

**Baldwin™-Series**  
**Model 5210**  
**Thermo-Electric Cooler**  
User's Manual



PERMA PURE LLC

A HALMA COMPANY

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## Unpacking

Perma Pure has made every effort to ship you a high quality product that has been thoroughly inspected and tested. It has been carefully packed to ensure that it arrives at your facility in good condition. Even though every effort has been made to prevent damage during the transportation process, damage can occur by the carrier. This is out of control of Perma Pure and is the responsibility of the carrier to ensure that your equipment arrives intact and undamaged.

- ❖ Inspect outside packaging. If there is any visible damage, inform the carrier at the time of deliver. ***This inspection is important! Once the package is signed for, responsibility for any visible damage then transfers to the consignee.***
- ❖ Unpack your equipment. Visually inspect the outside of your equipment for any damage. If there is any damage, ***contact the carrier immediately.*** Generally, a carrier must be notified within 24 hours of the delivery to make a hidden damage claim.

### **Items in the carton include:**

- (1) Model 5210 thermo-electric cooler
- (1) User's Manual

Optional glass impingers will ship separately.

If any of the above parts are missing or damaged, call the helpline at **(800) 337-3762 ext-145.**

## Introduction

Thank you for purchasing this product from Perma Pure LLC. This manual has been assembled so that it can answer all questions regarding operation. Please keep the operators manual near the equipment for future reference. There may also be optional equipment available that was not ordered at the time of original purchase, which may be described and/or illustrated in this manual.

If you still have any questions regarding your equipment's operation, available options or technical support, please contact your purchasing dealer or contact Perma Pure directly.

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This equipment is to be installed and operated by trained personnel, with sufficient command of the English language to clearly understand the instructions and safety warnings.

## General description

Sampling combustion product stack gas or exhaust from internal combustion engines requires a method to remove the moisture from the sample, without removing the gas compounds of interest. The Baldwin-Series Classic TE Cooler is an ideal way to decrease the dew point of combustion gases to a repeatable, stable, constant low dew point. The Classic cooler prevents water condensation in sample pre-filters, pumps, and analyzers. For gas analyzers where water vapor is an interferent, a stable, repeatable dew point becomes a part of the gas analyzer performance specification. Classic coolers provide this constant low water concentration, resulting in an accurate gas measurement.

All Classic coolers use thermo-electric elements (Peltiers) to cool the sample gas to the desired dew point temperature. A Classic Thermo-Electric (TE) Cooler is best illustrated as a small heat pump with no moving parts. The Peltier operates 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.

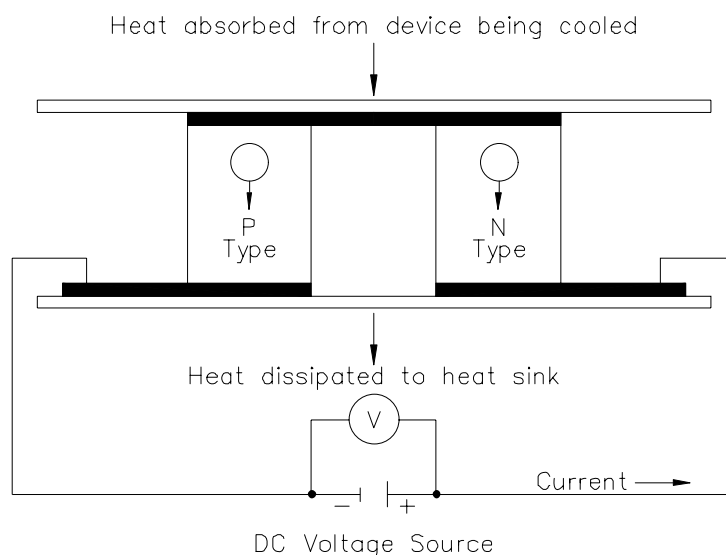


Figure 1: Thermo-electric element (Peltier)

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.

The Classic Cooler removes the moisture from the sample gas by cooling it 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 an analog 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.

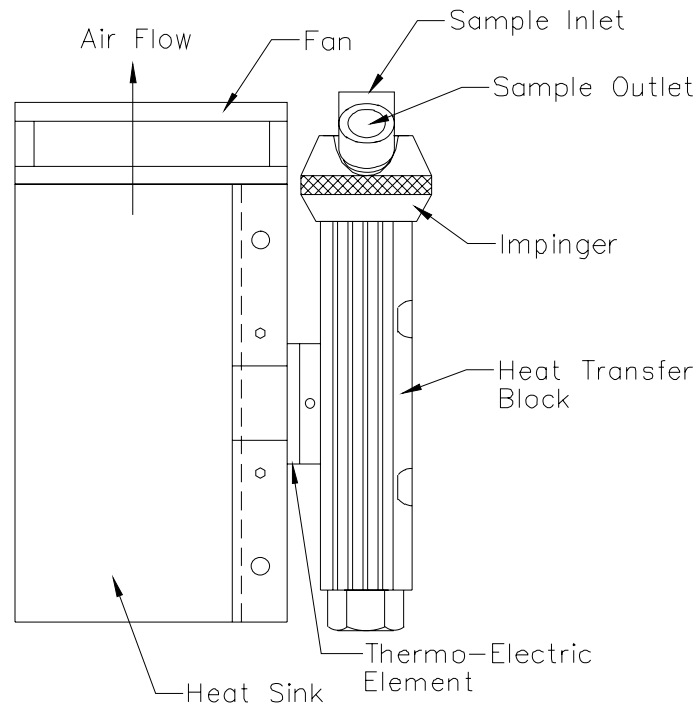


Figure 2: Heat Exchanger, Impinger and Heat Sink

The sample gas is passed to the cooler via the heated filter sample probe and heated sample line. The 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 passing through the sample cooler can be removed by an optional Baldwin-Series 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.

## Physical Description

- Single channel system
- 2 x 10" heat exchangers connected in series only
- 1 Passive (cooled to ambient), 1 Active (cooled to 4°C) heat exchangers
- LCD temperature display
- Dimensions: 14.5" x 11" x 10.5" HWD (37 x 28 x 26.5 cm)
- Weight: 27 lbs (12 kg)

## Specifications

|                                    |   |
|------------------------------------|---|
| Sample gas flow range              | Up to 8 LPM (Up to 17 SCFH)   |
| Avg. inlet dew point at rated flow | 20% H <sub>2</sub> O (60°C DP) @ 5 LPM  |
| Maximum cooling rate               | 440 BTU/ht (464 kJ/hr)  |
| Maximum inlet sample temp.         | 400°F (205°C) for SS or glass impingers<br>280°F (138°C) for Kynar™ impingers |
| Maximum inlet pressure             | 15 psig (1 bar; 760 mmHg)   |
| Maximum pressure drop              | < +1 in H <sub>2</sub> O  |
| Ambient temperature range          | 33-110°F (0.6-43°C)   |
| Outlet sample gas dew point        | 41°F (5°C)  |
| Voltage                            | 115/230 VAC<br>50/60 Hz   |
| Power supply                       | 250W  |
| Cooling down time                  | Less than 6 minutes   |

## Connections

- Sample gas inlet: Kynar, 3/8" tube compression fitting
- Sample gas outlet: Kynar, 1/4" tube compression fitting
- Drain tubing connection: Kynar, 3/8" tube compression x 1/4" barbed tube fitting

***An automatic condensate drain, dual-head peristaltic drain pump is recommended for water removal, Perma Pure part number 3KPB-003; size 17 tubing.***

Always use factory supplied fittings; Perma Pure cannot warrantee against damage to the Peltier elements or heat exchangers if our fittings are not used.



## **Important Safety Warnings**

Please be sure to review the following basic safety procedures. These procedures represent the MINIMUM requirements to operate the equipment safely. It is the ultimate responsibility of the operator to ensure proper safety practices are utilized at the point of operation.

- **NEVER** attempt to operate this equipment in an explosive or otherwise hazardous area.
- **NEVER** exceed any specified rating for the equipment. Voltage, temperature and pressure ratings must be closely observed and not exceeded. Voltage rating of the equipment **MUST** match the rating on the data label. Please make sure that it matches before powering up the equipment.
- This equipment is **NOT** designed to be used in an explosive environment.
- This equipment is **NOT** designed to operate in a wet environment.
- **Condensate is potentially dangerous. NEVER** handle drain lines, impingers or any other item that may have come in contact with the gas stream or any hazardous material, without adequate personal protective equipment. **ALWAYS** assume that any liquid present is hazardous.
- **Sample gas is potentially dangerous.** A leak test is recommended at initial startup and as often as necessary to maintain a safe working environment around the equipment. The gas stream exhaust must exit away from all personnel to prevent dangerous exposure.
- **NEVER operate the equipment with any part of the enclosure unsecured.** All operated doors and covers must be in place and secured prior to operation. Electrical current may be present behind covers or doors, even if tools are not necessary to access these components.
- **NEVER** attempt service on this equipment without first disconnecting all energy sources. Repair of this equipment should only be done by properly trained personnel that are familiar with the potential risks involved with servicing of the equipment.
- **NEVER** replace fuses with types other than the sample specification of type and current. Do not bypass this or any other safety device.
- **NEVER** operate this equipment if it is visibly damaged or the possibility exists that it may have been damaged.
- The use of components that have not been purchased through an authorized Perma Pure dealer or directly from Perma Pure may compromise the safety of the operator. Additionally, use of non-authorized components may change the operating characteristics of this equipment. Any changes to the equipment, that modify its operation in any way, are dangerous, and are strictly prohibited.
- Read the entire operating manual before attempting to set up or operate the equipment.
- Please heed all warning labels that are on the equipment. They are there to remind you of possible hazardous conditions.
- Verify the integrity of any mechanical and/or electrical connections that are made to the unit.
  - Verify that the unit is connected to the proper rated power for the system
  - Verify that the unit is plumbed properly to operate effectively

## **Installation**

### **Hardware required for installation**

- (4) ¼-20 mounting screws
- For stainless steel sample lines, 2 inches of 3/8" Teflon tube
- Peristaltic drain pump, dual head

### **Mounting**

The Classic Model 5210 Thermo-Electric Cooler should be installed away from heat sources in a well vented area.

