PERMA PURE

INSTRUCTION MANUAL

BALDWIN™ - Series

THERMO-ELECTRIC COOLERS

MODULAR SERIES

Model M325

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A: SPECIFICATIONS

Physical Description

Single (Series) / Dual (Parallel) Channel System
2 x 5" Heat Exchangers connected in series or parallel
1 Passive (cooled to ambient), 1 Active (cooled to 4°C) Heat Exchangers
LCD temperature display

Operating Specifications

Sample Gas Flow Range	2-4 LPM 4.3-8.6 SCFH
Inlet Dew Point at Rated Flow	168°F @ 20% H2O @ 3LPM 76°C
Maximum Cooling Rate	222 BTU/Hr 234kJ/Hr
Dimensions	11.20 x 7.25 x 11.20 in. HWD 28.5 x 18.4 x 28.5 cm
Weight	17 lbs 7.7 kg
Maximum Inlet Sample Temperature	392°F (200°C) SS, Glass Impingers 280°F (138°C) Kynar Impinger
Maximum Inlet Pressure	45 psig 3 bar / 2250 mmHg
Maximum Heat Exchanger Pressure Drop	<+1 in. H_2O
Ambient Temperature Range	33-104°F 0.56-40°C
Outlet Sample Gas Dew Point	41°F 5°C
Inlet Tubing Connection	⅜ in. FPT
Outlet Tubing Connection	¼ in. FPT
Drain Tubing Connection	⅜ in. FPT
Voltage	110 (220 optional) VAC 50/60 Hz
Thermoelectric Elements	40 mm
Power Supply	100W
Cooling Down Time	Less than 3 minutes

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.

SELLER MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, OF THE PRODUCT SUPPLIED HEREUNDER, INCLUDING, WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE, AND ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY EXCLUDED. SELLER SHALL HAVE NO LIABILITY FOR LOSS OF PROFITS, OR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES UNDER ANY CIRCUMSTANCES OR LEGAL THEORY, WHETHER BASED ON NEGLIGENCE, BREACH OF WARRANTY, STRICT LIABILITY, TORT, CONTRACT, OR OTHERWISE. SELLER SHALL IN NO EVENT BE LIABLE IN RESPECT OF THIS ORDER AND OR PRODUCT DELIVERED ON ACCOUNT OF THIS ORDER FOR ANY AMOUNT GREATER THAN THAT PAID TO SELLER ON ACCOUNT OF THIS ORDER.

C: PRINCIPLE OF OPERATION

Thank you for purchasing a Perma Pure Baldwin™-Series Thermo-Electric Cooler. This Modular Series features a unique slim design leaving additional space to install or access other sample conditioning system components. A unique drop-down door on the Modular Series provides easy access to electronic boards and the power supply. All electronic boards (control, relay, and display) are mounted on the door for easy access.

The process of 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 components of interest. The Baldwin-Series cooler is an ideal way to decrease the dew point of combustion gases to a repeatable, stable, constant low dewpoint. The Baldwin cooler prevents water condensation in sample pre-filters, sample pumps, and gas analyzers. For gas analyzers where water vapor is an interferant, a stable, repeatable dewpoint becomes a part of the gas analyzer performance specification. Baldwin-Series coolers provide this constant low water concentration, resulting in an accurate component gas measurement.

All Baldwin-Series 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.

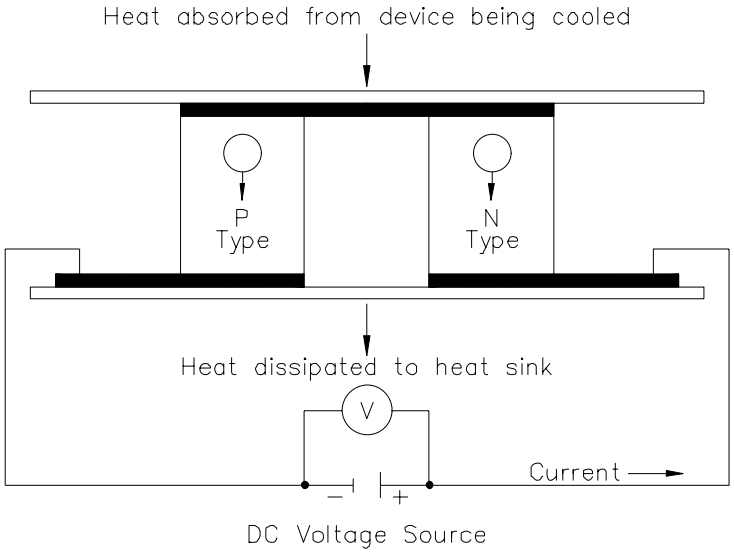

Figure 1: Thermo-electric element (Peltier)

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 elements. This heat is transferred to the hot side of the Peltier element where it is dissipated into the heat sink and surrounding environment.

Baldwin-Series 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 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.

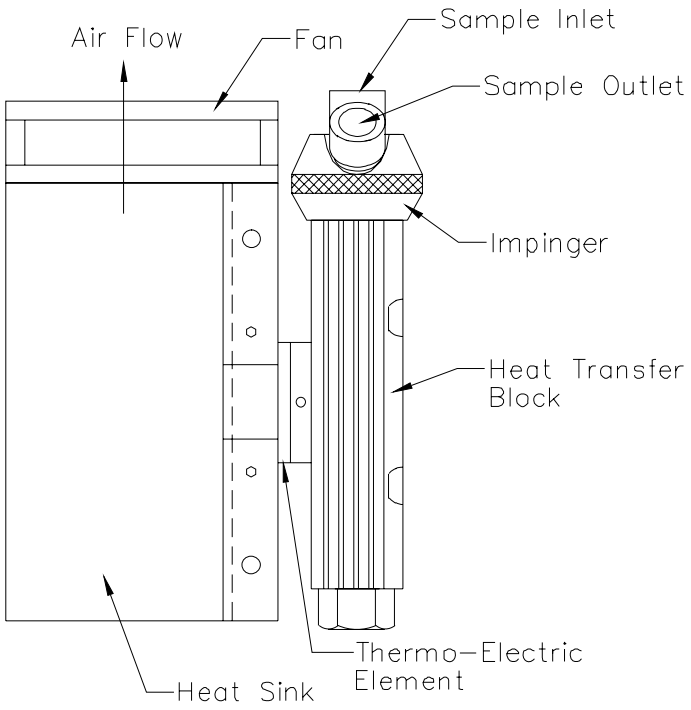

Figure 2: Heat Exchanger, Impinger and Heat Sink Assembly

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 passing through the sample cooler is removed by an optional Perma Pure 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 Model M325 should be installed away from heat sources in a well ventilated area of an instrument rack or enclosure. The more stable the ambient temperature environment around the Model M325, the better the output dew point stability.

Sample tubing connections to the Model M325 depend on the heat exchanger material of construction. A cooler with a stainless steel heat exchanger uses a stainless steel inlet fitting. The outlet is Kynar® standard compression type tube fitting with Teflon® ferrules. A PVDF (Kynar®) heat exchanger uses Kynar® standard compression type tube fittings with Teflon® ferrules. Baldwin cannot warrantee against damage to the Peltier element or heat exchanger if our supplied Kynar® tube fittings are not used.

The inlet and outlet tubing for all metal or Kynar heat exchangers is 1/4" NPT; the user should always use the compression type fittings provided for that purpose by the factory. The inlet of the Channel 1 heat exchanger uses a 3/8” tube x ¼” MNPT fitting to mate with most standard 3/8” sample lines.

The condensate drain connection is a Kynar® elbow (or straight), 3/8” MNPT x 1/4” barbed tube fitting. An automatic condensate drain, Baldwin Model 3KPB-003 Peristaltic Pump, dual head, is recommended for water removal. This pump uses size 17 tubing.

CAUTION: Do no reduce the size of the condensate tubing since doing so restricts water flow resulting in water slip (moisture carryover) in the sample.

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.

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E: START-UP PROCEDURE

Plug in the power cord to a properly grounded main circuit. The Ready Green LED will come on within 3 minutes, indicating the relay temperature (10°C) has been achieved. After approximately 3 minutes, the set point of +5°C. (41°F) is achieved. The SLIP Green LED should also be on if a water slip sensor is connected to the internal relay board. The sample gas flow may be started immediately after the READY Green LED comes on.

The Model M325 is virtually maintenance free. However, in the event of electrical problems, refer to the troubleshooting guide in this manual. All voltages can be read at the PCB terminal strip. Any deviations from the correct voltages indicate a problem.

F: LED INDICATORS

The Model M325 has two green and one red LED operating indicators. These indicators are arranged vertically on the front of the cooler. The bottom green LED indicates the READY operating temperature status, normally set for 10°C (50°F). After the set-point temperature is reached, the sample pump may be turned on by other devices. When the impinger temperature is below 10°C (50°F) the ready LED will be on. Above this temperature, the ready LED will be off. The middle green LED (applicable when the alarm relay option is installed) is ON when there is NO water carry over and OFF when there IS water carry over. The red LED at the top is the thermocouple failure indicator. When this occurs, the red LED stays illuminated.

The M325 Modular cooler has an analog voltage output. This output is factory standard at 0-2.5 VDC = 0-25°C. The connector for this output is located on the bottom of the cooler. It is labeled “Analog Out” (TB1).

G: I/O TERMINAL BLOCK DESCRIPTION

The I/O terminal blocks are found on the bottom panel of the cooler:

TB1 TB1 is the standard analog output (low voltage DC output) for all Modular Series Thermo-Electric Coolers. Model M325 is a single-channel cooler with one passive and one active 5" heat exchanger connected in series. The output is 0vdc to 2.5vdc for a temperature range of 0°C to 25°C.

- Terminal 1 is earth ground. This terminal should be used to ground the shield of the shielded twisted pair cable that is used to connect the analog output to a receiving instrument.
- Terminal 2 is the signal return.
- Terminal 3 is the channel 1 output.
- Terminal 4 is the channel 2 output.

TB2 TB2 is the I/O terminal block (low level DC voltage or current or no voltage contact) used for all installed options, such as the alarm relay/water slip option or auxiliary analog output option.

- Terminal 1 is earth ground. This terminal should be used to ground the shield of the shielded twisted pair cable that is used to connect the analog output board of the auxiliary analog output to a receiving instrument.
- Terminal 2 is the signal return for the auxiliary analog voltage output.
- Terminal 3 is the auxiliary analog voltage output.
- Terminal 4 is the negative side of the auxiliary analog 4-20mA output.
- Terminal 5 is the positive side of the auxiliary analog 4-20mA output.
- Terminals 6 & 7 are the dry contact form A relay output used for computer sense for the alarm relay/water slip option.
- Terminals 8 & 9 are the water slip sensor input for the alarm relay / water slip (moisture carryover) option.
- Terminal 10 is earth ground. This terminal should be used to ground the shield of the twisted pair cable that is used to connect the water slip sensor to terminals 8 & 9.

TB3 TB3 is the switched AC terminal block (line AC voltage output) used for sample pump control when the alarm relay/water slip option is installed.

- Terminal 1 is the AC LINE voltage.
- Terminal 2 is the AC NEUTRAL.
- Terminal 3 is the EARTH GROUND.

TB4 **Note:** The description for TB4 is the same as for TB2. TB4 is used for Channel 2's I/O (not applicable for Model M325).

TB5 **Note:** The description for TB5 is the same as for TB3. TB5 is used for Channel 2's switched AC (not applicable for Model M325).

H: TEST & ADJUSTMENT PROCEDURES

NOTE: All test and adjustment procedures have been performed at the factory. Therefore, no adjustment should be necessary.

A. Main Control board

(1) **WARNING**: Before connecting power to the cooler, be aware of the HAZARDOUS LIVE VOLTAGE on the control board. Disconnect power from the cooler before opening the swing-down "L-door". **Note**: The auxiliary output board must be removed if the cooler is so equipped. Remove the thermocouples from TB1 and TB2. The thermocouple generator should not be connected to either of the thermocouple inputs at this time. Connect power to the cooler. After 10 to 20 seconds, the red LED(s) (thermocouple failure indicators) should be on.

(2) Connect the thermocouple generator to the Channel 1 thermocouple input, (TB1 terminal), inserting the yellow wire into the terminal marked Y and the red wire into the terminal marked R. Turn on the generator. The red LED should turn off. Connect a voltmeter between the ground test point, TP7 and TP1, the red lead to TP1 and the black lead to TP7. Set the thermocouple generator to 0°C. Set the voltmeter to 20vdc range.

(3) Adjust POT1 (the zero pot) to obtain a 0vdc reading on the voltmeter.

(4) Set the thermocouple generator to 10°C.

(5) Adjust POT3 (the span pot) to obtain a 1.0vdc reading on the voltmeter.

(6) Move the positive lead (red lead) of the voltmeter to TP5.

(7) Adjust POT8 (the ready pot) to obtain a 1.0vdc reading on the voltmeter.

(8) Move the positive lead (red lead) of the voltmeter to TP3.

(9) Adjust POT5 (the set pot) to obtain a 0.5vdc reading on the voltmeter.

(10) Set the thermocouple generator to 11°C. The bottom green LED should be off.

(11) Set the thermocouple generator to 8°C. The bottom green LED should be on.

B. Display Board

(1) **WARNING**: Before connecting power to the cooler, be aware of the HAZARDOUS LIVE VOLTAGE on the control board. Disconnect power from the cooler before opening the swing-down "L-door". Remove display cover from the front of the swing-down "L-door". Connect a voltmeter between the ground test point, TP7 on the main control board and TP1 on the display board, the red lead to TP1 and the black lead to TP7.

(2) Connect power to the cooler and allow the temperature of the cooler to stabilize around 5°C.

(3) Adjust POT1 on the display board so the display corresponds to the voltmeter reading. That is, if the voltmeter reads 0.5vdc, adjust the pot so that the display reads 0.5.

C. Auxiliary Analog Output Board

(1) **WARNING**: Before connecting power to the cooler, be aware of the HAZARDOUS LIVE VOLTAGE on the control board. Disconnect power from the cooler before opening the swing-down "L-door". Remove the thermocouples from TB5 and TB6 on the auxiliary analog output board. The thermocouple generator should not be connected to either of the thermocouple inputs at this time. Connect power to the cooler. After 10 to 20 seconds, the red LED(s) (thermocouple failure indicator) on the auxiliary analog output board should be on.

