

---

Technical  
Publication

# GE Hangwei Medical Systems

## Liquid Cooling System

GE Part # 5332026  
Lytron Part # LCS7593G1



Lytron, Inc., 55 Dragon Court, Woburn MA, 01801, USA  
Phone: +1-781-933-7300 Fax: +1-781-935-4529  
[www.Lytron.com](http://www.Lytron.com)

**(THIS PAGE IS LEFT BLANK INTENTIONALLY)**

## TABLE OF CONTENTS

<b>Revision History</b> .....	<b>4</b>
<b>1.0 Introduction</b> .....	<b>5</b>
<b>2.0 Safety Precautions</b> .....	<b>6</b>
<b>3.0 Specifications</b> .....	<b>7</b>
<b>4.0 Definition of System Labels</b> .....	<b>9</b>
<b>5.0 Major Components Description</b> .....	<b>11</b>
Pump .....	11
Motor .....	11
Heat Exchanger .....	11
Reservoir .....	11
Fluid Connectors .....	11
Strain Relief Connectors.....	11
Flow Switch .....	11
Level Switch .....	11
<b>6.0 Parts Description (refer to view)</b> .....	<b>12</b>
<b>7.0 Start-up Instructions</b> .....	<b>16</b>
<b>8.0 Tank Fill / Refill Procedure</b> .....	<b>17</b>
<b>9.0 Adjusting Mixing Valve</b> .....	<b>18</b>
<b>10.0 Draining the Process Coolant</b> .....	<b>19</b>
<b>11.0 Periodic Maintenance</b> .....	<b>20</b>
<b>12.0 Trouble Shooting Guide</b> .....	<b>21</b>
<b>Appendix A</b> .....	<b>22</b>
Plumbing Diagram LCS7593G1 (840-0111) .....	22
<b>Appendix B</b> .....	<b>23</b>
Electrical Schematic LCS7593G1 (830-0205).....	23
<b>Appendix C</b> .....	<b>24</b>
Wiring Schematic LCS7593G1 (830-0206) .....	24
<b>Appendix D</b> .....	<b>25</b>
Liquid Cooling System Cooling Capacity .....	25
<b>Appendix E</b> .....	<b>26</b>
Centrifugal Pump Performance (Output Pressure) .....	26
<b>Appendix F</b> .....	<b>27</b>
Centrifugal Pump Performance (Available Process Flow) .....	27
<b>Appendix G</b> .....	<b>28</b>
Pressure Drop Through Heat Exchanger .....	28
<b>Appendix H</b> .....	<b>29</b>
Lytron Warranty.....	29

## Revision History

<b>REV</b>	<b>ECN#/REASON FOR CHANGE</b>	<b>DATE</b>	<b>APPRV'D</b>
B	ECN# 17090 Updated schematics	5/7/10	K. Gay
C	ECN# 17736 Update tank level, troubleshooting	4/12/11	H. Bufe

## 1.0 Introduction

### Receiving the Liquid Cooling System

Inspect the Liquid Cooling System immediately upon receiving it. If the unit shows shipping damage, contact the transportation company and file freight damage claim. Retain all cartons and packing material until the unit is operated and found to be in good condition. The system has been fully tested at the Lytron factory with clean water. Although the system has been drained, some residual fluid may remain. This will not hinder the performance of the system.

### About the Warranty

All units returned for warranty claims must have an RMA (Return Material Authorization) number on the outside of the container. Call Lytron Customer Service at 781-933-7300 for an RMA number. Refer to the end of manual for the Modular Cooling System warranty. The system should be drained of all fluids and packaged in its original packaging prior to return shipment to Lytron.

### Customer Service Support

Lytron is committed to servicing the customer, both during and after the sale. If there are questions concerning the operation of the system, contact our Application Engineering Department at +1-781-933-7300. To facilitate your call, please have the **model number** and **serial number** (located on the nameplate of the system) of the system for the Lytron Application Engineer.

#### **Email:**

Lytron's service department can be reached by sending an e-mail to [Service@Lytron.com](mailto:Service@Lytron.com).

### Service Hotline

Lytron has a 24 hour per day, 7 day per week service hotline to assist with questions on the startup and operation of the Liquid Cooling System. Lytron service can be reached by dialing +1-781-933-7300. To facilitate your call please have the model number and serial number (located on the nameplate of the system) of the system for the Lytron Service Engineer.

## 2.0 Safety Precautions

This system is designed to provide fluid cooling only as specified in this manual. Using this system in a manner other than as specified may impair the safety protection of the system.

Warnings are posted throughout the manual. Read and follow these important instructions. Failure to observe these instructions or use the system other than as specified may impair safety protection, void the warranty, or result in permanent damage to the unit, property damage, and/or personal injury.

Prior to operating the system, be sure to read, understand, and follow all instructions and safety precautions listed in this manual. If there are questions concerning the operation of the system or the information in this manual, please contact Lytron's Applications Engineering Department at +1-781-933-7300.

1. Do not operate the system without fluid in the reservoir.
2. Never place the system in a location where excessive heat, moisture, or corrosive materials are present. The system must be installed in the vertical position so that the reservoir access cover is on the top of the unit and the text of the all labels is upright.
3. The system is not suitable for use in the presence of flammable mixtures.
4. The system is classified as Class 1 equipment and must be supplied with a properly grounded power source.
5. The system is not supplied with a power cord. The power cord supplying power to the system must be in accordance with local code and from a circuit that provides protection against excessive current draw.
6. In the event of electromagnetic or other interference with nearby equipment, move the system an appropriate distance from the nearby equipment to eliminate the interference.
7. Attach building water supply or another pressurized source to the Facility Water In and Facility Water Out connections respectively.
8. Do not use or maintain the system outdoors. This system was not designed to withstand outdoor weather conditions.
9. Performance of installation, operation or maintenance procedures other than those described in this manual may result in a hazardous situation and may void the Lytron warranty.
10. Transport the system with care. Sudden jolts or drops may result in damage the system.
11. Observe all warning labels. Never remove warning labels.
12. Do not operate damaged or leaking equipment.
13. Always disconnect the power source prior to performing any service, maintenance procedures or before moving the system. When the system is energized the green indicator light on the front panel will be illuminated.
14. Do not operate the system with damaged power cords.
15. A qualified technician should perform all system service and repairs.
16. Once the system has reached the end of its useful life, the system components should be recycled in accordance with the appropriate local code.

### 3.0 Specifications

<b>LCS7593G1</b>		
<b>Cooling Capacity*</b>	Watts	8,000
	Btu/Hr	27,300
<b>Physical Data</b>	Width	15 Inches (381mm)
	Depth	25 Inches (635mm)
	Height	27 Inches (686mm)
	Dry Weight	107 lbs (48.5 kg)
<b>Operating Temperature</b>	°C	+10°C to +32°C
<b>Operating Relative Humidity</b>	% RH	30% to 75%
<b>Storage Temperature</b>	°C	-40°C to +70°C
<b>Storage Relative Humidity</b>	% RH	5% to 100%
<b>Fluid Connections</b>	Facility	½" MNPT Barbed Nylon
	Process	1" MPT Barbed Nylon
<b>Reservoir Capacity</b>	Gallons	6.0
	Liters	22.7
<b>Electrical Requirements</b>	Input Power	208/230 VAC, 60 Hz, 3Ph 190 VAC, 50 Hz, 3Ph
	Full Load Amps**	60 Hz – 7.4 A 50 Hz – 8.2 A
<b>Max Pressure Rating</b>	Facility loop	100 psi
	Process loop	100 psi
<b>Facility Loop Water Quality</b>	Particle size	Largest particle not to exceed 200 microns
	Concentricity	Not to exceed 10 mg/L
<b>Recommended Coolant</b>		Water

\* - Cooling capacity assumed with process set point 11°C higher than facility water temperature, minimum facility flow rate of 15 LPM and minimum process flow rate of 30 LPM

\*\* - This amperage rating accounts for the LCS7593G1 powering its sister unit, the LCS7594G1

#### Functional Description

The Liquid Cooling System (LCS) can be used to cool a variety of applications. This particular model was designed to provide coolant to cold plates mounted with electronics. The LCS process coolant is pumped from the reservoir at a flow rate of approximately 40 to 50 liters per minute to the Supply and ultimately the cold plates. Upon return from the cold plates, the process coolant is

cooled in the LCS liquid-to-liquid heat exchanger before returning to the reservoir. The reservoir tank is vented and maintained at ambient atmospheric pressure.