**NOTE: The operational stability of the cooler dew point is influenced by the stability of the ambient temperature.**

For proper operation, the ambient temperature cannot exceed 43°C (110°F). At, or close to the maximum ambient temperature, the cooler will not be able to control the temperature to reduce the dew point of the sample gas to the 5°C set point. This will result in compromised operation and water slip or carryover, possibly into the analyzer. Also, at or near this temperature, the cooler will be running "full on" and Peltier life will be greatly reduced.

## **Connections**

### **Sample and Drain**

1. Connect the sample inlet to the 3/8" tube fitting shown in figure 1.

**NOTE: If using 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.**

2. Connect the sample outlet to the 1/4" tube fitting shown in figure 1.
3. Connect the peristaltic pumps to the 1/4" barbed tube fittings shown in figure 1.

**NOTE: Do not reduce the size of the condensate tubing since doing so restricts water flow resulting in water carryover into the sample.**

For instructions on installing a Perma Pure peristaltic pump, see appendix 1. Note that the rating on this pump tubing is 20 psi (1.7 bar).

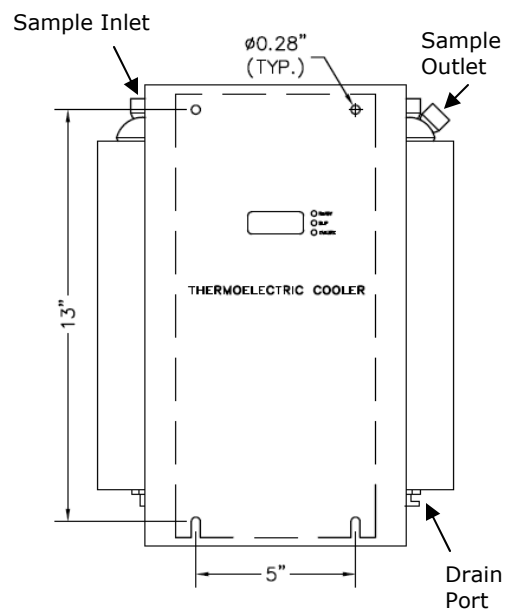


Figure 1 - Model 5210 Cooler





### **Electrical –Relay Board**

Make the following connections while referring to Appendix B3: Interconnect wiring diagram.

- Computer status alarms wire to TB2
  - a. Terminals 1 and 3 for water slip alarms
  - b. Terminals 4 and 6 for ready/slip alarm status
  
- Sample pump control-water slip only
  - a. Jumper line, neutral, and ground from the power supply line terminals to TB8 (GNL) on the relay board.
  - b. Wire the sample pump power leads to TB2, terminals 6 (hot), 7 (neutral), and 8 (ground).
  
- Sample pump control-water slip plus read/slip/power fail safe start
  - a. Jumper hot, neutral, and ground from the power supply line terminals to TB8 (GNL) on the relay board.
  - b. Wire the sample pump power leads to TB2, 7 (neutral), and 8 (ground).
  - c. Wire a jumper on TB1 from terminal 3 to terminal 4, and wire another jumper on TB9 from terminal 1 to terminal 2.
  - d. Wire sample pump hot wire to TB9 terminal 5.
  - e. Wire water slip sensor to TB1 terminals 1 and 2.

Sample pump is now in series with water slip sensor and the ready/slip/power failure relay, which will only allow the sample pump to start if both conditions are true; ie. No water slip and safe operating temperature of the sampling system.

### **LED Summary**

The Classic Model 5210 has a single-channel, digital operating temperature front panel indicator and 3 LED status displays, 2 green and 1 red. These indicators are arranged vertically on the front of the cooler.

- "Ready" Green LED comes on when output stream dew point is below 10°C.
- "Slip" Green LED comes on when water is not present on water slip sensor.
- "Failure" Red LED comes on if the thermocouple failed.

NOTE: "Slip" LED is connected to the water slip sensor, which is normally dry on start up. If the "Slip" Green LED goes out, this indicates water is "slipping" past the heat exchanger. The relay then shuts off the sample pump so that water is not allowed to reach the analyzers, preventing damage to the analytical instruments. Steps need to be taken at this time to determine the cause of the moisture and correct the situation.

**Classic Model 5210 is operating properly when both Green LED's are lit.**

### **Start-up**

1. Plug power cord into a properly grounded main circuit. Green "Slip" LED will come on.
2. Wait for the green "Ready" LED light to come on, approx. 6 minutes. This will indicate the impinger temperature is below 10°C and the sample gas flow can begin.
3. After approx. 3 more minutes, the factory set-point of +5°C (41°F) will be reached.

The SLIP Green LED is always on unless;

- Moisture is detected by the water slip sensor
- There is a malfunction (eg. Shorted water slip sensor leads or a bad relay board)

NOTE: All voltages can be read at the PCB terminal strip.



## **Set Points**

Both the operating control temperature and ready relay set points are adjusted by 20 turn potentiometers located on the control board.

Using a digital voltmeter (DVM), attach the black lead to P1 for ground reference point and attach the red lead to test points 1, 2, or 3 located just above terminal TB1 where the control thermocouple terminates.

TP1 is the thermocouple zero/span adjustment test points, and should **not** be adjusted by the user.

TP2 is the control set point temperature (set point #2)

TP3 is the ready relay set point temperature (set point#3)

To adjust either set point, open the cooler front door, attach the DVM, and adjust the labeled potentiometer on the control card.

NOTE: These set point potentiometers are factory set and sealed for proper cooler operation. Please consult the factory before making any changes to these set point adjustments.

**SET POINT #2 is factory adjusted to 5°C (.500 VDC)**  
**SET POINT #3 is factory adjusted to 10°C (1.00 VDC)**

## Troubleshooting and Maintenance Guide

| Symptom  | Diagnostic  | Fix   |
|--|---|---|
| No LED(s) and no fan.  | AC power input.   | Ensure that AC power is connected.  |
| No LED(s) and no fan.  | DC 3A fuse (F1) on control Bd.<br>AC 15A fuse on power supply.<br>Check for +15VDC at P1 & P11 of control bd.       | Replace fuse as necessary.<br>Replace fuse as necessary.<br>If low reading, remove wires from P1 & P11, measure at power supply and replace supply if voltage still is low. |
| LED(s) on and no fan.  | Wire harness at P10 on control board over to P1 on relay boards.<br>Relay Board for +12VDC at TB7 pins 1&2 and 3&4. | If loose then reseal connectors.<br>If no voltage or low reading, replace relay board.  |
| F1 on control board keeps blowing.                                       | Replace fuse (3A) and disconnect P10 cable going to relay board.  | If fuse does not blow, replace relay board.   |
| Impinger remains at ambient temperature.                                 | Peltier current draw. Should be between 6 and 8 amps.   | Replace Peltier element.  |
| Thermocouple failure LED is on.  | Thermocouple connection TB1.  | Ensure proper connection.<br>Try a good thermocouple in place of old one<br>Replace thermocouple.   |
| Impinger frozen and cooler indicates ambient temperature.                | Thermocouple placement in heat exchanger block.<br>Peltier current draw (>6A) for both elements on that channel.    | Ensure proper placement.<br><br>Replace bad peltier   |
| Impinger does not reach set temperature, but is below ready temperature. | System loading.<br><br>Calibration and set temperature adjustment.  | Ensure system loading is not exceeding cooler capacity.<br>Adjust as necessary.   |
| Impinger temperature cycles up and down.                                 | Peltier connections on control board.<br><br>Ferrite bead on thermocouple going into terminal TB1.                  | Ensure a firm connection on flag connectors on control board. Ensure system loading is not exceeding cooler capacity.<br>Wrap thermocouple wires around a Ferrite bead      |



|   |  |  |
|---|--|--|
| Water carryover in system.                        | Impinger temperature. Should be below 6°C.                       | Ensure system loading is not exceeding cooler capacity.  |
| Slip LED does not come on                         | Water carryover in system.<br><br>Water slip sensor connections. | Ensure system loading is not exceeding cooler capacity.<br><br>Ensure that all water slip sensor connections are made. Disconnect sensor at base of unit, Clean tip of sensor. Replace alarm relay/water slip board. |
| Pump does not start. Ready and slip LED(s) are on | Pump electrical connections.                                     | Ensure proper connections. Replace board.  |