(2) Connect the thermocouple generator to the Channel 1 thermocouple input (TB5 terminal), inserting the yellow wire into the terminal marked Y and the red wire into the terminal marked R. Turn on the generator. The red LED (CR5) should turn off. Set the thermocouple generator to 0°C.

<u>For Voltage Output</u>
(3) If the auxiliary analog output board is set for voltage output, set the voltmeter to 20vdc range. Connect the voltmeter to TB2 (the channel 1 voltage output terminal), the black lead to the negative (-) terminal and the red lead to the positive (+) terminal.

(4) Adjust POT4 (the zero pot) to obtain a 0vdc reading on the voltmeter.

(5) Set the thermocouple generator to 25°C.

(6) Adjust POT1 (the span pot) to obtain a full scale voltage reading on the voltmeter. This value will depend on the gain that was specified for the cooler at the time of manufacture. Available gains are 0-1.0vdc, 0-2.5vdc, 0-10.0vdc for a 0°C-25°C temperature range.

For Current Output

(3a) If the auxiliary analog output board is set up for current output, set the ammeter to 200ma range. Connect the ammeter to TB1 (the channel 1 current output terminal), the black lead to the negative (-) terminal and the red lead to the positive (+) terminal.

(4a) Adjust POT4 (the zero pot) to obtain a 4mA reading on the ammeter.

(5a) Set the thermocouple generator to 25°C.

(6a) Adjust POT1 (the span pot) to obtain a 20mA reading on the ammeter.

I: DESCRIPTION OF OPTIONS

Baldwin Modular Series Thermo-Electric Coolers have three available options: (1) temperature display; (2) alarm relay/water slip, and (3) auxiliary analog output. Modular Series Coolers may be equipped with any one or all of the options. All external I/O connections for these options are available through the terminal blocks on the bottom of the cooler.

1. Display Option (standard on model M325)
The display option is a secondary board that is mounted on the main control board. This board has a three-digit LCD display that displays the temperature (in degrees C) of the active channel(s). If the cooler has two active channels, there will be a toggle switch installed to select Channel 1 or 2.

2. Alarm Relay/Water Slip Option (standard on model M325)
The alarm relay/water slip option is a secondary board that is mounted on the main control board. This board has two inputs and three outputs per channel. The first input, which comes from the main control board, is the ready input. The second input, which comes from the water slip sensor, is the water slip input. The first output, which is fed back to the main control board, controls the ready and water slip LED(s). The second output is a 1/4 amp SPST form A dry contact relay. This relay is used for computer sensing and is **NOT** intended for the controlling of electrical loads. The third output is a 6-amp DPST form C dry contact relay. This relay can be used for sample pump or other heavier electrical load control. This relay output terminal is normally wired for a 120vac sample pump (ground, neutral, and line). If there is water carry over (water slip LED), computer sense and load control relays will be turned off. If the temperature of the cooler rises above 10°C (50°F), the ready LED, computer sense and load control relays will be turned off. This means that the relays operate in a fail-safe manner.

Note: If the alarm relay/water slip option is not installed, the SLIP LED(s) on the front of the cooler will be off.

3. Auxiliary Analog Output Option
The auxiliary analog output option is a secondary board that is mounted on the main control board. This board has one input and two outputs per channel. The input is for a K type thermocouple. The first output is an analog voltage output that can be configured for either 0vdc to 2.5vdc or 0vdc to 10vdc for a 0°C (32°F) to 25°C (77°F) temperature range. The second output is a 4-20 mA for the same temperature range. The K type thermocouple is normally a 1/32-inch diameter hypodermic type thermocouple that is installed in a special impinger so the actual sample dew point temperature can be measured.

Note: This option is sometimes referred to as the New Jersey thermocouple outlet temperature option.

J: "NEW JERSEY" THERMOCOUPLE OPTION

Some air quality management districts (e.g., those in New Jersey and Southern California) require temperature measurement of the gas stream at the outlet of the last heat exchanger on the cooler. Perma Pure offers a 1/32-inch diameter hypodermic-style type K thermocouple that can be inserted into a special heat exchanger (i.e., it has a small port for insertion of the thermocouple) so the actual sample dew point temperature can be measured. This is sometimes referred to as the New Jersey thermocouple outlet temperature option.

The second 5" heat exchanger on the M325 can be upgraded to include the New Jersey thermocouple option. This heat exchanger will have a New Jersey thermocouple to sense the temperature inside the heat exchanger (upgrade option: 4C-NJ/K-5). In the part number, the "NJ" identifies the upgrade for a NJ type thermocouple. The "K" identifies the thermocouple itself as a type "K" thermocouple. The "-5" is the height of the heat exchangers.

In addition, Perma Pure offers an optional temperature transmitter board for signal or voltage temperature output. This board has one input and two outputs per channel. The input is for the type K thermocouple. The first output is an analog voltage output that can be configured for either 0-2.5vdc or 0-10vdc for a 0°C (32°F) to 25°C (77°F) temperature range. The second output is a 4-20mA for the same temperature range. The M325 utilizes a single-channel NJ thermocouple transmitter board (3CCB-012).

Model M325 New Jersey Thermocouple Option

Part No.	Description
4C-NJ/K-5	Heat exchanger upgrade to include NJ thermocouple port
3CXS-002	Heat exchanger, 5" SS w/ NJ thermocouple port
3CXD-002	Heat exchanger, 5" Durinert® w/ NJ thermocouple port
3CXK-002	Heat exchanger, 5" Kynar® w/ NJ thermocouple port
3CCB-012	Temperature transmitter board, single stream
3KTC-001	Thermocouple, Type K, replacement kit

K: TROUBLESHOOTING

Symptom	*Check*	*Action*
No LED(s) and no fan.	AC power input.	Ensure that AC power is connected.
No LED(s) and fan on.	AC input fuse on control board. DC output fuse on control board. VC on control board.	Replace fuse as necessary. Replace fuse as necessary. Replace control board.
LED(s) on and no fan.	AC input fuse on power supply. +12vdc TB4 on control board.	Replace fuse as necessary. Replace power supply.
Impinger remains at ambient temperature.	Peltier current draw. Should be above 6 amps.	Replace Peltier element.
Thermocouple failure LED is on.	Thermocouple connection TB1, 2.	Ensure proper connection. Replace thermocouple.
Impinger frozen and cooler indicates ambient temperature.	Thermocouple placement in heat exchanger block.	Ensure proper placement. Replace control board.
Impinger 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.
Impinger temperature cycles up and down.	Peltier connections on control board.	Ensure a firm connection on flag connectors on control board. Ensure system loading is not exceeding cooler capacity.
Ready LED does not come on when impinger is below 7°C.	Ready temperature adjustment.	Adjust as necessary.
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 *(alarm relay/water slip option installed)*.	Water carryover in system. Water slip sensor connections.	Ensure system loading is not exceeding cooler capacity. Ensure that all water slip sensor connections are made. Clean tip of sensor. Replace alarm relay/water slip board.
Pump does not start. Ready and slip LED(s) are on *(alarm relay/water slip option installed)*.	Pump electrical connections.	Ensure proper connections. Replace 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
or your local representative

L: SPARE PARTS

Model M325

Part No.	Description
3CCB-016	Alarm Relay Board: Single Channel
2FAN-004	Fan: Muffin, 4” x 1 ½”, 12 VDC
3CXD-001	Heat Exchanger: 5" Durinert®
3CXG-005	Heat Exchanger: 5" Glass, threaded w/ fittings
3CXK-001	Heat Exchanger: 5" Kynar
3CXS-001	Heat Exchanger: 5" Stainless Steel
3CCB-017	LCD Temperature Display Board: Single Channel
3KPE-004*	Peltier Element Kit, 40 mm
1PSD-013*	Power Supply: 100 W, 12 VDC
3TCB-001*	Temperature Control Board: Single Channel
1TTC-003	Thermocouple, Temperature, Control, Type K 36”

* Recommended Spares

Sample Conditioning Systems w/ Model M325 Thermo-Electric Cooler

Model C1 (Model 4S-M325-9AC1, 4S-M325-9DC1)

Part No.	Description
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

Model CD (Models 4S-M325-9ACD, 4S-M325-9DCD)

Part No.	Description
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-002*	Sample Pump: Assembly, Dual Head w/ Check Valve, 115V
2PAD-006	Sample Pump: Dual Head, Mini-Dia-Vac, 115V (bare)
2PAM-002*	Sample Pump: Repair Kit, Dual
3CWS-001	Water Slip Sensor (Hastelloy/SS Pins)
3KCW-002	Water Slip Sensor (SS Pins) w/ Holder Assembly

* Recommended Spares **Consumables

APPENDIX A: MODEL M325

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
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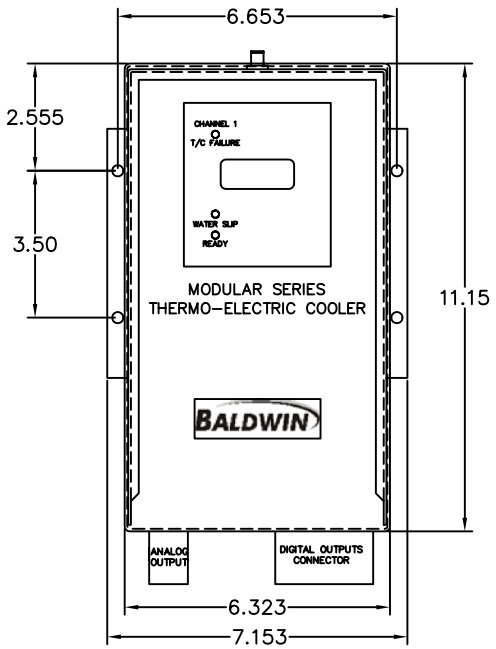
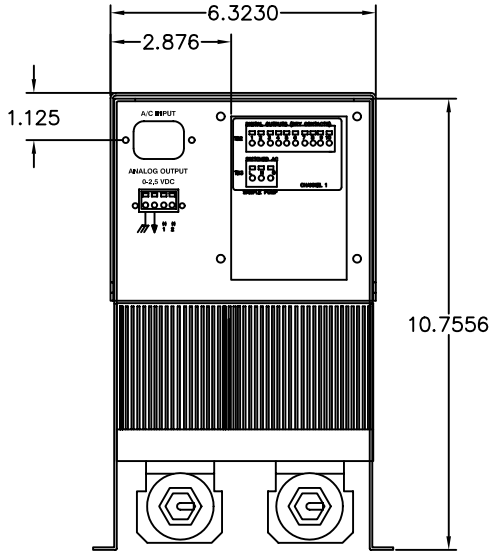
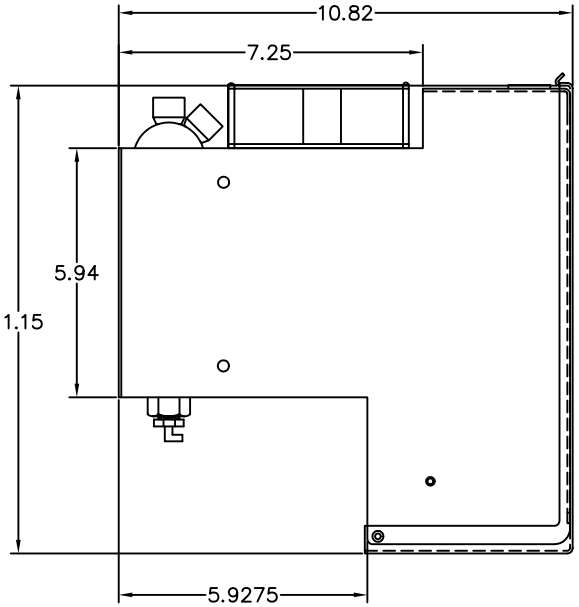


FRONT VIEW



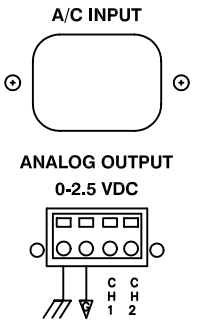
BOTTOM VIEW

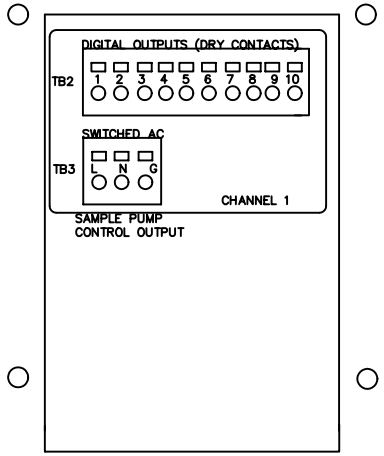


LEFT SIDE VIEW

DIGITAL I/O ASSIGNMENTS

PIN #	DESCRIPTION
1	EARTH GROUND
2	AUX ANALOG COMMON
3	AUX ANALOG SIGNAL
4	AUX ANALOG 4-20MADC -
5	AUX ANALOG 4-20MADC +
6	ALARM/WATER SLIP COM
7	ALARM/WATER SLIP
8	WATER SLIP SENSOR IN
9	WATER SLIP SENSOR IN
10	EARTH-SHIELD W/S SENSOR





NOTES:

FINISH TO BLACK
MEDIUM TEXTURE

ITEM	QTY	DESCRIPTION	MANUF.
USED FOR:		MODEL NUMBER: 4C-M325	
		DESCRIPTION:	

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

DRAWN BY: RAW DATE 01/13/04
APP'D: DATE
MATERIAL: AS NOTED
FINISH: AS NOTED
DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

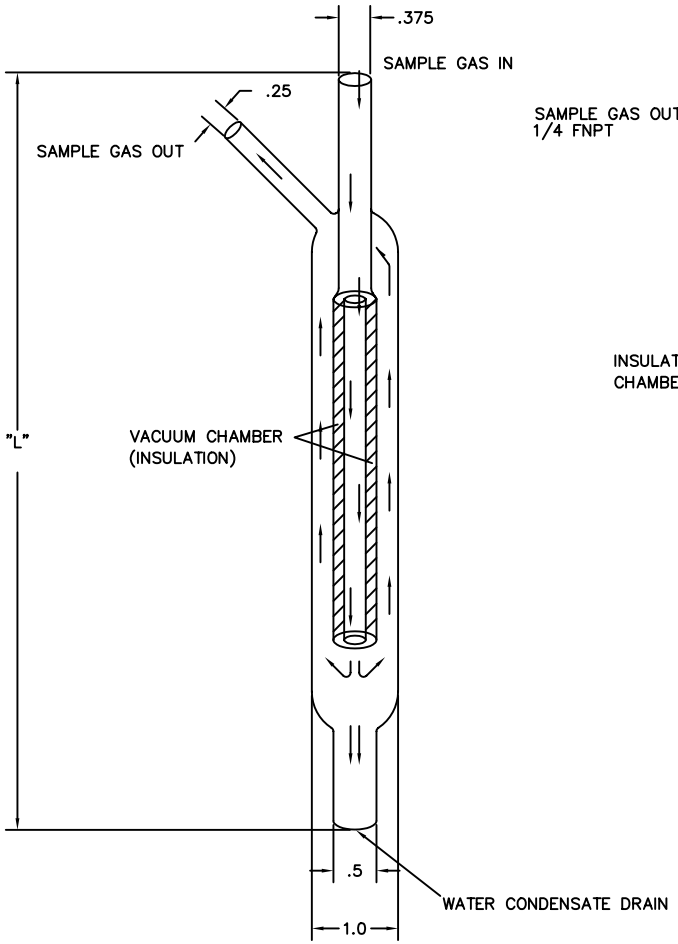
BALDWIN, INC.

