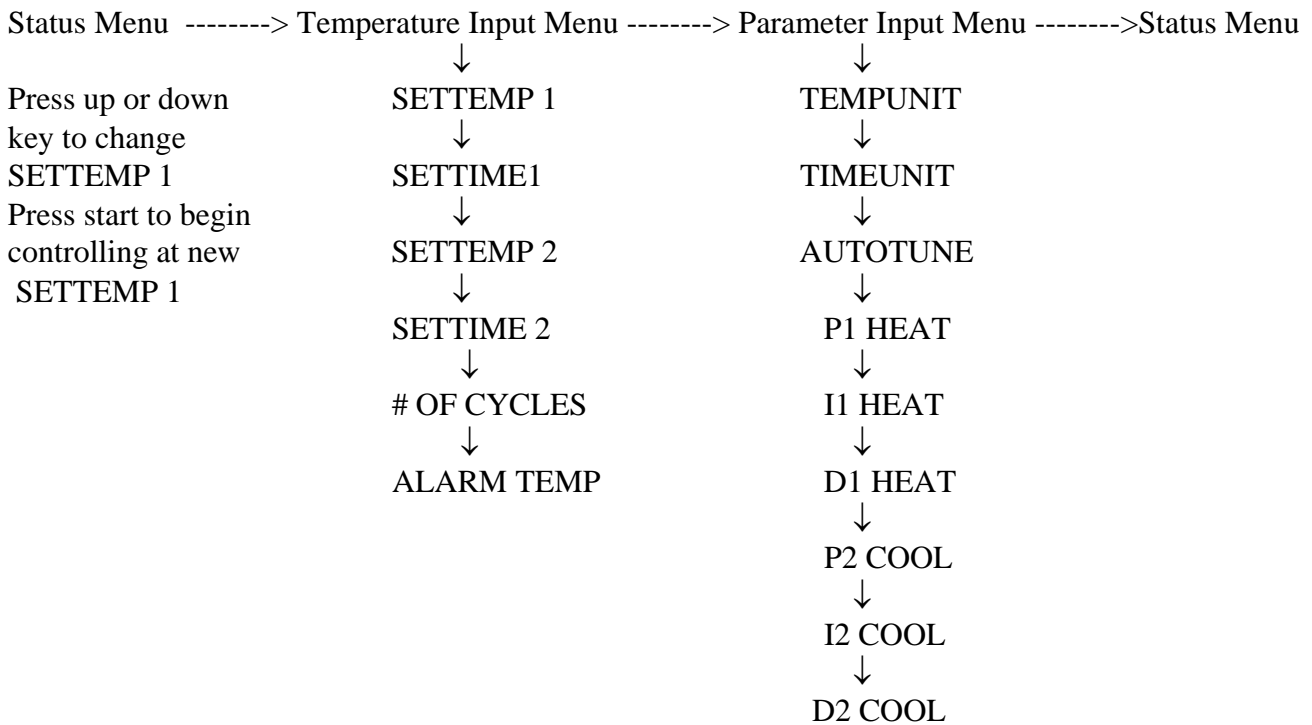
The ThermoCube will now control to the set point temperature. To change the set point temperatures just press the UP or DOWN keys again to change SETTEMP 1 to the new set point, followed by the START key.

5.2 ADVANCED OPERATION

The ThermoCube controller has three menus: the Status Menu, the Temperature Input Menu and the Parameter Input Menu. The Status Menu shows the chiller operating status and current temperature of fluid leaving the chiller (see Figure 3). The Status Menu also allows input of new coolant temperature setpoints when the cycling feature is off. The Temperature Input Menu allows input of set point temperatures; soak times, number of cycles if cycling between two temperatures, and an alarm temperature. The Parameter Input Menu allows input of the temperature units; the time units for soak times, the PID parameters and the auto tune function.

The PID parameters have been preset at the factory for most applications. If, however, temperature control is not sufficiently accurate or if overshoot is excessive, the PID parameters may be modified. Unless the user is well versed in PID theory, we recommend calling Solid State Cooling Systems technical support group for assistance.

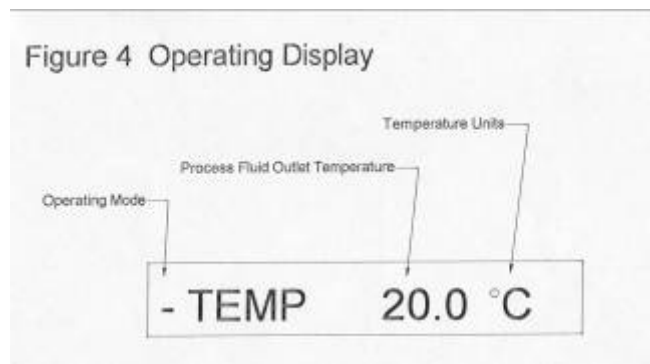
Menu Structure



Press ENTER key once to scroll between menu items (↓).

Press and hold ENTER key for 3 seconds to scroll between menus (----->).

Status Menu: The status menu displays the chiller operating status and coolant temperature. The chiller operating mode is shown in the display's first character: (See Figure 4)



- * = Standby mode, no temperature control
- + = Heating mode with temperature control
- = Cooling mode with temperature control
- A= Autotune in progress

The coolant outlet temperature is shown after TEMP in °C or °F. Pressing the UP or DOWN keys with # of cycles set to zero will change the set point temperature upon pressing the START key.

Temperature Input Menu: The temperature input menu allows input of operating temperatures, soak times, number of cycles desired, and an optional alarm temperature. Note: If # of cycles is set to zero, only TEMP 1 and ALARM TEMP will be used.

SETTEMP1 = Set-point of first control temperature. If # OF CYCLES is set to zero, this is the control temperature.

SETTIME1 = Soak time at temperature 1. Not used if # OF CYCLES is set to zero.

SETTEMP2= Set-point of second control temperature. Not used if # OF CYCLES is set to zero.

SETTIME2 = Soak time at temperature 2. Not used if # OF CYCLES is set to zero.

OF CYCLES = Number of cycles between temperature 1 and temperature 2, 0-999 cycles. If set to zero, then the ThermoCube 300 will continuously control at temperature 1.

ALARMTEMP = Alarm temperature set-point. Will output TTL high (>4Vdc) when coolant temperature is Below ALARMTEMP and will output TTL low (<0.5 Vdc) when coolant temperature is Above ALARMTEMP.

Parameter Input Menu: The parameter input menu allows input of temperature units, time units, PID parameters, and turns on or off auto-tune.

TEMPUNIT = °C or °F

TIMEUNIT = s: seconds, m: minutes, h: hours

AUTOTUNE = on/off. On turns on auto-tune where the controller determines PID parameters. Once PID parameters have been determined AUTO-TUNE reads off.

| | |
|---|-----------------------------------|
| P1 HEAT = Proportional band for heating, 0-99.9 °C or °F. | Factory Default Value: 5.6 |
| I1 HEAT = Integral term for heating, 0-999 seconds | Factory Default Value: 22 |
| D2 HEAT = Derivative term for heating, 0-999 seconds | Factory Default Value: 2 |
| P2 COOL = Proportional band for cooling, 0-99.9 °C or °F | Factory Default Value: 2.8 |
| I2 COOL = Integral term for cooling, 0-999 seconds | Factory Default Value: 22 |
| D2 COOL = Derivative term for cooling, 0-999 seconds | Factory Default Value: 2 |

- Notes: 1) If the user enters the temperature input or the parameter input menus and does not press a key for 30 second the display will revert back to the Status menu.
2) If continuous control at one set-point temperature is desired, set # OF CYCLES to zero.

5.3 ALARMS

The ThermoCube chiller has two TTL level alarms, one for temperature and one for system failure:

Temperature: TTL high (>4 VDC) fluid temp below alarm set point

TTL low (<0.5 VDC) fluid temp above alarm set point

System: TTL high (>4 VDC) system operating normally

TTL low (<0.5 VDC) system failure has occurred

A list of system failures causing the system alarm to change to TTL low can be found in Section 6. In the event of a system failure, the alarm type will be shown on the front display.

