PERMA PURE

INSTRUCTION MANUAL

BALDWIN™ - Series

e COOL Mini Portable

Model MP5400

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A: SPECIFICATIONS

General Description

Digital control board
Dual channel system
2 x 5 inch heat exchangers connected in series (single stream) or parallel (dual stream)
Jumbo 2-line LCD temperature and alarm display
Single head mini sample pump
Dual head mini peristaltic drain pump

Model Specifications

Model	Standard Capacity	Heat Exchangers		Dimensions	Weight	Power Supply
		Passive	Active			
MP5400	3-4 LPM 6-8 SCFH	---	2x5 in.	10 x 9 x 18 in. HWD 25 x 23 x 46 cm HWD	27 lbs 12 kg	240W

General Specifications

Digital Boards	Main control board Water slip alarm relay board
Alarms	Cooler over temperature Cooler thermocouple failure Water slip (optional)
Display	Jumbo dual-line LCD LED red, amber, green heat exchanger status indicators
Heat Exchanger Type	EZ-Clean™ twist apart
Heat Exchanger Material	Stainless steel (standard); Durinert® treated stainless steel, Kynar® (optional)
Heat Exchanger Connections	1/4" FNTP Inlet 1/8" FNTP Outlet 3/8" FNTP Drain
Heat Sink	High heat transfer aluminum
Voltage	110/120 VAC, 220/240 VAC, 12 VDC, 15 VDC, 24 VDC

Digital Board Specifications

Main Control Board	4 thermocouple inputs 4 analog outputs
Water Slip Alarm Relay Board	2 water slip (moisture carryover) inputs 2 high current digital contact outputs 2 digital PLC outputs

Operating Specifications

Maximum Inlet Sample Temperature	400°F (205°C) SS, Durinert®, Glass Impingers 280°F (138°C) Kynar® Impingers
Maximum Inlet Pressure	45 psig 3 bar / 2250 mmHg
Maximum Heat Exchanger Pressure Drop	<+1 in. H2O
Ambient Temperature Range	33-104°F 0.6-40°C
Outlet Sample Gas Dew Point	41°F 5°C

B: LIMITED WARRANTY

Perma Pure LLC
WARRANTY and DISCLAIMERS

Perma Pure (Seller) warrants that product supplied hereunder shall, at the time of delivery to Buyer, conform to the published specifications of Seller and be free from defects in material and workmanship under normal use and service. Seller's sole obligation and liability under this warranty is limited to the repair or replacement at its factory, at Seller's option, of any such product which proves defective within one year after the date of original shipment from seller's factory (or for a normal usable lifetime if the product is a disposable or expendable item) and is found to be defective in material or workmanship by Seller's inspection.

Buyer agrees that (1) any technical advice, information, suggestions, or recommendations given to Buyer by Seller or any representative of Seller with respect to the product or the suitability or desirability of the product for an particular use or application are based solely on the general knowledge of Seller, are intended for information guidance only, and do not constitute any representation or warranty by Seller that the product shall in fact be suitable or desirable for any particular use or application; (2) Buyer takes sole responsibility for the use and applications to which the product is put and Buyer shall conduct all testing and analysis necessary to validate the use and application to which Buyer puts the product for which Buyer may recommend the use or application of the product by others; and (3) the characteristics, specifications, and/or properties of the product may be affected by the processing, treatment, handling, and/or manufacturing of the product by Buyer or others and Seller takes no responsibility for he nature or consequence of such operations or as to the suitability of the product for the purposes intended to be used by Buyer or others after being subjected to such operations.

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C: PRINCIPLE OF OPERATION

Thank you for purchasing a Baldwin eCOOL™ Mini Digital Portable Gas Sample Conditioning System.

All Baldwin coolers use thermo-electric elements (Peltiers) to cool the sample gas to the desired dew point temperature. A thermo-electric cooler is best illustrated as a small heat pump with no moving parts. The Peltiers operate on direct current and may be used for heating or cooling by reversing the direction of current flow. This is achieved by moving heat from one side of the module to the other with current flow and the laws of thermodynamics. A typical single stage Peltier (Figure 1) consists of two ceramic plates with p- and n-type semiconductor material (bismuth telluride) between the plates. The elements of semiconductor material are connected electrically in series and thermally in parallel.

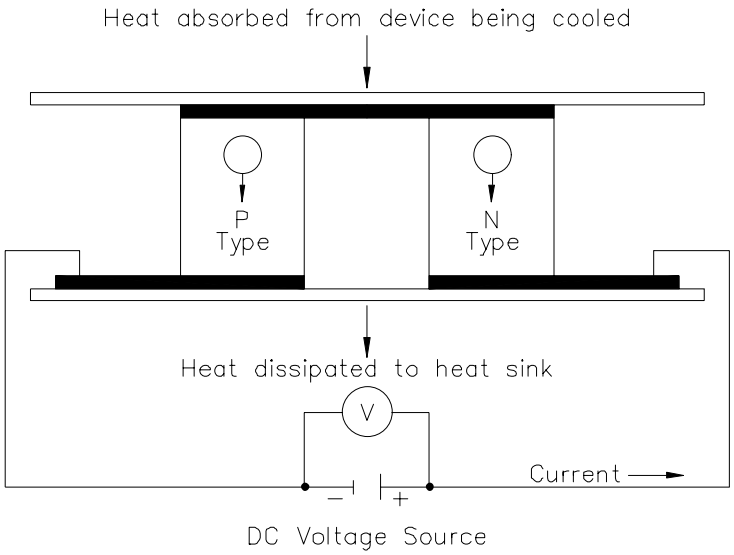

Figure 1: Thermo-electric element (Peltier)

When a positive DC voltage is applied to the n-type thermo-electric element, electrons pass from the p- to the n-type thermo-electric element and the cold side temperature will decrease as heat is absorbed. The heat absorption (cooling) is proportional to the current and the number of thermo-electric couples. This heat is transferred to the hot side of the Peltier element where it is dissipated into the heat sink and surrounding environment.

Baldwin Thermo-Electric Coolers remove the moisture from the sample gas by cooling the gas as it passes through a laminar impinger (heat exchanger). A diagram showing the gas flow path through an impinger is shown in the Appendix. The heat exchanger, made of 316L stainless steel, Durinert® (a corrosion-resistant inert coating over 316L stainless steel), PVDF (Kynar®), or glass, is mounted within a thermally insulated heat transfer block bored to receive the heat exchanger without a mechanical lock. This assembly allows the easy removal of any heat exchanger simply by slipping it out of the cooling block by hand. The heat transfer block cools the heat exchanger through the heat pumping action of the peltier element. The heat transfer block is on the cold side of the thermo-electric element and the heat sink is on the hot side of the thermo-electric element. The heat from the heat

transfer block is pumped to the heat sink where it is then dissipated into the air by the heat sink fan. See Figure 2. The desired temperature is maintained by a closed loop control system, which is implemented through a proportional controller. The controller uses a type K thermocouple in the heat transfer block located very close to the cold side of the peltier element as the input sensor.