PART DESCRIPTION
MODEL M325 SAMPLE COOLER ARRANGEMENT DRAWING

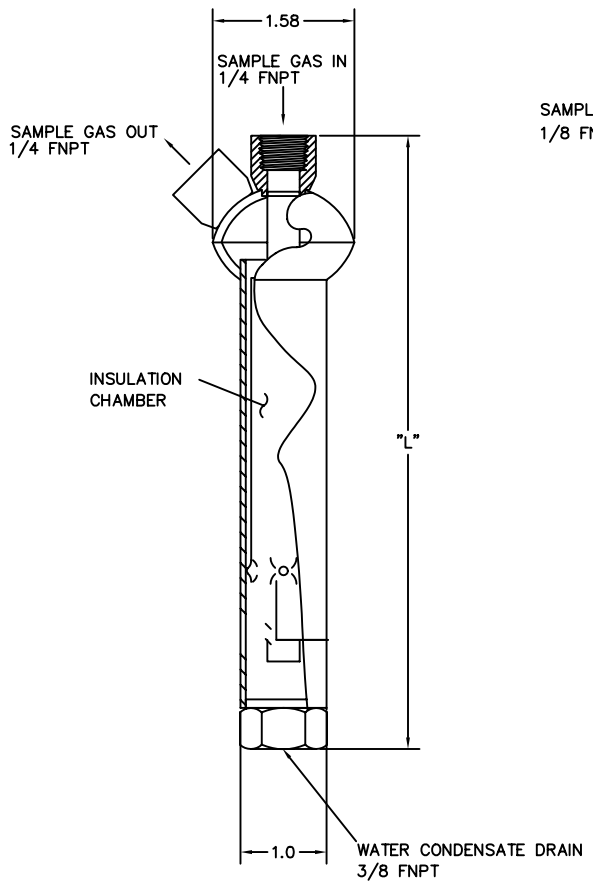
SIZE	SCALE:	DRAWING/PART NO.:
A	NTS	M325

CAD DIR: S:\S&M\DWGS\T.E.COOLER-MOD. SERIES | SHEET 1 OF 1

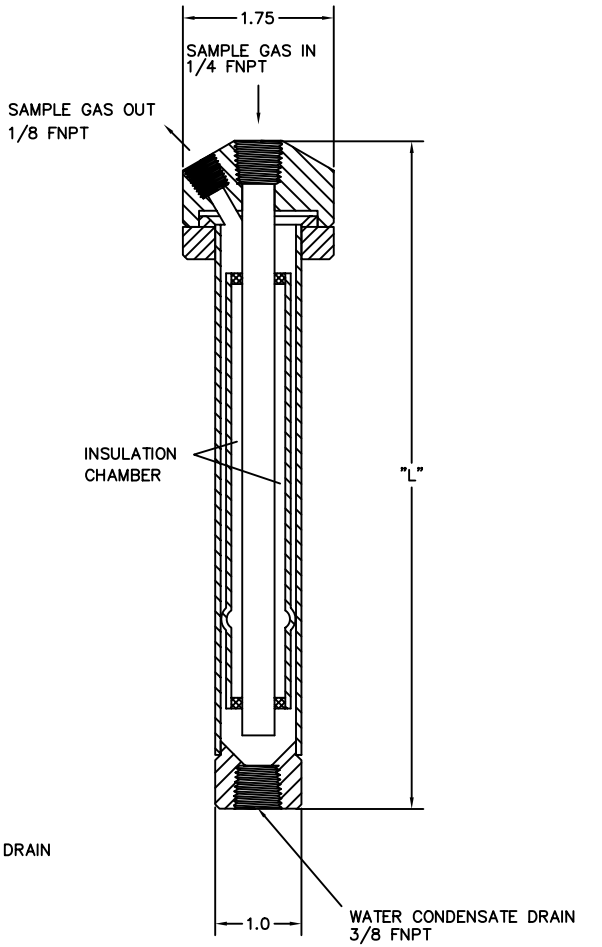
REVN	DATE	DESCRIPTION	DRAWN	APPROVED
0	11/13/98	INITIAL DRAWING	MES	MES



BOROSILICATE GLASS



STAINLESS STEEL &
DURINERT COATED



KYNAR

NOTE:
INLET OF FIRST IMPINGER IS
3/8" FNPT.
INLET OF SECOND IMPINGER IS
1/4" FNPT.

LENGTH TABLE

	"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

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

UNLESS OTHERWISE SPECIFIED
TOLERANCE DECIMALS
1 PLACE = ±.02
2 PLACE = ±.02
3 PLACE = ±.010
SURFACE FINISHES 125
ANGLES = ±5°
HOLES = +.003/-.001
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DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

DRAWN BY:	DATE
MES	11/13/98
APP'D:	DATE

MATERIAL

FINISH

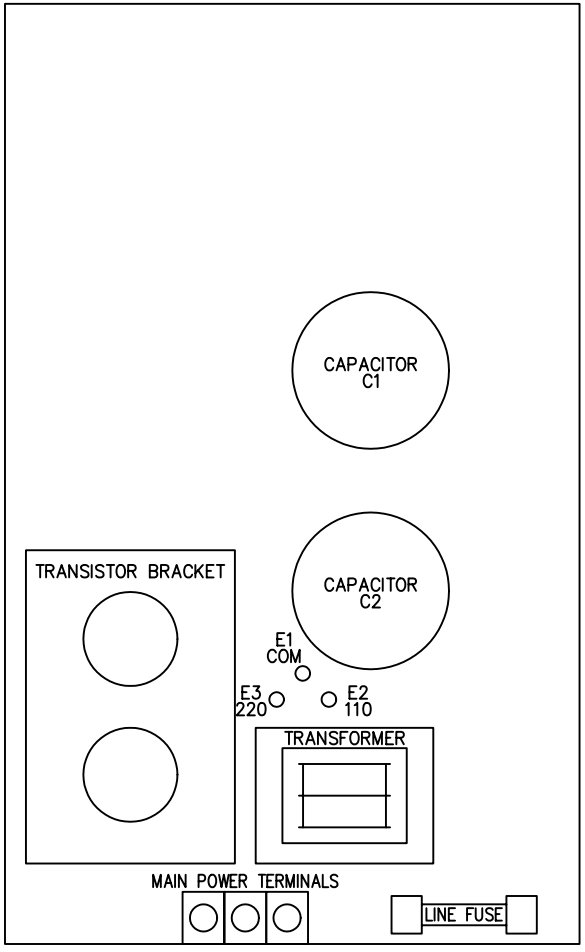
BALDWIN, INC.

PART DESCRIPTION
HEAT EXCHANGER
SCHEMATIC

SIZE	SCALE:	DRAWING/PART NO.:
A	NTS	IC0060

CAD DIR: S:\DRAW\MRKT. & SALES\O&M\COOLERS | SHEET 1 OF 1

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
0	00/00/00	INITIAL DRAWING	LD	RD



POWER SUPPLY MAINS JUMPER PROCEDURE:

1. FOR 110VAC 60Hz JUMPER COMMON (E1) TO 110 (E2).
2. FOR 220VAC 50Hz JUMPER COMMON (E1) TO 220 (E3).

ITEM	QTY	DESCRIPTION	MANUF.
USED FOR:	MODEL NUMBER: All Baldwin Thermo-Electric Coolers		
	DESCRIPTION: POWER SUPPLY		

UNLESS OTHERWISE SPECIFIED

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

SURFACE FINISHES 125

ANGLES = ±5°

HOLES = +.003/-.001

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

DRAWN BY: RAW DATE: 04/28/97

APP'D: DATE

MATERIAL

FINISH

BALDWIN, INC.

PART DESCRIPTION
POWER SUPPLY MAINS
JUMPER CONFIGURATION

SIZE	SCALE:	DRAWING/PART NO.:
A	NTS	5C-PJUMP

CAD DIR: S:\DRAW\SCHEMATICS\ELECTRICAL

SHEET 1 OF 1

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
0	11/12/02	SINGLE/ALARM WATER SLIP SENSOR	JDW	JDW

3 pin molex connector

TB3

GRN
WHT
BLK

G
N
L

SAMPLE PUMP

TB2

WATER SLIP SENSOR

BLK

GRN
GRN
GRN

RED
BLK

CHN 1

TYPE K THERMOCOUPLE

TB1

POWER SUPPLY
15vdc 120 watts

+ + − −

G Y R
CHN 2

G Y R
CHN 1

G
CHN2
CHN1

BLK
RED

POWER SUPPLY COOLING FAN 12 VDC

RED
BLK

CHANNEL 1
THERMOELECTRIC COOLING ELEMENT

CONTROL BOARD

1 amp

EARTH GROUND

2 amp 250vac
F2

FUSE
1 AMP

L
N
G

PERISTALTIC DRAIN PUMP

FUSE
5 AMP

L N G

BLK WHT GRN

GRN WHT BLK

ITEM	QTY	DESCRIPTION	MANUF.
USED FOR:		MODEL NUMBER: M-325, M-115 w/relay board	
		DESCRIPTION:	

DRAWN BY: DWM DATE: 9/15/98
APP'D: DATE:

BALDWIN ENVIRONMENTAL, INC.

MATERIAL:
FINISH:

PART DESCRIPTION: M-325 singl chn/out relay brd one pump electrical intercon

SIZE: B | SCALE: 1/1 | DRAWING/PART NO.: m325sele_single

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

UNLESS OTHERWISE SPECIFIED
SURFACE FINISHES 125
TOLERANCE DECIMALS
2 PLACE = ± .02
3 PLACE = ± .010
ANGLES = ± .5°
HOLES =
CONCENTRICITY .005 TI R
INSIDE CORNERS .031 R MAX
REMOVE BURRS BREAK EDGES TO .005 MIN. - .020 MAX.