## **Replacement Parts**

### **Classic Model 5210**

| <b>Part No.</b> | <b>Description</b>                                      |
|-----------------|---|
| 3CCB-010*       | Control Board: Single Channel                           |
| 2FAN-005        | Fan: Muffin, 4" x 1", 12 VDC                            |
| 2FAN-004        | Fan: Muffin, 4" x 1½", 12 VDC                           |
| 3CXD-022        | Impinger: 10" EZ-clean twist-apart Durinert®            |
| 3CXD-024        | Impinger: 10" NJ, EZ-clean twist-apart Durinert coated  |
| 3CXG-002        | Impinger: 10" Glass, threaded w/ fittings               |
| 3CXK-003        | Impinger: 10" Kynar                                     |
| 3CXS-022        | Impinger: 10" Stainless Steel, EZ-clean twist-apart     |
| 3CXS-024        | Impinger: 10" NJ, Stainless Steel, EZ-clean twist-apart |
| 3KPE-004*       | Peltier Element Kit, 40 mm                              |
| 1PSD-008*       | Power Supply: 250 W, 15 VDC                             |
| 3CCB-004*       | Relay Board: Single Channel                             |
| 1TTC-001        | Thermocouple: Temperature, Control, Type K, 24"         |

\* Recommended Spares

### **Sample Conditioning Systems w/ Classic Model 5210 Thermo-Electric Cooler**

| <b>Part No.</b> | <b>Description</b>                                      |
|-----------------|---|
| 3KFA-001        | Filter Assembly, Sample in-line, 2-micron               |
| 3FHG-001        | Filter Bowl, Glass                                      |
| 3FEC-002**      | Filter Element: Ceramic, 2-micron                       |
| 3KPB-003        | Peristaltic Pump: Dual, Kit, 115V Complete w/ Enclosure |
| 2PBM-003        | Peristaltic Pump: Head Only, Standard                   |
| 2PBM-001        | Peristaltic Pump: Motor Only, 115V AC 60 Hz             |
| 2PBT-002PK*     | Peristaltic Pump: Tubing, Norprene, Size 17 (10 feet)   |
| 3KPA-001*       | Sample Pump: Assembly, Single Head w/ Check Valve, 115V |
| 2PAS-008        | Sample Pump: Single Head, Mini-Dia-Vac, 115V (bare)     |
| 2PAM-001*       | Sample Pump: Repair Kit, Single                         |
| 3CWS-001        | Water Slip Sensor (Hastelloy/SS Pins)                   |
| 3KCW-002        | Water Slip Sensor (SS Pins) w/ Holder Assembly          |

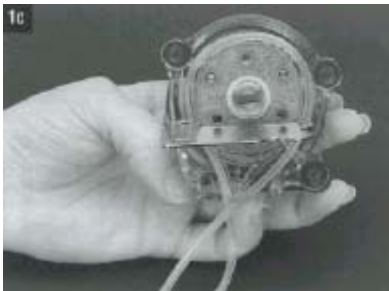
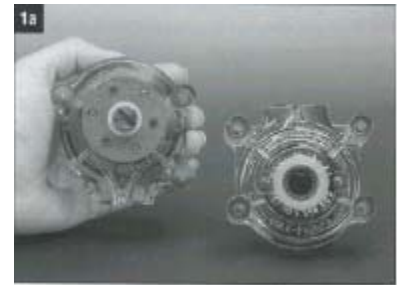
\* Recommended Spares    \*\*Consumables

## **Appendix A: Installation of Peristaltic Pump**

**NOTE: Perma Pure peristaltic pumps are rated for a maximum pressure of 20 psi.**  
If supplied loading key is not available, use a flat head screwdriver.

### **Single pump head loading**

- a) Separate the end bells (the pump head halves). Hold the end bell containing the rotor as shown with the tubing retainer grooves facing down.
- b) Place tubing in the right groove and against the first two rollers. Hold tubing with thumb. Near groove, insert smaller prong of loading key between the top of the rotor and tubing. Push key in as far as possible.
- c) Push down and turn key counterclockwise completely around the rotor. The key will push the tubing uniformly into the end bell assembly. Hold the second end of the tubing. Remove key.
- d) Position the other end bell on top and press the end bells together. Be careful not to pinch the tubing. If end bells do not snap tightly together, reload tubing. If necessary, turn key in slot on rotor shaft to adjust tubing (as in step e).
- e) With key in slot on rotor shaft, turn key to align tang on rotor shaft with slot in motor drive shaft. Point tubing retainer grooves up. Shift the pump head slightly till it snaps on the alignment pins (if present). Secure with four provided screws. Tighten with fingers only.



### **Multi-channel mounting**

- a) Load the pump heads with tubing.
- b) Install the four correct length mounting screws in drive.
- c) Slide the first pump head into the mounting screws.
- d) Place key in slot on mounting shaft. Twist to align tang on rotor shaft with slot in motor drive shaft. Shift the pump housing around till it drops over the alignment pins (if present).
- e) Repeat for each additional pump head, aligning pump head tang with slot on previously mounted pump head.
- f) Slide the flow flat washers onto screws and secure with the four wingnuts. Tighten with fingers only.



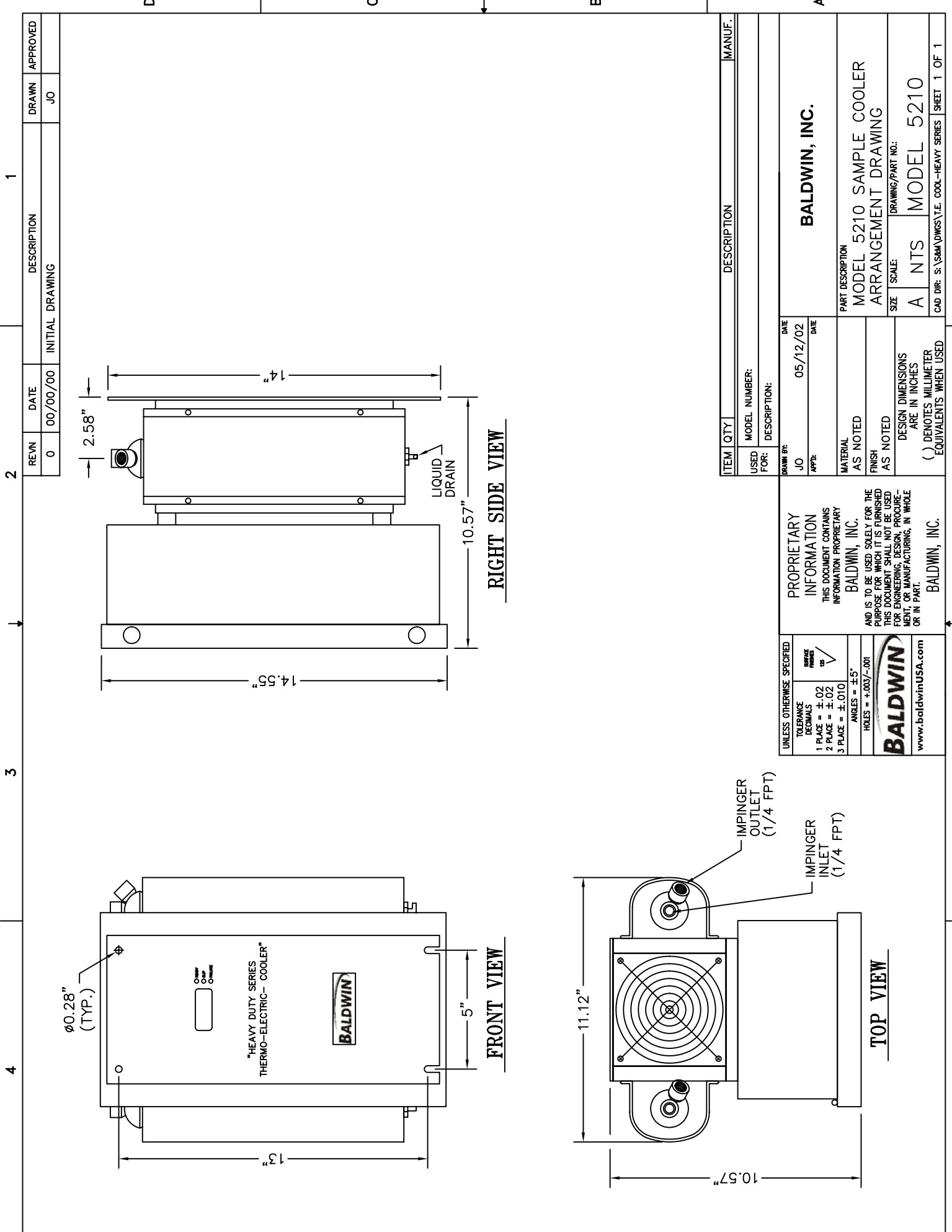
### **Replacement parts**

|            |   |
|------------|---|
| 2PBM-001   | Peristaltic pump, motor only, 115 VAC 60 Hz           |
| 2PBM-002   | Peristaltic pump, motor only, 230 VAC 50 Hz           |
| 2PBM-003   | Peristaltic pump, head only, standard                 |
| 2PTB-002PK | Peristaltic pump, tubing, Norprene, size 17 (10 feet) |
| 2PBM-015   | Single head hardware kit                              |
| 2PBM-006   | Dual head hardware kit                                |