5.4 AUTO-TUNING

The ThermoCube 300 and 400 chillers come with an automatic tuning (auto-tune) feature. Changing the PID parameters is normally not recommended unless the RTD probe is moved to a new location. However, the controller can calculate new PID parameters via the auto-tune function. The following keystrokes initiate the auto-tune function:

- 1) Press and hold the Enter key until the Status Menu changes to the Temperature Input menu.
- 2) Press and hold the Enter key again until the Temperature Input menu changes to the Parameter Input menu.
- 3) Press the Enter key three times. The display should read AUTOTUNE off.
- 4) Press the Up key to change off to on.
- 5) Press and hold the Enter key until the parameter input menu returns to the Status Display.
- 6) Press the Start key once. The left most display character will show the letter A until the auto tune is complete. The ThermoCube will then begin controlling at the set point temperature.

5.5 MANUAL TUNING

For users well versed in PID theory, Solid State Cooling Systems recommends the closed-loop “Ziegler Nichols” method for manually tuning the controller. The method consists of three steps:

- 1) Turn off both the integral and derivative terms for heating and cooling by setting I1, I2, D1, and D2 to zero.
- 2) Set proportional band to 50 °C. Begin controlling the process at the desired set-point temperature. Look for a small-sustained oscillation in the coolant temperature. Observe the status menu operating mode character and note if system is heating (+) or cooling (-). If no oscillation occurs, lower the proportional band in 50% increments until a small oscillation occurs. Write down this proportional band setting (P)
- 3) Measure the “Natural Frequency” (t) of the system in seconds. This is the time required for the temperature oscillation to cycle from one maximum temperature to the next maximum temperature.

Now set the controller input parameters as follows:

P1 HEAT = 2*P if system was heating in step 2.

P1 HEAT = 4*P if system was cooling in step 2.

I1 HEAT = 1.2*t

D1 HEAT = t/8

P2 COOL = P if system was heating in step 2.

P2 COOL = 2*P if system was cooling in step 2.

I2 COOL = 1.2*t

D2 COOL = t/8

SECTION 6

SYSTEM ALARMS/TROUBLESHOOTING

The ThermoCube has 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. The P&ID is included at the end of this section for your reference.

Tank Level Low: Liquid reservoir level is too low. *Unless filling for the first time, check all outside plumbing lines for leaks. Once all leaks are sealed, remove the cap and add more water until the alarm disappears.*

WARNING

Warning! Always disconnect the AC power cord before opening the ThermoCube cover, as electrical shock hazards exist inside.

RTD Open: The temperature sensor has failed or its connector has come loose. *Turn off the ThermoCube and disconnect the AC power cord. Open the cover and check if the 5-pin connector is firmly attached to the controller board located on the under side of the cover. If the connector is firmly attached, contact SSCS for a replacement RTD, or for a RMA number to return the unit for RTD replacement.*

Fan Fail: Fan is supplying insufficient air to cool the thermoelectric. *Either the fan has failed or the airflow into or out of the system is blocked. Check that the side air inlet and outlet gratings are not blocked. The ThermoCube requires at least 3 inches of clearance around these gratings. If airflow is not blocked, contact SSCS for a replacement fan, or for a RMA number to return the unit for fan replacement.*

Pump Fail (or Check Lines on some models): The liquid heat exchanger plate temperature is either too hot or too cold, indicating pump failure or a blockage in the external plumbing lines or operation outside of the normal 5 – 50°C coolant temperature without the –LT or –HT options. *Turn off the ThermoCube and disconnect the AC power cord. Verify that no kinks or blockages exist in plumbing line, both outside and inside the ThermoCube. If no coolant flow blockages exist, contact SSCS for a replacement pump, or for a RMA number to return the unit for pump replacement.*

No Display: If the liquid crystal display does not illuminate upon turning on the ThermoCube, either the 3-pin connector to the controller board has come loose, the internal 12 or 24VDC power supply has failed, the diaphragm pump has failed, or the LCD display has failed. *First, determine if the pump is running, then turn off the ThermoCube and disconnect the AC power cord. If the pump was running, open the cover and check if the 3-pin connector is firmly attached to the controller board located on the under side of*

the cover. If the connector is firmly attached, call SSCS for a RMA number to return the unit for replacement of the temperature controller. If the pump was not running, check the connectors on the 24 VDC power supply located at the top of the unit are firmly attached. If the connectors are firmly attached, disconnect the pump via the two 0.25 fast-on connectors. If the display comes back on the pump has failed, if not, the 24 VDC power supply has failed. Contact SSCS for a replacement pump or power supply, or for a RMA number to return the unit for a pump or power supply replacement.

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. *First check the PID constant values shown section 5.2 match the factory defaults. If not, change the values to the default values. Otherwise, contact SSCS for technical support.*

Important: The tank level low alarm will automatically reset when the tank is filled. The RTD, Fan and Pump failure alarms will not reset until the system power is turned off.

SECTION 7

OPTIONS

7.1 DI WATER OPTION (-DI)

The ThermoCube 200/265/300/400 can be configured for operation with de-ionized (DI) water. When this option is selected all wetted parts of the ThermoCube are compatible with DI water.

7.2 RUN/FILL TWO-SPEED PUMP OPTION (-3G)

Thermocubes with -3G pumps come with a Run/Fill switch located above the signals connector. This switch allows the user to run the pump at low speed (Fill) during initial filling and then, once all air-bubbles are out of the plumbing lines, increase the pump speed (Run) for normal operation. Failure to run the pump in the fill mode after initial hook-up or with drained plumbing lines can result in water being blown out of the tank from compressed air bubbles in the lines.

Note: The coolant flow rate in the fill mode is approximately 1.3 liters/minute.

7.3 RS-232 COMMUNICATION OPTION (-ES)

The ThermoCube 200/265/300/400 can be configured with RS232 communication. With this option selected, the ThermoCube can receive a remote set point, return the current temperature, and signal an alarm has occurred. The RS232 signals are located on the 9-pin d-subminiature connector located on the left side of the ThermoCube.

Note: When the RS-232 option is selected the standard alarm outputs are not available.

Signal connections:

| 9 Pin D-Sub Pin# | RS-232 Signal Description |
|------------------|---------------------------|
| 2 | Transmit Data (TXD) |
| 3 | Receive Data (RXD) |
| 5 | Ground |

Wiring:

| Host/Master 9-Pin D-sub Pin# | Host/Master RS-232 Signal Description | Thermocube 9-Pin D-sub Pin# |
|---------------------------------|--|--------------------------------|
| 2 | Receive Data (RXD) | 2 |
| 3 | Transmit Data (TXD) | 3 |
| 5 | Ground | 5 |

SPECIFICATION:

| | |
|-------------------------|---|
| Speed: | 9600 baud |
| Data Flow Control: | None |
| Data Format: | 8-bit serial |
| Number of Stop bits: | 1 |
| Transmission Breakdown: | One command byte followed by zero, one, or two data bytes depending on data type. |
| Master/Slave: | The ThermoCube is always the SLAVE |
| Interrupts Reported: | None, must be polled for status |
| Transmission Length: | ≤ 15 meters |

Code Breakdown:(All bytes are hexadecimal)

Command Byte: Bit 7 (MSB) remote control active (1 = remote control, 0 = local control)
 Bit 6 remote on/off (1 = ThermoCube running, 0 = ThermoCube in standby mode)
 Bit 5 communication direction (1 = remote to ThermoCube [command from master],
 0 = ThermoCube to remote [status from ThermoCube])
 Bits 4 thru 0 parameter being communicated per table

Data Bytes: 1 or 2 data bytes depending on parameter (see table).

Parameter Table:

| Bits 4 thru 0 | Parameter | No of Bytes |
|---------------|--|-------------|
| 00001 | ThermoCube set-point 1 temperature | 2 |
| 01001 | Current ThermoCube coolant out temperature | 2 |
| 01000 | Faults (fan, pump, RTD failures etc.) | 1 |

Temperature Data bytes:

The 2 data bytes for the temperature set-point and transmission of the current temperature represent the value of the temperature in 0.1°F increments.