The process coolant removes the approximate 8 kW heat load applied by the application. This heat is exchanged from the process coolant to the facility water through the LCS liquid-to-liquid heat exchanger.

## 4.0 Definition of System Labels



This label tells maintenance personnel and users to consult the manual for more information.



Disconnect power before servicing.



Identifies the port where heated fluid returning from the customer's machine is connected.



Identifies the connection where chilled fluid is supplied to the user's machine.



Identifies the connection where facility fluid is supplied to the LCS.



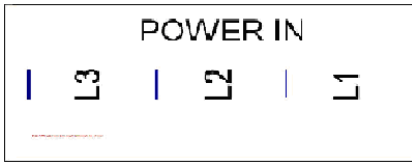
Identifies the connection where facility fluid returned from the LCS.



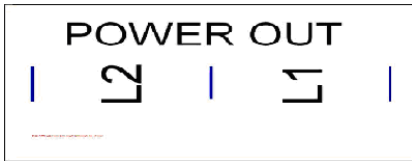
Identifies strain relief location where the power cord is brought into the LCS.



Identifies strain relief location where the power cord is brought out of the LCS.



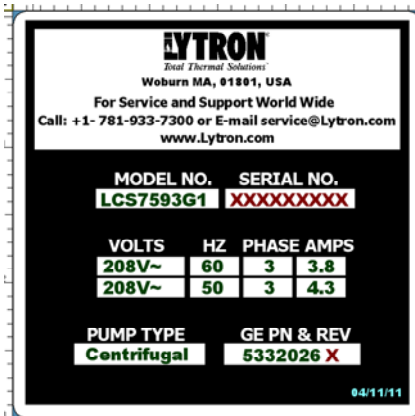
Identifies the terminal block where three phase current is connected to power the unit.



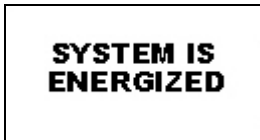
Identifies the terminal block where single phase current is connected to bring out of the unit.



Positive earth (ground) terminal.



The Product ID Label identifies the model number, serial number, electrical information and pump type.



This label identifies when the system is energized. When power is connected to the system the green light above this label will illuminate.

## 5.0 Major Components Description

### Pump

The Pump is an end suction, center discharge pump with stainless steel housing and impeller, 1" discharge, and 1.25" suction. The pump is designed to deliver the following flow and pressure:

At 50Hz operation: 56 LPM at 32 psi

At 60Hz operation: 65 LPM at 46 psi

### Motor

The Pump is mechanically coupled to a standard C-Face 56J frame, 1.5 HP, Open Drip Proof, 3 Phase, 50/60 Hertz, 200-240 Volt Electric Motor.

### Heat Exchanger

The heat exchanger is a brazed plate type constructed with stainless steel plates and a copper brazed alloy. The fittings on the heat exchanger are (2) 1/2" FNPT and (2) 3/4" FNPT

### Reservoir

The reservoir has a 20 liter capacity. The reservoir cover has a vent hole to vent the system. The reservoir is filled by removing the reservoir access panel and cover and filling through the opening. A sight indicator can be viewed through the sheet metal of the LCS to view water level.

### Fluid Connectors

The hose assemblies are constructed from flexible nylon reinforced PVC tubing and spring wire reinforced PVC tubing. The internal connections are made with tubing on plastic barbs. The FACILITY IN and FACILITY OUT fluid connectors are 1/2" barbed nylon fittings and the SUPPLY and RETURN process loop fluid connectors are 1" barbed nylon fittings.

### Strain Relief Connectors

The POWER IN strain relief is a HEYCO P/N 3222 that will secure the power cord providing three phase power into the unit and the POWER OUT strain relief is a HEYCO P/N 3219 that will secure the power cord providing single phase power out of the unit.

### Flow Switch

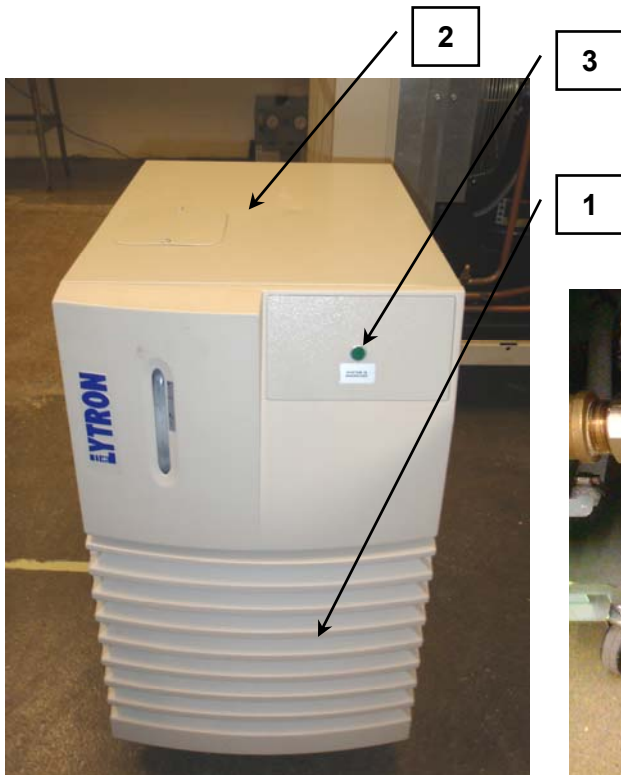
The flow switch is a Gems P/N 170235, 5 GPM, normally open pilot duty 20 VA, SPST switch rated for 120-240 VAC. The connectors on the flow switch are 3/4" FNPT. While the flow switch is normally open, a DPDT relay was installed to present it as normally closed. If the flow rate of the system approaches 5 GPM (18.9 LPM) the flow switch will trip causing the switch to open, which will result in the relay switching to closed.

### Level Switch

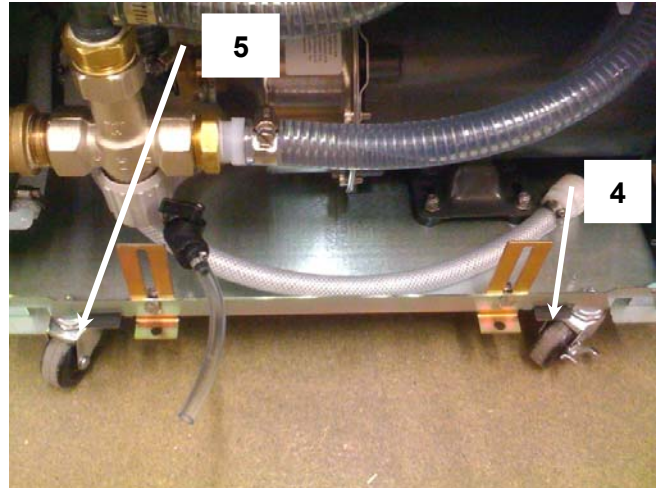
The level switch is a Gems LS-7 Series, normally closed, 20 VA, SPST switch. The switch is horizontally mounted in the reservoir as part of the tank sub-assembly. If the reservoir level reaches approximately 3.5 gallons (13.2 liters) the level switch will trip causing the switch to close.