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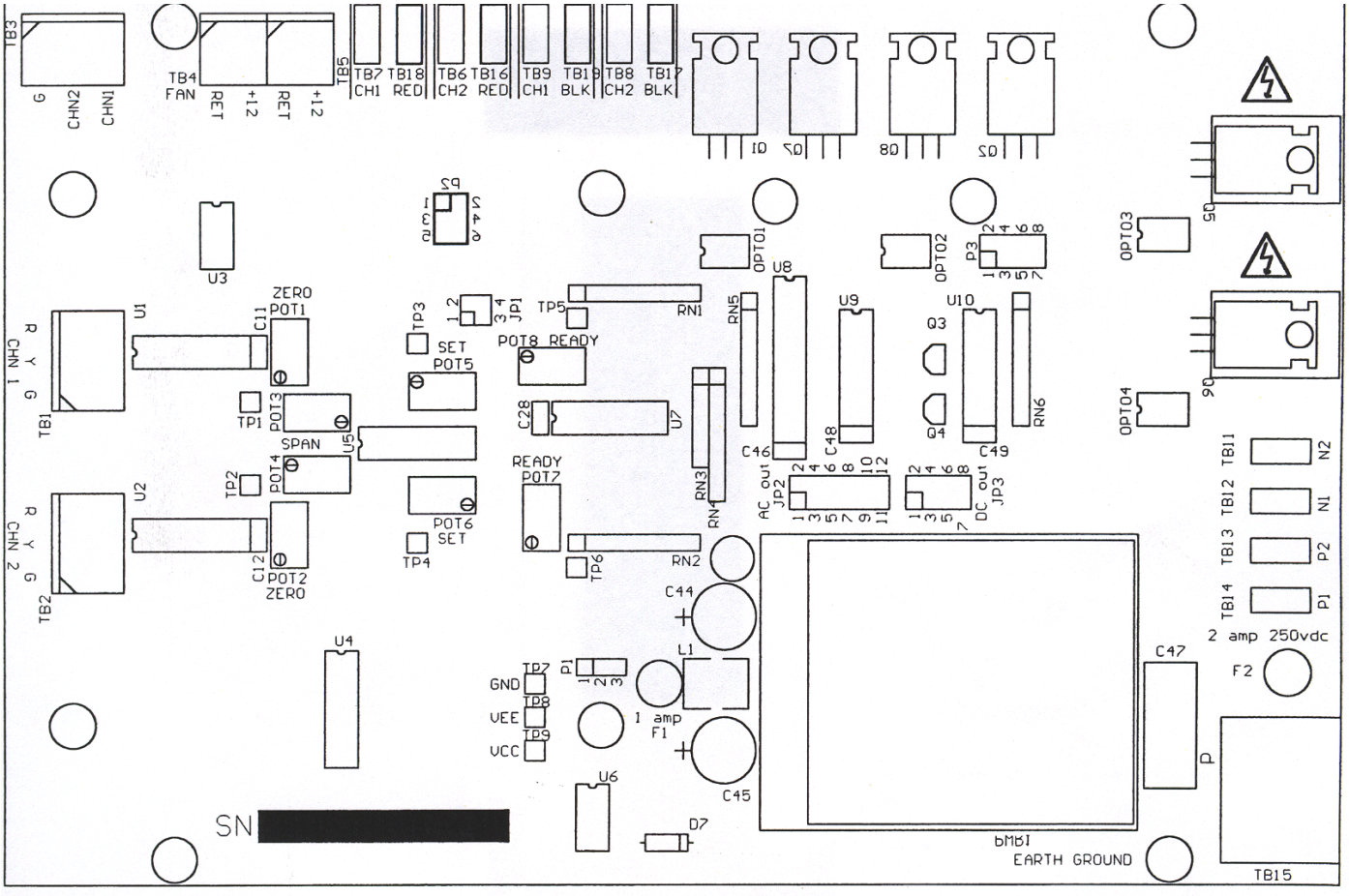
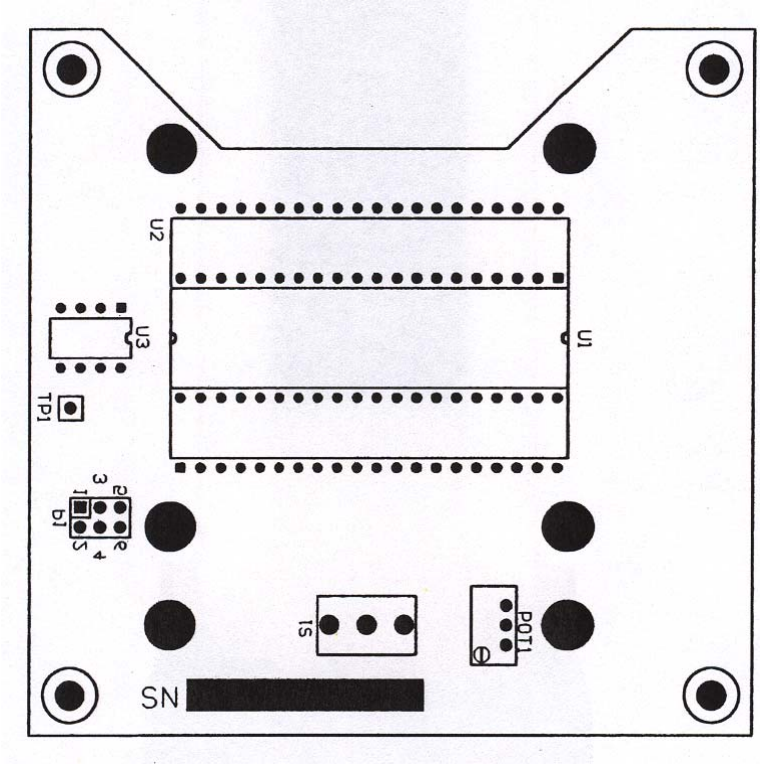
BALDWIN ENVIRONMENTAL

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

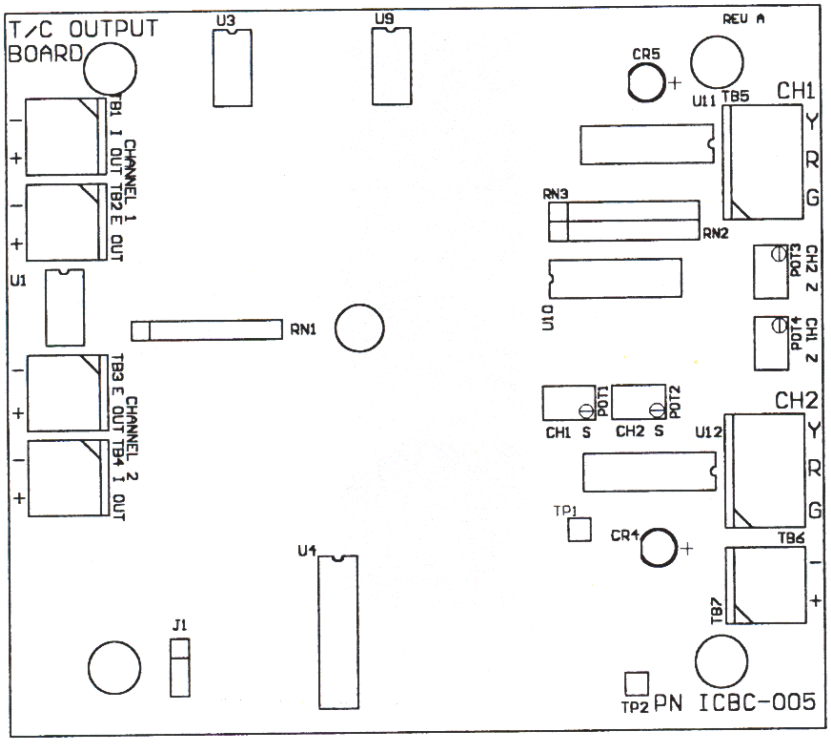
Modular Series Thermo-Electric Coolers
Control Board



Modular Series Thermo-Electric Coolers
Display Board



Modular Series Thermo-Electric Coolers
Auxiliary Analog Output Board



Header for Relay Alarm Board

P3: CHN2_READY, TC_2_OK, CHN1_READY, TC_1_OK, WATER_SLIP2, WATER_SLIP1

D3 WATER_SLIP2 GREEN

D4 WATER_SLIP1 GREEN

Channel 2

TB2: RED, YEL

C4 15uf, C6 .1uf, R4 100, U2 AD595AQ (+IN, -IN, +C, -ALM, +T, +ALM, COM, V+, -T, COMP, -C, Vo, V-, FB)

C12 .1uf

R6 4.7K, TC_2_SENSE

FOR ZERO / SPAN ADJ.

TP2

U5A LF347N

R17 24.9K

C21 .1uf

NOTE 1

R13 200K, POT4 100K, SPAN

POT2 ZERO 20K, R14 100K, R15 2K, C17 .1uf

TEMP_2

RN2B 10K, RN4C 1M, C28 .1uf

U7A LM339

C32 .001uf, C35 .1uf, C33 .1uf, RN2A 10K

TP6

20K POT7 READY TEMP.

RN4D 1M, RN2D 10K, C38 .001uf, C42 .1uf, C39 .1uf, U7B LM339

RN2C 10K, R29 200K, U5B LF347N, R20 1M, JP1, CLK_1, CLK_2, TP4

NOTE 3

20K POT6 SET TEMP.

RN3D 4.7K, U8A MC74HC240A

TC2_SENSE

RN5D 470, RN5C 470, GREEN D6, RED D2

CHN2_READY, TC_2_OK

RN3C 4.7K, CHN_2_CONTROL_OUT

C29 15uf, U6 ICL7660 (NC, +CAP, GND, -CAP, +V, OSC, LV, Vout), TP9, TP8, C40 15uf, C43 .1uf, D7 SA5.0

F1 1 amp, L1 100uH, C45 68uf, C44 68uf, TP7

PWR1 5V_ACDC (+OUT, -OUT, ACL, ACN, ACG)

AC_LINE, AC_NEUTRAL, C47 .1uf X type 250vac, F2 2 amp 250vdc, TB15, TB10

CHAN 1 AC OUTPUT

TB13 AC_LINE, TB11, Q5 MAC8D, AC_NEUTRAL

CHN_1_CONTROL_OUT, R25 10K, R23 100K, Q3 2N3904

TC_1_OK, CHN1_READY, U9A MC74HC11, RN6C 220, OPTO3 MOC3023, R27 200

C48 .1uf

CHAN 2 AC OUTPUT

TB14 AC_LINE, TB12, Q6 MAC8D, AC_NEUTRAL

JP2: TC_1_OK, TC_2_OK, CHN1_READY, CHN2_READY, CHN_1_CONTROL_OUT, CHN_2_CONTROL_OUT

NOTE 2

R26 10K, R24 100K, Q4 2N3904

U9B MC74HC11, RN6D 220, OPTO4 MOC3023, R28 200

C46 .1uf

Channel 1

TB1: RED, YEL

C3 15uf, C5 .1uf, R3 100, U1 AD595AQ (+IN, -IN, +C, -ALM, +T, +ALM, COM, V+, -T, COMP, -C, Vo, V-, FB)

C11 .1uf

R5 4.7K, TC1_SENSE

FOR ZERO / SPAN ADJ.

TP1

U5D LF347N

R16 249K

C20 .1uf

NOTE 1

R12 200K, POT3 100K, SPAN

POT1 ZERO 20K, R11 100K, R10 2K, C16 .1uf

TEMP_1

RN1A 10K, RN4B 1M, C31 .001uf, C30 .1uf, C34 .1uf, RN1B 10K

TP5

20K POT8 READY TEMP.

RN4A 1M, RN1C 10K, C37 .001uf, C36 .1uf, C41 .1uf, U7C LM339

RN1D 10K, R30 200K, U5C LF347N, R19 1M, CLK_1, TP3

20K POT5 SET TEMP.

RN3A 4.7K, U8B MC74HC240A

TC1_SENSE

RN5B 470, RN5A 470, GREEN D5, RED D1

CHN1_READY, TC_1_OK

RN3B 4.7K, CHN_1_CONTROL_OUT

U10A MMT4C08, RN6B 220, OPTO1 MOC8113, R21 2K

CHAN 1 DC OUTPUT

TB6 +12vdc, TB8, Q1 MPT50N06V, TB16, TB17, Q7 MPT50N06V

C49 .1uf

U10B MMT4C08, RN6A 220, OPTO2 MOC8113, R22 2K

CHAN 2 DC OUTPUT

TB7 +12vdc, TB9, Q2 MPT50N06V, TB18, TB19, Q8 MPT50N06V

JP3: TC_1_OK, TC_2_OK, CHN_1_CONTROL_OUT, CHN_2_CONTROL_OUT

NOTE 2

+12vdc power input: TB5

fan power output: TB4, D8 1N4006, D9 1N4006

C14 .1uf, U4A LM556C (CON, TRG, THRES, RST, OUT, DIS), R9 200K, C15 .1uf, CLK_1

NOTE 4: C13 .01uf

NOTE 5

C23 .1uf, U4B LM556C, R18 200K, C25 .1uf, CLK_2

NOTE 4: C24 .01uf, C18 .1uf

P2: C19 15uf, C22 .1uf, TEMP_2, VEE, VCC, TEMP_1, C27 15uf, C26 .1uf

Header for Display Board

U3B LM358A, C10 .1uf, R7 100K, TEMP_1

U3A LM358A, C9 .1uf, R1 100K, R8 200, R2 200, TEMP_2

TB3: TEMP1 output, TEMP2 output, GND

NOTE 1: R12 & R13 are installed when the controller board is used for cooling.
R12 & R13 are removed and jumper wires are installed when the controller board is used for heating.

NOTE 2: For JP3, jumper pins 1 &2 and pins 5 & 6 for channel 1 control.
For JP3, jumper pins 3 &4 and pins 7 & 8 for channel 2 control.
For JP2, jumper pins 1 &2, pins 5 &6, and pins 9 & 10 for channel 1 control.
For JP2, jumper pins 3 & 4, pins 7 &8, and pins 11 & 12 for channel 2 control.

NOTE 3: if both channels are used for either cooling or heating, then jumper pins 1 & 2.
if one channel is used for cooling and the other channel is used for heating, jumper pins 3 & 4.

NOTE 4: if the channel is used for cooling, C13 or C24 is a .01uf monoceramic cap.
if the channel is used for heating, C13 or C24 is a 3.3uf monoceramic cap.

NOTE 5: if both the channels are used for the same function,
that is cooling or heating, only CLK_1 is used for both channels.
Refer to NOTE 3

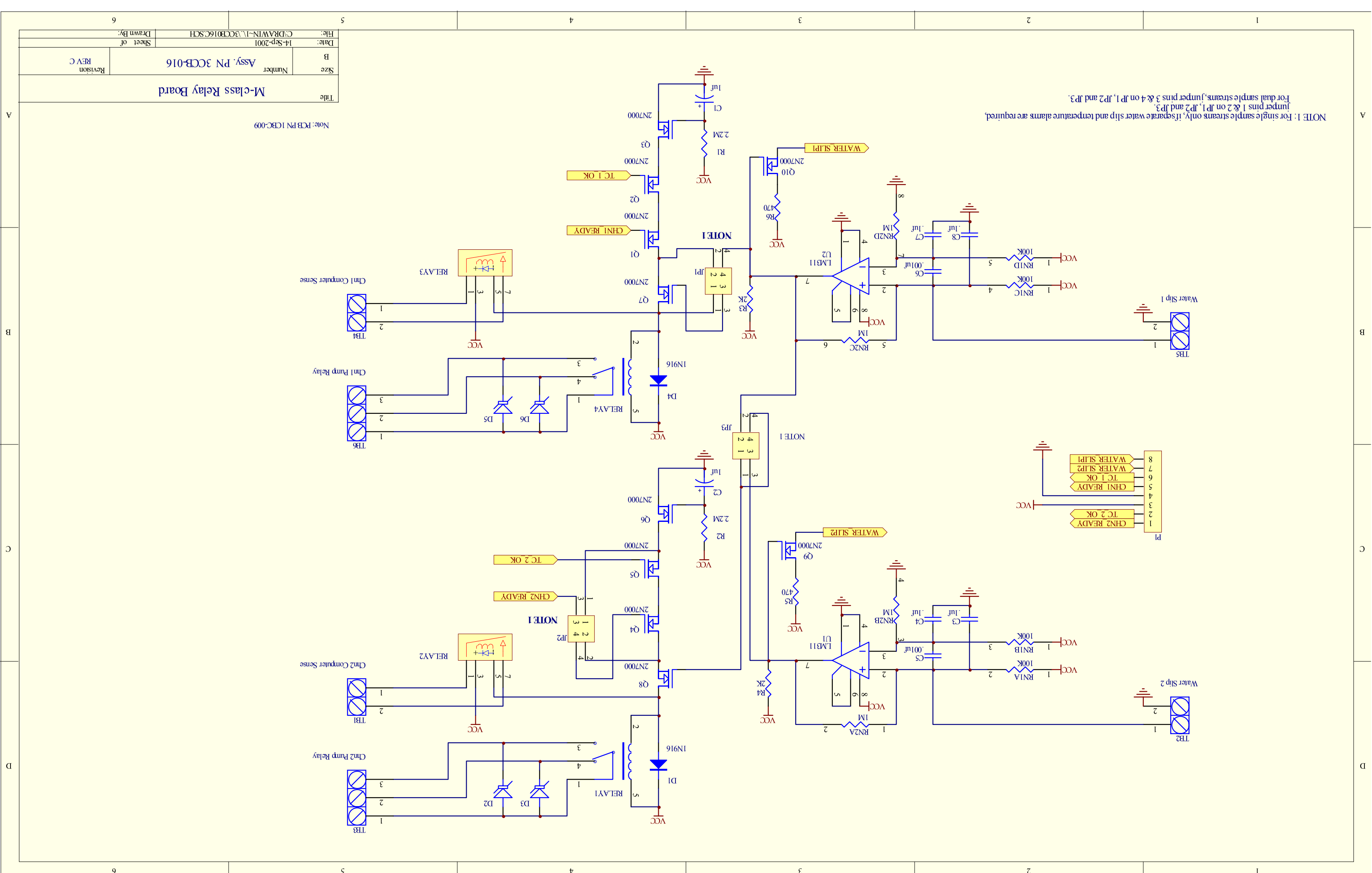
NOTE: PCB PN 1CBT-001 REV B

Title: M-class Cooler Control Board		
Size: C	Number: PN 3TCB-001	Revision: REV C
Date: 14-Sep-2001		Sheet of
File: C:\DRAWIN~1\...\3TCB001C.SCH		Drawn By:

NOTE 1 : For single sample streams only, if separate water slip and temperature alarms are required,
jumper pins 1 & 2 on JP1, JP2 and JP3.
For dual sample streams, jumper pins 3 & 4 on JP 1, JP2 and JP3.