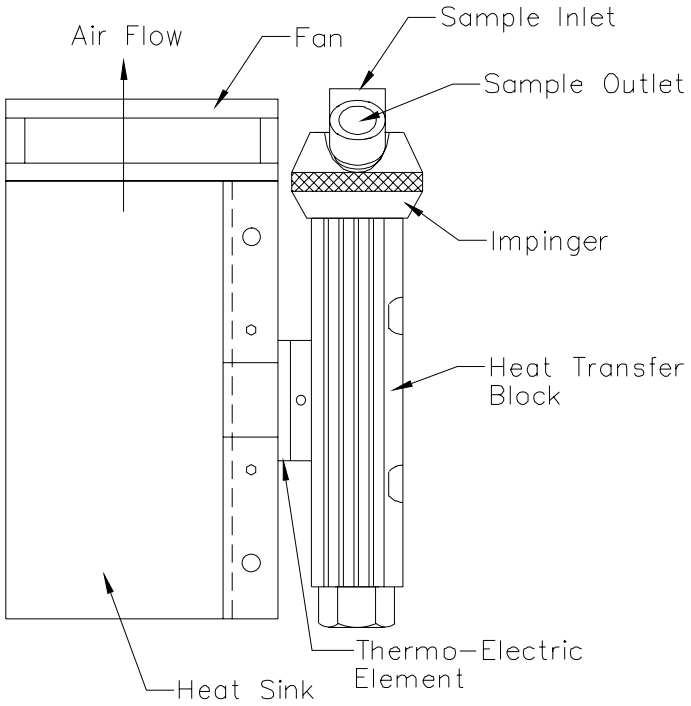

Figure 2: Heat Exchanger, Impinger and Heat Sink Assembly

The sample gas is passed to the thermo-electric cooler via the heated filter sample probe and heated sample line. The thermo-electric cooler lowers the sample dew point to 5°C (41°F). As the gas cools and the moisture vapor condenses, the condensate exits the heat exchanger through the bottom drain connection. Particulate matter which passes through the sample cooler is removed by an optional Baldwin pre-filter, located downstream from the cooler along with an optional water slip sensor. The conditioned sample gas can then be directed to the gas analyzers.

D: INSTALLATION

The eCOOL™ Mini should be located away from heat sources in a well ventilated area of an instrument rack or enclosure.

Sample tubing connections to the eCOOL™ Mini depend on the heat exchanger material of construction. A cooler with stainless steel heat exchangers uses a stainless steel inlet fitting on the first heat exchanger. All other inlets and outlets are Kynar® standard compression type tube fittings with Teflon® ferrules. PVDF (Kynar®) heat exchangers use all Kynar® standard compression type tube fittings with Teflon® ferrules. Baldwin cannot warrantee against damage to the Peltier elements or heat exchangers if our supplied Kynar® tube fittings are not used.

CAUTION: If using a stainless steel sample line, place 2 inches of Teflon® tubing in between the exchanger inlet fitting and the heated line. This prevents the sample cooler from heat sinking the incoming heated line, which adds undue load to the cooler.

The inlet and outlet tubing of all metal or Kynar® heat exchangers is 1/4" NPT. The operator should use the compression type fittings. The inlet of the first heat exchanger uses a 1/4” tube x ¼” MNPT, tube connector fitting to mate with most standard 1/4” sample lines. The condensate drain connections are Kynar® elbows, 3/8” MNPT x 1/4” barbed tube fittings.

CAUTION: Do not reduce the size of the condensate tubing since doing so restricts water flow resulting in water slip (moisture carryover) in the sample.

E: START-UP PROCEDURE

Plug in the power cord to a properly grounded main circuit. The LCD will display the actual temperature. The temperature of each heat exchanger will fall until it reaches approximately 5°C.

If there are no alarms (an alarm condition consists of water slip detection after the cooler, thermocouple failure, or actual temperature > 10°C), then the LED(s) should turn to an amber color. This indicates that the alarms are cleared and the user can **PRESS THE RESET BUTTON**, located on the back of the unit, to begin operation. Once the reset button is pressed, the LED(s) should turn green indicating that there are no alarms and sample flow can begin. If the sample pump is wired through the relay board alarm contacts and all alarms are cleared, the sample pump will start. The sample pump will stop if any alarms are detected.

Note: Current alarm conditions are displayed on the second line of the LCD.

The eCOOL™ Mini Digital Portable Gas Sample Conditioning System is virtually maintenance free. However, in the event of electrical problems, refer to the *Troubleshooting* section in this manual.

F: LEDs & LCD

The eCOOL™ Mini has a jumbo 2-line LCD display and 2 LED indicators.

Each of the two LED indicators corresponds to an active heat exchanger and will be colored Green, Amber, or Red:

LED Summary

GREEN:	Status OK, Sampling can begin. Sample pump will run.
AMBER:	Alarm is no longer present. User must press the reset button to acknowledge the alarm and return to normal operation. Sample pump off.
RED:	Alarm - see message on LCD screen. Sample pump off.

The top line of the LCD screen displays the temperature of each active heat exchanger in degrees Celsius (e.g., 4.5°C). The scrolling bottom line of the LCD screen displays cooler status, such as alarm messages.

Alarm Summary

Thermocouple failure
Channel over-temperature alarm
Water slip (water detect) alarm

Please refer to the *Troubleshooting* section of this manual if your cooler displays any of the alarms above. Press the reset button, located on the back of the unit, to clear the alarms.

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G: BOARDS

Control Board

The control board is the motherboard for the eCOOL™ system. The control board handles the majority of the functions for the cooler module. It contains the microprocessor that controls all of the functional areas of the design, as well as the temperature measurement of the controlled vapor flow as well as the Pulse Width Modulation (PWM) control of the peltier modules to cool the vapor.

Inputs:
4 Thermocouple Inputs (Channel 1, Channel 2, and two Spare)
12-24VDC Power Inputs
12-24VDC Control Board Power Inputs
1 Analog Input

Input/Outputs:
Relay Board 1 Input/Output
Relay Board 2 Input/Output

Outputs:
4 Analog Outputs (scaled 0 to 4.5VDC matching the Thermocouple Inputs)
Peltier Power Outputs (spade terminals)
DC Fan Power Output 1
DC Fan Power Output 2