## **Appendix B: Cooler Drawings**

- B1: Model 5210 dimensional drawing, 4C-5210-01-01
- B2: Interconnect wiring diagram
- B3: Contact states diagram





| REV# | DATE     | DESCRIPTION     | DRAWN | APPROVED |
|------|----------|-----------------|-------|----------|
| 0    | 00/00/00 | INITIAL DRAWING | JO    |          |

| ITEM  | QTY | DESCRIPTION | MANUF. |
|---|-----|-------------|--------|
| MODEL NUMBER:   |     |             |        |
| DRAWN BY: JO  |     |             |        |
| DATE: 05/12/02  |     |             |        |
| APPR: [Signature]   |     |             |        |
| MATERIAL: AS NOTED  |     |             |        |
| FINISH: AS NOTED  |     |             |        |
| DESIGN DIMENSIONS ARE IN INCHES<br>( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED |     |             |        |
| PART DESCRIPTION: MODEL 5210 SAMPLE COOLER ARRANGEMENT DRAWING                  |     |             |        |
| SIZE   SCALE: A NTS MODEL 5210  |     |             |        |
| DRAWING/PART NO.: MODEL 5210  |     |             |        |
| CAD DIR: s:\\$BAM\DWGS\T.E. COOL-HEAVY SERIES                                   |     |             |        |

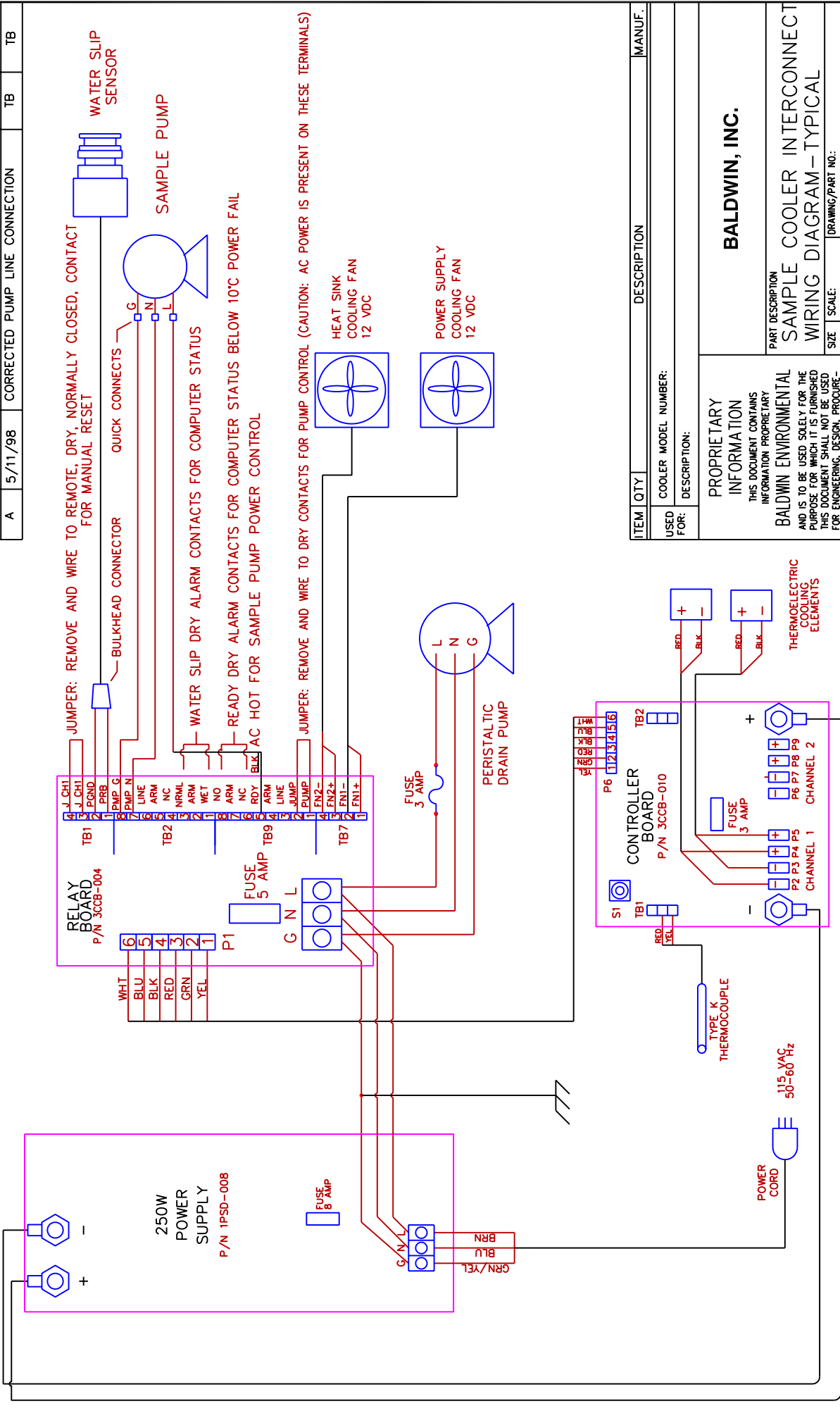
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 BALDWIN, INC.

UNLESS OTHERWISE SPECIFIED

|                    |                      |
|--------------------|----------------------|
| TOLERANCE DECIMALS | 1 PLACE = ±.02       |
| 2 PLACE = ±.02     | 3 PLACE = ±.010      |
| ANGLES = ±5°       | HOLES = +.003/- .001 |

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| REVNO | DATE    | DESCRIPTION                    | DRAWN | APPROVED |
|-------|---------|--------------------------------|-------|----------|
| A     | 5/11/98 | CORRECTED PUMP LINE CONNECTION | TB    | TB       |
| REVNO | REVDATE | REV                            | DRN   | APP      |
| A     | 5/11/98 |                                | TB    | TB       |

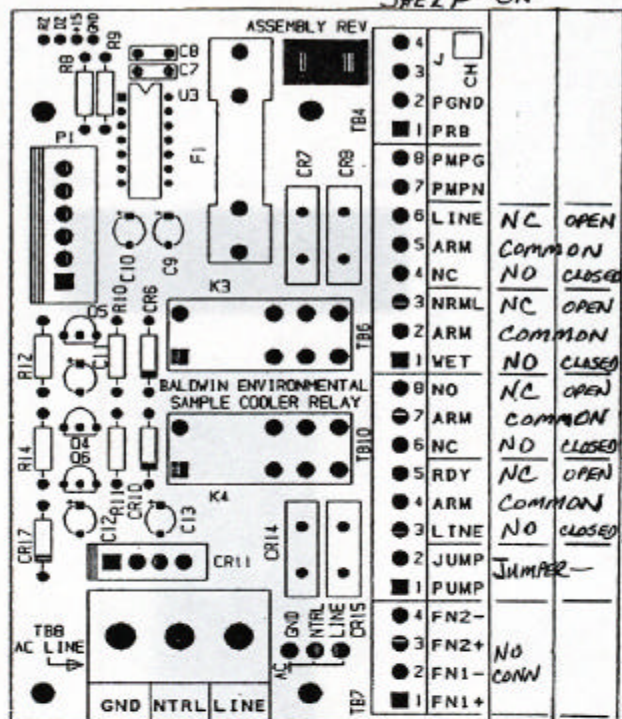


| ITEM   | QTY      | DESCRIPTION          | MANUF.   |
|--|----------|----------------------|----------|
| USED FOR:  |          | COOLER MODEL NUMBER: |          |
|  |          | DESCRIPTION:         |          |
| <b>PROPRIETARY INFORMATION</b>   |          |                      |          |
| THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION   |          |                      |          |
| <b>BALDWIN ENVIRONMENTAL</b>   |          |                      |          |
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| <b>BALDWIN, INC.</b>   |          |                      |          |
| PART DESCRIPTION<br><b>SAMPLE COOLER INTERCONNECT WIRING DIAGRAM - TYPICAL</b>   |          |                      |          |
| SIZE   | SCALE:   | DRAWING/PART NO.:    |          |
| A  | A        | SCALE                | 1DC1C2Pa |
| CAD DIR:   | S:\DRAWN |                      |          |
|  |          |                      | SHEET    |