Note: PCB PN 1CBC-009

Title	M-class Relay Board	
Size: B	Number: Assy. PN 3CCB-016	Revision: REV C
Date: 14-Sep-2001	Sheet of	
File: C:\DRAWIN~1\3CCB016C.SCH	Drawn By:	



APPENDIX B: SAMPLE CONDITIONING SYSTEM

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
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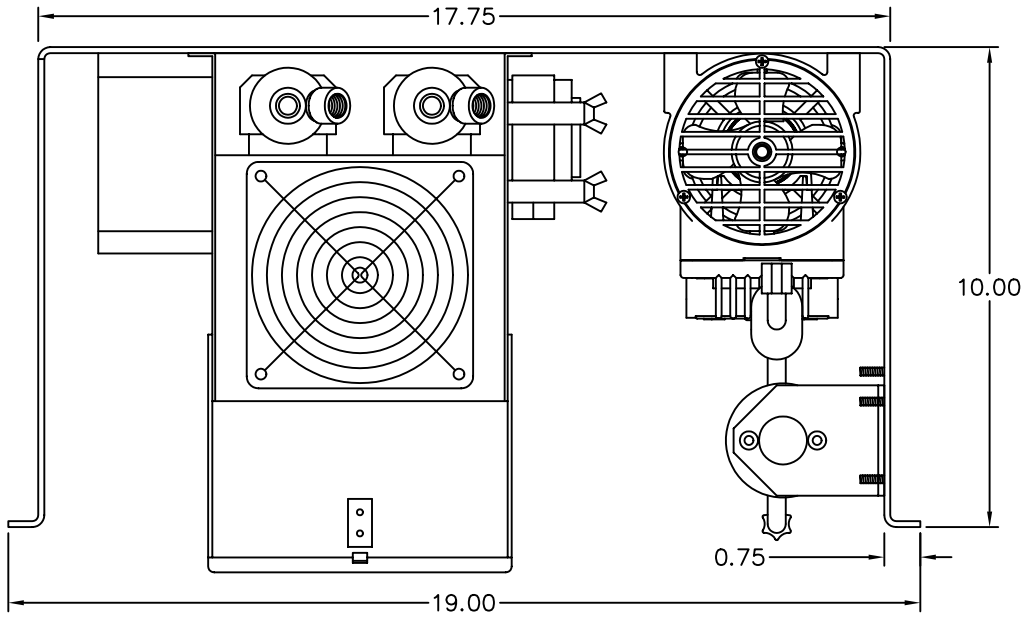
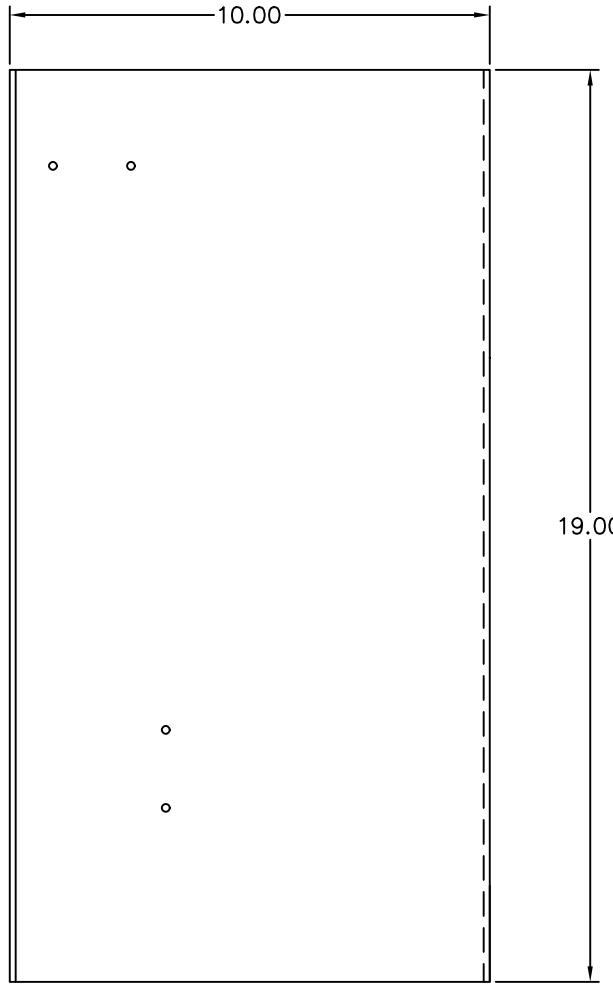
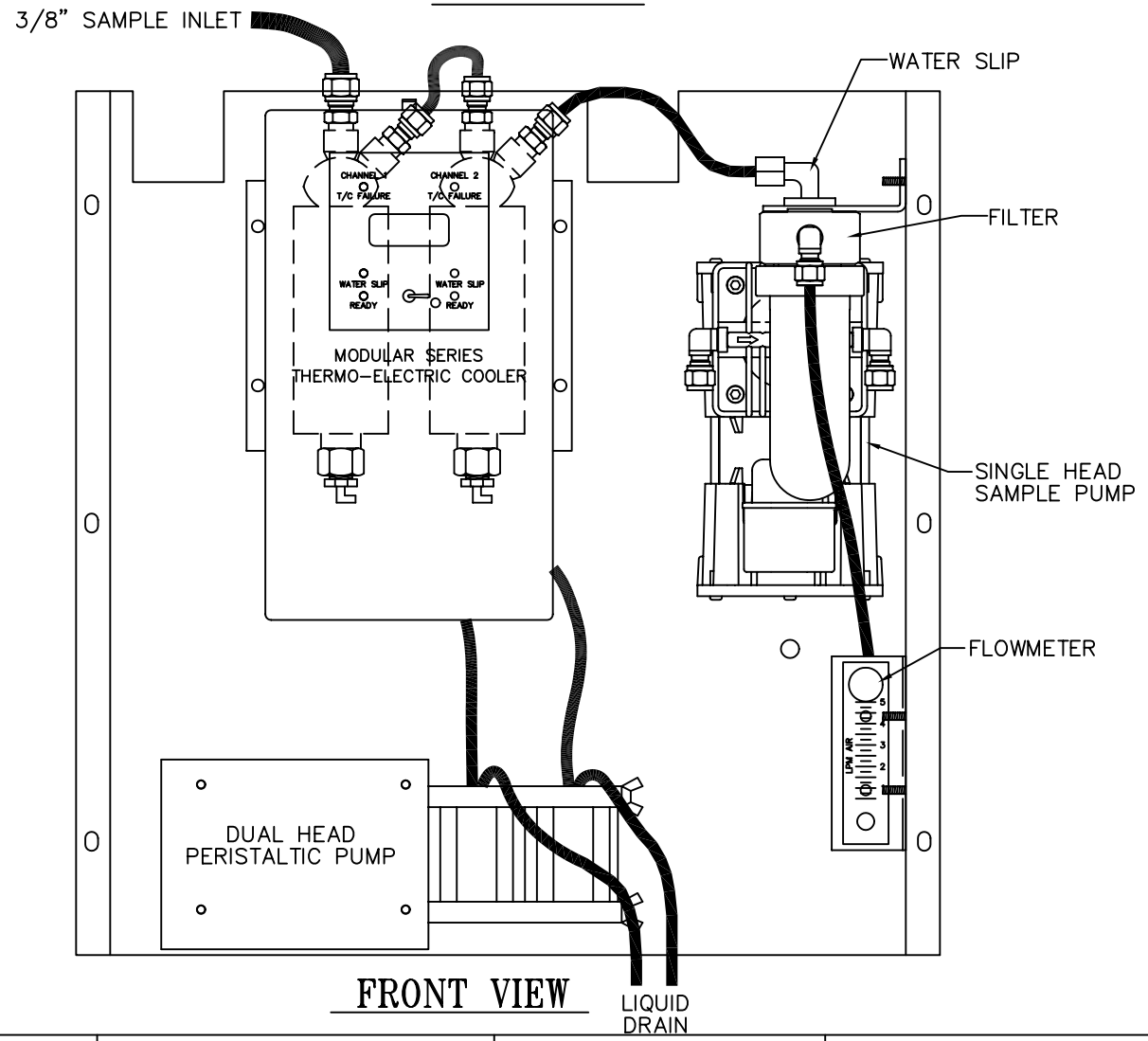


TOP VIEW



RIGHT SIDE VIEW



FRONT VIEW

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

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BALDWIN, INC.

DRAWN BY: RAW DATE: 02/11/04
APP'D: DATE:

BALDWIN, INC.

MATERIAL

FINISH

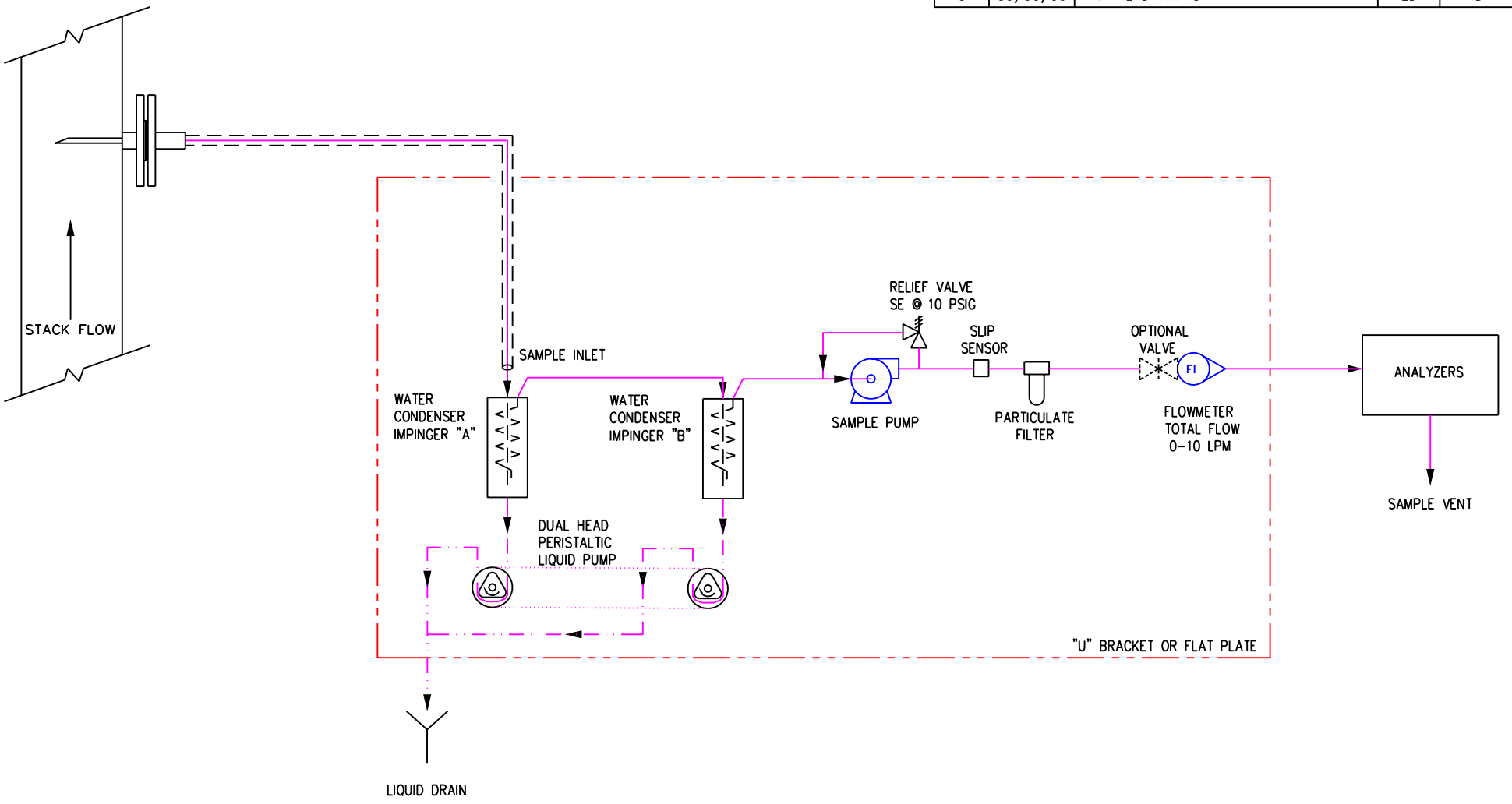
DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

PART DESCRIPTION
MODEL M425 SAMPLE CONDITIONING SYSTEM

SIZE	SCALE:	DRAWING/PART NO.:
B	1/4	4S-M425-9AC1

CAD DIR: S:\S & M\DWGS\S. COND. SYSTEMS\DWG | SHEET 1 OF 1

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
0	00/00/00	INITIAL DRAWING	LD	RD



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:	

UNLESS OTHERWISE SPECIFIED
TOLERANCE DECIMALS
1 PLACE = ±.02
2 PLACE = ±.02
3 PLACE = ±.010
SURFACE FINISHES 125
ANGLES = ±5°
HOLES = +.003/-.001
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DRAWN BY: MES DATE
APP'D: DATE
MATERIAL
FINISH
DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

BALDWIN, INC.