## 6.0 Parts Description (refer to view)

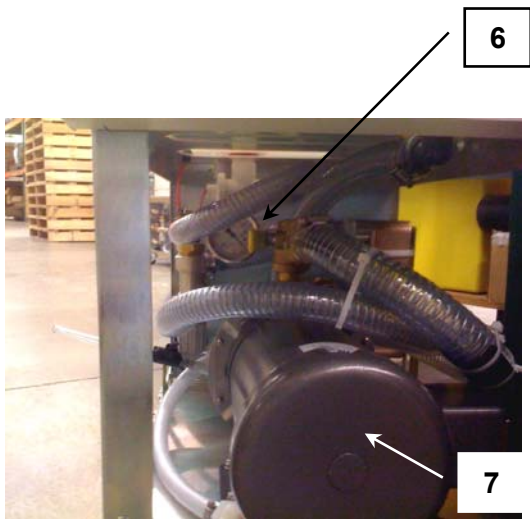
ITEM #	DESCRIPTION
1	PANEL, BOTTOM
2	COVER, TOP
3	ENERGIZED INDICATOR LIGHT
4	CASTER, 2" DIA SWIVEL W/BRAKE
5	CASTER, 2" DIA SWIVEL
6	GAUGE, PRESSURE 60 PSI LIQ FILLED
7	PUMP, CENTRIFUGAL 50LPM AT 22PSIG MIN
8	SWITCH, FLOW 5 GPM
9	BALL VALVE, 1" FEMA
10	VALVE, MIXING 70-120° F
11	HEAT EXCHANGER, COMPACT BRAZED
12	CABLE ASSY, LEVEL SWITCH
13	POWER IN TERMINAL BLOCK, THREE PHASE
14	POWER OUT TERMINAL BLOCK, SINGLE PHASE
15	RELAY, COIL 240V 30 AMP
16	MOTOR, STARTER 240V
17	RELAY, REVERSE PHASE 208/240VAC SPDT
18	POWER IN STRAIN RELIEF
19	POWER OUT STRAIN RELIEF
20	EXTERNAL DRY CONTACTS
21	FACILITY WATER OUT ½" NYLON FITTING
22	FACILITY WATER IN ½" NYLON FITTING
23	PROCESS SUPPLY 1" FITTING
24	PROCESS RETURN 1" FITTING