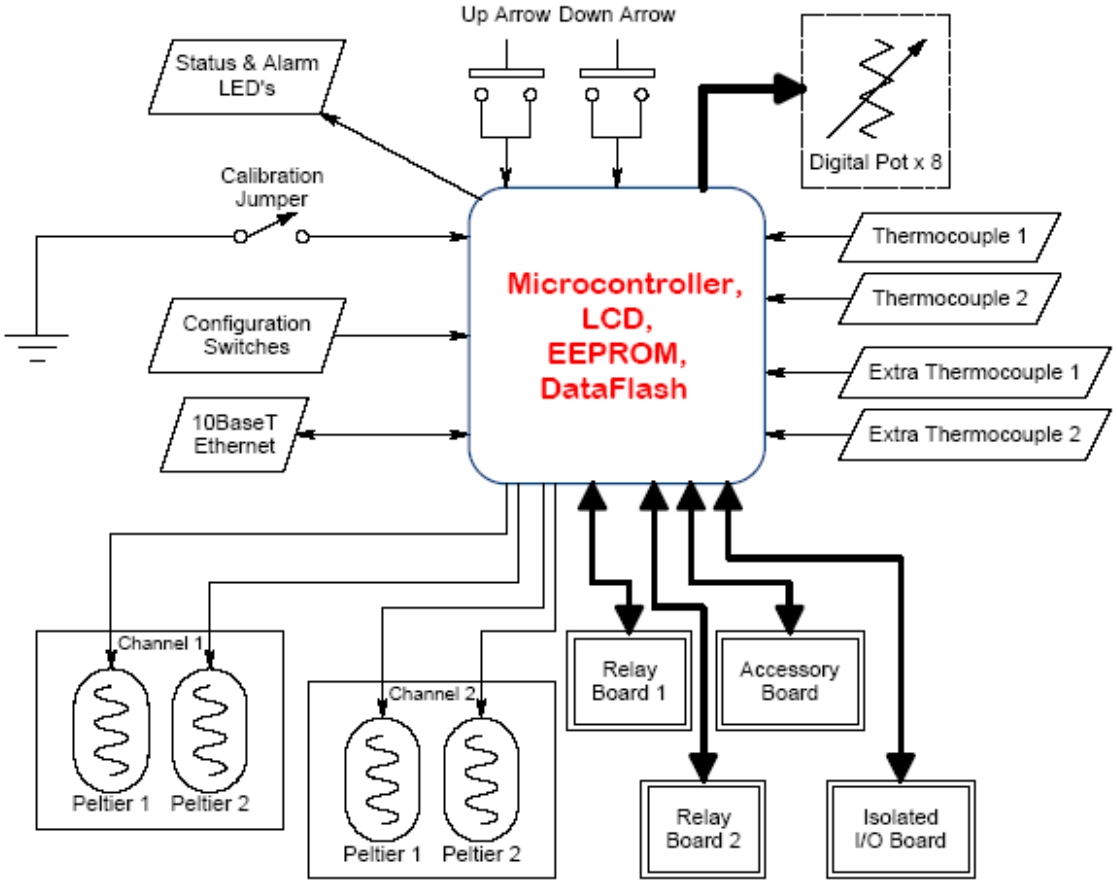
Power Connections

The board is powered in two locations by a DC power supply rated to handle the current required by the peltiers present in the system. The thermo-electric element (Peltier) power is supplied via the E1 and E2 lugs, where E2 is connected to the positive terminal and E1 is connected to ground. The rest of the board is powered by the JP1 power connector. This connector has two terminals on it with number 1 connected to the positive DC voltage coming from the power supply and number 2 connected to ground. The wires that are used to connect to the power supply should be individually routed back to the power supply to minimize the noise created by the peltiers.

Fuses

The fuses are labeled as F1, F2, F3. They are self-resetting fuses. If one of the fuses trips, disconnect all power, identify and correct the problem that caused the high current draw, and reconnect power. It could take up to 5 minutes for a fuse to self-reset in a power off state.

Main Control Board Overview



Configuration Switches

The configuration switches identify which components are connected to the system. They are used by the control firmware to determine how the board is going to operate in the system. The switches are read at power up, or when the external reset switch is activated. The table below identifies the switch positions and their functions.

SW3	Function	OFF	ON
1	Heated Line Control	OFF	ON
2	Probe Control	OFF	ON
3	Peltiers	1 per channel	2 per channel
4	Channels	1	2
5	Peltier Power Share	Full Power	Power Sharing
6	ISO Channels	Inactive	Displayed

SW2	Function	ON	OFF
1	ICE VCC	Enabled	Disabled
2	JTAG ICE ResetN	Enabled	Disabled
3	Calibration	Enabled	Normal Operation
4	Dflash Res	Enabled	Normal Operation
5	Init Clr	Enabled	Normal Operation

Button Control

The buttons are used to control the calibration settings. Follow the bottom line on the display to determine the functions in the different modes. The three combinations that are available are left only, right only, or both. To select the center option on the bottom line of the display, press both buttons together.

Calibration Menus

The calibration mode allows the board to be setup with min and span points as well as all of the other configuration information applicable depending on the configuration switch settings.
Ch1, Ch2, TC1, TC2
Min = 0
Span = 5°C
Max = 8*Span Temp (360°C limit)
The calibration is performed by first calculating the expected settings for the calibration resistors before entering the calibration operation to get a good starting point. Then the 0 point is adjusted to the minimum point in the ADCC (memory chip). The span temperature is then set and the span gain is adjusted to make the span point 1/8 of the entire range for the temperature measurements.

```
ChX: MIN  = xx°C
ChX: SPAN = xx°C
ChX:RDY TMP= xx°C
ChX:SET TMP= xx°C
ChX GAIN=%3u
```

Probe, Heated Line
Min = 0°C
Span =
Max = 360°C
Calibration is performed by setting the gain of the span circuit to minimal gain then adjusting the 0 point to the minimum reading from the ADCC. The span temperature is used to measure the ADCC value and calculate the step size of the ADCC.

```
ChX: MIN  = xx°C
ChX: SPAN = xx°C
ChX:MIN TMP= xx°C
ChX:MAX TMP= xx°C
ChX:SET TMP= xx°C
ChX: GAIN=%3u
```

Isolation Channels
Min = 0°C
Max = 25°C
The temperature range for the isolation circuit is 0 to 25°C. The calibration is performed by first calculating a good starting point for the offset and span resistors. Then adjust the 0 point to the minimum point in the ADCC. The last step is to set the input to 25°C and adjust the span gain to achieve the max value in the ADCC.

```
ChX: MIN  = xx°C
ChX: MAX  = xx°C
ChX:MIN TMP= xx°C
ChX:MAX TMP= xx°C
ChX:SET TMP= xx°C
ChX: GAIN=%3u
```

Water Slip (Moisture Carryover) Relay Board (OPTIONAL)

Note: For the following instructions, typical applications run each of the relays in series through the Common and Normally Open (NO) contacts.

A: Computer Status Alarms (External PLC monitoring).

Wire computer status alarms to JP4 & JP2. Wire the Common and Normally Open Contacts in series to a PLC. If an alarm occurs, one or both of these contacts will open.

B: Sample Pump Control – Water slip, over-temperature, thermocouple failure alarms.

Wire the Line (hot) power for the sample pump through terminals through JP3 and JP1. Wire the Common and Normally Open (NO) contacts in series. If an alarm occurs, one or both of these contacts will open.

The sample pump is now in series with the Water Slip (Moisture Carryover) Sensor and the Ready/Slip/power failure relay, which will only allow the sample pump to start if conditions are satisfactory (i.e., no water slip, and safe operating temperature of the sampling system, and no thermocouple failure).

H: DEFAULT SETPOINTS

eCOOL Mini Heat Exchangers:
Setpoint Temperature = 5°C
Ready (Run) Temperature = 10°C
Cooler must operate below the Ready Temperature to avoid the over temperature alarm condition.

Relay Board:
Relay contacts are in their Normal state (de-energized state) during an alarm condition.

Analog output 0-4.5 VDC equates to 0-10°C corresponding to each thermocouple.

I: MAINTENANCE

Note: Please refer to the Spare Parts section of this manual for part numbers and descriptions.

Daily

Verify each channel is running at 5°C (+/- 1.5°C).

LED's should be Green.

Verify cooling fans are running.

Verify that the peristaltic pump is running and water is draining out.

Verify that the sample pump is drawing full flow.