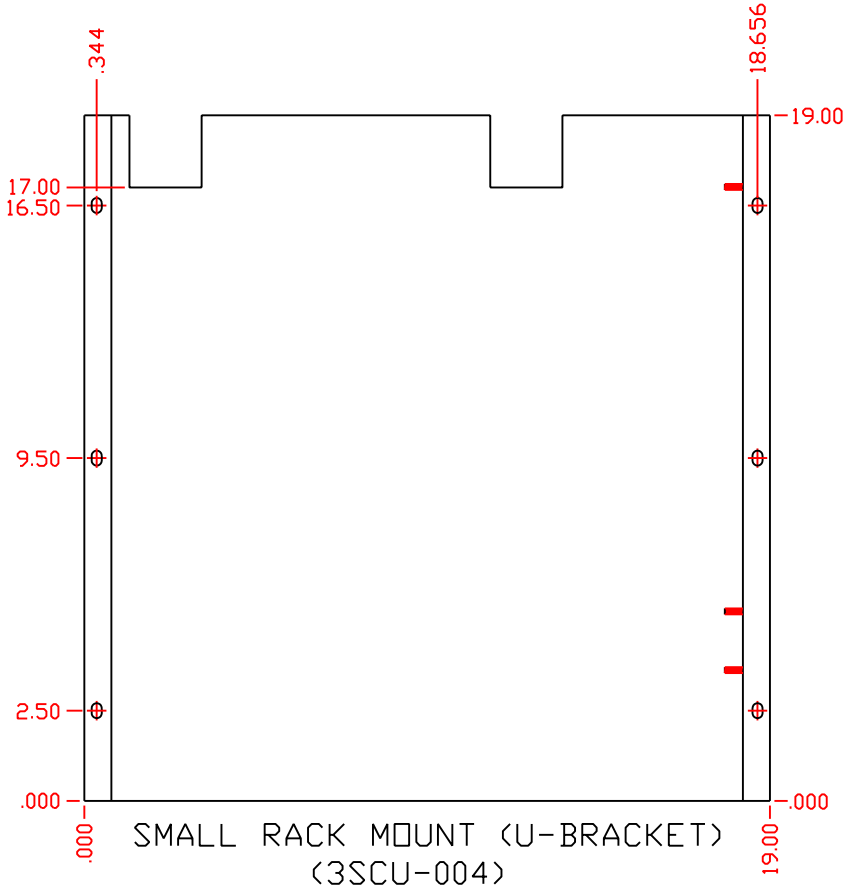
PART DESCRIPTION
PASSIVE/ACTIVE SAMPLE CONDITIONING SYSTEM FLOW DIA.

SIZE	SCALE:	DRAWING/PART NO.:
A	NTS	PASSIVE/ACTIVE

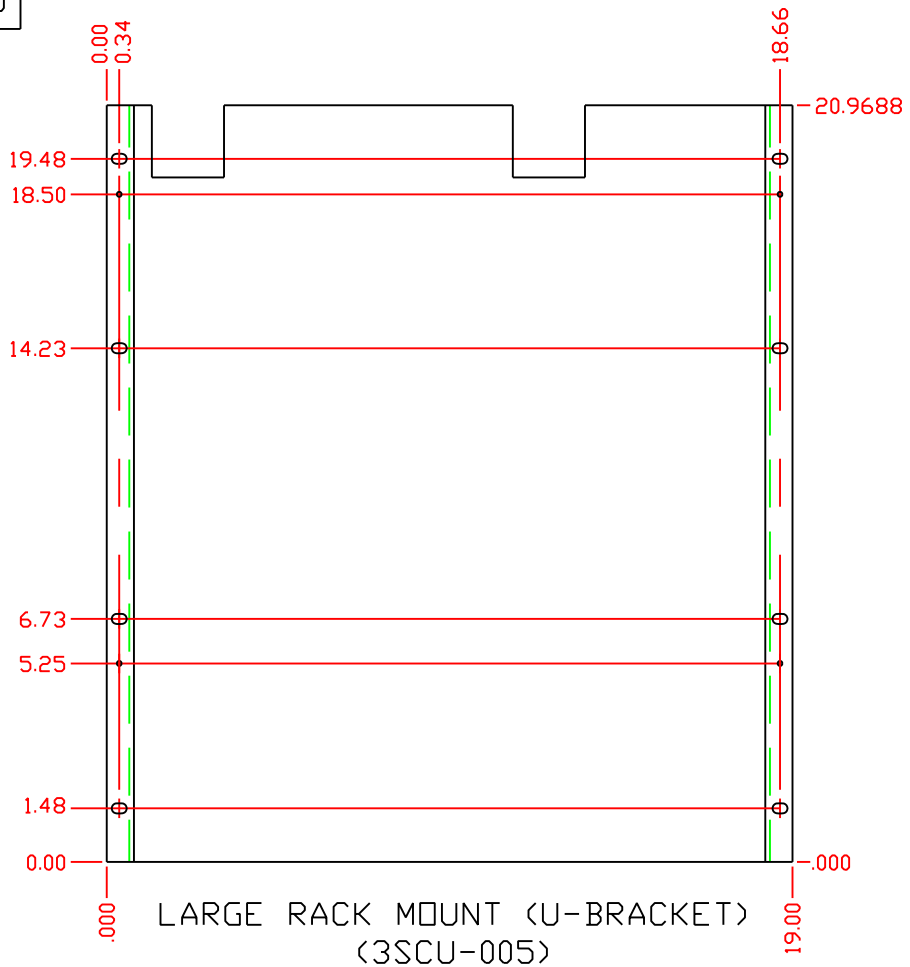
CAD DIR: S:\S&M\DWGS\SAM. COND. SYSTEM\DWG | SHEET 1 OF 1

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

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



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



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

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
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www.baldwinUSA.com

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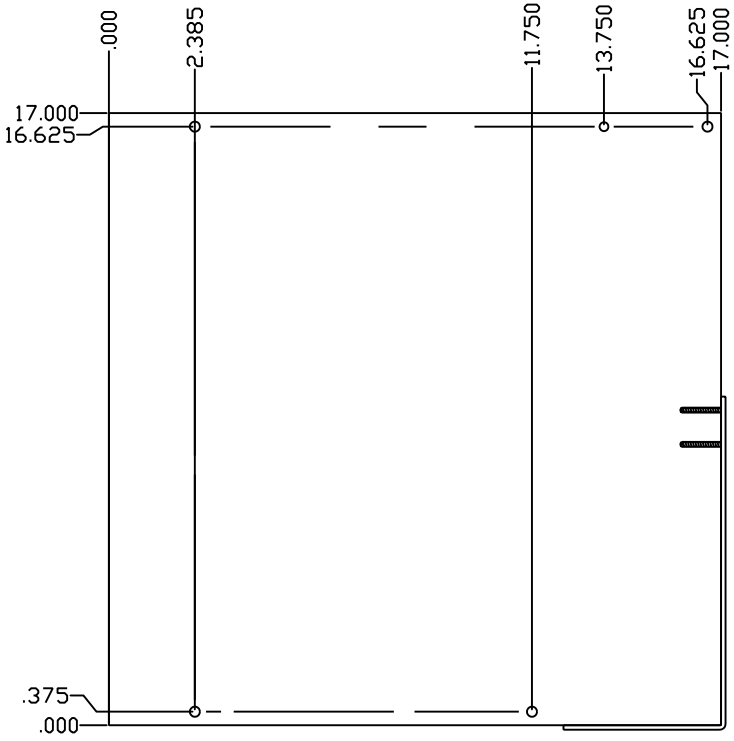
DRAWN BY: JO DATE: 06/19/02
APP'D: DATE
MATERIAL: AS NOTED
FINISH: AS NOTED
DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

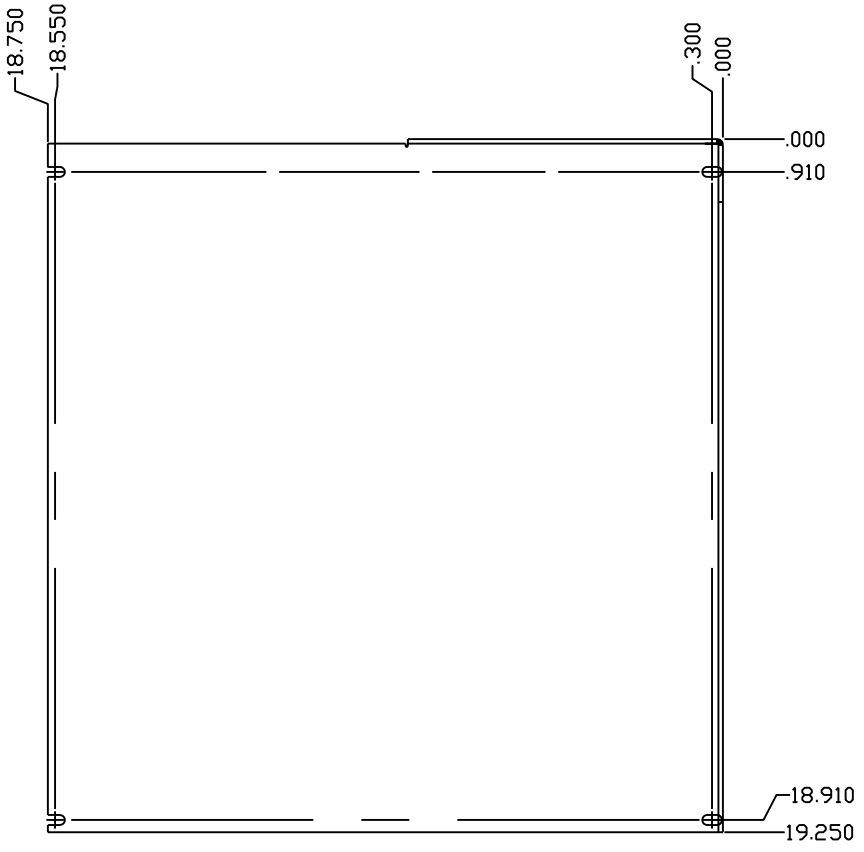
BALDWIN, INC.

PART DESCRIPTION: SAMPLE CONDITIONER RACK MOUNT MOUNTING DIMENSIONS
SIZE: A | SCALE: 3/16 | DRAWING/PART NO.: RACK MOUNT
CAD DIR: S:\S&M\DWG\S_C-SYSTEMS\WALL MOUNT | SHEET 1 OF 1

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



SMALL WALL MOUNT (FLAT PLATE)
(3SCP-002)



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

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

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

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

DRAWN BY: JO DATE: 06/19/02
APP'D: DATE:
MATERIAL: AS NOTED
FINISH: AS NOTED

BALDWIN, INC.

PART DESCRIPTION: SAMPLE CONDITIONER WALL MOUNT MOUNTING DIMENSIONS

SIZE	SCALE:	DRAWING/PART NO.:
A	3/16	WALL MOUNT

CAD DIR: S:\S&M\DWG\S_C-SYSTEMS\WALL MOUNT | SHEET 1 OF 1

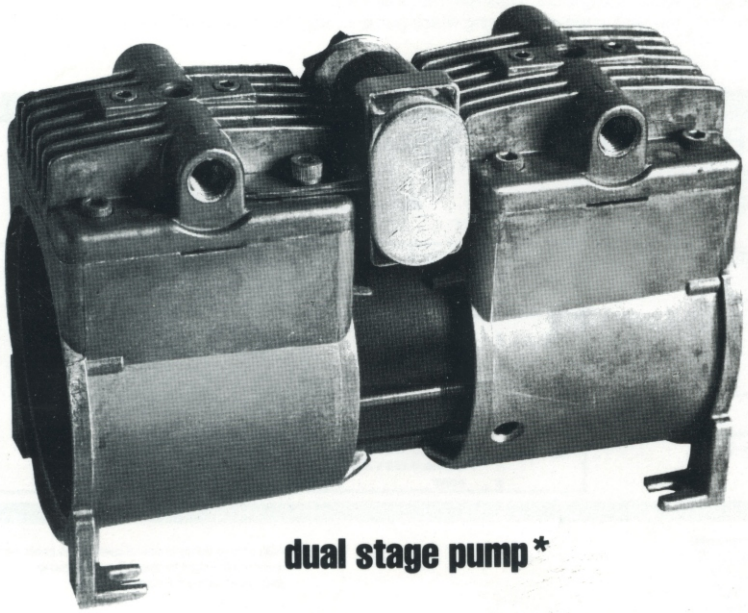
MINI DIA-VAC® SINGLE AND DUAL STAGE PUMPS FOR PRESSURE AND/OR VACUUM SYSTEMS

Meet ADI's Mini Dia-Vac®, the workhorse pump in our stable. The Mini Dia-Vac® pumps are completely self contained and may be used for either built in or portable applications. They are designed as a combination vacuum/pressure pump so you can mount the Mini Dia-Vac in mid-stream and push or pull air to either end of your system. The Mimi Dia-Vac® pumps are ideal for use in laboratories, industrial plants, process control, environmental and remote sampling as well as an ideal choice for OEM customers requiring customized gaseous vacuum/pressure sampling applications.