For example:

| <u>High Byte</u> | <u>Low Byte</u> | |
|------------------|-----------------|-----------|
| 00000000 | 00000001 | = 0.1 °F |
| 00000000 | 00001010 | = 1.0 °F |
| 00000000 | 01100100 | = 10.0 °F |
| 00000000 | 11001000 | = 20.0 °F |
| 00000001 | 00101100 | = 30.0 °F |
| 00000001 | 10010000 | = 40.0 °F |
| 00000001 | 11110100 | = 50.0 °F |
| 00000010 | 01011000 | = 60.0 °F |
| 00000010 | 10111100 | = 70.0 °F |

SYSTEM FAULTS DATA BYTE ASSIGNMENTS:

| Bit No: | Fault Assigned: |
|---------|-----------------|
| 0 | Tank Level Low |
| 1 | Fan Fail |
| 2 | Unassigned |
| 3 | Pump Fail |
| 4 | RTD open |
| 5 | RTD short |
| 6 | Unassigned |
| 7 | Unassigned |

Note: 0 = System ok, 1 = Fault

RS232 COMMUNICATIONS EXAMPLE

The following code example is for exchanging data directly with a ThermoCube with the RS-232 Interface card.

H: = Host command
T: = ThermoCube (Slave).

Send Setpoint:

H: sends Command byte (HEX<E1>)
H: sends the Setpoint low byte (HEX<XX> in tenths °F)
H: sends the Setpoint high byte (HEX<XX>)

Receive Setpoint:

H: sends Command byte (HEX<C1>)
T: sends the Setpoint low byte (HEX<XX> in tenths °F)
T: sends the Setpoint high byte (HEX<XX>)

Receive RTD temperature:

H: sends Command byte (HEX<C9>)
T: sends the RTD low byte (HEX<XX> in tenths °F)
T: sends the RTD high byte (HEX<XX>)

Receive Faults Table:

H: sends Command byte (HEX<C8>)
T: sends the Faults Table byte (HEX<XX> per table definitions)

Send Remote Start only:

H: sends Command byte (HEX<E0>)

Send Remote Stop only:

H: sends Command byte (HEX<A0>)

Notes:

- 1) Each data set is independent and can be run separately.
- 2) The command byte is always active. So be careful when sending that the three most significant bits (5-7) are set correctly. Bit 7 is remote operation (1 = remote), bit 6 is ON/OFF (1 = ON = unit controlling temperature), bit 5 is Data direction (1 = host to controller, e.g. host sends set point to controller)
- 3) All of the command examples shown keep the controller in remote mode and controlling temperature.
- 4) The Thermocube has an 8-byte buffer and can only handle up to 20 commands per second.
- 5) The Thermocube does not echo back commands from the host.

Labview Users: A Labview RS-232 driver for the Thermocube is available. Contact Solid State Cooling Systems for details.

7.4 DRY CONTACT ALARM OPTION (-DC)

The ThermoCube can be configured with two normally closed 1 amp 250V dry contact alarm relays instead of the standard TTL alarms, one for system faults and one for temperature exceeding the alarm range. These contacts are wired to the 9-pin dsub connector as follows:

| | |
|----------------------------|-------|
| System Fault Alarm Common: | Pin 6 |
| System Fault Alarm: | Pin 7 |
| Temperature Alarm Common: | Pin 8 |
| Temperature Alarm: | Pin 9 |

If the RS232 option is chosen with dry contact alarm option, then the dry contacts are wired to the 9-pin dsub connector as follows:

| | |
|----------------------------|-------|
| System Fault Alarm Common: | Pin 6 |
| System Fault Alarm: | Pin 1 |
| Temperature Alarm Common: | Pin 9 |
| Temperature Alarm: | Pin 4 |

7.5 VARIABLE SPEED FAN OPTION (-VS)

The Thermocube can be configured with a variable speed fan option that slows the fan speed down based upon the internal air heat sink temperature. This option substantially reduces the Thermocube noise when the Thermocube is not running at full cooling. When full cooling is required, the fans speed increases to full power. This option can lead to reduced cooling capacity, depending upon the ambient air temperature and coolant set point. Contact Solid State Cooling Systems for further details.

7.6 LOW TEMPERATURE OPTION (-LT)

The Thermocube normally has a 5°C thermostat on its liquid cold plate that shuts off cooling to prevent freeze damage when using water as a coolant. The -LT option removes this thermostat and adds insulation to allow operation below the freezing point of water (0°C). When selecting this option, the operator must ensure coolants are selected that will not freeze within 5°C of set point. Repairs to thermoelectric heat exchangers damaged by freezing water in Thermocubes with this option selected will not be covered by warranty.

7.7 HIGH TEMPERATURE OPTION (-HT)

The Thermocube normally has a 55 °C thermostat on its liquid cold plate that shuts off heating to protect against hot coolant damaging the operator's equipment. The -HT option replaces this thermostat with a 70 °C thermostat and adds insulation to allow operation up coolant temperatures of 65 °C. This option is not available with the centrifugal pump.

7.8 AUTO-RESTART OPTION (-AR)

Normally upon power up, the Thermocube does not start controlling the coolant temperature until the START/STOP button is pressed. With this option selected, the Thermocube begins controlling the coolant temperature automatically upon power up. After start-up, the START/STOP button operates like normal: pressing this button while running puts the Thermocube in standby mode (no heating or cooling), pressing this button while in standby mode initiates coolant temperature control.

7.9 VIBRATION DAMPENING OPTION (-VD)

This option adds vibration dampening material to interior sheet metal surfaces for applications such as scanning electron microscopes that are highly sensitive to vibrations from pumps and fans. This option is usually combined with the -EF external filter option which dampens vibrations in the coolant flow.

7.10 EXTERNAL FILTER OPTION (-EF)

This option adds an external 5 micron filter to the Thermocube coolant outlet for systems sensitive to particulate matter in the coolant. Note that this option also dampens coolant flow pulses, producing a smoother coolant flow.

7.11 AIR FILTER OPTION (-AF)

The air filter option adds a filter to the Thermocube air inlet. This option is recommended for environments with high levels of airborne contaminants such as dust or animal hair as these contaminants can stick to the internal air heat sinks, reducing efficiency and cooling capacity.

SECTION 8

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. Eastern Time, Monday - Friday

Telephone: (845) 296-1300

Fax: (845) 296-1303

E-mail: info1@sscooling.com

John Guest

Time and Labor Savings

In contrast to the lengthy procedure of traditional copper connections and multiple parts in compression fittings, the installation of John Guest **Super Speedfit**® and **Superseal**® products is a simple push-to-connect. There is no need to remake leaky solder joints or adjust awkward compression fittings; an especially important feature when working in confined spaces. Typical installation times can be cut by as much as 40%.

With John Guest **Super Speedfit**® Fittings, Shut-Off Valves and Tubing you can expect:

- Leak proof installations
- Efficient, quick connections (even in tight working quarters)
- Reductions in time and labor cost
- Suitability for plastic and soft metal tubing
- Quick disconnect and reusability



Materials of construction

The fittings are made up of three components:

Bodies are produced in an acetal copolymer or polypropylene.

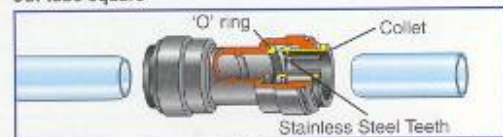
'O' rings are nitrile rubber or EPDM.

Collets are produced in acetal copolymer or polypropylene with stainless steel teeth.

How to make a connection

To make a connection, the tube is simply pushed in by hand. The unique patented John Guest collet locking system then holds the tube firmly in place without deforming it or restricting flow.

1 Cut tube square



Cut the tube square. It is essential that the outside diameter be free of score marks and that burrs and sharp edges be removed before inserting into fitting. For soft thin walled plastic tubing we recommend the use of a tube insert.

