

UC160-190

Ultra Compact Series - The Smallest Recirculating Chiller on the Planet



Product Manual

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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

UC160-190 (formerly named "Oasis") - All Models

meets the provisions of the directives:

2004/108/EC	EMC Directive
2006/95/EC	Voltage Directive
EN 61326-1: 2006	Emissions and Immunity
EN 61000-3-2: 2006	Harmonics Emissions
EN 61000-3-3: 2008	Voltage Fluctuations and Flicker
EN 61010-1: 3 rd Edition	Safety: Low Voltage Directive Safety requirements for electrical equipment for measurement, control, and laboratory use.

Lloyd F Wright Chief Technology Officer	
Date	October 22, 2013

SAFETY PRECAUTIONS AND SYMBOLS



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 opening the cover for any reason.

CAUTION

- * Never disassemble the chiller as irreparable damage may occur.
- * Never store the chiller over 60 °C.
- * Never operate the chiller in ambient temperatures of 40 °C or greater.
- * Never operate the chiller within 2 °C of the coolant's freezing point.
- * Never use alcohol (methanol, ethanol or isopropanol) based coolants.
- * Always use only proper coolants as specified in manual. Solid State Cooling Systems recommends Koolance LIQ-702CL-B (27% propylene glycol and water)
- * Never ship the chiller with coolant inside the liquid cold plate as freezing temperatures may be encountered which would damage the unit. Always pump all coolant out of the chiller prior to shipping.
- * Always match wetted materials (metal) to the wetted materials in your system. If your system has aluminum cold plates/tubing, use the standard UC160-190. If your system has copper cold plates/tubing, select the UC160-190 copper models. Stainless steel may be used with either material.

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.



UC160/UC170/UC180/UC190 THERMOELECTRIC CHILLER

PRODUCT Manual

SECTION 1 INTRODUCTION



The "Ultra Compact" UC160-190 recirculating chiller (formerly named "Oasis") utilizes thermoelectric technology to deliver between 160 and 190 Watts of cooling capacity without the use of compressors or refrigerants. With fewer moving parts, the system is highly reliable and energy efficient.

As the world's smallest, air cooled recirculating chiller, UC160-190 is the ideal solution for a variety of applications, including precision lasers, analytical equipment, medical equipment, lab equipment, low-light CCD cameras, microtiter testing, or any other application requiring precise, point of use temperature control. UC160-190 provides 500 ml/min of constant temperature coolant with a stability of $\pm 0.1^{\circ}\text{C}$.

The system is versatile and simple to operate. 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.

The chiller ships with the items listed below. Please locate them prior to discarding the shipping box.

- (1) UC160-190 Recirculating Liquid Chiller
- (1) 200 watt 13.5 VDC Table Top Power Supply
- (1) AC Line Cord
- (1) 250 ml Squirt Bottle
- (2) Valve quick disconnect fittings, 1/8th inch hose barb

SECTION 2

SPECIFICATIONS

Operating Range (Set Point):	Model UC160 or UC180: 2°C to 45°C Model UC170 or UC190: 10°C to 45°C
Ambient Temperature Range:	10°C to 40°C non-condensing
Stability / Repeatability:	±0.1°C with constant load (even near ambient)
Cooling Capacity (typical ¹):	Model UC160: 160 Watts @ 20°C in 20°C ambient air Model UC170: 170 Watts @ 20°C in 20°C ambient air Model UC180: 180 Watts @ 20°C in 20°C ambient air Model UC190: 190 Watts @ 20°C in 20°C ambient air
Noise Level (at 1 meter):	< 63 dBA
Coolant / Process Fluid:	Koolance (27% propylene glycol / water mix) or 27-50% ethylene glycol / water mix (contact SSCS for advice on other fluids)
Process Fluid Fittings:	1/8" female CPC quick connect with shut-off valve
Process Fluid Flow Rate:	~0.45 lpm @ 10 psi
Pump Options:	G3: Long life 500 ml/min @ 10 psig magnetically coupled gear pump G1: Original gear pump with 450 ml/min @ 10 psig flow
Tank Volume:	75 ml with level sensor (optional sealable tank cap)
Wetted Materials:	Aluminum + polymers or Copper + polymers
Dimensions (L x W x H):	7.5" x 5" x 7" (19cm x 13cm x 18cm)
Weight:	8 lbs (3.5 kg) [10 lbs (4.5 kg) with copper]
Power Input (external supply):	Universal: 100-240 VAC, 50/60 Hz, 2.8 amps max
Electrical Connections:	Plug in AC adaptor on 2 pin male connector
Power Consumption:	less than 200 Watts
Operating Voltage:	13.5 VDC, 15 amps max (less than 200W power consumption)
Controls:	Digital PID controller for heating and cooling
Communications:	Keypad or RS232 interface
Alarms	Temperature, fluid level, system or component failure (display, RS232 and dry contact)
Standards	TUV listed to UL, CAN/CSA and EN 61010-1, CE 61010-1, (optional upgrade for RoHS compliance)
Warranty	1 year

Note 1: Cooling capacities shown are typical. Actual cooling capacity may vary with configuration.