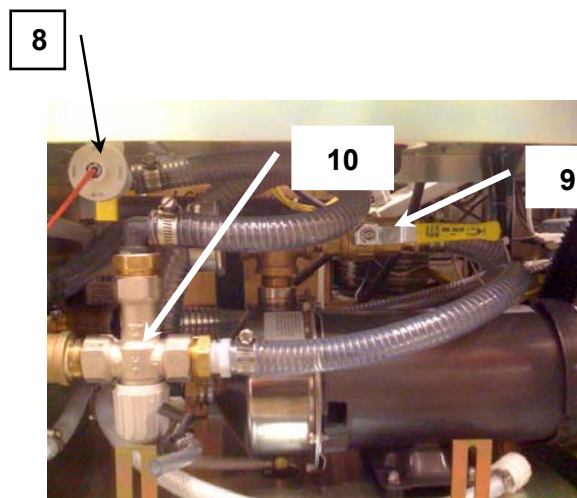
**Front Panel, Top Cover**



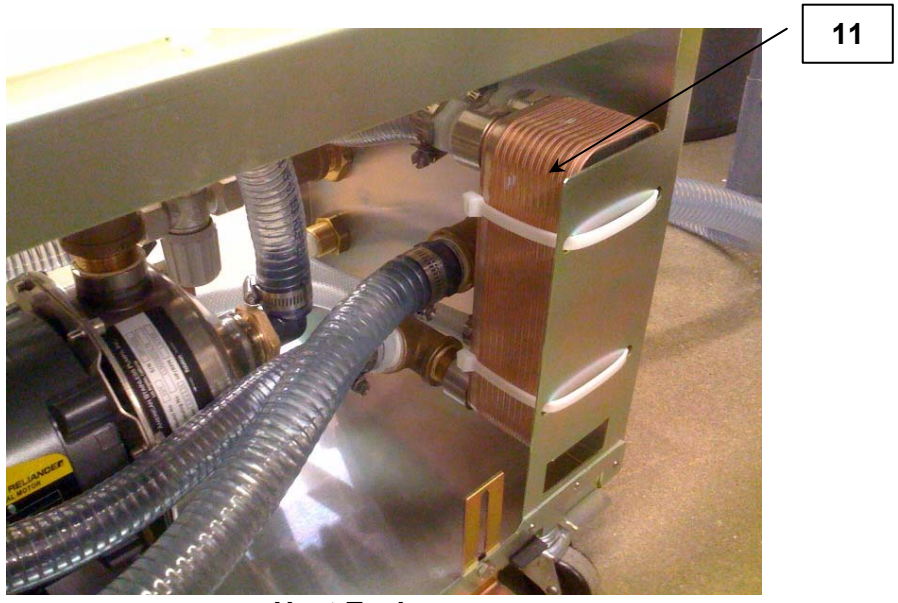
**Casters**



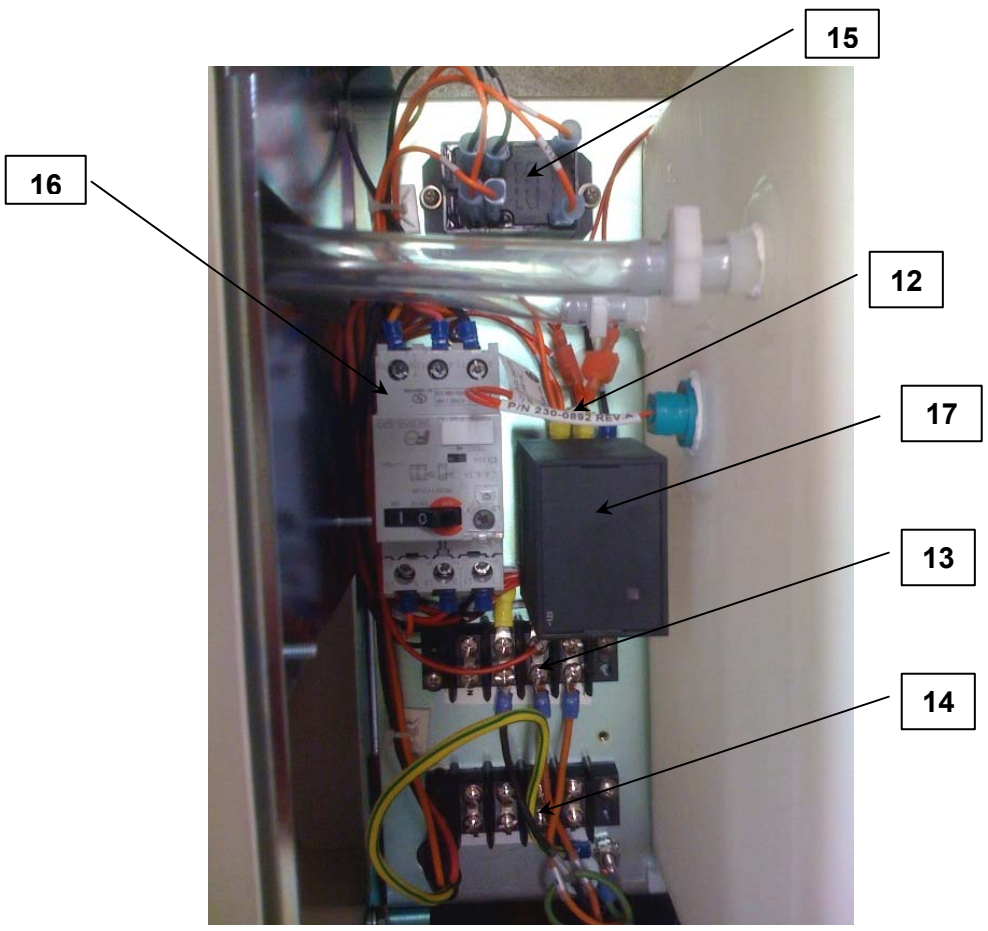
**Pressure Gauge, Pump/Motor**



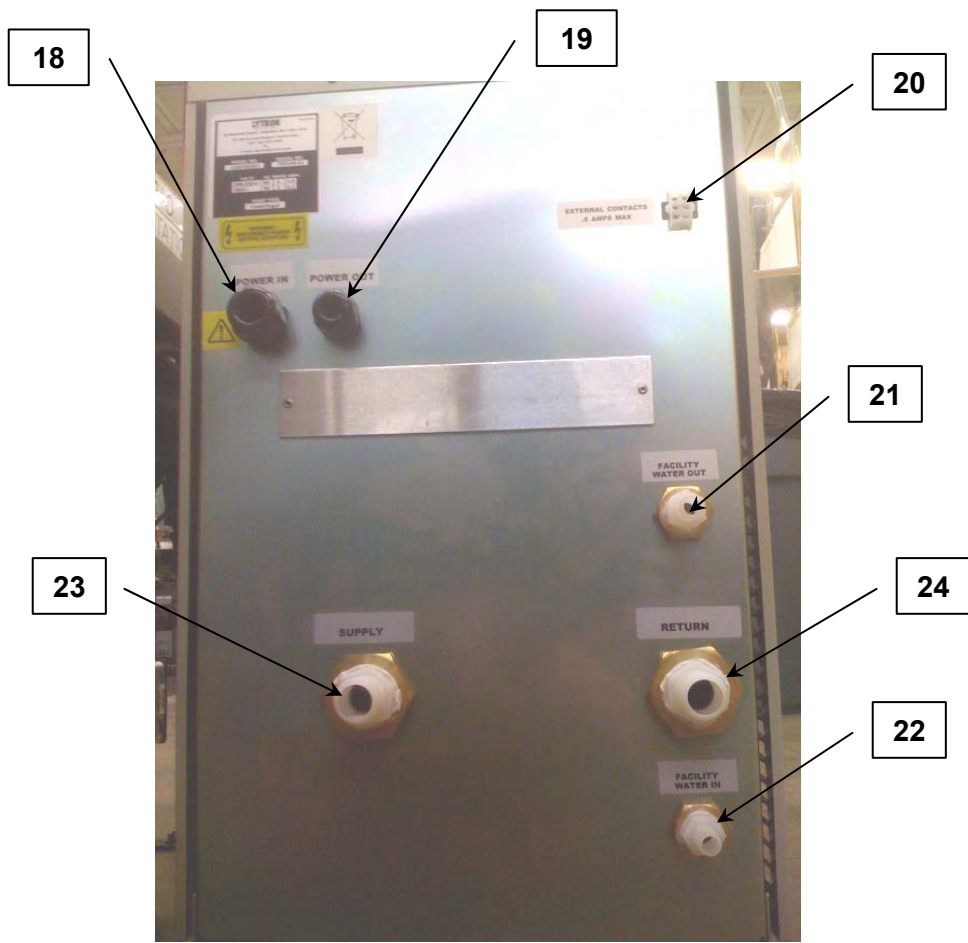
**Flow Switch, Flow Control Valve, Temperature Valve**



Heat Exchanger



Level Switch, Relay, Motor Starter, Reverse Phase Relay, Terminal Blocks



**Connection Points**

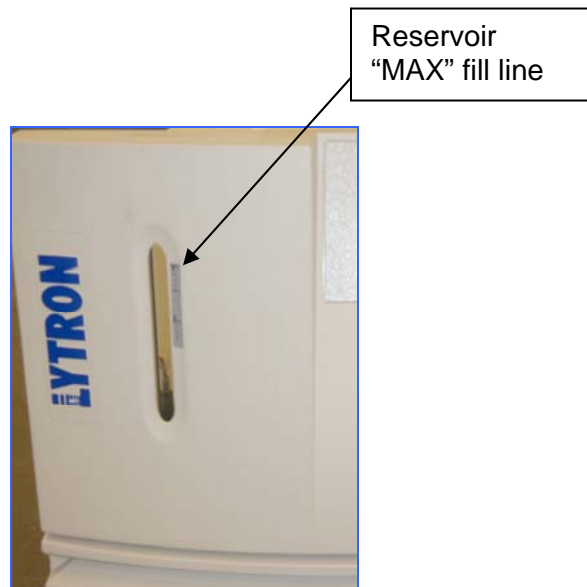
## 7.0 Start-up Instructions

1. Remove the Liquid Cooling System (LCS) from the shipping crate and visually inspect for damage. Use the lifting straps shipped with the unit to lift the system using an overhead lift. Caution, the LCS weighs approximately 107 lbs (48.5 kg) and is to be removed from its shipping container by two people if an overhead lift is not available.
2. Position the LCS in its place of installation. The LCS must be installed in the vertical position so that the reservoir access cover is on the top of the unit and the text of the all labels is upright.
3. Assemble both facility and process water lines to the LCS. The FACILITY IN and FACILITY OUT fluid connectors are 1/2" barbed nylon fittings and the SUPPLY and RETURN process loop fluid connectors are 1" barbed nylon fittings.
4. Fill the reservoir with approximately 20 liters of coolant. Refer to Section 9.0 for detailed procedure and exact coolant level.
5. Be sure the ball valve between the pump and process supply is fully open (the LCS ships from the factory with this valve open).
6. The system is not supplied with a power cord. The power cord supplying power to the system will be a 4/10 AWG, SJT cable with agency approval relative to the country of intended use and from a circuit that provides protection against excessive current draw. The power cord should be installed through the strain relief connector marked POWER IN on the back of the system.
7. The cord supplying power to the unit should be connected to the three phase terminal block marked POWER IN and the ground stud. Once energized, the green indicator light on the front panel of the system will illuminate. If the phases are supplied to the system out of order then the red LED light on the reverse phase relay will illuminate and the system will be unable to start.
8. Enable power to the pump motor by switching the MMS to ON. Begin to "jog" the pump by switching the MMS ON-and-OFF rapidly. This will "prime" the pump to ensure all air is purged out of the of the process loop and ensure the pump will not be damaged by running dry.
9. Allow the pump to run continuously. Once the pump has circulated cooling fluid to the process air will be displaced back into the LCS and vented through the reservoir cap. It will be necessary to refill the reservoir with coolant until the level in the reservoir is to the top of the sight indicator located on the front panel. If one of the phases of the system is lost at any time the motor starter will trip causing the pump motor to shut down.
10. Visually check the unit and all plumbing connections for water leaks.
11. Top off reservoir per Section 9.0.

## 8.0 Tank Fill / Refill Procedure

To fill the Liquid Cooling System (LCS) reservoir with coolant follow procedure below:

1. Turn off the LCS by switching the MMS to the OFF position.
2. De-energize power to the LCS by disconnecting the power source that feeds the unit. The green indicator light located on the front panel should NOT be illuminated.
3. Remove access panel from the top of LCS using a Phillips screwdriver to turn the two quarter-turn fasteners counter-clockwise.
4. Remove the reservoir cover by turning cover counter-clockwise.
5. Fill reservoir with coolant until the level in sight indicator is at FULL. Note that the reservoir has vent holes in the overflow collar. Avoid overfilling the reservoir as coolant may leak out from vent hole.
6. Reinstall the cover to the reservoir turning the cover clockwise until it is tight.
7. Reinstall the access panel to the top of LCS using a Philips screwdriver to turn the two quarter-turn fasteners clockwise.
8. Energize the LCS by connecting the power source to the unit. Once energized, the green indicator light on the front panel of the system will illuminate.
9. Start the unit by switching the MMS to the ON position.
10. When the pump is turned on the system will fill with coolant and the air will be purged through the vent holes in the reservoir. As the coolant fills the system the level in the reservoir will drop. Repeat the procedure above until the system is filled with coolant.
11. After all air is purged from lines, Fill reservoir with coolant to top line of "MAX".



## 9.0 Adjusting Mixing Valve

The mixing valve has a range of settings between 70°F (21°C) and 120°F (49°C). The valve is factory set by Lytron for approximately 86°F (30°C). If coolant temperature is out of the required range then adjust the mixing valve by following the procedure below:

1. In order access the mixing valve the left-side panel of the LCS must be removed. To do this remove the top panel of the unit by removing the two screws at the top rear of the unit and sliding the panel towards the rear of the unit. Doing this will grant you access to the screws securing the side panels. Remove the two screws securing the left-side panel, while holding the panel, and lift the panel out of its slots.
2. Loosen the lock screw at the base of the valve's handwheel. Do not completely remove the screw from its threads however it should be loose enough slide the handwheel vertically and freely turn the valve.
3. Turn the valve counter-clockwise to lower the system set point. This will result in the valve calling for a lower temperature coolant, routing more coolant through the heat exchanger. Turn the valve clockwise to raise the system set point. This will result in the valve calling for a higher temperature coolant, routing less coolant through the heat exchanger.
4. Upon verification of proper temperature, slide the handwheel vertically back into its original position and tighten the lock screw to secure.
5. Replace left-side and top panels on the unit.