2 Insert tube



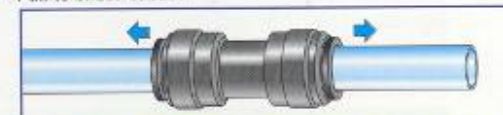
Fitting grips before it seals. Ensure tube is pushed into the tube stop.

3 Push up to tube stop



Push the tube into the fitting, to the tube stop. The collet (gripper) has stainless steel teeth which hold the tube firmly in position while the 'O' ring provides a permanent leak proof seal.

4 Pull to check secure



Pull on the tube to check that it is secure. It is a good practice to test the system prior to leaving site and/or before use.

Disconnecting

Push in collet and remove tube



In disconnect, ensure the system is depressurized before removing the tube. Push in collet squarely against face of fitting. With the collet held in this position, the tube can be removed. The fitting can then be re-used.

Figure 5 How to Use a John Guest Fitting

SECTION 9

MSDS FOR COOLANTS

MSDS FOR PROPYLENE GLYCOL

Material Safety Data sheet Propylene glycol



1. CHEMICAL PRODUCT & COMPANY IDENTIFICATION

24-Hour Emergency Phone Number: 989-636-4400

Product: DOWFROST* HD 25 HEAT TRANSFER FLUID, DYED

Product Code: 44030

Effective Date: 08/03/04

Date Printed: 08/04/04

MSD: 004984

The Dow Chemical Company, Midland, MI 48674

Customer Information Center: 800-258-2436

2. COMPOSITION/INFORMATION ON INGREDIENTS

| | | | |
|-----------------------|------|------|-------------|
| Propylene glycol | | CAS# | |
| 000057-55-6 | 25% | | |
| Dipotassium phosphate | | CAS# | 007758-11-4 |
| <5% | | | |
| Deionized water | | CAS# | |
| 007732-18-5 | <75% | | |

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

* Clear yellow liquid. Odorless. Avoid temperatures above 350 F, *

* (177 C). *

POTENTIAL HEALTH EFFECTS (See Section 11 for toxicological data.)

EYE: May cause slight temporary eye irritation. Corneal injury is unlikely.

SKIN: Prolonged contact is essentially nonirritating to skin. Prolonged skin contact is unlikely to result in absorption of harmful amounts. Repeated contact may cause flaking and softening of skin.

INGESTION: Very low toxicity if swallowed. Harmful effects not anticipated from swallowing small amounts.

INHALATION: At room temperature, exposure to vapor is minimal due to low volatility. Mist may cause irritation of upper respiratory tract (nose and throat).

* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

Product: DOWFROST* HD 25 HEAT TRANSFER FLUID, DYED

Product Code: 44030

Effective Date: 08/03/04 Date Printed: 08/04/04 MSD: 004984

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: In rare cases, repeated excessive exposure to propylene glycol may cause central nervous system effects.

CANCER INFORMATION: Did not cause cancer in laboratory animals.

TERATOLOGY (BIRTH DEFECTS): Contains component(s) which did not cause birth defects or any other fetal effects in lab animals. The component(s) is/are propylene glycol.

REPRODUCTIVE EFFECTS: Contains component(s) which did not interfere with reproduction in animal studies. Contains component(s) which did not interfere with fertility in animal studies. The component(s) is/are propylene glycol.

4. FIRST AID

EYES: Flush eyes thoroughly with water for several minutes. Remove contact lenses after initial 1-2 minutes and continue flushing for several additional minutes. If effects occur, consult a physician, preferably an ophthalmologist.

SKIN: Wash skin with plenty of water.

INGESTION: No emergency medical treatment necessary.

INHALATION: Move person to fresh air; if effects occur, consult a physician.

NOTE TO PHYSICIAN: No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT: None

METHOD USED: TCC

AUTOIGNITION TEMPERATURE: Not determined

FLAMMABILITY LIMITS

LFL: Not determined

UFL: Not determined

HAZARDOUS COMBUSTION PRODUCTS: Under fire conditions some components of this product may decompose. The smoke may contain

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Unidentified toxic and/or irritating compounds. Hazardous combustion products may include and are not limited to carbon monoxide, carbon dioxide.

OTHER FLAMMABILITY INFORMATION: This material will not burn until the water has evaporated. Residue can burn. Spills of these organic liquids on hot fibrous insulations may lead to lowering of the auto ignition temperatures possibly resulting in spontaneous combustion.

EXTINGUISHING MEDIA: To extinguish combustible residues of this product use water fog, carbon dioxide, dry chemical or foam. Alcohol resistant foams (ATC type) are preferred if available. General purpose synthetic foams (including AFFF) or protein foams may function, but much less effectively.

MEDIA TO BE AVOIDED: Do not use direct water stream.

FIRE FIGHTING INSTRUCTIONS: Keep people away. Isolate fire area and deny unnecessary entry. To extinguish combustible residues of this product use water fog, carbon dioxide, dry chemical, or foam. Fight fire from protected location or safe distance. Consider use of unmanned hose holder or monitor nozzles. Use water spray to cool fire exposed containers and fire affected zone until fire is out and danger of re-ignition has passed. Immediately withdraw all personnel from area in case of rising sound from venting safety device or discoloration of the container. Move container from fire area if this is possible without hazard.

PROTECTIVE EQUIPMENT FOR FIRE FIGHTERS: Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, pants, boots, and gloves). If protective equipment is not available or not used, fight fire from a protected location or safe distance.

6. ACCIDENTAL RELEASE MEASURES (See Section 15 for Regulatory Information)

PROTECT PEOPLE: Use appropriate safety equipment. For additional information, refer to Section 8, Exposure Controls/Personal Protection.

PROTECT THE ENVIRONMENT: Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. See Section 12, Ecological

* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

Product: DOWFROST* HD 25 HEAT TRANSFER FLUID, DYED

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Information.

CLEAN-UP: See Section 13, Disposal Considerations.

7. HANDLING AND STORAGE HANDLING: See Section 8, Exposure Controls/Personal Protection.

STORAGE: See Section 10, Stability and Reactivity.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines.

PERSONAL PROTECTIVE EQUIPMENT

EYE/FACE PROTECTION: Use safety glasses.

SKIN PROTECTION: No precautions other than clean body-covering clothing should be needed. Use gloves chemically resistant to this material.

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guideline. When respiratory protection is required for certain operations, use an approved air-purifying respirator. In dusty or misty atmospheres, use an approved particulate respirator.

EXPOSURE GUIDELINES: Propylene glycol: AIHA WEEL is 10 mg/m³ for total vapor and aerosol.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE: Clear yellow liquid

ODOR: Odorless

VAPOR PRESSURE: 17 mmHg @ 20C, 68F

VAPOR DENSITY: >1

BOILING POINT: 214 deg F

SOLUBILITY IN WATER/MISCIBILITY: Complete

SPECIFIC GRAVITY OR DENSITY: 1.025 @ 25/25C

10. STABILITY AND REACTIVITY CHEMICAL STABILITY: Thermally stable at typical use temperatures.

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Product: DOWFROST* HD 25 HEAT TRANSFER FLUID, DYED

Product Code: 44030

Effective Date: 08/03/04 Date Printed: 08/04/04 MSD: 004984

CONDITIONS TO AVOID: Avoid temperatures above 350 F (177 C).

Some components of this product can degrade at elevated temperatures.

INCOMPATIBILITY WITH OTHER MATERIALS: Avoid contact with oxidizing materials. Avoid contact with strong acids.

HAZARDOUS DECOMPOSITION PRODUCTS: Hazardous decomposition products depend upon temperature, air supply and the presence of other materials.

HAZARDOUS POLYMERIZATION: Will not occur.

11. TOXICOLOGICAL INFORMATION (See Section 3 for Potential Health Effects. For detailed toxicological data, write or call the address or non-emergency number shown in Section 1)

SKIN: The LD50 for skin absorption in rabbits in >10,000 mg/kg.

INGESTION: The oral LD50 for female rats is 20,300 mg/kg.

MUTAGENICITY: In vitro mutagenicity studies were negative. Animal mutagenicity studies were negative.