Quarterly

Verify power supply voltage is above 14.5 VDC.

Inspect and clean the EZ-Clean Twist-Apart heat exchangers with de-ionized water. Depending on the composition of the sample stream, heat exchangers may need to be cleaned more often.

Inspect and replace the sample pump diaphragm when needed.

Inspect and replace the peristaltic pump tubing.

Inspect the water slip sensor and verify that there is no corrosion or restrictions to the sensing pins.

Annually

Check and replace the Peltier cooling elements. At room temperature, a Peltier should have a resistance of 5-10 Ohms. Higher resistance signifies the Peltier is stressed and could fail soon.

Using a K-type thermocouple simulator, disconnect each thermocouple and simulate a temperature between 0°C and 10°C. Verify that the readout on the display matches the temperature to within 0.5°C. If it does not, the cooler needs to be recalibrated. Contact Baldwin for the calibration procedure and assistance.

J: TROUBLESHOOTING

Alarm Message	Symptom	Action(s)
Thermocouple Failure Channel #	Thermocouple is failing or disconnected	Ensure proper connection to TB6 for Channel 1, TB7 for Channel 2. Replace K-type thermocouple.
Water Slip Alarm	Water has slipped passed the thermo-electric cooler and tripped the water slip sensor.	Ensure system loading (gas flow and water %) does not exceed cooler capacity. Verify that the cooler last impinger is holding a constant temperature near 5°C. If a dry sensor still trips the alarm, clean the sensor or replace if necessary.
Heat Exchanger (Channel) Over Temp Alarm	Cooler channel does not maintain a temperature below 10°C.	Verify that the system loading (gas flow and water %) does not exceed the cooler capacity. Verify that each Peltier element is drawing approximately 6 Amps. Replace the Peltier element if the current draw is low. Calibrate the temperature inputs using a thermocouple simulator.

Problem	Check	Action(s)
No LCD or LED(s) and no fan.	AC power input. DC 3A fuse (F1) on control board. AC 15A fuse on power supply. Check for +15VDC at P1 & P11 of control board.	Ensure that AC power is connected. Replace fuse as necessary. Replace fuse as necessary. If low reading, remove wires from P1 & P11, measure at power supply and replace supply if voltage still is low.
Heat exchanger remains at ambient temperature.	Peltier element current draw. (Should be above 6 amps.)	Replace Peltier element.
Heat exchanger frozen and cooler indicates ambient temperature.	Thermocouple placement in heat exchanger block. Peltier current draw (>6A) for both elements on that channel.	Ensure proper placement. Replace Peltier element.
Heat exchanger does not reach set temperature, but is below ready temperature.	System loading. Calibration and set temperature adjustment.	Ensure system loading is not exceeding cooler capacity. Adjust as necessary.
Heat exchanger temperature cycles up and down.	Peltier element connections on control board. Ferrite beads on thermocouples going into terminal TB1 & TB2	Ensure a firm connection on flag connectors on control board. Ensure system loading is not exceeding cooler capacity. Wrap a Ferrite bead around thermocouple wires.
Water carryover in system.	Heat exchanger temperature. (Should be below 6°C.)	Ensure system loading is not exceeding cooler capacity.
Pump does not start. LCD(s) are green.	Pump electrical connections.	Ensure proper connections. Replace relay board.

For further service assistance, contact:

Perma Pure LLC
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8 Executive Drive (08755)
Toms River, NJ 08754
Tel: 800-337-3762 (toll free U.S.)
Tel: 732-244-0010
Fax: 732-244-8140
Email: info@permapure.com

K: SPARE PARTS

Model MP5400

Part No.	Description
3CCB-023	Circuit Board, eCool™, Relay Board
2FAN-004	Fan: Muffin, 4” x 1 ½”, 12 VDC
3CXD-023	Heat Exchanger, SS, EZ-Clean™ Twist-Apart, 5", Durinert® Coated
3CXK-001	Heat Exchanger: 5" Kynar
3CXS-023	Heat Exchanger, SS, Twist-Apart, 5"
3KPE-004	Peltier Element Kit, 40 mm
3KPB-014	Peristaltic Drain Pump: Mini Dual Head w/ 115 VAC Motor & Tubing
2PBM-012	Peristaltic Drain Pump: Mini Dual Head w/ 115 VAC Motor
2PBT-002PK	Peristaltic Drain Pump Tubing, Norprene, Size 17 (10 feet)
1PSD-027	Power Supply: 240 W, 15 VDC
2PAS-018	Sample Pump: Mini Single Head, 115V
2PAM-017	Sample Pump: Repair Kit, Mini Single Head
1TTC-003	Thermocouple, Temperature, Control, Type K 36”

APPENDIX: eCOOL™ MINI

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
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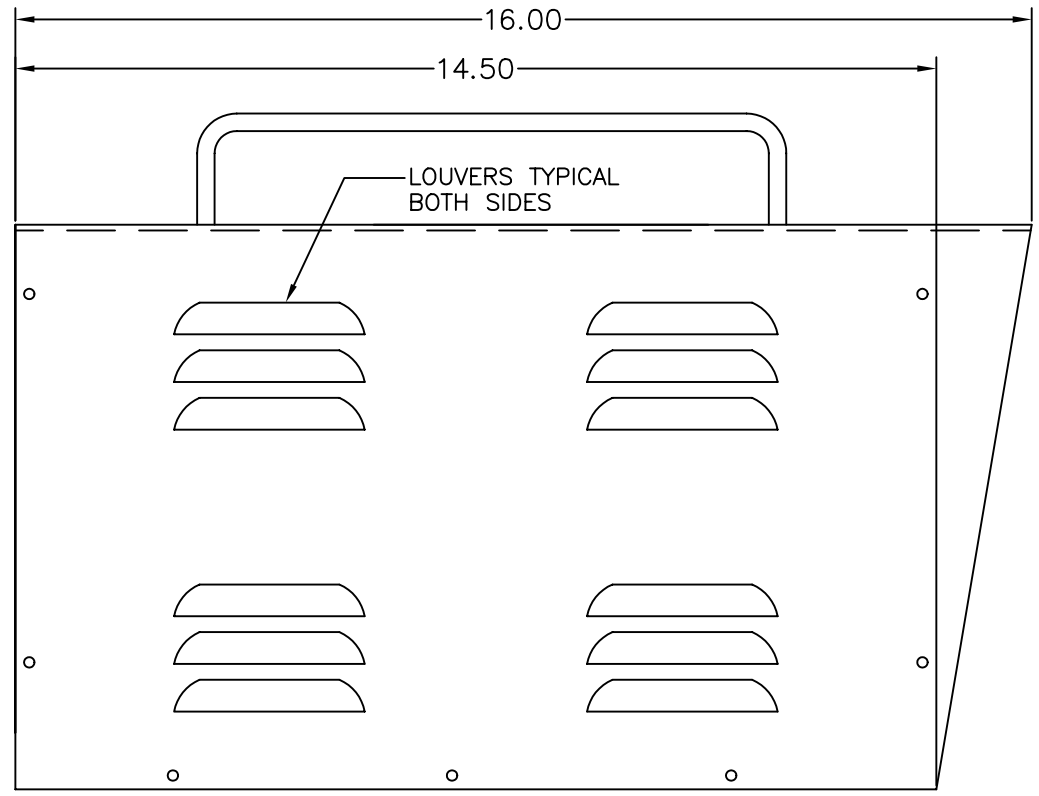