Loosen locking screw to release and slide hand wheel



Turn counter-clockwise for more cooling

Turn clockwise for less cooling

## 10.0 Draining the Process Coolant

To drain the process coolant from the system, follow the procedure below:

1. De-energize power to the LCS by disconnecting the power source that the unit. The green indicator light located on the front panel should NOT be illuminated.
2. Open the heat exchanger drain line by turning the cap on the drain fitting counter-clockwise and allow coolant to drain into a bucket or vacuum in order to remove coolant. The drain line will allow the contents of the reservoir and heat exchanger to drain.
3. Open pump drain line by opening valve and allow coolant to drain into a bucket or attach to a vacuum in order to remove coolant. The drain line will allow the contents of the pump to drain.
4. The two drain lines will remove a majority of the coolant however in order to ensure all coolant has been removed from the system a vacuum should be used.

## 11.0 Periodic Maintenance

The Liquid Cooling System (LCS) has been designed so that the periodic maintenance procedures are uncomplicated and minimize down time. The periodic maintenance includes the following:

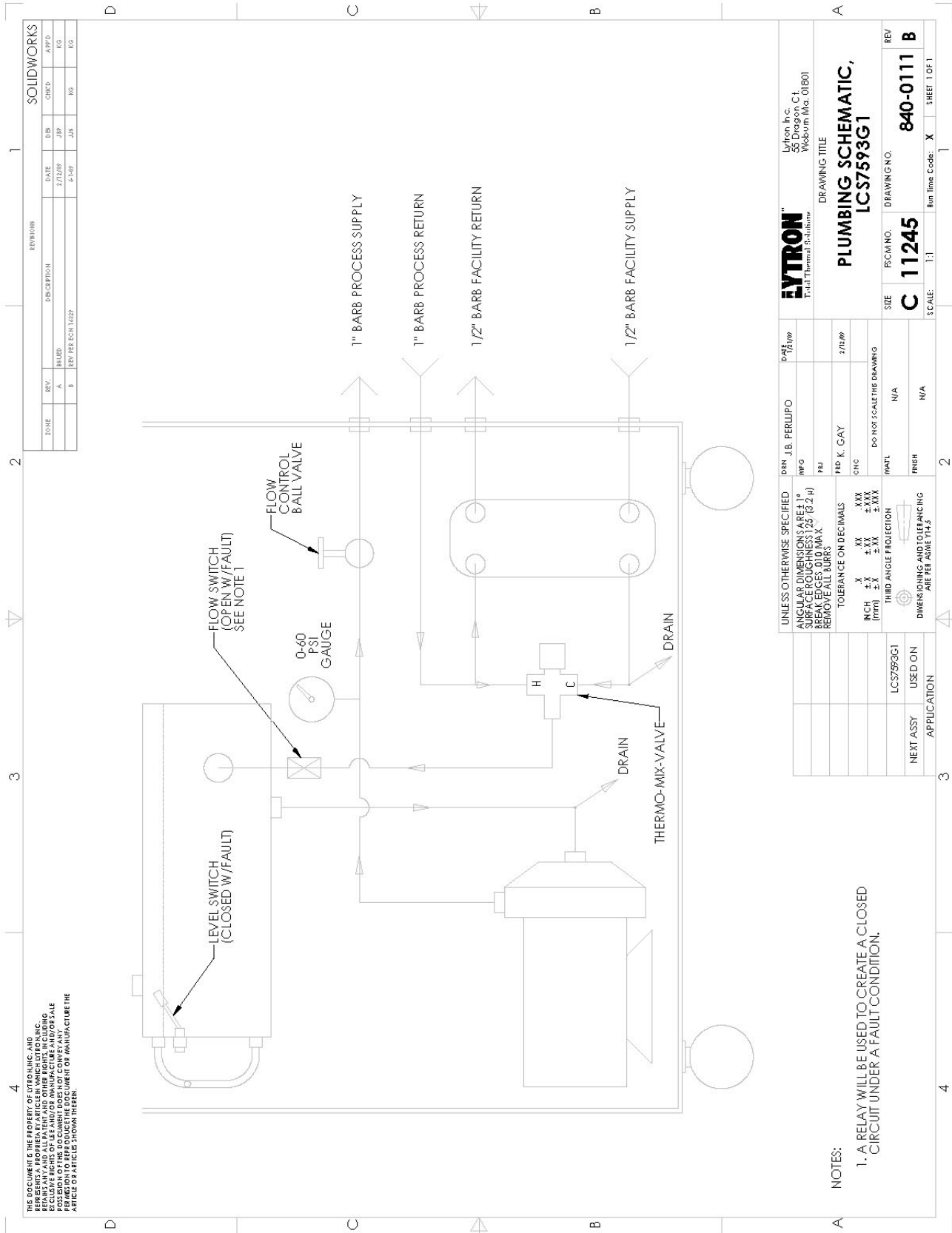
1. The system cabinet should be cleaned annually using a mild soap mixed with water. Moisture on the system should be minimized by using a cloth immersed in the solution that has had excess liquid squeezed out of the cloth.
2. Weekly verify the proper process water level in the reservoir by observing the water level in the sight indicator located on the front of the system. When the level is below the recommended level, tap water should be added to the reservoir in accordance with section 9.0 of this manual. Fill to "**MAX**" line.
3. Verify the noise level of the system weekly. Any abnormal sounds or substantial increase in noise level since the last weekly inspection may indicate an impending pump or coolant blockage problem. Investigate the cause and perform necessary service by referring to the troubleshooting section located in section 12.0 of this manual.
4. Remove the cover and side panels and inspect the system for internal leaks weekly. Focus on the deck and the case, as this is where fluid will collect. If fluid is detected then disconnect the power and repair the leaks. If fluid is found on the floor surrounding the system then disconnect the power immediately and repair the leaks.
5. The level switch protects the pump in the event of accidental fluid loss. Since this switch is "open" during normal operation it is suggested to verify its functionality every six months. Do this by opening the tank cover and gently pushing down on the switch to see if the low level alarm is activated.
6. Periodically inspect the coolant inside the reservoir. If the coolant appears dirty then drain it per section 10.0 of this manual, flush the reservoir, replace the drain cap and refill per 8.0 of this manual.

## 12.0 Trouble Shooting Guide

Problem	Possible Cause	Recommended Remedy
<b>Unit does not start or shuts off shortly after starting.</b>	No power to the unit.	Make sure the unit is plugged in. Verify power to the unit by checking if green indicator light is illuminated.
	Low voltage	Have a qualified electrician check the electrical service to the unit. Check the voltage on the power source and make sure it is within the rated voltage of the unit + 10%.
	Power is supplied to system out of phase	Check phase monitoring relay to see if red light is illuminated if so, reverse two of the three incoming power lines and recheck phase monitoring relay to ensure red light is no longer illuminated.
	The pump motor shuts off shortly after starting	Check to ensure all phases are being correctly supplied to the system as this is a sign of phase loss to the system. Reset the motor starter and replace the system power cord if necessary.
<b>Noisy pump motor</b>	Pump shaft seal damaged	Replace pump
<b>Pump motor overheats</b>	Excessive flow rate	Use a flow control valve to control flow output.
	Improper voltage to the system	Verify and correct the voltage to the unit.
<b>Low coolant flow</b>	Obstruction in pump head	Shut down unit, clear obstructions and restart unit.
	Low coolant level or no coolant in the reservoir	Check for leaks. Repair leaks and fill reservoir to " <b>MAX</b> " line.
<b>Supply pressure is too high</b>	Restriction in coolant lines external to the unit	Eliminate restrictions in the lines. Open any valves.
	Pump overload has tripped	Turn unit off. Wait for overload to cool. It will reset on its own in 30 minutes or less.
<b>Low coolant level alarm</b>	Low coolant level or no coolant in the reservoir.	Check for leaks, repair leaks and fill reservoir to " <b>MAX</b> " line.
	Unit not level	Place unit on level floor.
	Level switch sticking	Clear debris from switch or replace the switch.
<b>Diminished system performance</b>	Pressure drop through system is too large.	Reduce line length or increase line diameter.
	Pump is not delivering adequate flow. To check the pump's performance, close the flow control valve on the pump discharge port and verify that the pressure gauge reads a minimum of 53 psig for 60Hz or 36 psig for 50Hz.	Replace the pump.
	Ball valve is not open enough.	Adjust ball valve until desired pressure is achieved.
	The temperature valve setting is set improperly.	See step 9.0 in this manual (Adjusting Mixing Valve).
	The facility coolant is low flow or high temperature.	Check facility coolant flow and temperature.
	Leaks in external piping	Repair leaks