**CONTACT STATES**  
POWER ALARM  
SHELF ON

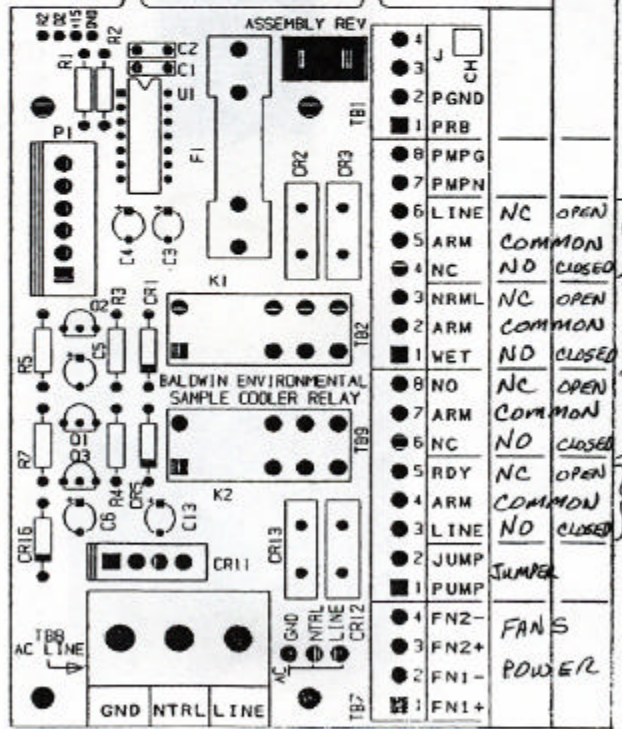
REVISIONS

| NO. | DATE | BY | DESCRIPTION |
|-----|------|----|-------------|
| 1   |      |    |             |



|   |      |           |
|---|------|-----------|
| 4 | J    | CH        |
| 3 | PGND |           |
| 2 | PRB  |           |
| 1 |      |           |
| 8 | PMPG |           |
| 7 | PMPN |           |
| 6 | LINE | NC OPEN   |
| 5 | ARM  | COMMON    |
| 4 | NC   | NO CLOSED |
| 3 | NRML | NC OPEN   |
| 2 | ARM  | COMMON    |
| 1 | WET  | NO CLOSED |
| 8 | NO   | NC OPEN   |
| 7 | ARM  | COMMON    |
| 6 | NC   | NO CLOSED |
| 5 | RDY  | NC OPEN   |
| 4 | ARM  | COMMON    |
| 3 | LINE | NO CLOSED |
| 2 | JUMP | JUMPER    |
| 1 | PUMP |           |
| 4 | FN2- |           |
| 3 | FN2+ |           |
| 2 | FN1- |           |
| 1 | FN1+ |           |

AC PUMP CONTROL CHANNEL #2  
 DRY COMPUTER STATUS ALARM CONTACTS  
 AC POWER PUMP CONTROL  
 WATER SLIP ALARM  
 READY TEMPERATURE ALARM



|   |      |           |
|---|------|-----------|
| 4 | J    | CH        |
| 3 | PGND |           |
| 2 | PRB  |           |
| 1 |      |           |
| 8 | PMPG |           |
| 7 | PMPN |           |
| 6 | LINE | NC OPEN   |
| 5 | ARM  | COMMON    |
| 4 | NC   | NO CLOSED |
| 3 | NRML | NC OPEN   |
| 2 | ARM  | COMMON    |
| 1 | WET  | NO CLOSED |
| 8 | NO   | NC OPEN   |
| 7 | ARM  | COMMON    |
| 6 | NC   | NO CLOSED |
| 5 | RDY  | NC OPEN   |
| 4 | ARM  | COMMON    |
| 3 | LINE | NO CLOSED |
| 2 | JUMP | JUMPER    |
| 1 | PUMP |           |
| 4 | FN2- |           |
| 3 | FN2+ |           |
| 2 | FN1- |           |
| 1 | FN1+ |           |

AC PUMP CONTROL CHANNEL #1  
 DRY COMPUTER STATUS ALARM CONTACTS  
 AC POWER PUMP CONTROL  
 FANS POWER  
 WATER SLIP ALARM  
 READY TEMPERATURE ALARM

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 BALDWIN ENVIRONMENTAL DIVISION  
 1000 W. 10TH ST. S.W.  
 MINNEAPOLIS, MN 55415  
 BALDWIN ENVIRONMENTAL INC.  
 BALDWIN ENVIRONMENTAL DIVISION  
 1000 W. 10TH ST. S.W.  
 MINNEAPOLIS, MN 55415

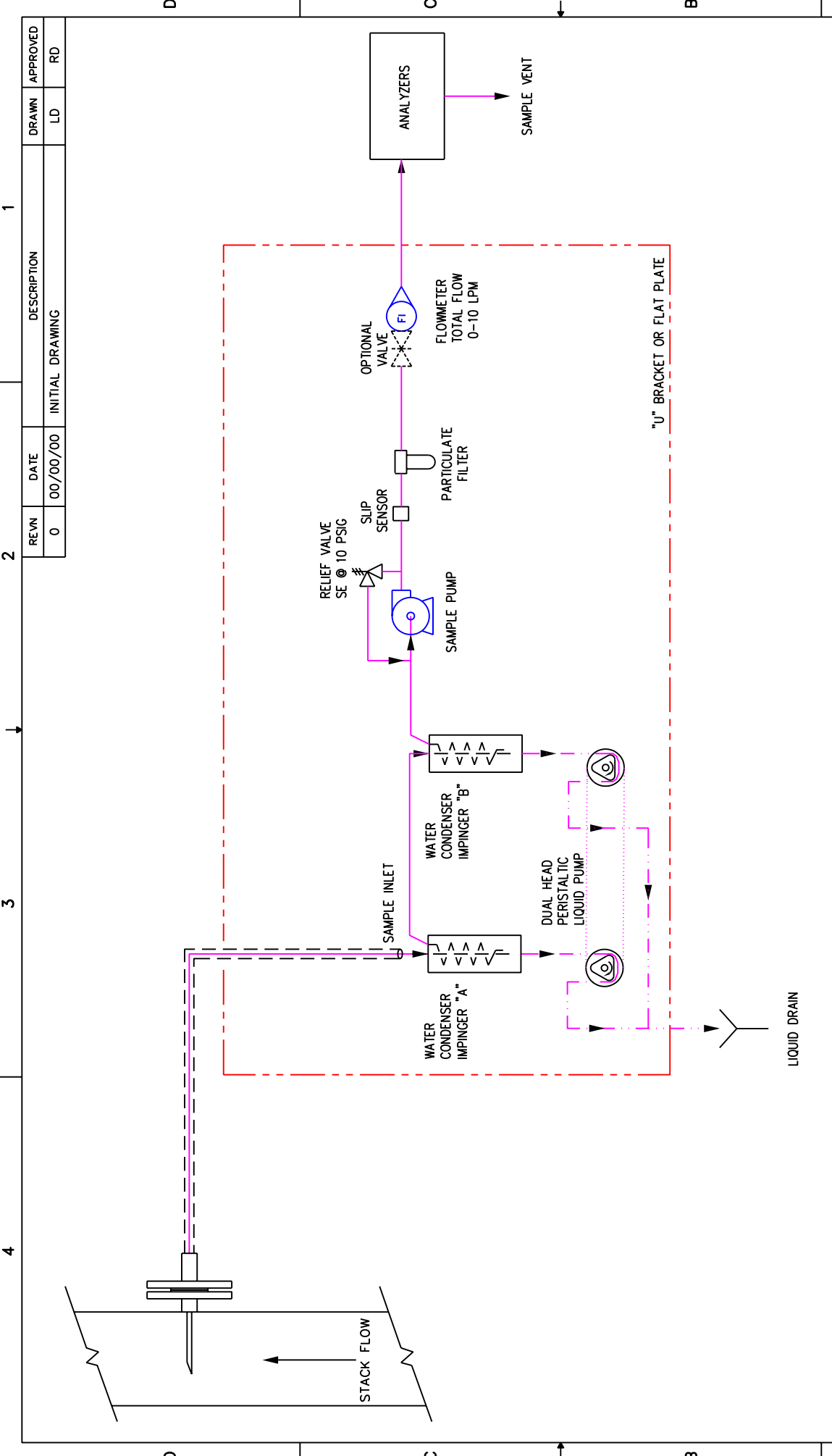
ASSEMBLY P.C.B.  
 SAMPLE RELAY BOARD  
 DATE: 10/21/79  
 BY: J.S.

3. ASSUME PHS AND IEC-4-100C.  
 2. VERIFY LED INDICATOR OF COMPONENTS ON P.C.B. SHALL NOT EXCEED 100 MA. 100 P.P.S.  
 1. COMPONENTS ARE IDENTIFIED BY PART NUMBER OR DESIGNATION IN PARTS LIST AND ARE TO BE USED EXACTLY AS SHOWN. NO SUBSTITUTIONS OR ALTERATIONS ARE TO BE MADE UNLESS OTHERWISE SPECIFIED.