Figure 1
UC160-190 Cooling Capacity in 20°C Ambient

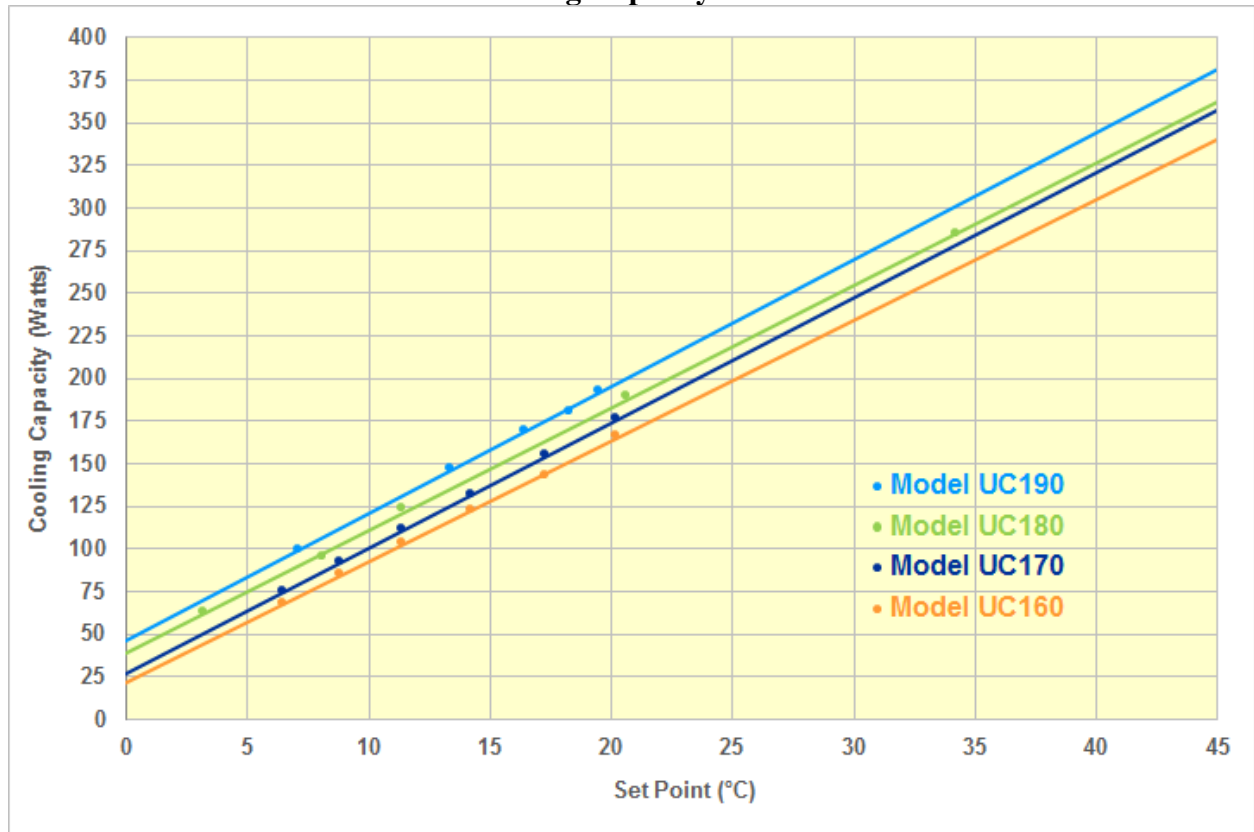
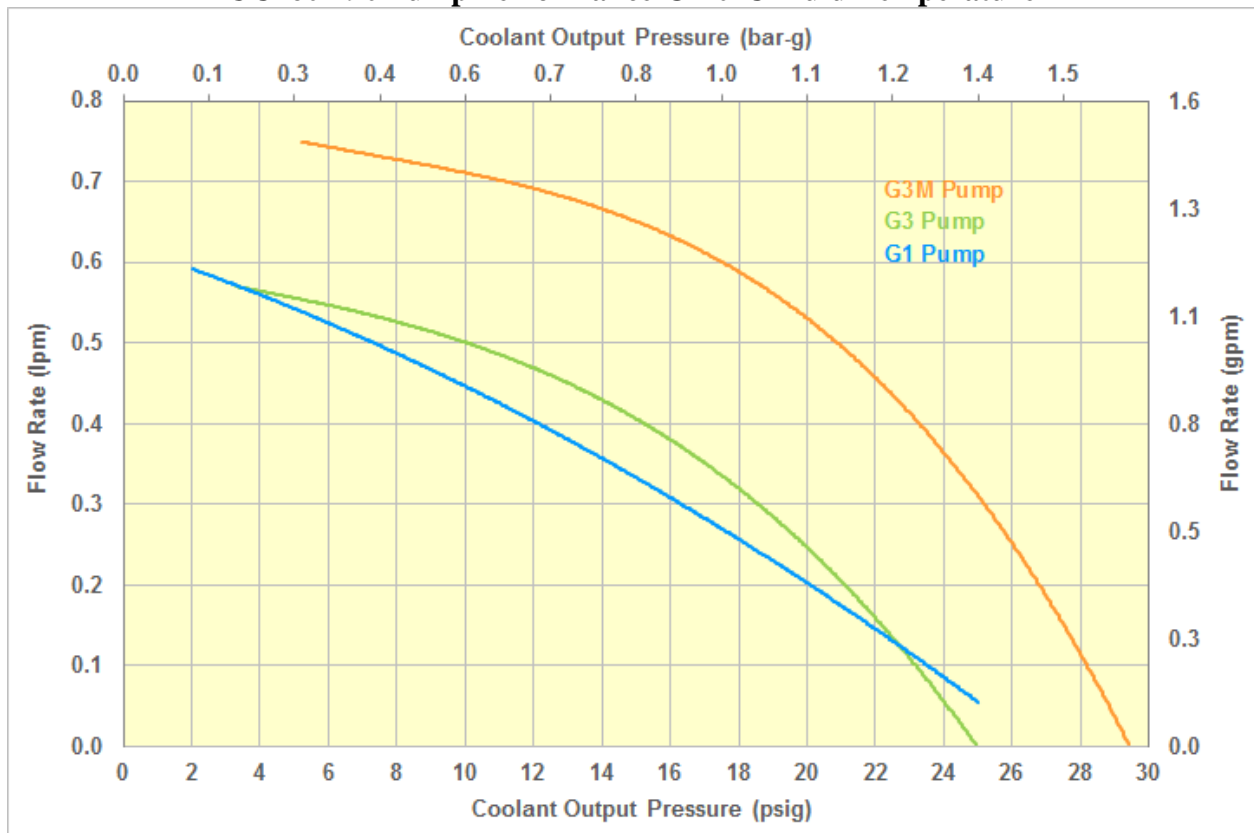


Figure 2
UC160-190 Pump Performance @ 20°C Fluid Temperature



Note: Pump to pump variation is +/- 10%.