12. ECOLOGICAL INFORMATION (For detailed Ecological data, write or call the address or non-emergency number shown in Section 1)

ENVIRONMENTAL FATE

MOVEMENT & PARTITIONING: Based largely or completely on data for major component(s). Bioconcentration potential is low (BCF less than 100 or Log Pow less than 3). Potential for mobility in soil is very high (Koc between 0 and 50).

DEGRADATION & PERSISTENCE: Based largely or completely on data for major component(s). Material is readily biodegradable. Passes OECD test(s) for ready biodegradability. Degradation is expected in the atmospheric environment within minutes to hours.

ECOTOXICITY: Based largely or completely on data for major component(s). Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50 >100 mg/L in most sensitive species).

13. DISPOSAL CONSIDERATIONS (See Section 15 for Regulatory Information)

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Product: DOWFROST* HD 25 HEAT TRANSFER FLUID, DYED

Product Code: 44030

Effective Date: 08/03/04 Date Printed: 08/04/04 MSD: 004984

DISPOSAL: DO NOT DUMP INTO ANY SEWERS, ON THE GROUND OR INTO ANY BODY OF WATER. All disposal methods must be in compliance with all Federal, State/Provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator.

THE DOW CHEMICAL COMPANY HAS NO CONTROL OVER THE MANAGEMENT PRACTICES OR MANUFACTURING PROCESSES OF PARTIES HANDLING OR USING THIS MATERIAL. THE INFORMATION PRESENTED HERE PERTAINS ONLY TO THE PRODUCT AS SHIPPED IN ITS INTENDED CONDITION AS DESCRIBED IN MSDS SECTION 2 (Composition/Information On Ingredients).

FOR UNUSED & UNCONTAMINATED PRODUCT, the preferred options include sending to a licensed, permitted: recycler, reclaimer, incinerator or other thermal destruction device.

As a service to its customers, Dow can provide names of information resources to help identify waste management companies and other facilities which recycle, reprocess or manage chemicals or plastics, and that manage used drums. Telephone Dow's Customer Information Center at 800-258-2436 or 989-832-1556 for further details.

14. TRANSPORT INFORMATION

DEPARTMENT OF TRANSPORTATION (D.O.T.): For D.O.T. regulatory information, if required, consult transportation regulations, product shipping papers or contact your Dow representative.

15. REGULATORY INFORMATION (Not meant to be all-inclusive--selected regulations represented)

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations. See other sections for health and safety information.

U.S. REGULATIONS =====

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Product: DOWFROST* HD 25 HEAT TRANSFER FLUID, DYED

Product Code: 44030

Effective Date: 08/03/04 Date Printed: 08/04/04 MSD: 004984

REGULATORY INFORMATION (CONTINUED)

SARA 313 INFORMATION: To the best of our knowledge, this product contains no chemical subject to SARA Title III Section 313 supplier notification requirements.

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

Not to have met any hazard category

TOXIC SUBSTANCES CONTROL ACT (TSCA):

All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

STATE RIGHT-TO-KNOW: The following product components are cited on certain state lists as mentioned. Non-listed components may be shown in the composition section of the MSDS.

CHEMICAL NAME CAS NUMBER LIST

1,2-PROPANEDIOL 000057-55-6 PA1

PA1=Pennsylvania Hazardous Substance (present at greater than or equal to 1.0%).

OSHA HAZARD COMMUNICATION STANDARD:

This product is not a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

16. OTHER INFORMATION

* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

Product: DOWFROST* HD 25 HEAT TRANSFER FLUID, DYED

Product Code: 44030

Effective Date: 08/03/04 Date Printed: 08/04/04 MSD: 004984

MSDS STATUS: Revised Section 8 (Exposure Guidelines).

* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY The Information Herein Is Given In Good Faith, But No Warranty, Express Or Implied, Is Made. Consult The Dow Chemical Company For Further Information.

MSDS FOR COOLANTS

MSDS FOR ETHYLENE GLYCOL

ETHYLENE GLYCOL

MSDS Number: E5125 --- Effective Date: 02/25/99

1. PRODUCT IDENTIFICATION

Synonyms: 1,2-Ethanediol; glycol; 1,2-Dihydroxyethane;
Ethylene Alcohol; Ethylene Dihydrate

CAS No.: 107-21-1

Molecular Weight: 62.07

Chemical Formula: CH₂OHCH₂OH

Product Codes:

J.T. Baker: 5387, 5845, 9140, 9298, 9300, 9346, 9349, 9356,
L715

Mallinckrodt: 5001, 5037

2. COMPOSITION/INFORMATION ON INGREDIENTS

| Ingredient | CAS No | Percent | Hazardous |
|-----------------|----------|-----------|-----------|
| Ethylene Glycol | 107-21-1 | 99 - 100% | Yes |

3. HAZARDS IDENTIFICATION

Emergency Overview

-----!
HARMFUL OR FATAL IF SWALLOWED. HARMFUL

IF INHALED OR ABSORBED THROUGH SKIN. MAY CAUSE ALLERGIC SKIN REACTION. MAY CAUSE IRRITATION TO SKIN, EYES, AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.

J.T. Baker SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate

Flammability Rating: 1 - Slight

Reactivity Rating: 1 - Slight

Contact Rating: 2 - Moderate

Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

Storage Color Code: Orange (General Storage)

POTENTIAL HEALTH EFFECTS

Inhalation:

Vapor inhalation is generally not a problem unless heated or misted. Exposure to vapors over an extended time period has caused throat irritation and headache. May cause nausea, vomiting, dizziness and drowsiness. Pulmonary edema and central nervous system depression may also develop. When heated or misted, has produced rapid, involuntary eye movement and coma.

Ingestion:

Initial symptoms in massive dosage parallel alcohol intoxication, progressing to CNS depression, vomiting, headache, rapid respiratory and heart rate, lowered blood pressure, stupor, collapse, and unconsciousness with convulsions. Death from respiratory arrest or cardiovascular collapse may follow. Lethal dose in humans: 100 ml (3-4 ounces).

Skin Contact:

Minor skin irritation and penetration may occur.

Eye Contact:

Splashes may cause irritation, pain, and eye damage.

Chronic Exposure:

Repeated small exposures by any route can cause severe kidney problems. Brain damage may also occur. Skin allergy can develop. May damage the developing fetus.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders, eye problems, or impaired liver, kidney, or respiratory function may be more susceptible to the effects of this substance.

4. FIRST AID MEASURES

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:

Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get

medical attention.

Skin Contact:

Remove any contaminated clothing. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:

Give sodium bicarbonate intravenously to treat acidosis. Urinalysis may show low specific gravity, proteinuria, pyuria, cylindruria, hematuria, calcium oxalate, and hippuric acid crystals. Ethanol can be used in antidotal treatment but monitor blood glucose when administering ethanol because it can cause hypoglycemia. Consider infusion of a diuretic such as mannitol to help prevent or control brain edema and hemodialysis to remove ethylene glycol from circulation.

5. FIRE FIGHTING MEASURES

Fire:

Flash point: 111C (232F) CC

Autoignition temperature: 398C (748F)

Flammable limits in air % by volume:

l_{el}: 3.2; u_{el}: 15.3

Slight to moderate fire hazard when exposed to heat or flame.

Explosion:

Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Containers may explode when involved in a fire.

Fire Extinguishing Media:

Dry chemical, foam or carbon dioxide. Water or foam may cause frothing. Water spray may be used to extinguish surrounding fire and cool exposed containers. Water spray will also reduce fume and irritant gases.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full-face piece operated in the pressure demand or other positive pressure mode. Toxic gases and vapors may be released if involved in a fire.

6. ACCIDENTAL RELEASE MEASURES

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry

sand, earth), and place in a chemical waste container. Do not use combustible materials, such as sawdust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. HANDLING AND STORAGE

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Separate from acids and oxidizing materials. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Airborne Exposure Limits:

-OSHA Permissible Exposure Limit (PEL):

50 ppm Ceiling

-ACGIH Threshold Limit Value (TLV):

50 ppm Ceiling (vapor)

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, a half-face respirator with an organic vapor cartridge and particulate filter (NIOSH type P95 or R95 filter) may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece respirator with an organic vapor cartridge and particulate filter (NIOSH P100 or R100 filter) may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. Please note that N series filters are not recommended for this material. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. **WARNING:** Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear protective gloves and clean body-covering clothing.