## **Appendix C: Sample Conditioning System Drawings**

- C1: Flow schematic
- C2: 4S-9PA Piping and dimensional drawing
- C3: Rack mounting plates dimensional drawing
- C4: Wall mounting plates dimensional drawing



**NOTES:**

1. ALL COMPONENTS WETTED BY SAMPLE AND CALIBRATION GASES SHALL BE STAINLESS STEEL, BOROSILICATE GLASS, TEFLON OR VITON.
2. TOTAL FLOW SHALL BE RATED CAPACITY OF SAMPLE CHILLER.

| ITEM  | QTY | DESCRIPTION              | MANUF.         |
|---|-----|--------------------------|----------------|
| USED FOR:                                   |     | MODEL NUMBER: M325, 5210 |                |
| DESCRIPTION:                                |     |                          |                |
| DRWN BY:                                    |     | DATE                     |                |
| MES   |     | DATE                     |                |
| APPR:                                       |     |                          |                |
| MATERIAL                                    |     |                          |                |
| FINISH                                      |     |                          |                |
| DESIGN DIMENSIONS ARE IN INCHES             |     | SIZE                     | A NTS          |
| () DENOTES MILLIMETER EQUIVALENTS WHEN USED |     | DRAWING/PART NO.:        | PASSIVE/ACTIVE |

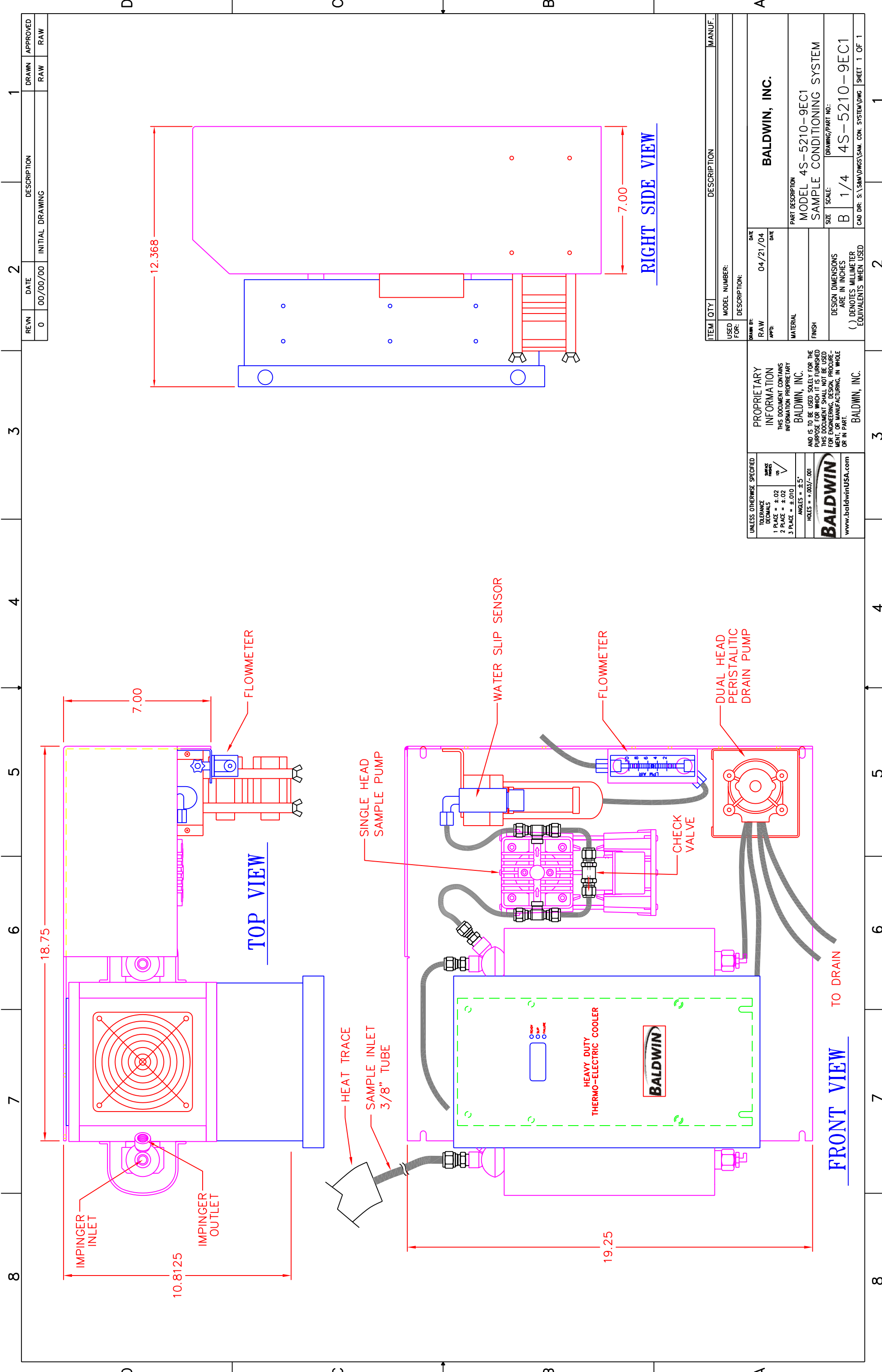
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 www.baldwinUSA.com

|                            |        |
|----------------------------|--------|
| UNLESS OTHERWISE SPECIFIED |        |
| TOLERANCE DECIMALS         | FINISH |
| 1 PLACE = ±.02             | 10     |
| 2 PLACE = ±.02             | 15     |
| 3 PLACE = ±.010            |        |
| ANGLES = ±5°               |        |
| HOLES = +.003/- .001       |        |

**BALDWIN, INC.**

PART DESCRIPTION  
**PASSIVE/ACTIVE SAMPLE CONDITIONING SYSTEM FLOW DIA.**

SIZE SCALE: A NTS  
 DRAWING/PART NO.: PASSIVE/ACTIVE  
 CAD DIR: S:\S&M\DWGS\SAM. COND. SYSTEM.DWG | SHEET 1 OF 1



| REV# | DATE     | DESCRIPTION     | DRAWN | APPROVED |
|------|----------|-----------------|-------|----------|
| 0    | 00/00/00 | INITIAL DRAWING | RAW   | RAW      |

| ITEM                | QTY | DESCRIPTION                             | MANUF.     |
|---------------------|-----|---|------------|
| MODEL NUMBER: _____ |     |   |            |
| USED FOR: _____     |     |   |            |
| DESCRIPTION: _____  |     |   |            |
| DRAWN BY: _____     |     | DATE: 04/21/04                          |            |
| RAW APPR: _____     |     | DATE: _____                             |            |
| MATERIAL: _____     |     | PART DESCRIPTION: <b>BALDWIN, INC.</b>  |            |
| FINISH: _____       |     | MODEL 4S-5210-9EC1                      |            |
|                     |     | SAMPLE CONDITIONING SYSTEM              |            |
|                     |     | SIZE: B                                 | SCALE: 1/4 |
|                     |     | DRAWING/PART NO: 4S-5210-9EC1           |            |
|                     |     | CAD DIR: S:\S&M\DWGS\S&M_CON_SYSTEM\DWG |            |
|                     |     | SHEET 1 OF 1                            |            |

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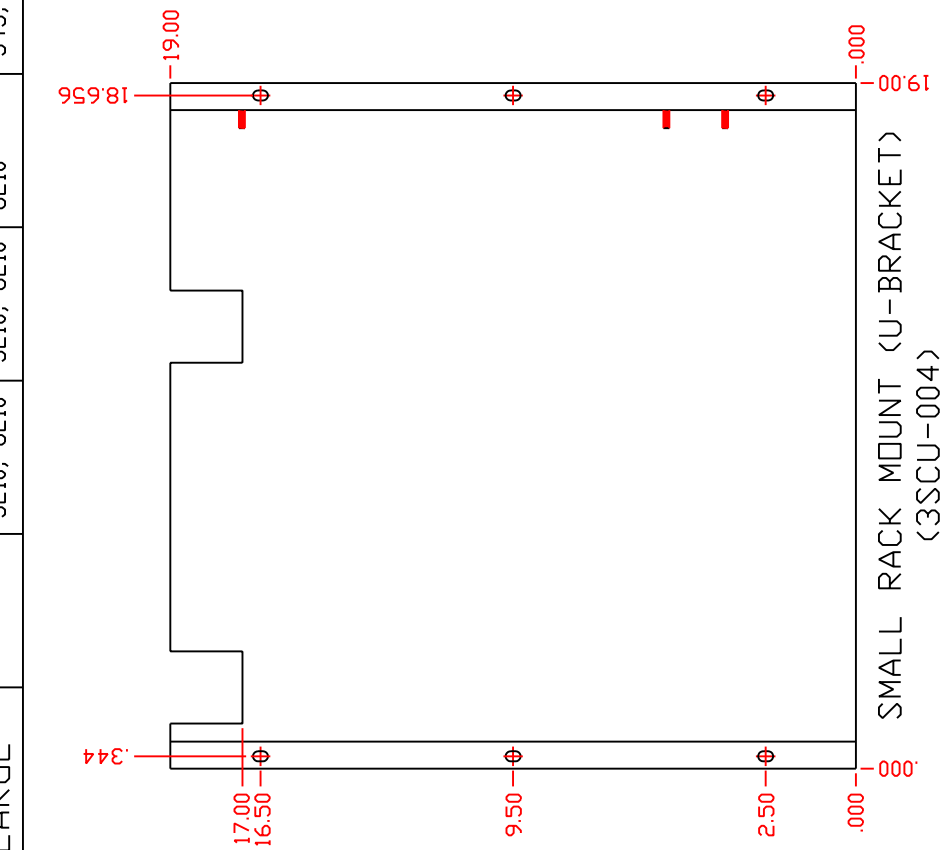
UNLESS OTHERWISE SPECIFIED

|                    |                |
|--------------------|----------------|
| TOLERANCE DECIMALS | 1 PLACE = ±.02 |
| 2 PLACE = ±.02     |                |
| 3 PLACE = ±.010    |                |