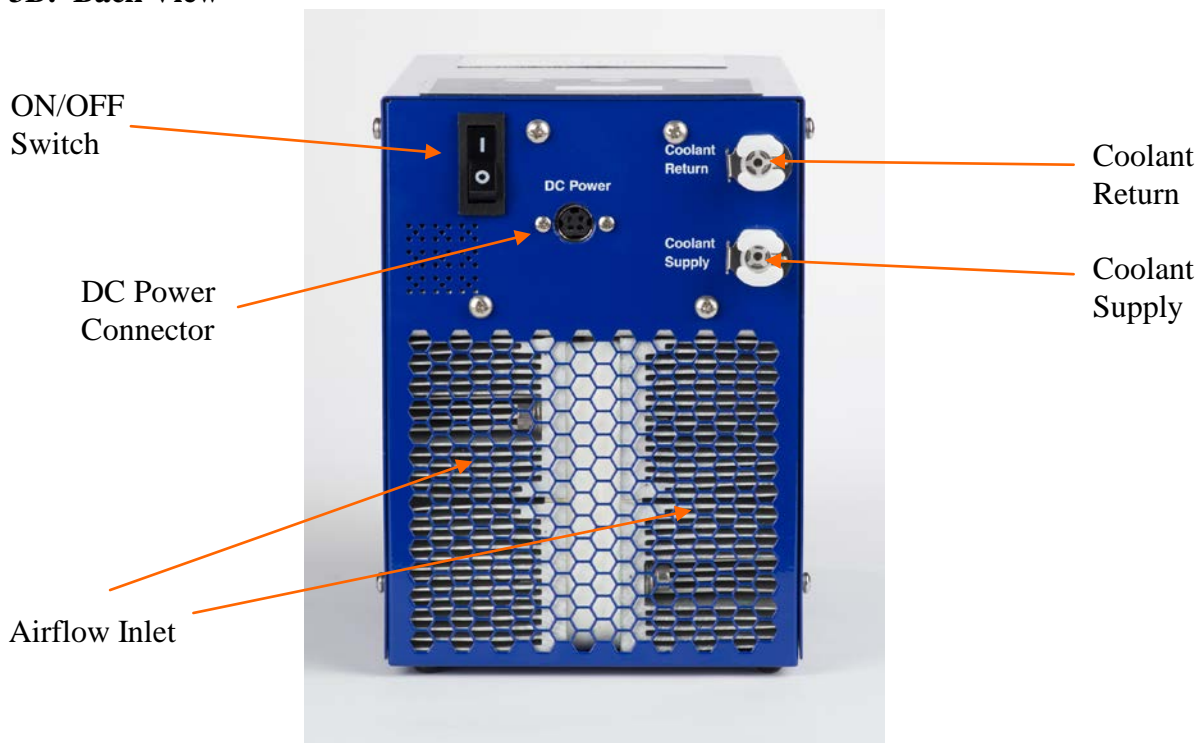
SECTION 3

HOOK UP

Figure 3A: Top View



Figure 3B: Back View



3.1 ELECTRICAL CONNECTIONS (SEE FIGURES 3A AND 3B)



WARNING

Electrical Shock
Hazard: Never Plug
in a Line Cord with
Wet Hands

Power: UC160-190 comes with a 200w 13.5VDC bench top power supply. Plug the DC output connector into the UC160-190 as shown in figure 3B.

The Kycon KPPX-4P has the following pin configuration:

Pin 1	13.5 VDC (+)
Pin 2	13.5 VDC (-)
Pin 3	13.5 VDC (+)
Pin 4	13.5 VDC (-)

A wide variety of power cords are available to support universal power operation:

Code	Country / Region	Part Number
-P1	USA/Canada	22-22333-1
-P2	Europe	22-22333-2
-P3	Japan	22-22333-3
-P4	UK	22-22333-4
-P5	Israel	22-22800-1
-P6	Australia	22-23213-1
-P7	Korean	22-23526-1
-P8	China (3 prong)	22-23661-1
-P9	Brazil	22-25122-1
-P10	India/South Africa Type D - 5A	16-23918-1
-P11	India/South Africa Type M - 15A	16-23918-2
-P20	IEC C13 to C14 39"	22-26026-1

Alarms: UC160-190 has one 250 VAC 1 amp dry contact relay to indicate a system alarm or temperature out of range. Connect to this dry contact on the 9-pin dsub connector as follows:

System/Temp Alarm: Pin 1
Alarm Signal Return: Pin 6

RS 232: UC160-190 comes with a RS-232 communication link. Connections are made via a 9-pin dsub connector as follows:

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

See Section 7 for details on the RS-232 protocol.

3.2 PLUMBING CONNECTIONS (SEE FIGURE 3A AND 3B)



CAUTION

Always match wetted materials to avoid potentially corroding your system or clogging the cold plates

The UC160-190 has two Colder Products compatible 1/8" valved quick disconnect coolant fittings. Two mating valved quick disconnect inserts are included with 1/8" ID hose barb fittings for convenience.