Eye Protection:

Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:

Clear oily liquid.

Odor:

Odorless.

Solubility:

Miscible in water.

Specific Gravity:

1.1 @20C/4C

pH:

No information found.

% Volatiles by volume @ 21C (70F):

100

Boiling Point:

197.6C (388F)

Melting Point:

-13C (9F)

Vapor Density (Air=1):

2.14

Vapor Pressure (mm Hg):

0.06 @ 20C (68F)

Evaporation Rate (BuAc=1):

No information found.

10. STABILITY AND REACTIVITY

Stability:

Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

Carbon dioxide and carbon monoxide may form when heated to decomposition. May produce acrid smoke and irritating fumes when heated to decomposition.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Strong oxidizing agents. Reacts violently with chlorosulfonic acid, oleum, sulfuric acid, perchloric acid. Causes ignition at room temperature with chromium trioxide, potassium permanganate and sodium peroxide; causes ignition at 212F(100C) with ammonium dichromate, silver chlorate, sodium chloride and uranyl nitrate.

Conditions to Avoid:

Heat, flames, ignition sources, water (absorbs readily) and incompatibles.

11. TOXICOLOGICAL INFORMATION

Toxicological Data:

Oral rat LD50: 4700 mg/kg; skin rabbit LD50: 9530 mg/kg.

Irritation - skin rabbit: 555mg(open), mild; eye rabbit:

500mg/24H, mild.

Investigated as a tumorigen, mutagen, reproductive effector.

Reproductive Toxicity:

Has shown teratogenic effects in laboratory animals.

| Ingredient | ---NTP Carcinogen--- | | IARC Category |
|----------------------------|----------------------|-------------|---------------|
| | Known | Anticipated | |
| Ethylene Glycol (107-21-1) | No | No | None |

12. ECOLOGICAL INFORMATION

Environmental Fate:

When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is not expected to evaporate significantly. When released into water, this material is expected to readily biodegrade. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material is not expected to significantly bioaccumulate. This material has a log octanol-water partition coefficient of less than 3.0. When released into water, this material is not expected to evaporate significantly. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.

Environmental Toxicity:

The LC50/96-hour values for fish are over 100 mg/l.

13. DISPOSAL CONSIDERATIONS

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. TRANSPORT INFORMATION

Not regulated.

15. REGULATORY INFORMATION

-----\Chemical Inventory Status - Part 1\-----
 Ingredient TSCA EC Japan Australia

 Ethylene Glycol (107-21-1) Yes Yes Yes Yes

-----\Chemical Inventory Status - Part 2\-----
 --Canada--
 Ingredient Korea DSL NDSL Phil.

 Ethylene Glycol (107-21-1) Yes Yes No Yes

-----\Federal, State & International Regulations - Part 1\-----
 -SARA 302- -----SARA 313-----
 Ingredient RQ TPQ List Chemical Catg.

 Ethylene Glycol (107-21-1) No No Yes No

-----\Federal, State & International Regulations - Part 2\-----
 -RCRA- -TSCA-
 Ingredient CERCLA 261.33 8(d)

 Ethylene Glycol (107-21-1) 5000 No No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
 SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
 Reactivity: No (Pure / Liquid)

Australian Hazchem Code: No information found.

Poison Schedule: No information found.

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. OTHER INFORMATION

NFPA Ratings: Health: **1** Flammability: **1** Reactivity: **0**

Label Hazard Warning:

WARNING! HARMFUL OR FATAL IF SWALLOWED.
 HARMFUL IF INHALED OR ABSORBED THROUGH
 SKIN. MAY CAUSE ALLERGIC SKIN REACTION. MAY
 CAUSE IRRITATION TO SKIN, EYES, AND
 RESPIRATORY TRACT. AFFECTS CENTRAL
 NERVOUS SYSTEM.

Label Precautions:

Do not breathe vapor or mist.
 Use only with adequate ventilation.
 Keep container closed.
 Avoid contact with eyes, skin and clothing.
 Wash thoroughly after handling.

Label First Aid:

If inhaled, remove to fresh air. If not breathing, give artificial

respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. Call a physician if irritation develops or persists. If swallowed, give water or milk to drink and induce vomiting. Never give anything by mouth to an unconscious person. In all cases call a physician.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document includes: 8.

Disclaimer:

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MSDS FOR ETHYL ALCOHOL

Aldrich Chemical Co., Inc.

Valid 08/2001 - 10/2001

1001 West St. Paul
Milwaukee, WI 53233 USA
Tel: 414-273-3850

M A T E R I A L S A F E T Y D A T A S H E E T

SECTION 1. ----- CHEMICAL IDENTIFICATION-----

CATALOG #: 187380
NAME: ETHYL ALCOHOL, DENATURED

SECTION 2. ----- COMPOSITION/INFORMATION ON INGREDIENTS -----

CAS #: 64-17-5
MF: C₂H₆O
EC NO: 200-578-6

ADDITIONAL INFORMATION

CONTAINS METHYL ALCOHOL, CHEMICAL ABSTRACTS REGISTRY NUMBER 67-56-1.
CONTAINS ETHYL ACETATE, CHEMICAL ABSTRACTS REGISTRY NUMBER 141-78-6.
CONTAINS 4-METHYL-2-PENTANONE, CHEMICAL ABSTRACTS REGISTRY NUMBER 108-10-1.
CONTAINS HEPTANE, CHEMICAL ABSTRACTS REGISTRY NUMBER 142-82-5.

SYNONYMS

ABSOLUTE ETHANOL * AETHANOL (GERMAN) * AETHYLALKOHOL (GERMAN) *
ALCOHOL * ALCOHOL, ANHYDROUS * ALCOHOL DEHYDRATED * ALCOOL ETHYLIQUE
(FRENCH) * ALCOOL ETILICO (ITALIAN) * ALGRAIN * ALKOHOL (GERMAN) *
ALKOHOLU ETYLOWEGO (POLISH) * ANHYDROL * COLOGNE SPIRIT * ETANOLO
(ITALIAN) * ETHANOL (ACGIH:OSHA) * ETHYL ALCOHOL (DOT:OSHA) * ETHYL
ALCOHOL ANHYDROUS * ETHYL HYDRATE * ETHYL HYDROXIDE * ETYLOWY
ALKOHOL
(POLISH) * FERMENTATION ALCOHOL * GRAIN ALCOHOL * JAYSOL * JAYSOL S *
METHYLCARBINOL * MOLASSES ALCOHOL * NCI-C03134 * POTATO ALCOHOL * SD
ALCOHOL 23-HYDROGEN * SPIRITS OF WINE * SPIRT * TECSOL *

SECTION 3. ----- HAZARDS IDENTIFICATION -----

LABEL PRECAUTIONARY STATEMENTS

FLAMMABLE (USA)
HIGHLY FLAMMABLE (EU)
TOXIC
HARMFUL BY INHALATION AND IF SWALLOWED.
IRRITATING TO EYES, RESPIRATORY SYSTEM AND SKIN.
TARGET ORGAN(S):
NERVES
EYES
LIVER, KIDNEYS
KEEP CONTAINER TIGHTLY CLOSED.
KEEP AWAY FROM SOURCES OF IGNITION - NO SMOKING.

TAKE PRECAUTIONARY MEASURES AGAINST STATIC DISCHARGES.

DO NOT BREATHE VAPOR.

WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.

KEEP TIGHTLY CLOSED.

HYGROSCOPIC

SECTION 4. ----- FIRST-AID MEASURES-----

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.

IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS. CALL A PHYSICIAN.

WASH CONTAMINATED CLOTHING BEFORE REUSE.

SECTION 5. ----- FIRE FIGHTING MEASURES -----

EXTINGUISHING MEDIA

CARBON DIOXIDE, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.

SPECIAL FIREFIGHTING PROCEDURES

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

USE WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS.

FLAMMABLE LIQUID.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS

VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.