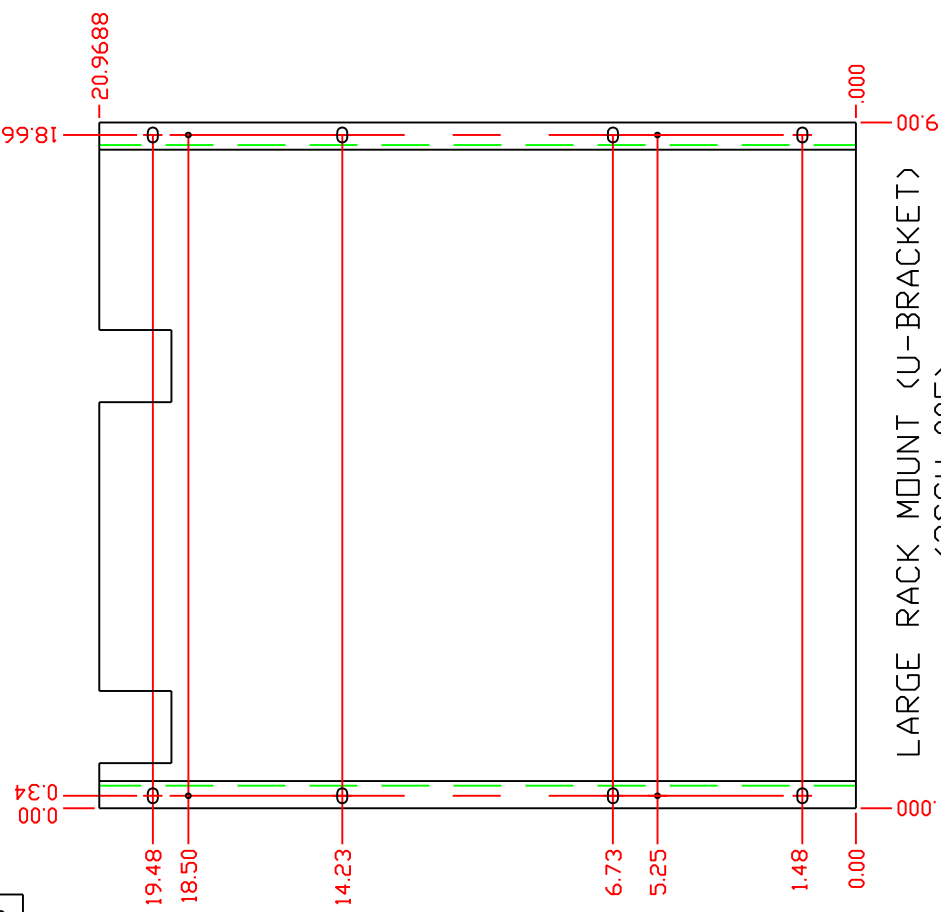
ANGLES = ±5°  
 HOLES = +.003/- .001

**BALDWIN**  
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| BRACKET | MODEL C | MODEL C1   | MODEL CD   | MODEL CD2 | MODEL 5    |
|---------|---------|------------|------------|-----------|------------|
| SMALL   | M115    | M325       | M425       | M425      |            |
| LARGE   |         | 5210, 8210 | 5210, 8210 | 8210      | 545, 10410 |



SMALL RACK MOUNT (U-BRACKET)  
(3SCU-004)



LARGE RACK MOUNT (U-BRACKET)  
(3SCU-005)

| REV/N | DATE     | DESCRIPTION     | DRAWN | APPROVED |
|-------|----------|-----------------|-------|----------|
| 0     | 00/00/00 | INITIAL DRAWING | JD    |          |

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

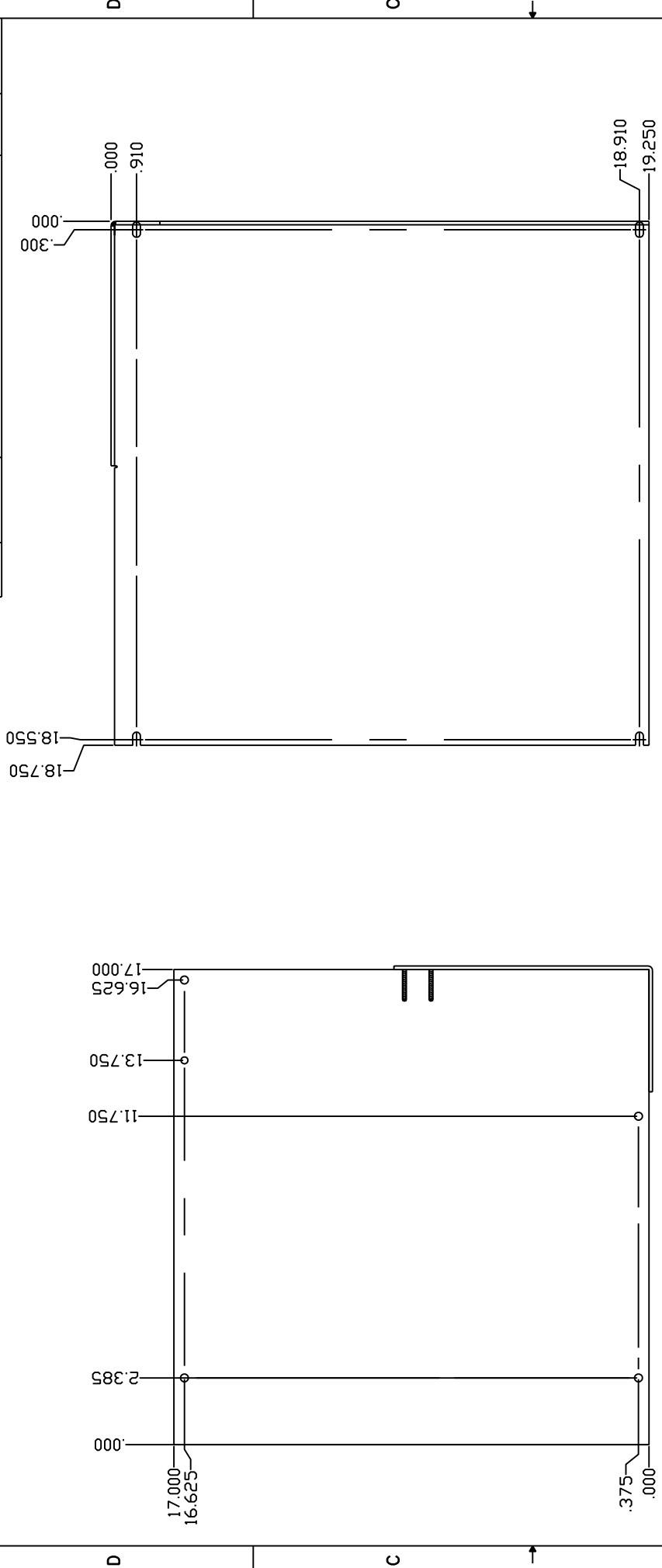
|  |          |
|--|----------|
| DATE   | 06/19/02 |
| DRAWN BY:                                    | JD       |
| APPR:  |          |
| MATERIAL                                     | AS NOTED |
| FINISH                                       | AS NOTED |
| DESIGN DIMENSIONS ARE IN INCHES              |          |
| ( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED |          |

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|                            |          |
|----------------------------|----------|
| UNLESS OTHERWISE SPECIFIED |          |
| TOLERANCE DECIMALS         | FINISH   |
| 1 PLACE = ±.02             | AS NOTED |
| 2 PLACE = ±.02             |          |
| 3 PLACE = ±.010            |          |
| ANGLES = ±5°               |          |
| HOLES = +.002/- .001       |          |
|                            |          |
| www.baldwinUSA.com         |          |

|   |   |
|---|---|
| <b>BALDWIN, INC.</b>                                    |   |
| PART DESCRIPTION  | SAMPLE CONDITIONER RACK MOUNT MOUNTING DIMENSIONS |
| SIZE  | A 3/16 RACK MOUNT                                 |
| SCALE:  | DRAWING/PART NO:                                  |
| CAD DIR: S:\SBA\DWG\S-C-SYSTEMS\WALL MOUNT SHEET 1 DF 1 |   |

|       |          |                 |       |          |
|-------|----------|-----------------|-------|----------|
| REV/N | DATE     | DESCRIPTION     | DRAWN | APPROVED |
| 0     | 00/00/00 | INITIAL DRAWING | JD    |          |