IMPORTANT NOTE: Always match wetted materials (metal) to the wetted materials in your system. If your system has aluminum cold plates/tubing, use the standard UC160-190. If your system has copper cold plates/tubing, select the UC160-190 copper models. Stainless steel may be used with either material. Using copper/brass and aluminum in the same system with water coolants may result in corroded metals and clogging of the cold plates in the UC160-190 unit or system being controlled.

3.3 AIR CONSIDERATIONS

Restricting airflow into or out of the UC160-190 unit will impair performance. Maintain at least 3" of clearance around the air inlet and outlet to ensure no restriction of airflow.

3.4 COOLANT FILL



WARNING

Read the Coolant MSDS
Prior to filling the chiller



CAUTION

Use only recommended coolants

The coolant fill cap (or optional sealable tank plug) is located at the top of the unit under the cover magnet. To open the yellow cap just lift the strap then use the 250 ml bottle (shipped with the chiller) to fill reservoir prior to starting unit. Turn on the UC160-190 chiller and add additional coolant as necessary to maintain the liquid level at the bottom of the tank neck.

For units with the sealable tank plug option, remove the cover magnet, twist the plug 90° and pull up to remove the plug. Fill the tank and then start the chiller. Allow the chiller to run 30 minutes with the plug removed, adding coolant as necessary to maintain the liquid level at the bottom of the tank neck. After 30 minutes carefully press the tank plug into the tank neck keeping the plug level, then twist the plug 90° under the cover and replace the magnet.

Solid State Cooling Systems recommends Koolance LIQ-702CL-B (27% propylene glycol and water) with corrosion inhibitors and algaecides. (Note: propylene glycol is non-toxic). This coolant has the added benefit of extending the UC160-190 chiller's pump life.

Water or ethylene glycol/water mixtures are also acceptable as coolants. Note that algae growth can occur when water is used without at least 25% propylene or ethylene glycol.

IMPORTANT NOTE: Use of methanol, ethanol or isopropanol as coolants, either by themselves or in water mixtures will damage the UC160-190 pump.

3.5 PRIMING THE PUMP

Normally, the UC160-190 pump primes immediately upon power up. Occasionally at initial start-up, or when starting up the UC160-190 after not having run for a long period of time, the UC160-190 pump will not prime and no coolant will flow out. If this occurs, use the following procedure to prime the pump:

Coolant Supply Fitting



- 1) Turn off the UC160-190 chiller.
- 2) Disconnect the Coolant Supply line.
- 3) Create a drain tube by pushing a piece of 1/8" ID tubing onto one of the 1/8" quick disconnect fittings supplied with the UC160-190 chiller. This tube needs to be long enough for coolant to be pumped into a bucket or other collection container.
- 4) Plug this drain tube into the coolant supply quick disconnect fitting.
- 5) Holding the tank lid open, turn on the UC160-190 chiller until coolant begins to come out of the drain tube turn, and then turn the UC160-190 chiller off.
- 6) Replace the drain tube with your coolant line disconnected in step 2. The UC160-190 pump is now primed and ready for operation.

SECTION 4

START UP



WARNING

Electrical Shock Hazard:
Never Plug in a Line Cord
with Wet Hands

Start-up the chiller using the following steps:

- 1) Connect 1/8" ID hose to fluid connections located on the back side, labeled Coolant Supply and Coolant Return.
- 2) Open the reservoir cap on top (or remove optional sealable plug). Using the 250 ml bottle provided, fill the reservoir to just below the bottom of its neck with coolant.
- 3) Plug in the 13.5 VDC table top power supply or connect 13.5 VDC power to the DIN connector (wired as shown in section 3.1).
- 4) Optional: connect the alarm signal to the 9-pin dsub connector as shown in section 3.1.
- 5) Turn on switch located to the left of the display. The front display should read the current coolant temperature. If the front display reads "TANK LOW", add coolant to the reservoir until the display changes to read the coolant temperature.

Important Notes:

- 1) The UC160-190 system performs a self-diagnostic check for 10 seconds after turn-on. If the tank level low alarm persists, or if another alarm is displayed, consult section 6.0 of this manual.
- 2) If the chiller tank is filled above the bottom of its neck, coolant can leak out the top when the cap is closed (unless the optional sealable tank plug is being used).

SECTION 5

OPERATION

The chiller is operated via the control panel located on the top of the unit. The control panel has an 8-character LCD display and three input keys: UP, DOWN, and ENTER. 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.

5.1 SIMPLE OPERATION

UC160-190 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 chiller and wait for display to read TEMP: XX.X°C
- 2) Press the UP or DOWN keys to change SETTEMP1 to the desired set point.
- 3) Press the ENTER key.

The chiller will now control to the set point temperature. To change the set point temperature just press the UP or DOWN keys again to change SETTEMP1 to the new set point, followed by the ENTER key.

5.2 ADVANCED OPERATION

UC160-190 has two menus: the Status Menu and the Parameter Input Menu. The Status Menu shows the current temperature of coolant leaving the chiller (see Figure 4). 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, an alarm temperature, a temperature offset, and a password to enter the Parameter Input Menu. (The default password is 0000 until changed by the user.) Press and hold the enter key for 3 seconds to enter the parameter menu.

Note: While in the Parameter Input Menu, if no keys are pressed for 30 seconds the display will revert to the status menu.