SECTION 6. ----- ACCIDENTAL RELEASE MEASURES-----

SHUT OFF ALL SOURCES OF IGNITION.

EVACUATE AREA.

WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.

ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.

USE NONSPARKING TOOLS.

VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

SECTION 7. ----- HANDLING AND STORAGE-----

REFER TO SECTION 8.

SECTION 8. ----- EXPOSURE CONTROLS/PERSONAL PROTECTION-----

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.

USE ONLY IN A CHEMICAL FUME HOOD.

SAFETY SHOWER AND EYE BATH.

DO NOT BREATHE VAPOR.

DO NOT GET IN EYES, ON SKIN, ON CLOTHING.

AVOID PROLONGED OR REPEATED EXPOSURE.

WASH THOROUGHLY AFTER HANDLING.

KEEP TIGHTLY CLOSED.

KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.

STORE IN A COOL DRY PLACE.

SECTION 9. ----- PHYSICAL AND CHEMICAL PROPERTIES -----

PHYSICAL PROPERTIES

BOILING POINT: 78 C

MELTING POINT: -130 C

FLASHPOINT 48F
8.88C

EXPLOSION LIMITS IN AIR:

UPPER 24.5%

LOWER 3.3%

AUTOIGNITION TEMPERATURE: 683 F

VAPOR PRESSURE: 44.6MM 20 C

SPECIFIC GRAVITY: 0.789

VAPOR DENSITY: 1.59

SECTION 10. -----STABILITY AND REACTIVITY -----

STABILITY

STABLE.

INCOMPATIBILITIES

OXIDIZING AGENTS

PEROXIDES

ACIDS

ACID CHLORIDES

ACID ANHYDRIDES

ALKALI METALS

AMMONIA

MOISTURE

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

TOXIC FUMES OF:

CARBON MONOXIDE, CARBON DIOXIDE

SECTION 11. ----- TOXICOLOGICAL INFORMATION -----

ACUTE EFFECTS

HARMFUL IF INHALED OR SWALLOWED.

MAY BE HARMFUL IF ABSORBED THROUGH THE SKIN.

VAPOR OR MIST IS IRRITATING TO THE EYES, MUCOUS MEMBRANES AND UPPER
RESPIRATORY TRACT.

CAUSES SKIN IRRITATION.

CAN CAUSE CNS DEPRESSION.

EXPOSURE CAN CAUSE:

NAUSEA, DIZZINESS AND HEADACHE

GASTROINTESTINAL DISTURBANCES

MAY CAUSE CONVULSIONS.

ANEMIA

NARCOTIC EFFECT

CONTACT WITH EYES CAN CAUSE REDNESS, TEARING, AND BLURRED VISION.

PROLONGED OR REPEATED CONTACT WITH SKIN CAN CAUSE DEFATTING AND
DERMATITIS.

CHRONIC EFFECTS

TARGET ORGAN(S):

NERVES

EYES

LIVER

KIDNEYS

BLOOD

HEART

TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

RTECS #: KQ6300000

ETHYL ALCOHOL

IRRITATION DATA

| | |
|-----------------------------|---------------------|
| SKN-RBT 400 MG OPEN MLD | UCDS** 7/22/1970 |
| SKN-RBT 20 MG/24H MOD | 85JCAE -,189,1986 |
| EYE-RBT 500 MG SEV | AJOPAA 29,1363,1946 |
| EYE-RBT 500 MG/24H MLD | 85JCAE -,189,1986 |
| EYE-RBT 100 MG/4S RINSE MOD | FCTOD7 20,573,1982 |

TOXICITY DATA

| | |
|----------------------------|----------------------|
| ORL-CHD LDLO:2 GM/KG | ATXKA8 17,183,1958 |
| ORL-HMN LDLO:1400 MG/KG | NPIRI* 1,44,1974 |
| SCU-INF LDLO:19440 MG/KG | AJCPAI 5,466,1935 |
| ORL-RAT LD50:7060 MG/KG | TXAPA9 16,718,1970 |
| IHL-RAT LC50:20000 PPM/10H | NPIRI* 1,44,1974 |
| IPR-RAT LD50:3600 UG/KG | PHMGBN 2,27,1969 |
| IVN-RAT LD50:1440 MG/KG | TXAPA9 18,60,1971 |
| IAT-RAT LD50:11 MG/KG | TXAPA9 18,60,1971 |
| ORL-MUS LD50:3450 MG/KG | GISAAA 32(3),31,1967 |
| IHL-MUS LC50:39 GM/M3/4H | GTPZAB 26(8),53,1982 |
| IPR-MUS LD50:528 MG/KG | STRAAA 127,245,1965 |
| SCU-MUS LD50:8285 MG/KG | FAONAU 48A,99,1970 |
| IVN-MUS LD50:1973 MG/KG | HBTXAC 1,128,1955 |
| ORL-RBT LD50:6300 MG/KG | HBTXAC 1,130,1955 |
| IPR-RBT LD50:963 MG/KG | EVHPAZ 61,321,1985 |
| IVN-RBT LD50:2374 MG/KG | EVHPAZ 61,321,1985 |
| ORL-GPG LD50:5560 MG/KG | JIHTAB 23,259,1941 |
| IPR-GPG LD50:3414 MG/KG | EVHPAZ 61,321,1985 |
| IPR-HAM LD50:5068 MG/KG | EVHPAZ 61,321,1985 |
| IPR-MAM LD50:4300 MG/KG | TXAPA9 13,358,1968 |

TARGET ORGAN DATA

BEHAVIORAL (SLEEP)

BEHAVIORAL (CHANGE IN MOTOR ACTIVITY)

BEHAVIORAL (ATAXIA)

BEHAVIORAL (ANTIPSYCHOTIC)

BEHAVIORAL (HEADACHE)

BEHAVIORAL (CHANGE IN PSYCHOPHYSIOLOGICAL TESTS)

LUNGS, THORAX OR RESPIRATION (CHRONIC PULMONARY EDEMA OR CONGESTION)

LUNGS, THORAX OR RESPIRATION (DYSPNAE)

LUNGS, THORAX OR RESPIRATION (OTHER CHANGES)

GASTROINTESTINAL (ALTERATION IN GASTRIC SECRETION)

GASTROINTESTINAL (HYPERMOTILITY, DIARRHEA)

GASTROINTESTINAL (NAUSEA OR VOMITING)

GASTROINTESTINAL (OTHER CHANGES)

LIVER (FATTY LIVER DEGENERATION)

LIVER (TUMORS)

ENDOCRINE (CHANGE IN GONADOTROPINS)

ENDOCRINE (OTHER CHANGES)

BLOOD (OTHER CHANGES)
BLOOD (LYMPHOMA INCLUDING HODGKIN'S DISEASE)
PATERNAL EFFECTS (TESTES, EPIDIDYMISS, SPERM DUCT)
EFFECTS ON FERTILITY (FEMALE FERTILITY INDEX)
EFFECTS ON FERTILITY (MALE FERTILITY INDEX)
EFFECTS ON FERTILITY (POST-IMPLANTATION MORTALITY)
EFFECTS ON FERTILITY (OTHER MEASURES OF FERTILITY)
EFFECTS ON EMBRYO OR FETUS (EXTRA EMBRYONIC STRUCTURES)
EFFECTS ON EMBRYO OR FETUS (CYTOLOGICAL CHANGES)
EFFECTS ON EMBRYO OR FETUS (FETOTOXICITY)
EFFECTS ON EMBRYO OR FETUS (FETAL DEATH)
EFFECTS ON EMBRYO OR FETUS (OTHER EFFECTS TO EMBRYO OR FETUS)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (EYE, EAR)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (CRANIOFACIAL)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (MUSCULOSKELETAL SYSTEM)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (RESPIRATORY SYSTEM)
EFFECTS ON NEWBORN (GROWTH STATISTICS)
TUMORIGENIC (EQUIVOCAL TUMORIGENIC AGENT BY RTECS CRITERIA)
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES
(RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR
COMPLETE INFORMATION.