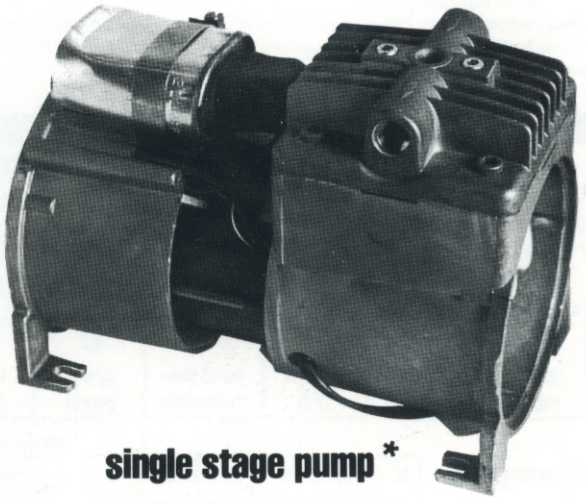
With the special capacitor run feature and oversized fan, the durable Mini Dia-Vac® is designed to provide you with cooler operating temperatures than many other pumps of its size on the market. You can count on the Mini Dia-Vac® for continuous operation, even under load conditions. This pump has 203 size heavy duty bearings and built-in overload protection in the motor. The Mini Dia-Vac® is also available in an air driven motor for explosion proof and non-spark applications. The entire line of Mini Dia-Vac® pumps are UL listed, CSA and CE approved. Choose either the single or dual stage design to meet your particular requirements...and let our Mini Dia-Vac® pump start to pass your gas!

Some of the outstanding quality features of the Mini Dia-Vac® include:

- CE approved
- Complete field serviceability
- Continuous operation
- Wetted parts made of chemically inert material to prevent sample contamination
- Optional eccentric sizing for greater flexibility to system performance requirements
- Capacitor-run feature
- Oversized fan to keep motor cool
- Oversized bearings and motor shaft
- Overload protection built into motor
- Starting and operating under heavy load conditions
- Exceptionally quiet at all pressures
- Low maintenance with minimal noise vibration
- No risk of damage even when inlet or outlet becomes blocked
- Will Customize The Mini Dia-Vac® to your specific application



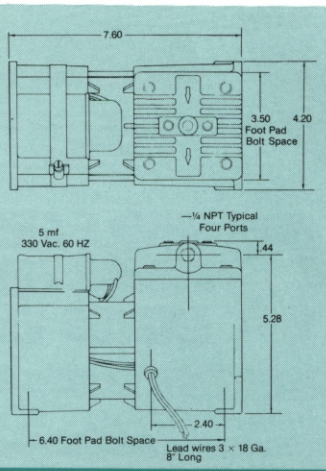
dual stage pump*



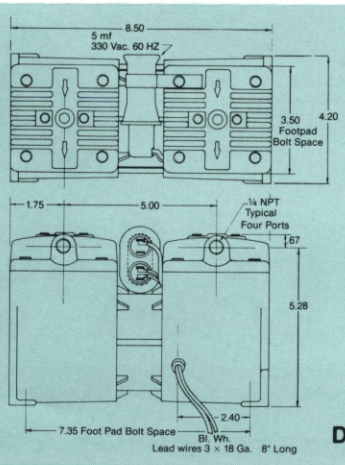
single stage pump*

*See reverse side for model # and ordering instructions

Dimensions



Single Stage Mini



Dual Stage Mini

Specifications

Maximum Pressure	35 PSIG
Maximum Vacuum	21" HG
Maximum Flow	.6-1.2 CFM
Head Material	*see below
Diaphragm Material	**see below
Check Valve Material	Teflon®
Body Material	Cast Aluminum
Connecting Rod Material	Cast Aluminum
Motor	1/15 hp, permanent split with 5 uf capacitor
Weight	8 lbs. (single), alum. 9 lbs. (dual) alum.
Gas Temperature Range	20°-210° F
Port Connections	1/4 NPT
Ambient Temperature Range	20°-130° F
Bearing	203 size
Full Load Lower Requirement (dual)	60 HZ 118 Watts, .93 Amps; 50 HZ, 140 Watts, 1.1 Amps
Motor, full load temperature rise (dual)	60 HZ, 33°C; 50 HZ, 40°C

* aluminum, Carpenter 20, stainless steel, Teflon® coated
**neoprene, FEP Teflon®, Viton®

Mini Dia-Vac Performance

ADI's Dia-Vac Pumps can Pass your Gas at the Speed of Need! Due to an increased interest in reducing the pressure, vacuum and/or flow on the Dia-Vac pumps, our engineers designed a modified eccentric design. This allows you to customize your Dia-Vac pump to meet your application requirements while at the same time increasing the diaphragm and bearing life. The normal eccentric size is .160 on the Mini Dia-Vac Pumps. To order any of the reduced eccentric pumps, simply add the number 5 to the end of the model number plus the first two digits of the eccentric designation. (M19310TC5-10).

Flow Averages Mini Dia-Vac

Eccentric Size	PSIG	bar	InHg	mbar	CFM	LPM
.080	6.0	0.41	7.0	237	.44	12.5
.100	17.0	1.17	17.0	575	.47	13.5
.150	27.0	1.86	20.0	676	.72	20.0
.160 (std.)	30.0	2.07	22.0	745	.78	22.0
Double	33.0	2.27	27.0	913	1.28	36.2

- Test results are approximate
- Tests performed with 316ss head, Teflon diaphragm, 3/8 diameter hose x 5 ft. line at 75 deg. F, using a std. 1725 rpm motor at 60 hz.
- These test results are for reference only, and are intended to help provide information to the user when determining which pump to buy. Actual pump performance will depend upon the users applications.

How To Specify and Order Pumps from Air Dimensions, Inc.

Your order number is made up from a series of order numbers for each of five letter codes - A through E. Each latter code specifies a different aspect of the pump you want.

IMPORTANT NOTE: The prefix "M" in front of the order number specifies the Mini pump.

M	A	B	C	D	E
mini pump	type o casting	type of unit	head con-figuration	type of power	type of coating

Example:

M	01	3	1	0	T

mini pump, aluminum, standard direct drive motor, single head, 115V, 60HZ, Teflon® coated/EPDM diaphragm.

letter code	order number	description
A	01	aluminum
	03	carpentor 20
	08	Hastelloy C
	19	stainless steel
B	3	standard direct drive 1600 RPM
	8	air driven
C	1	single head
	2	dual head
D	0	standard 115V 50-60 Hz
	3	standard 220 V 50 Hz
	4	none

letter code	order number	description
E	C	Teflon® coated/head add $50 per head
	F	Teflon® coated Viton® diaphragm
	N	EPDM diaphragm
	T	Teflon® coated EPDM diaphragm
	V	Viton® diaphragm
	TT	Teflon® 2 ply
	5	reduced eccentrical

ADI, whose policy is one of continuous improvement reserves the right to change specifications and prices without notice.

air dimensions incorporated

1015 West Newport Center, Suite 101, Deerfield Beach, FL 33442 (954) 428-7333, (800) 423-6464, Fax (954) 360-0987

AIR DIMENSIONS INCORPORATED

1371 West Newport Center Dr., Suite 101, Deerfield Beach, FL 33442 - Phone 954-428-7333 or 800-423-6464 Fax 954-360-0987
http://www.airdimensions.com e-mail address -Info@AirDimensions.com

MINI DIA-VAC®

MAINTENANCE AND DISASSEMBLY INSTRUCTIONS

A. General Operations Characteristics

1. Normal motor coil temperatures may be 160 - 180 degrees F. Winding insulation is Class B. Please note the two fans are different, so before removing the fans, note which side they belong on.

2. To check pumping efficiency, employ suitably damped gauges connected so as to dead-end either pressure or vacuum.
NOTE: Check each separately, One or the other port must be open during this test.
Use 0-60 PSI pressure gauge and 0-30 inch hg. vacuum gauge, (or mercury manometer).
Maximum pressure should be at least 33 PSIG for the .160 eccentric.
Maximum vacuum should be 21 inches Hg when using the .160 eccentric.

3. Match electrical power to motor

4. Do not start pump and motor with load of pressure or vacuum on pump head.

5. Pumps are intended for gaseous operation, eliminate liquids entering pump.

6. Nominal running amps for Mini Dia-Vac® at 115/230 volts are 1.7/0.8

B. Maintenance Procedures

1. Motor oiling - No oiling or other lubrication addition is necessary at all. All bearings are pre-lubricated and shielded from external contamination.

2. Diaphragm Replacement (also see Maintenance Procedure Below):

a. Standard EPDM (part 4302 or kit 11309) - Operating life can be five years or more under conditions of light pressure or vacuum loads and infrequent operation. Over 20 PSI and constant operation may require 3 month diaphragm inspection procedure. High ambient conditions over 100 degrees F may also decrease diaphragm life.

b. Teflon coated EPDM (part 4301 or kit 11305) - Satisfactory operation can be attained for periods of 12 months or more under conditions of light pressure of vacuum loads.

c. Viton/Nomex (part 4303 or kit 11307) - same as b above.

Where critical processes may involve the pumping of corrosive or toxic gas media, it is recommended that a monthly check of the diaphragm be part of a scheduled maintenance procedure.

Air Dimensions Inc. will supply recommendations on the choice of diaphragm material and or pump head construction on request.

*Diaphragms require close precision tolerance, therefore only ADI diaphragms should be used as replacements.

C. 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 three or four turns. When the valve body is removed, check all internal surfaces for any 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 routine 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 (part# 23001) 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.

NOTE: When replacing the service diaphragm, be sure the four projecting 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.

D. Disassembly and Replacement of the Connecting Rod

1. Remove head section and service diaphragm as described in (C) above. When this is done and the front screen has been removed, the connecting rod assembly may be taken out (refer to exploded view drawing). Gently pry up and remove the connecting rod cap (part# 3301) which is held in place by the diaphragm screw.

2. Loosen but do not remove the counterweight screw. This is accessible from the top of the pump base casting and will require a 5/32" hex allen wrench. The connecting rod eccentric assembly, including counterweight and fan, will then slide of the motor shaft.

3. When replacing the eccentric assembly, be careful to align the flat section on the motor shaft with the counterweight screw. The eccentric assembly should be aligned so the fan is on the outer side from the motor. Slide this assembly as far onto the motor shaft as it will go before tightening the counterweight screw onto the flat of the motor.

NOTE: After prolonged use, the eccentric assembly may freeze up on the motor shaft. A wheel puller may be needed to free the part. When replacing the eccentric assembly, the motor shaft should be lightly coated with a graphite or MDS based lubricant.

E. Related Torque Values

1. Head bolts - 110 inch pounds.
2. Valve body screws and Diaphragm plate screws - 70 inch pounds

ITEM	QTY	NAME	NOTE
1	1	A02005	VALVEBODY
2	1	A02303	FRONT CASTING
3	1	A02305	REAR CASTING–SINGLE
4	1	A02307	BUSHING–LONG
5	1	A02309	BUSHING–SHORT
6	3	A02311	BEARING
7	1	A03301	CAP
8	1	A03302	COUNTERWEIGHT
9	1	A03309	CAPACITOR BOOT
10	1	A03311	CAPACITOR
11	2	A04004	VALVE DISC
12	1	A04301	DIAPHRAGM
13	1	A05301	ECCENTRIC
14	1	A06302	FAN, FRONT
15	1	A06303	FAN, REAR
16	1	A07001	VALVE GASKET
17	1	A08003	HEAD
18	1	A13303	MOTOR, 115v 50/60
19	1	A16001	PLATE

ITEM	QTY	NAME	NOTE
20	1	A18301	CONNECTING ROD
21	3	A18302	TOLERANCE RING
22	4	A19005	SCREW, HEAD/BASE
23	2	A19006	SCREW, VALVE
24	2	A19008	SET SCREW
25	1	A19301	SCREW, PLATE
26	1	A19309	SCREW, CWGT.
27	2	A19321	SCREEN
28	6	A19322	SCREW, SCREEN
29	3	A19324	SCREW, HOUSING
30	1	A23001	TEFLON SEAL

ALTERNATE PARTS	
PART#	DESCRIPTION
A02005	Valve Body 316 SS
A02006	Valve Body Alum.
A02007	Valve Body, Carp. 20
A02009	Valve Body 316 SS TFE Co.
A02010	Valve Body Alum. TFE Co.
A02019	Valve Body Carp 20 TFE Co.
A02023	Valve Body Hast. C
A02024	Valve Body Hast. C TFE Co.
A02080	Valve Body Kynar (PVDF)
A04301	Diaphragm, Teflon/EPDM
A04302	Diaphragm, EPDM
A04303	Diaphragm, Hi–Temp Viton
A04311	Diaphragm, TFE/Viton
A08003	Head, 316 SS
A08004	Head, Alum.
A08005	Head, Carp. 20
A08007	Head, 316 SS TFE Co.
A08008	Head, Alum. TFE Co.
A08009	Head, Carp. 20 TFE Co.
A08020	Head, Hast. C
A08021	Head, Hast. C TFE Co.
A08080	Head, Kynar (PVDF)
A16001	Plate, Dia. 316 SS
A16002	Plate, Dia. Alum.
A16003	Plate, Dia. Carp. 20
A16005	Plate, Dia. 316 SS TFE Co.
A16006	Plate, Dia. Alum. TFE Co.
A16019	Plate, Dia. Carp. 20 TFE Co.
A16020	Plate, Dia. Hast. C
A16021	Plate, Dia. Hast. C TFE Co.
A16080	Plate, Dia. Kynar (PVDF)

HOW TO SPECIFY & ORDER PUMPS FROM AIR DIMENSIONS, INC.

Your order number is made up of a series of numbers from each of five letter codes [A–E].
Each letter code specifies a different aspect of the pump you desire. Single choice letter codes: A–D. Multiple choice letter codes E only.