Figure 4: MENU STRUCTURE:

NOMENCLATURE:

▲UP or Increase Value

▼Down or Decrease Value

↵ Press Enter Momentarily

————→ Press & Hold Enter Key 3 Sec

SIMPLE OPERATION		ADVANCED OPERATION
(STATUS MENU)	press and hold enter key	(PARAMETER INPUT MENU)
TEMP: XX.X°C (current temp)	————→	PASSWORD XXXX (see notes 1+2)
PRESS ▼OR ▲ (change set point)		↵
SETTEMP1 XX.X°C		SETTEMP1 XX.X°C
↵		↵
TEMP: XX.X°C (current temp)		SETTIME1 XXXX (in minutes ⁴)
		↵
		SETTEMP2 XX.X°C
		↵
		SETTIME2 XXX (in minutes ⁴)
		↵
		# CYC XXX (see note 3)
		↵
		ALRM TMP +/-X.X°C
		↵
		OFFSET +/-X.X°C
		↵
		CHNG PWD Y/N (change password)

Allowable Value Ranges:

	MODEL UC160 OR 180	MODEL UC170 OR 190
SETTEMP1	2 TO 45 °C	10 TO 45 °C
SETTIME1	0 TO 999 minutes	
SETTEMP2	2 TO 45 °C	10 TO 45 °C
SETTIME2	0 TO 999 minutes	
# OF CYC	0 TO 999	
ALRM TMP	1 TO 9 °C in 0.1°C increments	
OFFSET	-5 °C TO 5 °C in 0.1°C increments	
CHNG PWD	Y OR N	

NOTES:

1. When entering the PASSWORD, enter one digit at a time
2. The default password is 0000, until changed by the user
3. If continuous control at one set-point temperature is desired, set # OF CYCLES to zero.
4. Time units may be preset or reset to seconds or hours (contact SSCS for instructions how)

Status Menu: The status menu displays the current coolant temperature in °C or will display an alarm type should an alarm occur. Pressing the UP or DOWN keys with # of cycles set to zero will change the set point temperature upon pressing the START key.

Parameter Input Menu: The parameter input menu allows input of operating temperatures, soak times, number of cycles desired, temperature units desired, time units desired, the alarm temperature range and an offset temperature to change the displayed temperature.

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 CYC = Number of cycles between temperature1 and temperature2. If set to zero, the chiller will control at temperature SETTEMP1.

ALRM TMP = +/- Alarm temperature set point.

If the current temperature is outside of the set point +/- the dry contact alarm will open.

OFFSET = Used to adjust the current temperature displayed.

Entering 5 °C will increase the displayed temperature by 5 °C.

Typically used to match temperatures with an external sensor.

Also adjusts RS-232 temperature reported.

CHG PWD = Y/N Entering Y allows user to change the password allowing entry into the parameter input menu.

5.3 ALARM SIGNAL

UC160-190 has one normally closed dry contact alarm for temperature out of range or system failure, located on pins 1 & 6 of the 9-pin dsub connector.

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

5.4 DRAIN PROCEDURE



WARNING

Read the Coolant MSDS
prior to draining the
chiller

1. The use of chemical splash resistant gloves and eye protection is recommended
2. Insert the proper mating male fitting with approximately 12 inches of tubing attached into both the “**coolant supply**” and “**coolant return**” fittings on the back of the UC160-190 chiller.
3. Place the tubing attached to the “**coolant supply**” fitting into a container to catch the draining fluid.
4. While holding a finger over the end of the tubing attached to the “**coolant return**” fitting, Turn the unit on (making sure to hold the drain hose in place) and run for 5 seconds. (Note: this will create a vacuum to cause the fluid in the internal plumbing to be drained)
5. After 5 seconds, release finger from blocking the tube attached to the “coolant return” fitting and continue to run chiller until fluid stops draining.
6. When fluid stops draining, turn off unit.
7. Lift tank lid and inspect to make sure that most of the fluid is drained.
8. Dispose of the coolant in a manner consistent with local regulations.

SECTION 6

SYSTEM ALARMS/TROUBLESHOOTING



WARNING

Electrical Shock Hazard:
Always unplug the unit
before removing the cover.



WARNING

Do not attempt to service or
repair the unit beyond the
troubleshooting checks
described in this section
without first contacting
Solid State Cooling Systems

UC160-190 has two 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.

TANK 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 (or plug) and add more process fluid until the alarm disappears. Note: If the tank becomes empty, the display may read “pump fail”.*

RTD OPEN or RTD SHORT: The temperature sensor has failed or its connector has come loose. *Contact SSCS for an RMA number to return the unit for RTD replacement.*

PUMP FAIL: The pump motor speed is not within normal limits, indicating no coolant is flowing and/or the pump is damaged. *Either the pump has failed, or the external coolant lines are blocked. Check that there are no obstructions/closed valves or kinks in the coolant lines. Also check that the coolant lines are fully inserted into the CPC shut-off fittings on the UC160-190 chiller. If the coolant lines are not blocked, contact SSCS for an RMA number to return the unit for pump replacement.*

IMPORTANT NOTE: The tank level low alarm will automatically reset when the tank is filled. The RTD failure alarm will not reset until the system power is turned off.

OTHER ISSUES:

COOLING CAPACITY INSUFFICIENT: *If the chiller is not providing sufficient cooling, check that the air inlet and outlet are not restricted and that the fan is running. If airflow is not restricted, contact SSCS technical support.*

RS-232 COMMUNICATION NOT WORKING: *If the RS-232 communications does not seem to be working try cycling the power to reset the communications. If the problem persists, call SSCS technical support 845-296-1300.*

SECTION 7

RS-232 COMMUNICATION

The UC160-190 chiller comes with a modified (pin-out) RS232 communication port. The chiller uses this port to communicate a comprehensive set of control parameters with a Host PC - these parameters are outlined in Section 7.2. This port is a 9-pin female d-sub connector and is found on the front of the chiller (see Figure 3A).

Note also that pins 1 and 6 on this port are connected to a dry contact relay and thus the RS-232 connecting cable must be customized. This relay is "closed" when the unit is functioning properly and the RTD temperature is within the Alarm Range. The relay is "open" when the RTD temperature is outside the Alarm Range or any other fault exists.