# Appendix A

## Plumbing Diagram LCS7593G1 (840-0111)



REVISION		DATE		BY		CHKD.		APPRD.	
ZONE	REV.	DESCRIPTION	DATE	DES.	DBS	CHKD.	APPRD.	SOLIDWORKS	
	A	ISSUED	7/12/09	JRP				KG	KG
	B	REV PER ECR 10229	6-1-09	JAS				KG	KG

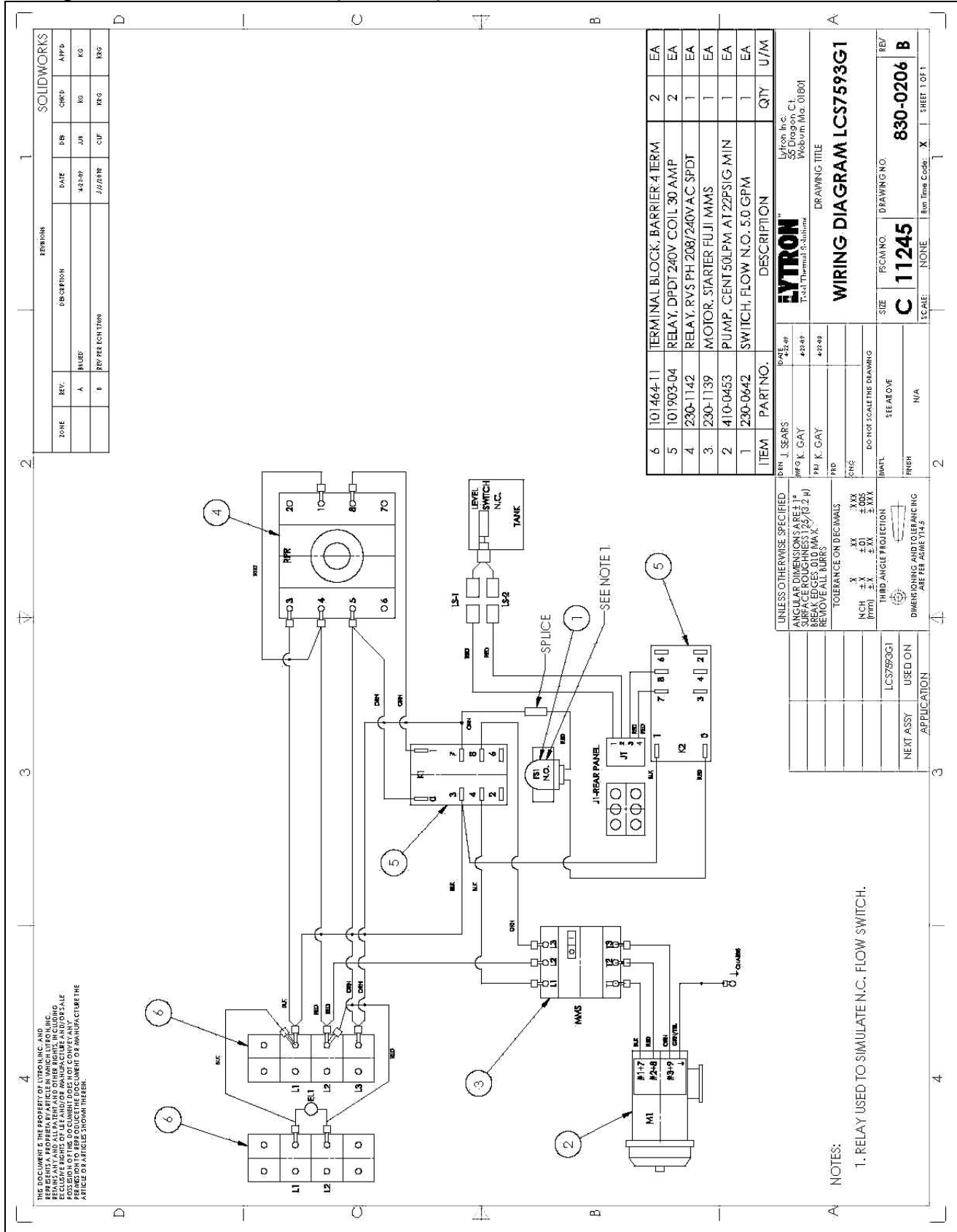
<b>EYTRON™</b> Total Thermal Solutions Lytron Inc. 55 Dragon Ct. Woburn, Ma. 01801		DATE	7/12/09
DRAWING TITLE		DATE	7/12/09
<b>PLUMBING SCHEMATIC,          LCS7593G1</b>		DESIGNER	J.B. PERLUPO
SIZE	C 11245	CHKD.	K. GAY
DRAWING NO.	840-0111 B	CNC	
FROM NO.		DO NOT SCALE THIS DRAWING	
SCALE:	1:1	MATL	N/A
Run Time Code:	X	FINISH	N/A
SHEET	1 OF 1	UNLESS OTHERWISE SPECIFIED ANGULAR DIMENSIONS ARE ± 1° SURFACE ROUGHNESS 125 (3.2 μ) BREAK EDGES 0.0 MAX. REMOVE ALL BURRS	
		TOLERANCE ON DECIMALS X .XX ± .XX XX ± .XX INCH ± .X (mm) ± .X	
		THIRD ANGLE PROJECTION DIMENSIONS SHOWN TO DECIMALS ARE PER ANGLE 114.5	
		NEXT ASSY USED ON APPLICATION LCS7593G1	

NOTES:  
 1. A RELAY WILL BE USED TO CREATE A CLOSED CIRCUIT UNDER A FAULT CONDITION.