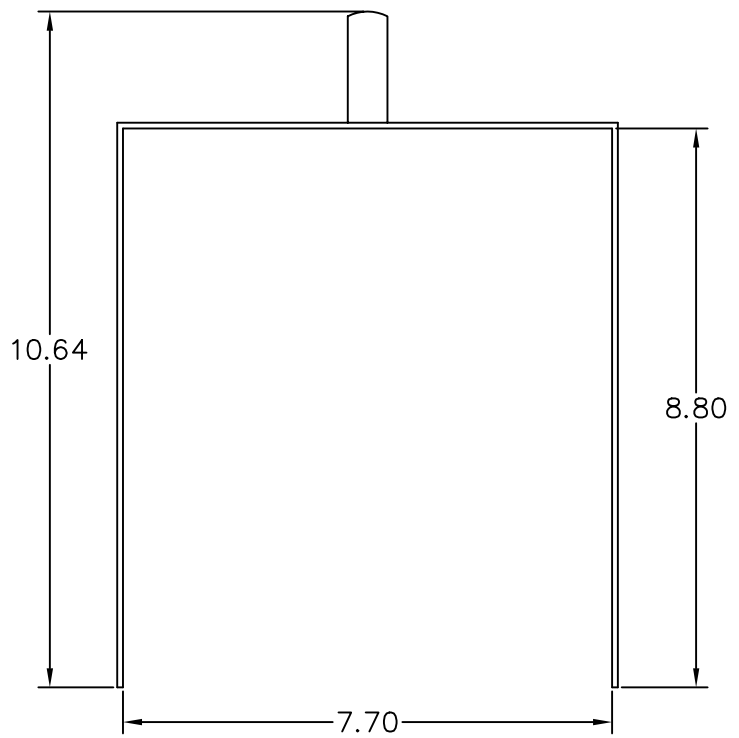

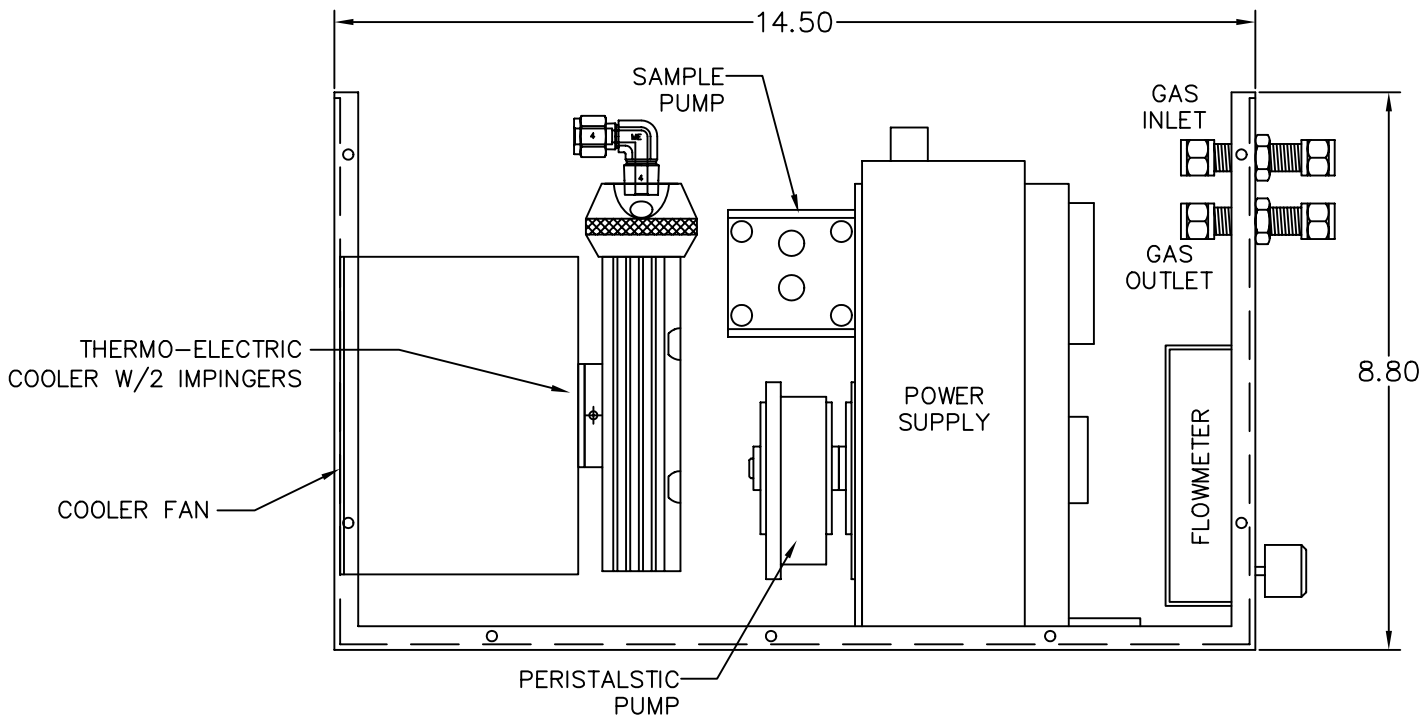

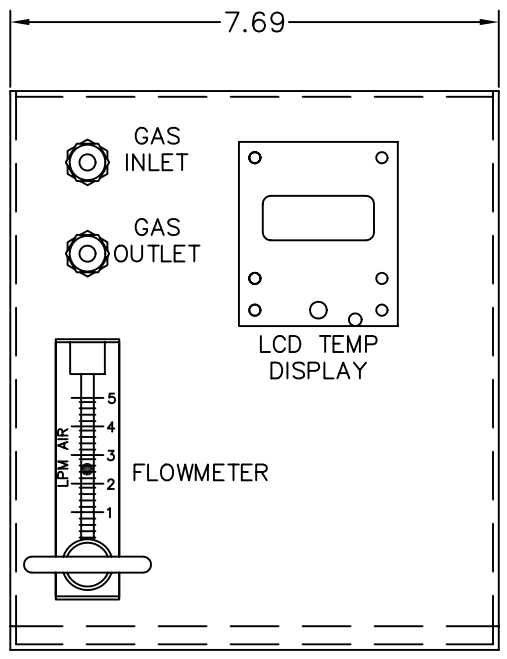

ITEM	QTY	DESCRIPTION	MANUF.
USED FOR:	MODEL NUMBER:		
	DESCRIPTION:		

UNLESS OTHERWISE SPECIFIED
TOLERANCE DECIMALS
1 PLACE = ±.02
2 PLACE = ±.02
3 PLACE = ±.010
SURFACE FINISHES 125
ANGLES = ±5°
HOLES = +.003/-.001
BALDWIN
www.baldwinUSA.com

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BALDWIN, INC.

DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

DRAWN BY:	DATE	BALDWIN, INC.
RAW	09/22/03	
APP'D:	DATE	
MATERIAL		PART DESCRIPTION: MINI PORTABLE SAMPLE CONDITIONER LAYOUT
FINISH		SIZE: B · SCALE: NTS · DRAWING/PART NO.:
		CAD DIR: S:\S&M\Drawings\Sample_Cond\Portable · SHEET 1 OF 1

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
0	00/00/00	INITIAL DRAWING	RAW	RAW

(OPTIONAL)
RELAY BOARD #2
FOR DUAL STREAM
APPLICATIONS

110 VAC LINE
GROUND
NEUTRAL
SAMPLE PUMP POWER
JP1
JP2
JP3
JP4
JP15
JP5
8-PIN RIBBON CABLE
WATER SLIP CONTINUITY SENSOR

RELAY BOARD #1
110 VAC LINE
GROUND
NEUTRAL
SAMPLE PUMP POWER
JP15
JP5
WATER SLIP CONTINUITY SENSOR
8-PIN RIBBON CABLE

10-PIN RIBBON CABLE
LAN CARD
JP16
RJ-45 CAT 5 ETHERNET CONNECTION
(OPTIONAL)
JP1

JP15
RESET BUTTON
JP19
JP29
RED
BLK
THERMOCOUPLE CH. 1 (RIGHT-HAND SIDE)
THERMOCOUPLE CH. 2 (LEFT-HAND SIDE)
JP5
JP7
YEL
RED
FAN #1
FAN #2
(OPTIONAL)

RED + 12-15VDC
RED + 12-15VDC
BLK RETURN
BLK RETURN
POWER SUPPLY

220/110VAC 50/60Hz
L
N
G
HEAT SINK FAN
(OPTIONAL)

HEATED LINE HEATER
PROBE HEATER
SSR
3-32 VDC COIL RELAY
G N L
HEATED LINE HEATED PROBE CONTROLLER
JP4
20-PIN RIBBON CABLE
ACCESSORY CARD
(OPTIONAL)

JP23
JP20
24-PIN RIBBON CABLE
JP1
E2 POS
E1 NEG
ISOLATED OUTPUT CARD
(OPTIONAL)

BLK RED + RED BLK -
BLK RED + RED BLK -
BLK RED + RED BLK -
BLK RED + RED BLK -
PELTIER(S) CHANNEL 1 RIGHT-HAND SIDE
PELTIER(S) CHANNEL 2 LEFT-HAND SIDE

ITEM	QTY	DESCRIPTION	MANUF.
USED FOR:		MODEL NUMBER: 5300-5900	
		DESCRIPTION:	

UNLESS OTHERWISE SPECIFIED
TOLERANCE DECIMALS
1 PLACE = ±.02
2 PLACE = ±.02
3 PLACE = ±.010
SURFACE FINISHES 125
ANGLES = ±5°
HOLES = +.003/-.001
BALDWIN
www.baldwinUSA.com

DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

DRAWN BY: RAW DATE: 07/02/04
APP'D: DATE
MATERIAL
FINISH

BALDWIN, INC.

PART DESCRIPTION
E-COOL ELECTRICAL
INTER CONNECT DETAIL

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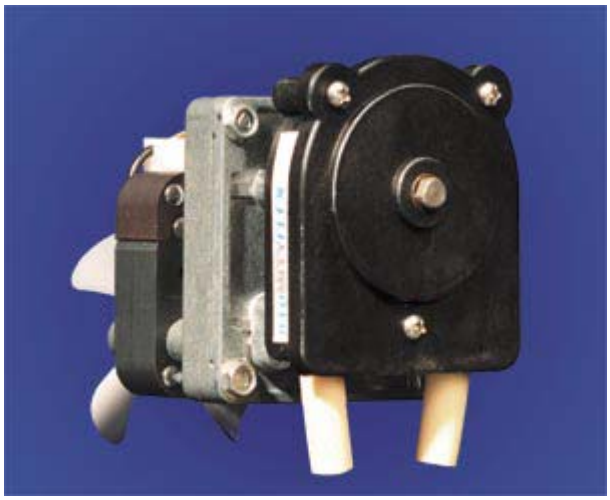
CAD DIR: S:\MANUAL SHEET 1 OF 1



Anko Peristaltic Drain Pump
Series 810 Standard Features
Electrical: 115 VAC, 60HZ with 6" leads.

In a peristaltic pump (dispensing pump), the material to be pumped only comes in contact with the tubing. This is ideal for applications where the product to be moved or pumped should not touch any foreign materials. For example; dispensing slurries, dispensing food products, chemical or other difficult to handle fluids.

The peristaltic pump is self priming and can handle a wide variety of viscosities, from air to gases to heavy slurries, with a consistent positive displacement. Each revolution of the roller assembly delivers a precise amount of product. The feature of small positive displacement pumps is particularly important for electronic metering applications . The amount of product moved depends on the motor speed, internal diameter of the tube, pump size and configuration.

MityFlex® 810 Series pumps are capable of pumping from 0.3mL/min to over 987mL/min.

Note: Gearmotors are UL & CSA recognized.

Series 810 General Specifications:

Flow Rate: 50 fixed flow rates available - .4 to 987mL/min

Mounting: 18 gauge zinc plated steel mounting plate.

Dimensions: 5.12"W x 3.74"H x 4.1"D maximum.

Motor: Shaded pole gearmotor
Stainless steel output shaft
Plastic cooling fan designed for operation at 25°C ambient temp.

Pressures: Up to 20 psi (2.7 bar)

Fluid Contacts:
Fluid being dispensed contacts tubing only

Pump:
Polypropylene with stainless steel fasteners self priming up to 29 ft. (8.8m)
Can be run dry continuously and is non-siphoning.

Rollers:
Nylon with bronze bearing, or for corrosive applications, UHMW polyethylene rollers with bronze bearing

Roller bracket:
Powdered iron with hardened steel roller pins and spring tension fastener. Roller bracket assembly attaches directly to motor output shaft.

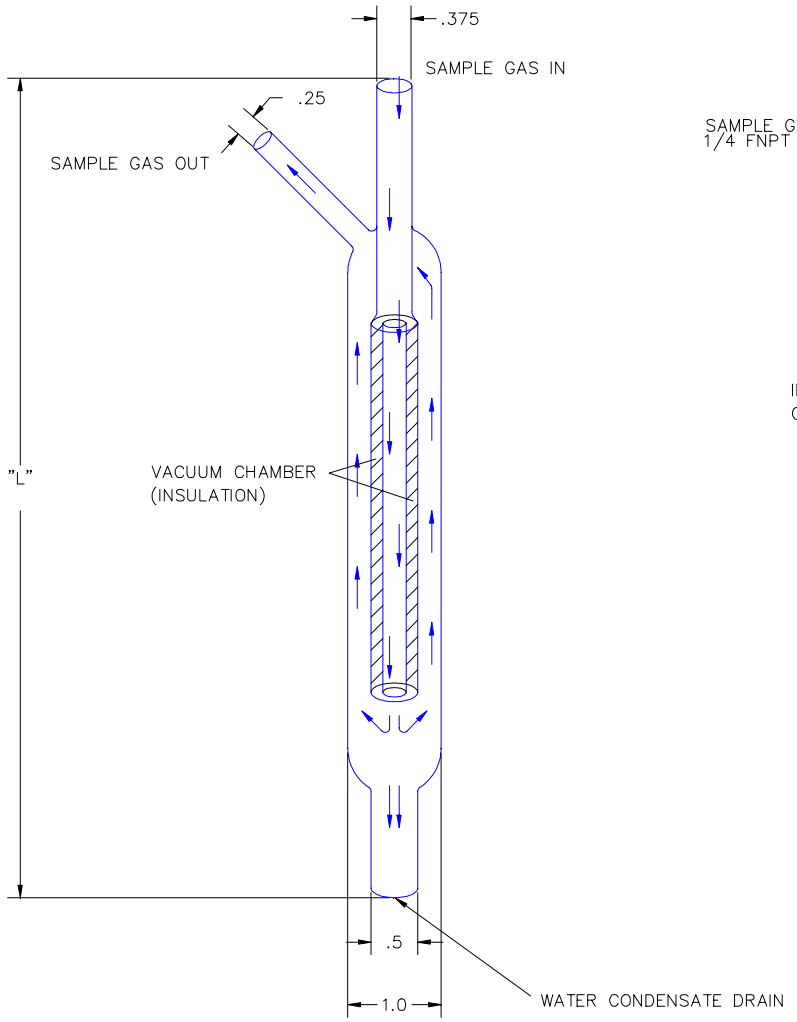
Tubing:
Standard pumps designed to squeeze tubing with a maximum 60 Shore A durometer.