SECTION 12. ----- ECOLOGICAL INFORMATION -----
DATA NOT YET AVAILABLE.

SECTION 13. ----- DISPOSAL CONSIDERATIONS -----
BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND
SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS MATERIAL IS HIGHLY
FLAMMABLE.
OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. ----- TRANSPORT INFORMATION -----
CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. ----- REGULATORY INFORMATION -----

EUROPEAN INFORMATION

EC INDEX NO: 603-002-00-5

HIGHLY FLAMMABLE

TOXIC

R 11

HIGHLY FLAMMABLE.

R 20/22

HARMFUL BY INHALATION AND IF SWALLOWED.

S 7

KEEP CONTAINER TIGHTLY CLOSED.

S 16

KEEP AWAY FROM SOURCES OF IGNITION - NO SMOKING.

S 24

AVOID CONTACT WITH SKIN.

S 45

IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE
IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).

TLV AND SOURCE

FOR METHYL ALCOHOL - SKIN:

ACGIH TLV-TWA: 200 PPM (260 MG/M3); STEL: 250 PPM (310 MG/M3).

OSHA PEL: 8 H TWA 200 PPM (260 MG/M3); STEL: 250 PPM (310 MG/M3).

FOR ETHYL ACETATE:

ACGIH TLV-TWA: 400 PPM (1440 MG/M3).

OSHA PEL: 8H TWA 400 PPM (1400 MG/M3).

FOR 4-METHYL-2-PENTANONE (METHYL ISOBUTYL KETONE):

ACGIH TLV-TWA: 50 PPM; STEL: 75 PPM.

OSHA PEL FINAL: 8H TWA 50 PPM (205 MG/M3); STEL: 75 PPM (300 MG/M3).

FOR HEPTANE:

ACGIH TLV-TWA: 400 PPM (1640 MG/M3); STEL: 500 PPM (2050 MG/M3).

OSHA PEL: 8H TWA 400 PPM; STEL: 500 PPM.

REVIEWS, STANDARDS, AND REGULATIONS

OEL=MAK

ACGIH TLV-NOT CLASSIFIABLE AS A HUMAN CARCINOGEN DTLVS* TLV/BEI,1999

ACGIH TLV-TWA 1000 PPM DTLVS* TLV/BEI,1999

IARC CANCER REVIEW:ANIMAL INADEQUATE EVIDENCE IMEMDT 44,35,1988

EPA FIFRA 1988 PESTICIDE SUBJECT TO REGISTRATION OR RE-REGISTRATION

FEREAC 54,7740,1989

MSHA STANDARD-AIR:TWA 1000 PPM (1900 MG/M3)

DTLVS* 3,103,1971

OSHA PEL (GEN INDU):8H TWA 1000 PPM (1900 MG/M3)

CFRGBR 29,1910.1000,1994

OSHA PEL (CONSTRUC):8H TWA 1000 PPM (1900 MG/M3)

CFRGBR 29,1926.55,1994

OSHA PEL (SHIPYARD):8H TWA 1000 PPM (1900 MG/M3)

CFRGBR 29,1915.1000,1993

OSHA PEL (FED CONT):8H TWA 1000 PPM (1900 MG/M3)

CFRGBR 41,50-204.50,1994

OEL-AUSTRALIA: TWA 1000 PPM (1900 MG/M3), JAN1993

OEL-AUSTRIA: MAK 1000 PPM (1900 MG/M3), JAN1999

OEL-BELGIUM: TWA 1000 PPM (1880 MG/M3), JAN1993

OEL-DENMARK: TWA 1000 PPM (1900 MG/M3), JAN1999

OEL-FINLAND: TWA 1000 PPM (1900 MG/M3), STEL 1250 PPM (2400 MG/M3),

JAN1999 OEL-FRANCE: VME 1000 PPM (1900 MG/M3), VLE 5000 PPM, JAN1999

OEL-GERMANY: MAK 1000 PPM (1900 MG/M3), JAN1999

OEL-HUNGARY: TWA 1000 MG/M3, STEL 3000 MG/M3, JAN1993

OEL-THE NETHERLANDS: MAC-TGG 500 PPM (950 MG/M3), JAN1999

OEL-NORWAY: TWA 500 PPM (950 MG/M3), JAN1999

OEL-THE PHILIPPINES: TWA 1000 PPM (1900 MG/M3), JAN1993

OEL-POLAND: MAC(TWA) 1000 MG/M3, MAC(STEL) 3000 MG/M3, JAN1999

OEL-RUSSIA: STEL 1000 MG/M3, JAN1993

OEL-SWEDEN: NGV 500 PPM (1000 MG/M3), KTV 1000PPM (1900 MG/M3), JAN1999

OEL-SWITZERLAND: MAK-W 1000 PPM (1900 MG/M3), JAN1999

OEL-THAILAND: TWA 1000 PPM (1900 MG/M3), JAN1993

OEL-TURKEY: TWA 1000 PPM (1900 MG/M3), JAN1993

OEL-UNITED KINGDOM: TWA 1000 PPM (1950 MG/M3), SEP2000

OEL IN ARGENTINA, BULGARIA, COLOMBIA, JORDAN, KOREA CHECK ACGIH TLV;

OEL IN NEW ZEALAND, SINGAPORE, VIETNAM CHECK ACGIH TLV

NIOSH REL TO ETHYL ALCOHOL-AIR:10H TWA 1000 PPM

NIOSH* DHHS #92-100,1992

NOHS 1974: HZD 31500; NIS 430; TNF 157709; NOS 242; TNE 2088926

NOES 1983: HZD 31500; NIS 334; TNF 86077; NOS 222; TNE 2069125; TFE
1014002

EPA GENETOX PROGRAM 1988, POSITIVE: RODENT DOMINANT LETHAL

EPA GENETOX PROGRAM 1988, NEGATIVE: ASPERGILLUS-FORWARD MUTATION;
SHE-CLONAL ASSAY

EPA GENETOX PROGRAM 1988, NEGATIVE: CELL TRANSFORM.-RLV F344 RAT EMBRYO

EPA GENETOX PROGRAM 1988, NEGATIVE: IN VITRO CYTOGENETICS-NONHUMAN;
MAMMALIAN MICRONUCLEUS

EPA GENETOX PROGRAM 1988, NEGATIVE: N CRASSA-ANEUPLOIDY; HISTIDINE
REVERSION-AMES TEST

EPA GENETOX PROGRAM 1988, NEGATIVE: IN VITRO SCE-HUMAN LYMPHOCYTES; IN
VITRO SCE-HUMAN

EPA GENETOX PROGRAM 1988, NEGATIVE: IN VITRO SCE-NONHUMAN; SPERM
MORPHOLOGY-MOUSE

EPA GENETOX PROGRAM 1988, NEGATIVE/LIMITED: CARCINOGENICITY-MOUSE/RAT

EPA TSCA SECTION 8(B) CHEMICAL INVENTORY

EPA TSCA SECTION 8(D) UNPUBLISHED HEALTH/SAFETY STUDIES

EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 2001

NIOSH ANALYTICAL METHOD, 1994: ETHANOL IN BLOOD, 8002

NIOSH ANALYTICAL METHOD, 1994: ALCOHOLS I, 1400

NTP CARCINOGENESIS STUDIES; ON TEST (TWO YEAR STUDIES), OCTOBER 2000

U.S. INFORMATION

4.7% METHANOL 67-56-1

1.0% METHYL ISOBUTYL KETONE 108-10-1

THESE PRODUCTS ARE SUBJECT TO SARA SECTION 313 REPORTING REQUIREMENTS.

SECTION 16. ----- OTHER INFORMATION-----

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO
BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. SIGMA, ALDRICH,
FLUKA SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING
OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR
PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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WARRANTY POLICY

This ThermoCube 200/265/300 or 400-Watt chiller is covered under a two-year parts and labor warrant. 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 warranted, 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.
- Employing pulse-width-modulated control at less than 1000 Hz.
- Operation of a power supply with a non-original enclosure or any replacement components. As well as voiding the warranty, these actions will also void the CE Mark (Switchback 6600 CE model power supply).
- 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.