7.1 COMMUNICATION SPECIFICATION

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 DCE

Host / Master (DCE) 9-Pin D-sub Pin #	ThermoCube / Slave (DTE) 9-Pin Female 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 DTE.

Specification

Speed:	9600 baud
Data Flow Control:	None
Data Format:	8-bit serial (Hex)
Number of Stop bits:	1
Parity:	None
Transmission Breakdown:	One command byte followed by zero, one, or two data bytes depending on the parameter.
Master/Slave:	UC160-190 is always the SLAVE (DTE)
Interrupts Reported:	None, must be polled for status
Transmission Length:	≤ 15 meters
Maximum Polling Frequency:	Two commands per second

7.2 COMMUNICATION PROTOCOL

Table 2: Command and Data Bytes (Hex)

	Bit Position	Description	Bit =1	Bit = 0
Command Byte	Bit 7 (MSB)	Set Remote Control	remote control	local control (chiller)
	Bit 6	Remote On/Off	chiller On	chiller in standby
	Bit 5	Communication Direction	remote to chiller (command from master)	chiller to remote (status from chiller)
	Bits 4 – 0	Parameters being communicated (see table 2)		
Data Bytes	1 or 2 bytes depending on parameter (see tables 3 and 4)			

Timing: UC160-190 can accept a maximum of two commands per second

Table 3: Control Parameter¹

Bits 4 – 0	Parameter	No of Data Bytes	Hex	
			Put	Get
00001	Chiller set point temperature	2	E1	C1
01001	Current temperature at chiller coolant output	2		C9
01000	Faults from chiller (fan, RTD failure, etc.)	1		C8
11110	% of Maximum thermoelectric power ²	3		DE
11111	Reset alarms and restart chiller	0	FF	

Notes: 1) UC160-190 echoes all commands prior to sending data except for the reset alarms command; the first byte returned is always the command byte, followed by data byte(s) for GET commands.

Table 4: Temperature Data Bytes (2 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°C increments. Data is transmitted Low Byte First, then High Byte

Temperature (examples)	Low Byte	High Byte	Hex
0.1 °C	00000001	00000000	01 00
1.0 °C	00001010	00000000	0A 00
10.0 °C	01100100	00000000	64 00
20.0 °C	11001000	00000000	C8 00
30.0 °C	00101100	00000001	2C 01
40.0 °C	10010000	00000001	90 01

Table 5: Faults Data Byte (1 byte)

0 = OK, 1 = Fault If multiple faults exist, more than one bit will =1

Bit Position	Fault Assigned	Hex value when fault is present
7 (MSB)	Temperature below alarm range	80
6	unassigned	N/A
5	Pump fault	20
4	RTD fault	10
3	unassigned	N/A
2	Temperature above alarm range	04
1	unassigned	N/A
0	Tank Level Low	01

Table 6: % TE Power Data Bytes (3 bytes)

The %TE power command returns three (3) data bytes, a sign byte that communicates heating or cooling, and two bytes of data from which the %TE power is calculated as follows:

Byte 1 = Mode, Cooling or Heating. If bit 7(MSB) = 0, then the system is cooling, if bit 7 = 1, then the system is heating. Ignore the remaining bits, they are arbitrary. (HEX<80 = cooling, HEX≥80 = heating)

Bytes 2 & 3 = %TE Power = $(61787 - (\text{Byte2} + 256 * \text{Byte3})) * 100 / 1235$

Mode	%TE Power	Byte 1 (Heat/Cool) Hex	Byte 2 Hex	Dec	Byte 3 Hex	Dec	Calculation
Cooling	10	<80	DB	219	F0	240	%TE= $(61787 - (219 + 256 * 240)) * 100 / 1235 = 10$
Cooling	25	<80	1C	28	F0	240	%TE= $(61787 - (28 + 256 * 240)) * 100 / 1235 = 25$
Heating	50	≥80	DD	221	EE	238	%TE= $(61787 - (221 + 256 * 238)) * 100 / 1235 = 50$
Heating	75	≥80	9E	158	ED	237	%TE= $(61787 - (158 + 256 * 237)) * 100 / 1235 = 75$
Cooling	100	<80	60	96	EC	236	%TE= $(61787 - (60 + 256 * 236)) * 100 / 1235 = 100$

Notes

- 1) The UC160-190 handles RS232 bytes as they come in - i.e. it has no message data buffer. Therefore you must wait for a response from the UC160-190 – even if it's just a command echo acknowledge, before sending the next message.
- 2) An acknowledgement of the transmission will be sent back to the master when the UC160-190 reads the data. In the case of data transmitted to the UC160-190 Controller only, the acknowledgement will be the command byte. In the case of data requested by the master, the acknowledgement will be the command byte plus the data byte(s) requested.
- 3) If RS-232 communications does not seem to be functioning, cycle the main power to reset.

7.3 RS232 COMMUNICATION EXAMPLES

Example	Communications Sequence
1) Send set point of 25°C to chiller	Host sends command byte = E1 (hex)
	Host sends LOW data byte = FA (hex)
	Host sends HIGH data byte = 00 (hex)
	Chiller sends command byte = E1 (hex)
2) Read chiller set point	Host sends command byte = C1 (hex)
	Chiller sends command byte = C1 (hex)
	Chiller sends LOW data byte = set point value in hex (LB)
	Chiller sends HIGH data byte = set point value in hex (HB)
3) Read the actual temperature	Host sends command byte = C9
	Chiller sends command byte = C9
	Chiller sends LOW data byte = actual temp in hex (LB)
	Chiller sends HIGH data byte = actual temp in hex (HB)
4) Read the faults table	Host sends command byte = C8
	Chiller sends command byte = C8
	Chiller sends faults data byte = fault data in hex
5) Reset Alarms/Restart Chiller	Host sends command byte = FF
	Chiller sends command byte FF
6) Read % TE Power	Host sends command byte DE
	Chiller sends command byte DE
	Chiller sends heating/cooling data byte <80=cool, >80=heat
	Chiller sends Low data byte = decimal used to calculate %TE
	Chiller sends High data byte = decimal used to calculate %TE