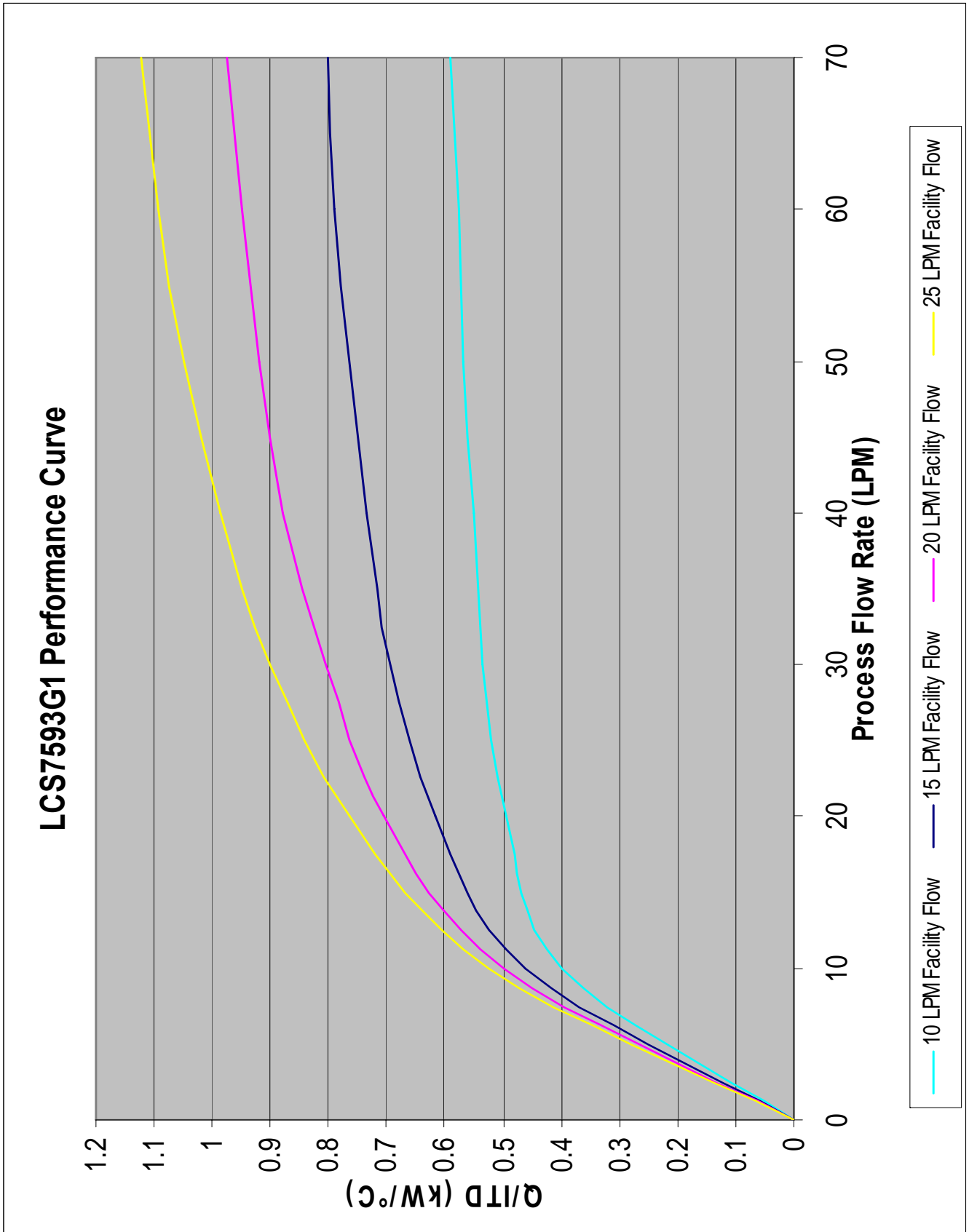


# Appendix C

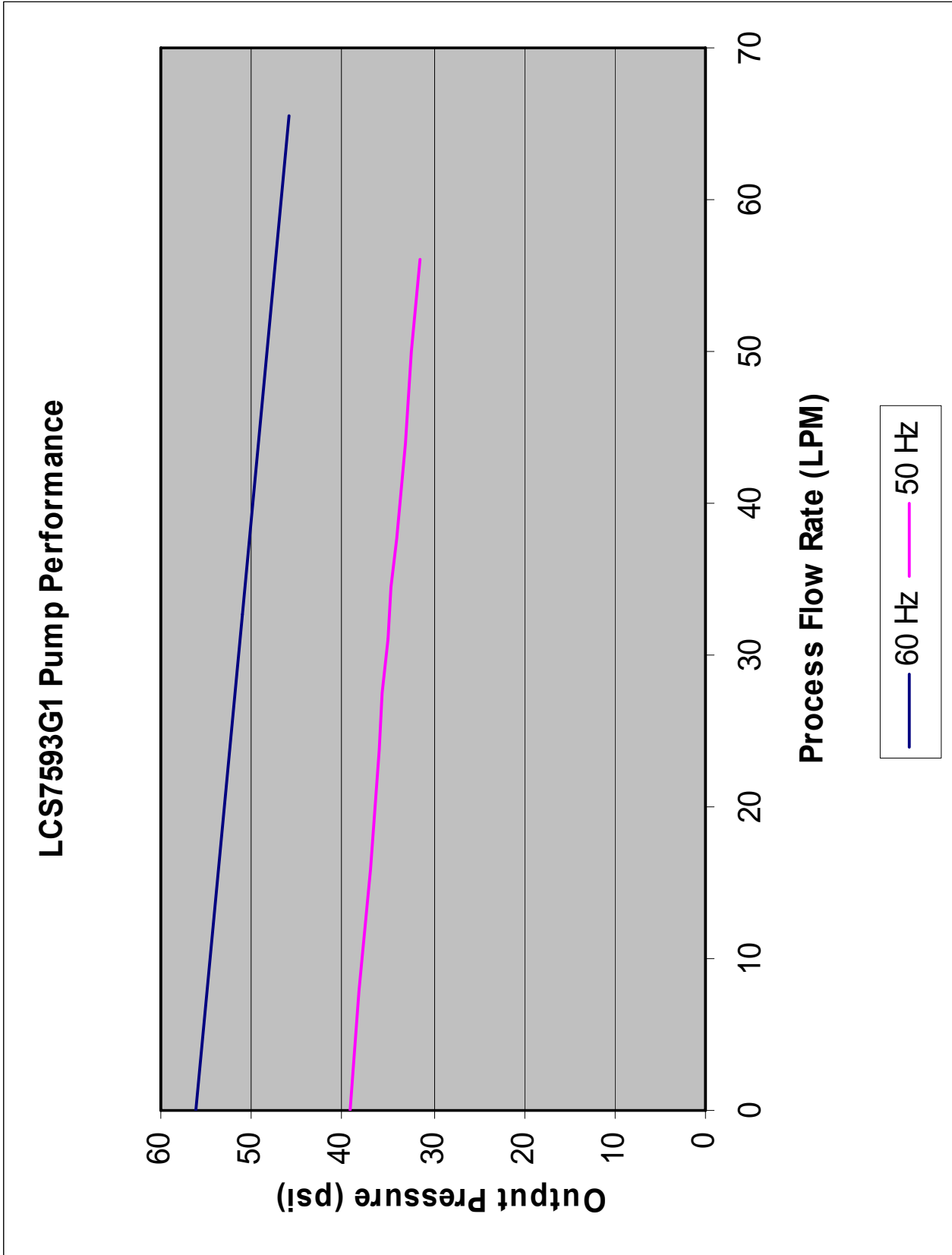
## Wiring Schematic LCS7593G1 (830-0206)



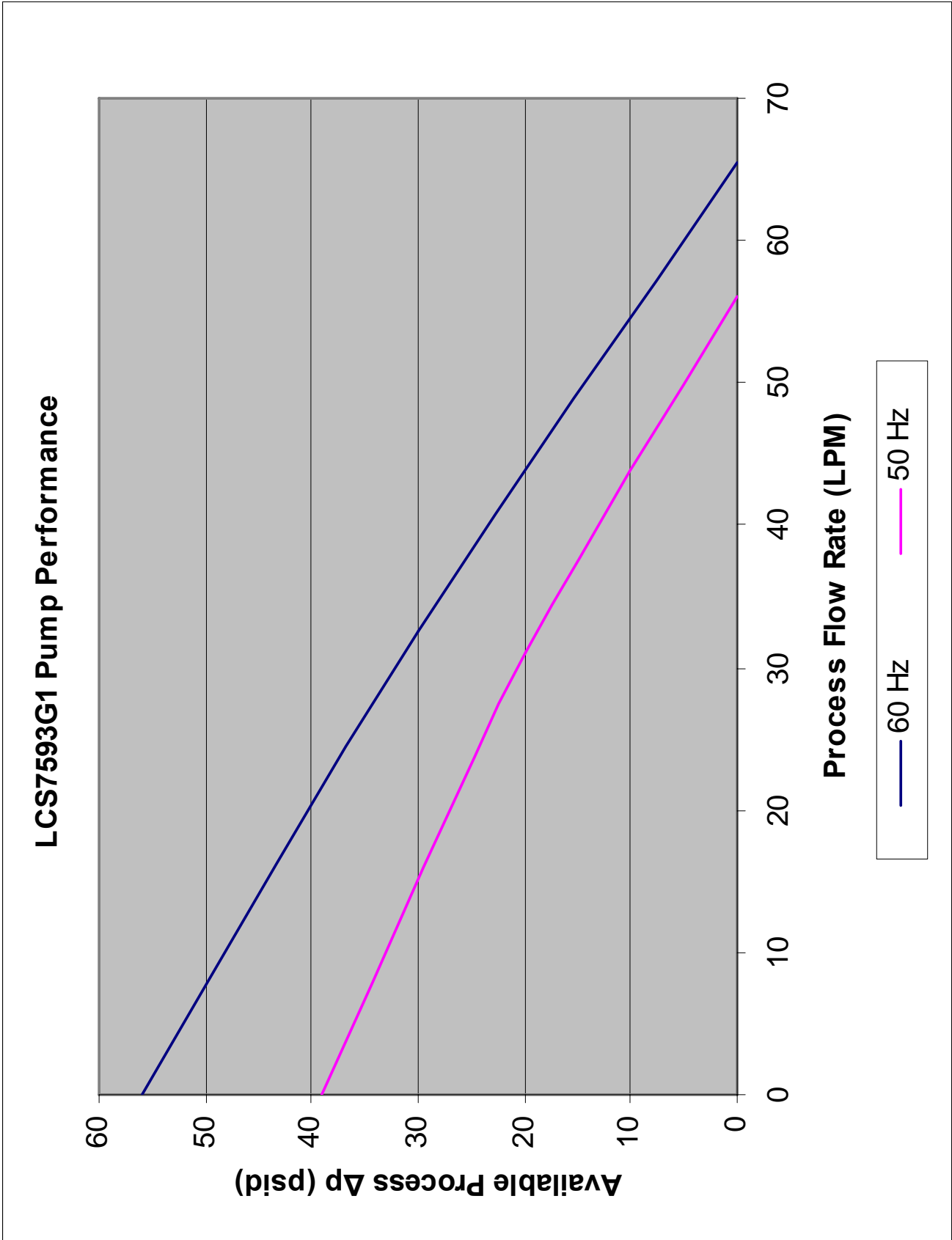
**Appendix D**  
**Liquid Cooling System Cooling Capacity**