LARGE WALL MOUNT (FLAT PLATE)  
(3SCP-001)

| BRACKET | MODEL C | MODEL C1   | MODEL C2   | MODEL CD | MODEL CD2  | MODEL 5 |
|---------|---------|------------|------------|----------|------------|---------|
| SMALL   | M115    | M325       | M425       | M425     | M425       |         |
| LARGE   |         | 5210, 8210 | 5210, 8210 | 8210     | 545, 10410 |         |

|  |   |                  |
|--|---|------------------|
| ITEM QTY                                     | DESCRIPTION                                       | MANUF.           |
| USED FOR:                                    | MODEL NUMBER:                                     |                  |
| DESCRIPTION:                                 |   |                  |
| DRAWN BY:                                    | DATE  |                  |
| JD   | 06/19/02  |                  |
| APPR:  | DATE  |                  |
| MATERIAL                                     | PART DESCRIPTION                                  |                  |
| AS NOTED                                     | SAMPLE CONDITIONER WALL MOUNT MOUNTING DIMENSIONS |                  |
| FINISH                                       | SIZE  | DRAWING/PART NO: |
| AS NOTED                                     | A   | 3/16 WALL MOUNT  |
| DESIGN DIMENSIONS ARE IN INCHES              | SCALE:  |                  |
| ( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED |   |                  |

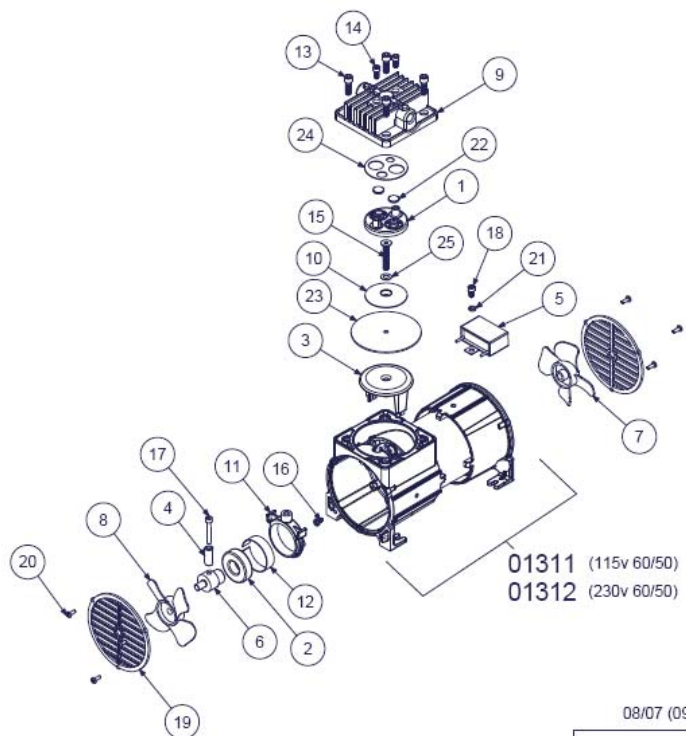
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BALDWIN, INC.  
www.baldwinUSA.com

|                            |              |
|----------------------------|--------------|
| UNLESS OTHERWISE SPECIFIED |              |
| TOLERANCE DECIMALS         | ANGLE FINISH |
| 1 PLACE = ±.02             | 15°          |
| 2 PLACE = ±.02             |              |
| 3 PLACE = ±.010            |              |
| ANGLES = ±5°               |              |
| HOLES = +.002/- .001       |              |



## **Appendix E: Perma Pure Sample Pump Maintenance Instructions**

| Item # | Description     |
|--------|-----------------|
| 1      | VALVEBODY       |
| 2      | BEARING         |
| 3      | CAP             |
| 4      | CWEIGHT         |
| 5      | CAPACITOR       |
| 6      | ECCENTRIC       |
| 7      | FAN, BLUE       |
| 8      | FAN, WHITE      |
| 9      | HEAD STD, SS    |
| 10     | PLATE DIAPH.    |
| 11     | CONNECTING ROD  |
| 12     | TOL. RING       |
| 13     | SCREW-HEAD/BASE |
| 14     | VALVE SCREW     |
| 15     | PLATE SCREW     |
| 16     | GROUND SCREW    |
| 17     | SCREW           |
| 18     | SCREW           |
| 19     | SCREEN          |
| 20     | SCREW           |
| 21     | LOCK WASHER     |
| 22     | DISC-VALVE      |
| 23     | DIAPHRAGM       |
| 24     | GASKET          |
| 25     | WASHER          |



### Disassembly of head section and service diaphragm

1. Remove head section by unscrewing the four large bolts. A flat-bladed screw driver may be needed to gently pry the head free of the service diaphragm. If you have Teflon coating on the heads, use caution not to scratch the surface.
2. The valve body can then be removed by unscrewing the two smaller screws (also accessible on the top of the head section). This part may be freed by gently tapping on these two screws after they have been loosened about 3 or 4 turns. When the valve body is removed, check all internal surfaces for an accumulation of dirt. The two valve discs can be wiped clean and replaced as long as they appear unaffected by usage. The valve gasket can be easily removed and should be inspected. As a matter of good practice, the valve discs and valve gasket should be replaced during any routine maintenance check of the head section. A once a year routing procedure is recommended.
3. The service diaphragm is secured by the single screw in its center. Remove this screw with a 5/32" Allen wrench. The diaphragm and its clamping plate should be easily lifted off. Some slight adherence to the metal may occur if the diaphragm has been in use for a long period.
4. When replacing the service diaphragm, a Teflon washer should be inserted under the head of the diaphragm cap screw. This is added insurance against small gas leaks through screw heads and may be essential in vacuum applications where outside air contamination cannot be tolerated. After tightening the screw, the excess Teflon should be trimmed away.
5. NOTE: When replacing the service diaphragm, be sure the four projection studs of the base casting are properly located in the four outer holes provided in the diaphragm before the part is clamped in place. Be sure the diaphragm plate is firmly replaced with its center screw.

### Replacement parts:

|          |                                     |
|----------|-------------------------------------|
| 2PAM-001 | Sample pump repair kit, single head |
| 2PAS-001 | Sample pump single head, 15/50Hz    |
| 2PAS-002 | Sample pump single head, 230/60Hz   |



**Appendix F Conversion Tables**

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      | 1.03     | -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 |                 |                         |               |                            |                         |
|---------------------------|-----------------|-------------------------|---------------|----------------------------|-------------------------|
| DEW POINT<br>°F           | DEW POINT<br>°C | VAPOR PRESSURE<br>Mm Hg | ppm by VOLUME | RELATIVE HUMIDITY<br>@70°F | ppm by WEIGHT<br>in air |
| -110                      | -166            | .000010                 | .00132        | .0000053                   | 0.00082                 |
| -108                      | -162            | .000018                 | .00237        | .0000096                   | .0015                   |
| -106                      | -159            | .000028                 | .00368        | .000015                    | .0023                   |
| -104                      | -155            | .000043                 | .00566        | .000023                    | .0035                   |
| -102                      | -152            | .000065                 | .00855        | .000035                    | .0053                   |
| -100                      | -148            | .000099                 | .0130         | .000053                    | .0081                   |
| -98                       | -144            | .00015                  | .0197         | .000080                    | .012                    |
| -96                       | -141            | .00022                  | .0289         | .00012                     | .018                    |
| -94                       | -137            | .00033                  | .0434         | .00018                     | .027                    |
| -92                       | -134            | .00048                  | .0623         | .00026                     | .039                    |
| -90                       | -130            | .0007                   | .0921         | .00037                     | .057                    |
| -88                       | -126            | .0010                   | .132          | .00054                     | .082                    |
| -86                       | -123            | .0014                   | .184          | .00075                     | .11                     |
| -84                       | -119            | .0020                   | .263          | .00107                     | .16                     |
| -82                       | -116            | .0029                   | .382          | .00155                     | .24                     |
| -80                       | -112            | .0040                   | .562          | .00214                     | .33                     |
| -78                       | -108            | .0056                   | .737          | .00300                     | .46                     |
| -76                       | -105            | .0077                   | 1.01          | .00410                     | .83                     |
| -74                       | -101            | .0105                   | 1.38          | .00559                     | .86                     |
| -72                       | -98             | .0143                   | 1.88          | .00762                     | 1.17                    |
| -70                       | -94             | .0194                   | 2.55          | .0104                      | 1.58                    |
| -68                       | -90             | .0261                   | 3.43          | .0140                      | 2.13                    |
| -66                       | -87             | .0349                   | 4.59          | .0187                      | 2.84                    |
| -64                       | -83             | .0464                   | 6.11          | .0248                      | 3.79                    |
| -62                       | -80             | .0614                   | 8.08          | .0328                      | 5.01                    |
| -60                       | -76             | .0808                   | 10.6          | .043                       | 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                       | 4730                    |
| +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                   |



## **Appendix G Warranty and Disclaimer**

### **Perma Pure LLC**

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.

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