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, weekdays

Telephone: (845) 296-1300

Fax: (845) 296-1303

E-mail: info1@sscooling.com

SECTION 9

MSDS FOR COOLANTS

9.1 MSDS FOR KOOLANCE LIQ-702 COOLANT FLUID

Koolance SDS – LIQ-702 Coolant Fluid



Safety Data Sheet

Last Updated: Mar, 2015

LIQ-702 Coolant Fluid

1. Identification

Product: LIQ-702xx Coolant Fluid ("xx" signifies liquid color)

Manufacturer: Koolance Korea

Address: Anyang-dong, Dongyoung Venturestel 3rd, RM801, 45, Deokcheon-ro, Manan-gu, Anyang-si, Gyeonggi-do, Korea 730-728

Telephone: (U.S.) +01 253-249-7669, Fax: (U.S.) +01 253-249-7453

Appearance: Liquid for cooling systems. Available in various colors and shipped in plastic bottles or containers.

Usage: For use in cooling systems only. Do not use in foodstuffs, beverages, or in other applications.

2. Hazard Identification

Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

- Physical Hazard: Not applicable
- Health Hazard: Skin Irritation – Category 2
Eye Irritation – Category 2
- Environmental Hazard: Not applicable

Label elements including precautionary statements.

Symbol:



Signal word: Warning

Hazard statement: H315 – May cause irritation to the skin.

H319 – May cause serious irritation to the eyes.

Prevention: P264 - Wash thoroughly after handling

P280 - Wear protective gloves, clothing, and eye protection.

Responses:

- P302+P352 If on skin: Wash exposure area with plenty of water and soap.
- P305+P351+P338 If in eyes: Rinse continuously with water for several minutes. Remove contact lenses if present and easy to do so. Continue rinsing.
- P337+P313: If skin or eye irritation persists, seek medical attention immediately.
- P362: Remove contaminated clothing and wash before reuse.

Storage / Disposal: P501: Refer to all federal, provincial, state, and local regulation prior to disposition of container and unused contents by reuse, recycle, or disposal.

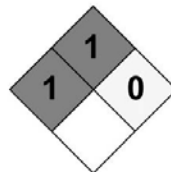
NFPA Rating (estimated)

Health: 1

Flammability: 1

Reactivity: 0

Water Reactivity: 0



3. Composition / Information on Ingredients

Ingredients	CAS No.	EINECS No.	Conc. %
Distilled Water	7732-18-5	231-791-2	70 – 75
Propylene glycol	57-55-6	200-338-0	25 – 30
Others (Proprietary)	-	-	0.2 – 2.0

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Koolance SDS – LIQ-702 Coolant Fluid

4. First Aid Measures

- In case of eye contact: Rinse thoroughly with plenty of water for at least 20 minutes. If irritation remains, consult a medical doctor immediately.
- In case of skin contact: Remove contaminated clothing. Wash with soap and plenty of water for at least 20 minutes. If irritation remains, consult a medical doctor immediately.
- If inhaled: Move person to fresh air. If not breathing, give artificial respiration and immediately contact emergency medical assistance.
- If ingested: Never give anything by mouth to an unconscious person. Rinse mouth with water and consult a medical doctor immediately.

Other medical attention: Medical persons should be aware of protective measures for handling.
Potential health effects: May be harmful or fatal if swallowed.

5. Fire-Fighting Measures

- Flash Point: 118°C (Cleveland open cup)
- Suitable extinguishing media: Water spray, alcohol-resistant foam, dry chemical, carbon dioxide
- Specific hazards arising from the chemical: No data available
- Special protective equipment for fire fighters:
 - Use water spray to cool unopened containers.
 - Fire fighters should enter area wearing respiratory protection and protective equipment.

6. Accidental Release Measures

Personal Precautions:

- Ensure adequate ventilation.
- Remove all sources of ignition.
- Avoid contact with skin and eyes.
- Avoid inhalation of vapor, mist, or gas.

Environmental Precautions:

- Follow local regulations.

Methods and materials for containment and clean-up:

- Collect with non-combustible absorbent materials (sand and soil).

7. Handling and Storage

Precautions for safe handling:

- Wear protective gloves, clothing, and eye/face protection.
- Do not spray on an open flame or other ignition source.
- Provide forced air ventilation in tanks and confined spaces.
- Avoid contact with skin and eyes.
- Avoid inhalation of vapor, mist, or gas.
- Keep away from sources of ignition. No smoking.

Conditions for safe storage:

- Keep container tightly closed.
- Keep in a dry and well-ventilated place.
- Keep cool.
- Avoid direct sunlight, heat sources, and strong oxidizing agents.

8. Exposure Control / Personal Protection

Conditions for safe storage:

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Koolance SDS – LIQ-702 Coolant Fluid

- KOSHA: No data available
- US ACGIH: No data available

Appropriate engineering controls:

- Respiratory protection: Approved respirator equipped with cartridge for organic vapors
- Eye protection: Protective goggles
- Hand protection: Chemical resistant gloves

Exposure limitation: No data available

9. Physical and Chemical Properties

- State: Liquid at 20°C
- Flash Point: 118°C (Cleveland open cup). No flash occurred under 93°C (Tag closed cup)
- pH: 7.0 – 8.0 at 20°C; Sample H₂O = 1:5 (V/V)
- Viscosity: 2.3 mPa x s (cP) at 20°C
- Density: 1.003 at 20°C
- Water solubility: Soluble at 20°C
- Explosive properties: No self-reaction hazard; UN TDG test & criteria – Test E3
- Autoignition temperature: No spontaneous combustion under 300°C
- Boiling point (initial): >98°C
- Melting range: No data available
- Vapor pressure: No data available
- Oxidizing properties: No data available
- Partition coefficient (n-octanol/water): No data available
- Evaporation rate: No data available
- Decomposition temperature: No data available
- Lower explosion limit / Upper explosion limit: No data available

10. Stability and Reactivity

Chemical stability:

Stable under recommended storage conditions.