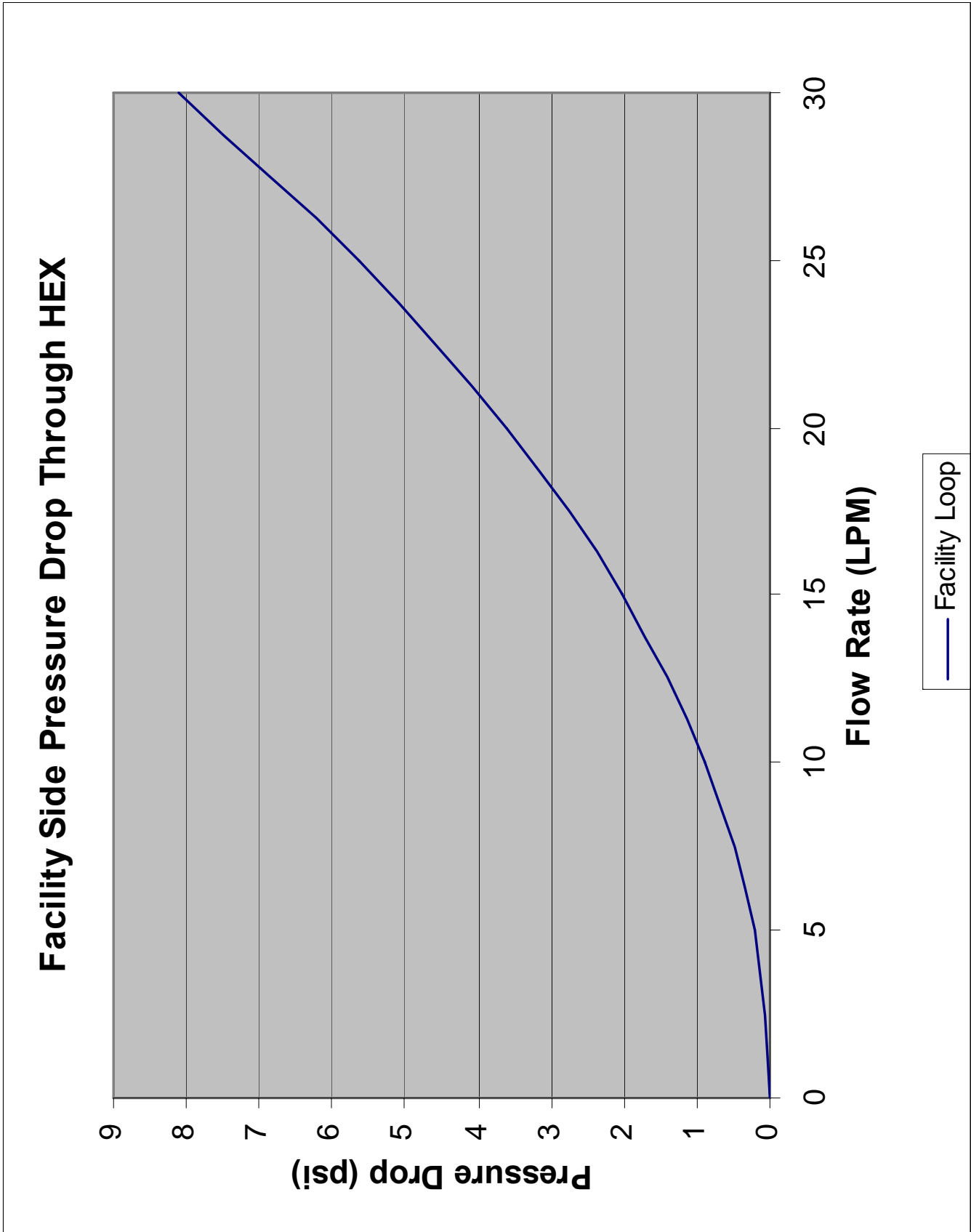
**Appendix E**  
**Centrifugal Pump Performance (Output Pressure)**



**Appendix F**  
**Centrifugal Pump Performance (Available Process Flow)**



**Appendix G**  
**Pressure Drop Through Heat Exchanger**



## Appendix H Lytron Warranty

Lytron agrees that the apparatus manufactured by it will be free from defects in materials and workmanship for the warranty period under normal use and service and when properly installed. The warranty period for recirculating chillers is two years from date of shipment of such apparatus to the original purchaser, maintenance items excluded, and one year from date of shipment of such apparatus to the original purchaser for all other products Lytron sells. Lytron's obligation under this agreement is limited solely to repair or replacement, at its option, at its factories, of any part or parts thereof, returned to Lytron with transportation charges prepaid, which examination shall disclose to Lytron's satisfaction to have been defective. THE FOREGOING EXPRESS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. LYTRON'S OBLIGATION UNDER THIS WARRANTY IS STRICTLY AND EXCLUSIVELY LIMITED TO THE REPAIR OR REPLACEMENT OF DEFECTIVE COMPONENT PARTS AND LYTRON DOES NOT ASSUME OR AUTHORIZE ANYONE TO ASSUME FOR IT ANY OTHER OBLIGATION. LYTRON ASSUMES NO RESPONSIBILITY FOR INCIDENTAL, CONSEQUENTIAL, OR OTHER DAMAGES INCLUDING, BUT NOT LIMITED TO LOSS OR DAMAGE TO PROPERTY, LOSS OF PROFITS OR REVENUE, LOSS OF THE UNIT, LOSS OF TIME, OR INCONVENIENCE. Lytron's liability does not include any labor charges for replacement of parts, adjustments, repairs, or any other work done outside its factories and its liability does not include any resulting damage to persons, property, equipment, goods or merchandise arising out of any defect in or failure of its apparatus. Lytron's obligation to repair or replace shall not apply to any apparatus which shall have been repaired or altered outside of its factory in any way, or which has been subject to negligence, to misuse, or to pressures in excess of stated limits. On parts not of Lytron's manufacture, such as motors, controls, etc., Lytron extends only those warranties given to Lytron, Inc. to the extent Lytron can do so. Lytron's agreement hereunder runs only to the immediate purchaser from Lytron, Inc. and does not extend, expressly or by implication, to any other person.

Form F4.3.18 Rev E Effective June 6, 2003