OPTIONS

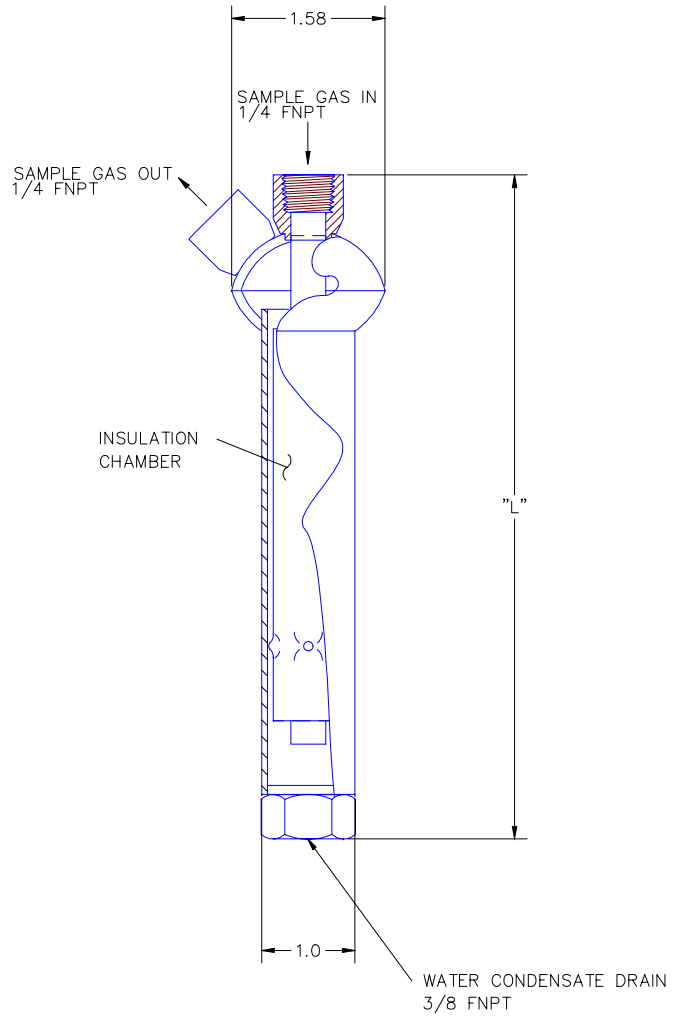
Electrical:
24 to 240 VAC
50 Hz, 60 Hz or 50/60 Hz

Flow Rates:
Dual heads allow you to choose any flow rate up to 900 mL/min.

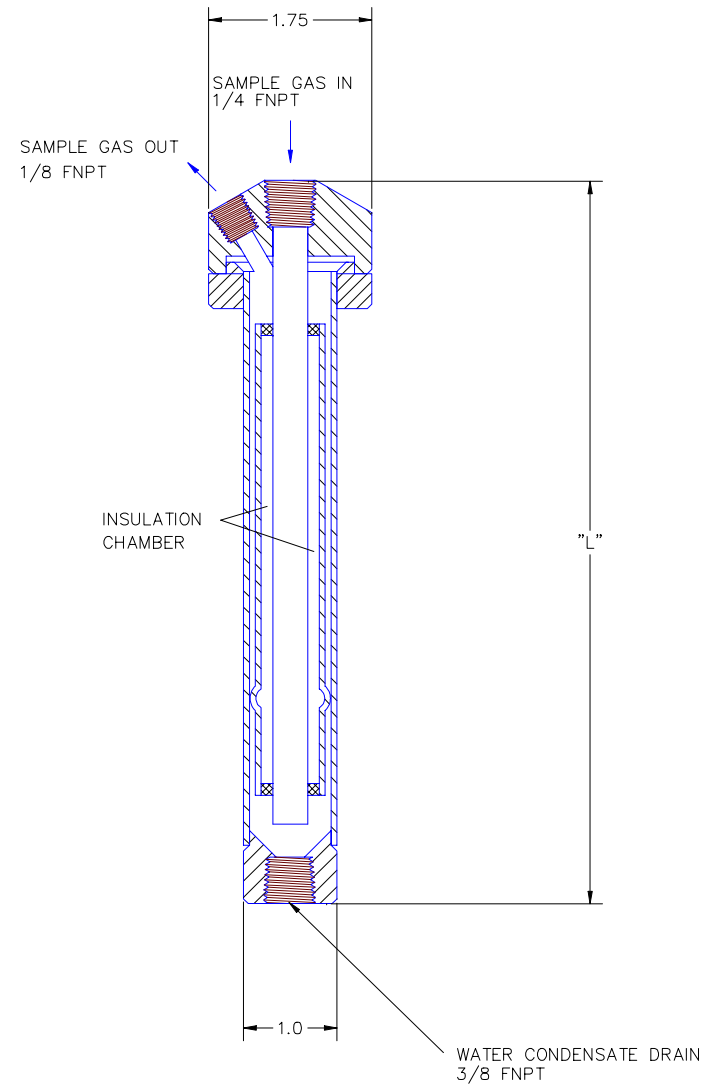
REVN	DATE	DESCRIPTION	DRAWN	APPROVED
0	00/00/00	INITIAL DRAWING	JO	



BOROSILICATE GLASS



STAINLESS STEEL



KYNAR

LENGTH TABLE

IMPINGER	"L"
5" GLASS	9.0
10" GLASS	14.5
5" STAINLESS STEEL	7.0
10" STAINLESS STEEL	12.25
5" KYNAR	7.0
10" KYNAR	12.25
5" KYNAR-GLASS COMBO	
10" KYNAR-GLASS COMBO	

ITEM	QTY	DESCRIPTION	MANUF.

PROJECT:

UNLESS OTHERWISE SPECIFIED

SURFACE FINISHES: 125

TOLERANCE DECIMALS: 2 PLACE = ± .02; 3 PLACE = ± .010

ANGLES = ± 5°

HOLES =

CONCENTRICITY .005T1 R
INSIDE CORNERS .031R MAX
REMOVE BURRS BREAK EDGES TO .005 MIN. - .020 MAX.

DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

DRAWN BY: JO DATE: 09/27/01

APP'D: DATE

MATERIAL

FINISH

BALDWIN ENVIRONMENTAL, INC.

PART DESCRIPTION: Heat Exchanger Schematic

SIZE: B | SCALE: 1/1 | DRAWING/PART NO.: IC0060

CAD DIR: S:\DRAW\ | SHEET 1 OF 1

CHART OF VOLUME PERCENT WATER CONCENTRATIONS
AT SATURATION FOR VARIOUS TEMPERATURES
AT STANDARD PRESSURE (ATMOSPHERIC PRESSURE)

DEGREES C	DEGREES F	VOLUME %	DEGREES C	DEGREES F	VOLUME %
+100	+ 212	100.00	+ 2	+ 36	0.696
+ 90	+ 194	69.20	+ 1	+ 34	0.649
+ 80	+ 176	46.70	0	+ 32	0.602
+ 75	+ 167	38.70	- 1	+ 30	0.555
+ 70	+ 158	30.70	- 2	+ 28	0.510
+ 65	+ 149	25.20	- 3	+ 27	0.469
+ 60	+ 140	19.70	- 4	+ 25	0.431
+ 55	+ 131	15.50	- 5	+ 23	0.396
+ 50	+ 122	12.20	- 6	+ 21	0.363
+ 45	+ 113	9.45	- 7	+ 19	0.333
+ 40	+ 104	7.25	- 8	+ 18	0.305
+ 35	+ 95	5.55	- 9	+ 16	0.281
+ 30	+ 86	4.19	- 10	+ 14	0.256
+ 29	+ 84	3.95	- 11	+ 12	0.234
+ 28	+ 82	3.73	- 12	+ 10	0.214
+ 27	+ 81	3.62	- 13	+ 9	0.196
+ 26	+ 79	3.32	- 14	+ 7	0.179
+ 25	+ 77	3.13	- 15	+ 5	0.163
+ 24	+ 75	2.94	- 16	+ 3	0.148
+ 23	+ 73	2.77	- 17	+ 1	0.135
+ 22	+ 72	2.61	- 18	0	0.123
+ 21	+ 70	2.46	- 19	- 2	0.112
+ 20	+ 68	3.31	- 20	- 4	0.102
+ 19	+ 66	2.17	- 22	- 8	0.084
+ 18	+ 64	2.04	- 24	- 11	0.069
+ 17	+ 63	1.91	- 26	- 15	0.057
+ 16	+ 61	1.79	- 28	- 18	0.046
+ 15	+ 59	1.68	- 30	- 22	0.038
+ 14	+ 57	1.58	- 32	- 26	0.031
+ 13	+ 55	1.48	- 34	- 30	0.025
+ 12	+ 54	1.38	- 36	- 34	0.019
+ 11	+ 52	1.29	- 38	- 37	0.016
+ 10	+ 50	1.21	- 40	- 40	0.013
+ 9	+ 48	1.13	- 42	- 44	0.011
+ 8	+ 46	1.06	- 44	- 47	0.008
+ 7	+ 45	0.988	- 46	- 51	0.006
+ 6	+ 43	0.922	- 48	- 54	0.005
+ 5	+ 41	0.861	- 50	- 58	0.004
+ 4	+ 39	0.803	- 52	- 62	0.003
+ 3	+ 37	0.751	- 54	- 65	0.002

MOISTURE CONVERSION TABLE

DEWPOINT		VAPOR PRESSURE (WATER/ICE in EQUALIBRIUM) mm MERCURY	PPM on VOLUME BASIS at 760 mm of Hg PRESSURE	RELATIVE HUMIDITY at 70 F	PPM on WEIGHT BASIS in AIR
F	C				
-110	-166	.0000010	.00132	.0000053	.00082
-108	-162	.0000018	.00237	.0000096	.0015
-106	-159	.0000028	.00368	.000015	.0023
-104	-155	.0000043	.00566	.000023	.0035
-102	-152	.0000065	.00855	.000035	.0053
-100	-148	.0000099	.0130	.000053	.0081
-98	-144	.000015	.0197	.000080	.012
-96	-141	.000022	.0289	.00012	.018
-94	-137	.000033	.0434	.00018	.027
-92	-134	.000048	.0632	.00026	.039
-90	-130	.00007	.0921	.00037	.057
-88	-126	.00010	.132	.00054	.082
-86	-123	.00014	.184	.00075	.11
-84	-119	.00020	.263	.00107	.16
-82	-116	.00029	.382	.00155	.24
-80	-112	.00040	.562	.00214	.33
-78	-108	.00056	.737	.00300	.46
-76	-105	.00077	1.01	.00410	.83
-74	-101	.00105	1.38	.00559	.86
-72	-98	.00143	1.88	.00762	1.17
-70	-94	.00194	2.55	.0104	1.58
-68	-90	.00261	3.43	.0140	2.13
-66	-87	.00349	4.59	.0187	2.84
-64	-83	.00464	6.11	.0248	3.79
-62	-80	.00614	8.08	.0328	5.01
-60	-76	.00808	10.6	.0430	6.59
-58	-72	.0106	13.9	.0565	8.63
-56	-69	.0138	18.2	.0735	11.3
-54	-65	.0178	23.4	.0948	14.5
-52	-62	.0230	30.3	.123	18.8
-50	-58	.0295	38.8	.157	24.1
-48	-54	.0378	49.7	.202	30.9
-46	-51	.0481	63.3	.257	39.3
-44	-47	.0609	80.0	.325	49.7
-42	-44	.0768	101	.410	62.7
-40	-40	.0966	127	.516	78.9
-38	-36	.1209	159	.644	98.6
-36	-33	.1507	198	.804	122.9
-34	-29	.1873	246	1.00	152
-32	-26	.2318	305	1.24	189
-30	-22	.2859	376	1.52	234
-28	-18	.351	462	1.88	287
-26	-15	.430	566	2.30	351
-24	-11	.526	692	2.81	430
-22	-8	.640	842	3.41	523
-20	-4	.776	1020	4.13	633
-18	0	.939	1240	5.00	770
-16	+3	1.132	1490	6.03	925
-14	+7	1.361	1790	7.25	1110
-12	+10	1.632	2150	8.69	1335
-10	+14	1.950	2570	10.4	1596
-8	+18	2.326	3060	12.4	1900
-6	+21	2.765	3640	14.7	2260
-4	+25	3.280	4230	17.5	2680
-2	+28	3.880	5100	20.7	3170
0	+32	4.579	6020	24.4	3640
+2	+36	5.294	6970	28.2	4330
+4	+39	6.101	8030	32.5	4990
+6	+43	7.013	9230	37.4	5730
+8	+46	8.045	10590	42.9	6580
+10	+50	9.029	12120	49.1	7530
+12	+54	10.52	13840	56.1	8600
+14	+57	11.99	15780	63.9	9800
+16	+61	13.63	17930	72.6	11140
+18	+64	15.48	20370	82.5	12650
+20	+68	17.54	23080	93.5	14330
+22	+71	19.827	26088		16699
+24	+75	33.377	29443		18847
+26	+79	25.209	33169		21232
+28	+8				