Conditions to avoid:

Direct sunlight, heat, flames, and sparks.

Materials to avoid:

Strong oxidizing agents.

Hazardous decomposition products:

Carbon oxides

11. Toxicological Information

- Acute toxicity (Calculated):

Oral	rat	LD50 : 23,779 mg/kg
Skin	rabbit	LD50 : 38,021 mg/kg
Inhalation	rat	LC50 : 145 mg/kg
- Skin irritation: Irritating (Calculated, Category 2)
- Eye irritation: Irritating (Calculated, Category 2)
- Respiratory sensitization: No data available
- Skin sensitization: No data available
- Germ cell mutagenicity: No data available
- Carcinogenicity: Not classifiable; from IARC / EC ESIS
- Reproductive Toxicity: No data available
- Specific target organ toxicity – single exposure (GHS): No data available

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Koolance SDS – LIQ-702 Coolant Fluid

- Specific target organ toxicity – repeated exposure (GHS): No data available
- Aspiration hazard: No data available

12. Ecological Information

- Acute toxicity (Calculated):
 - Fish LC50 : 8,700mg/l 96hr Pimephales promelas
 - Crustacean LC50: 7,921mg/l 48hr Daphnia magna
 - Bird EC50: 1,634mg/l 72hr Selenastrum capricornutum
- Persistence and degradability: No data available
- Bioaccumulative potential: No data available
- Mobility in soil: No data available
- Other adverse effects: No data available

13. Disposal Considerations

Disposal consideration:

Observe all environmental regulations.

Disposal precaution:

Avoid disposing in the environment.

14. Transport Information

- TSCA: All ingredients are listed on the TSCA inventory
- DOT Classification: Not a DOT controlled material (U.S.)
- UN TDG: Not dangerous goods
- IMDG: Not dangerous goods
- IATA: Not dangerous goods
- Marine pollution: Not applicable
- Special precaution:
 - Fire EmS Guide: F-E (Recommendation)
 - Spillage EmS Guide: Not dangerous goods

15. Regulatory Information

- Korea Industrial Safety and Health Act (GHS): Eye irritation – Category 2
- Korea Industrial Safety and Health Act (GHS): Skin irritation – Category 2
- Korea Hazardous Materials Safety Control Act: Not hazardous material
- Korea Toxic Chemicals Control Act: Not a toxic chemical
- Korea Persistent Organic Pollutants Control Act: Not applicable
- US OSHA Hazards (GHS): Eye irritation
- US OSHA Hazards (GHS): Skin irritation

16. Other Information

Last Updated: March, 2015

References:

- GHS Classification: EC ESIS, US NLM
- Physical and chemical properties: EC ESIS, US NLM
- Transport information: EC ESIS, US NLM
- Toxic and ecological information: OECD SIDS, IUCLID, US NLM, IARC, EC ESIS, CCRIS

Acronyms and Websites:

Koolance SDS – LIQ-702 Coolant Fluid

- EC ESIS : European chemical Substances Information System, <http://esis.jrc.ec.europa.eu/>
- IUCLID : International Uniform Chemical Information Database, <http://esis.jrc.ec.europa.eu/>
- US NLM : U.S. National Library of Medicine, <http://chem.sis.nlm.nih.gov/chemidplus/>
- HSDB : US Hazardous Substances Data Bank, <http://toxnet.nlm.nih.gov/>
- CCRIS : US Chemical Carcinogenesis Research Information System, <http://toxnet.nlm.nih.gov/>
- IARC : International Agency for Research on Cancer, <http://monographs.iarc.fr>

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9.2 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:

lcl: 3.2; ucl: 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.

\Cancer Lists\			
NTP Carcinogen			IARC Category
Ingredient	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\				
Ingredient	Korea	Canada		Phil.
		DSL	NDSL	
Ethylene Glycol (107-21-1)	Yes	Yes	No	Yes
\Federal, State & International Regulations – Part 1\				
Ingredient	SARA 302		SARA 313	
	RQ	TPQ	List	Chemical Catg.
Ethylene Glycol (107-21-1)	No	No	Yes	No
\Federal, State & International Regulations – Part 2\				
Ingredient	CERCLA	RCRA	TSCA	
		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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WARRANTY POLICY

The UC160-190 Chiller is covered under a one-year parts and labor warranty from the date of shipment, assuming proper use and maintenance of the unit. All warranty work shall be performed at Solid State Cooling Systems' facility, currently located in Wappingers Falls, NY, USA and requires pre-authorization by SSCS. 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 Systems' 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):

- Operating the unit outside the stated specification ranges
- Removing the serial number label.
- Any disassembly (partial or complete) of the product.
- Changing any components of the product.
- Subjecting the product to temperatures below the freezing point of the coolant used.
- 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 SSCS's factory, within 30 days or the reporting date will be moved ahead 30 days and a new 30-day waiting period will begin. Customers shall pay shipping cost of returning any unit to SSCS and SSCS shall pay shipping cost of returning any unit repaired under warranty to the customer.

All out of warranty returned goods will require an evaluation purchase order prior to receipt at Solid State Cooling Systems. The evaluation costs will depend on product model and will be deducted from the cost of any repairs required.