LETTER	ORDER#	DESCRIPTION
A	01	Aluminum
	03	Carpenter 20
	08	Hastelloy C
	11	Kynar (PVDF)
	19	316 Stainless Steel
B	3	Direct Drive Motor
	4◎☆	Extended Housing
	5◎☆	No Motor
	6	Hi–Speed Motor–3450 RPM
	7◎	Explosion Proof Motor
	8◎	Air Driven Motor
C	1	Single Head
	2	Double Head
	4◎☆	Quad Head
D	0	115 Volt/60 Hz Motor
	1	115 Volt/50 Hz Motor
	2	230 Volt/60 Hz Motor
	3	230 Volt/50 Hz Motor
	4	None
	[Numbers Below Must Specify Hz–Y or Z In Section E]	
	5◎☆	220/440 Volt 3 Phase Motor
	6◎☆	230/460 Volt 3 Phase Motor
	7◎☆	570/600 Volt 3 Phase Motor
	8 ☆	115/230 Dual Voltage Motor
	9◎☆	220/380 Volt 3 Phase Motor

LETTER	ORDER#	DESCRIPTION
E	A ◎	416ss Valve Disc
	C	Teflon Coated Head
	EH	Elevated Head
	F ◎☆	TFE/Viton Diaphragm
	J	DC Motor
	K ◎☆	Totally Enclosed Fan Cooled Motor
	M	Heated Head
	M8◎	Heated-Steam Traced Head
	N	EPDM Diaphragm
	P ◎☆	1/2 HP Motor
	Q ◎☆	1/3 HP Motor
	T ◎	Teflon/EPDM Diaphragm
	TT	All Teflon Diaphragm
	V ◎	Viton Diaphragm
	Y	50 Hz
	Z	60 Hz
	5	Special Eccentric

PREFIX	A	B	C	D	E
SEE BELOW	TYPE CASTING	TYPE UNIT	HEAD CONFIG	TYPE POWER	ADD'L DESC

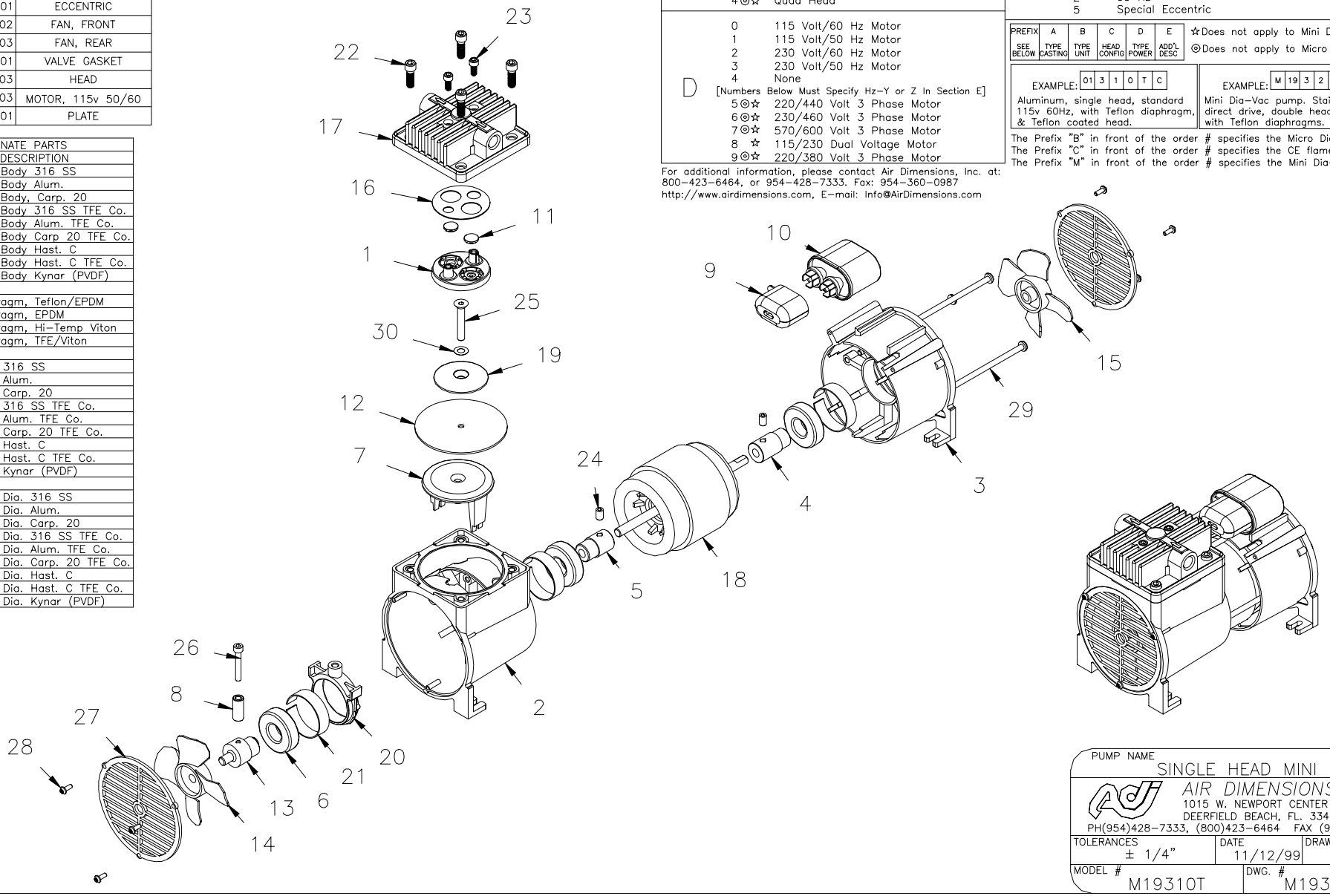
☆Does not apply to Mini Dia–Vac.
◎Does not apply to Micro Dia–Vac.

EXAMPLE: 01 | 3 | 1 | 0 | T | C
Aluminum, single head, standard 115v 60Hz, with Teflon diaphragm, & Teflon coated head.

EXAMPLE: M | 19 | 3 | 2 | 0 | T
Mini Dia–Vac pump. Stainless steel, direct drive, double head 115v 60Hz with Teflon diaphragms.

The Prefix "B" in front of the order # specifies the Micro Dia–Vac.
The Prefix "C" in front of the order # specifies the CE flameproof motor.
The Prefix "M" in front of the order # specifies the Mini Dia–Vac.

For additional information, please contact Air Dimensions, Inc. at:
800–423–6464, or 954–428–7333. Fax: 954–360–0987
http://www.airdimensions.com, E–mail: Info@AirDimensions.com



PUMP NAME
SINGLE HEAD MINI PUMP

AIR DIMENSIONS INC.
1015 W. NEWPORT CENTER DRIVE
DEERFIELD BEACH, FL. 33442
PH(954)428–7333, (800)423–6464 FAX (954)360–0987

TOLERANCES	DATE	DRAWN
± 1/4"	11/12/99	MIKE L.

MODEL #	DWG. #
M19310T	M19310T–E

HOW TO SPECIFY & ORDER PUMPS FROM AIR DIMENSIONS, INC.

Your order number is made up of a series of numbers from each of five letter codes [A–E].
Each letter code specifies a different aspect of the pump you desire. Single choice letter codes: A–D. Multiple choice letter codes E only.

LETTER	ORDER#	DESCRIPTION
A	01	Aluminum
	03	Carpenter 20
	08	Hastelloy C
	11	Kynar (PVDF)
	19	316 Stainless Steel
B	3	Direct Drive Motor
	4 ◎☆	Extended Housing
	5 ◎☆	No Motor
	6	Hi–Speed Motor–3450 RPM
	7 ◎	Explosion Proof Motor
	8 ◎	Air Driven Motor
C	1	Single Head
	2	Double Head
	4 ◎☆	Quad Head
D	0	115 Volt/60 Hz Motor
	1	115 Volt/50 Hz Motor
	2	230 Volt/60 Hz Motor
	3	230 Volt/50 Hz Motor
	4	None
	[Numbers Below Must Specify Hz–Y or Z In Section E]	
	5 ◎☆	220/440 Volt 3 Phase Motor
	6 ◎☆	230/460 Volt 3 Phase Motor
	7 ◎☆	570/600 Volt 3 Phase Motor
	8 ☆	115/230 Dual Voltage Motor
	9 ◎☆	220/380 Volt 3 Phase Motor

LETTER	ORDER#	DESCRIPTION
E	A ◎	416ss Valve Disc
	C	Teflon Coated Head
	EH	Elevated Head
	F ◎☆	TFE/Viton Diaphragm
	J	DC Motor
	K ◎☆	Totally Enclosed Fan Cooled Motor
	M	Heated Head
	M8 ◎	Heated-Steam Traced Head
	N	EPDM Diaphragm
	P ◎☆	1/2 HP Motor
	Q ◎☆	1/3 HP Motor
	T ◎	Teflon/EPDM Diaphragm
	TT	All Teflon Diaphragm
	V ◎	Viton Diaphragm
	Y	50 Hz
	Z	60 Hz
	5	Special Eccentric

PREFIX	A	B	C	D	E
SEE BELOW	TYPE CASTING	TYPE UNIT	HEAD CONFIG	TYPE POWER	ADD'L DESC

☆Does not apply to Mini Dia–Vac.
◎Does not apply to Micro Dia–Vac.

EXAMPLE: 01 3 1 0 T C
Aluminum, single head, standard 115v 60Hz, with Teflon diaphragm, & Teflon coated head.

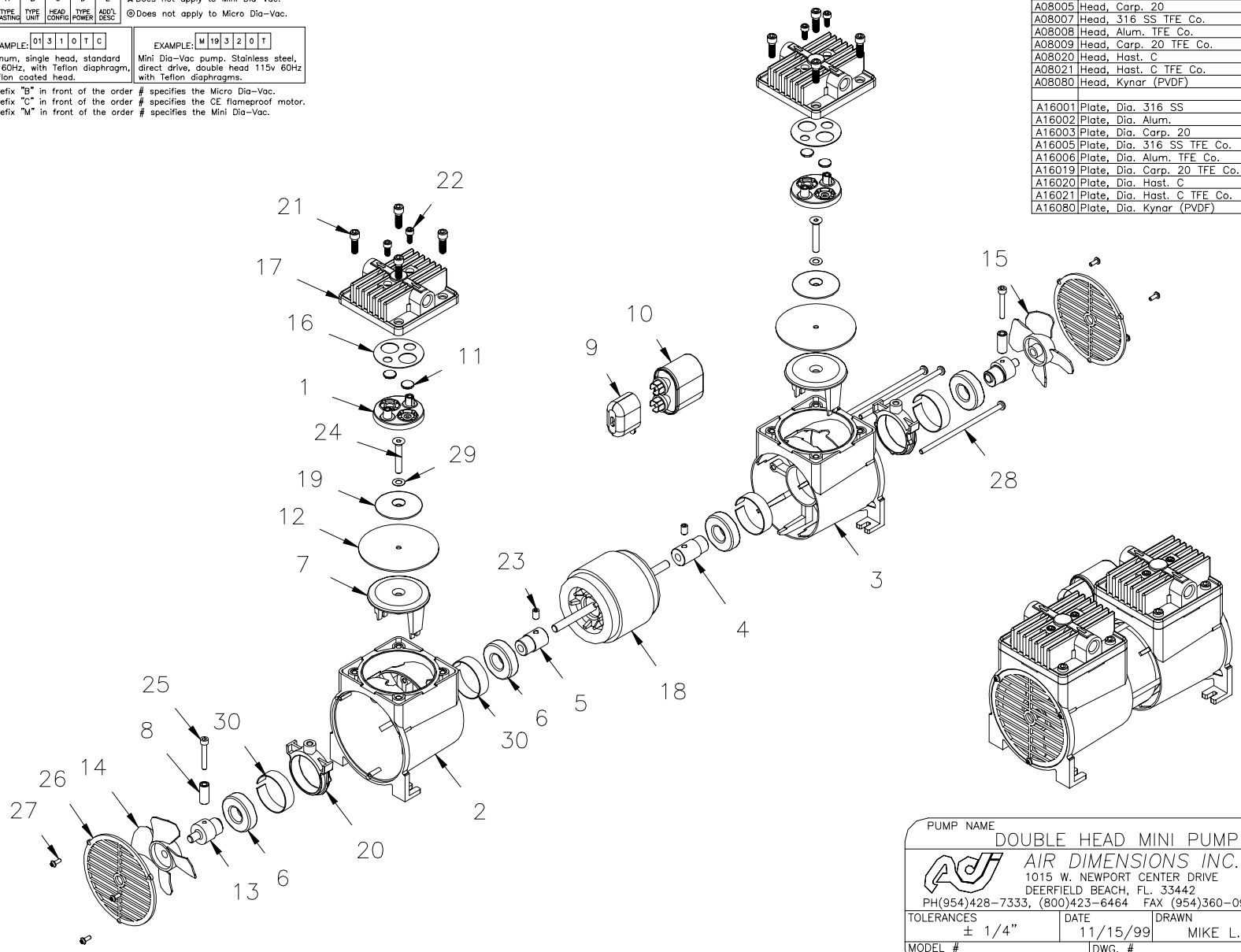
EXAMPLE: M 19 3 2 0 T
Mini Dia–Vac pump. Stainless steel, direct drive, double head 115v 60Hz with Teflon diaphragms.

The Prefix "B" in front of the order # specifies the Micro Dia–Vac.
The Prefix "C" in front of the order # specifies the CE flameproof motor.
The Prefix "M" in front of the order # specifies the Mini Dia–Vac.

For additional information, please contact Air Dimensions, Inc. at: 800–423–6464, or 954–428–7333. Fax: 954–360–0987
http://www.airdimensions.com, E–mail: Info@AirDimensions.com

ALTERNATE PARTS	
PART#	DESCRIPTION
A02005	Valve Body 316 SS
A02006	Valve Body Alum.
A02007	Valve Body, Carp. 20
A02009	Valve Body 316 SS TFE Co.
A02010	Valve Body Alum. TFE Co.
A02019	Valve Body Carp 20 TFE Co.
A02023	Valve Body Hast. C
A02024	Valve Body Hast. C TFE Co.
A02080	Valve Body Kynar (PVDF)
A04301	Diaphragm, Teflon/EPDM
A04302	Diaphragm, EPDM
A04303	Diaphragm, Hi–Temp Viton
A04311	Diaphragm, TFE/Viton
A08003	Head, 316 SS
A08004	Head, Alum.
A08005	Head, Carp. 20
A08007	Head, 316 SS TFE Co.
A08008	Head, Alum. TFE Co.
A08009	Head, Carp. 20 TFE Co.
A08020	Head, Hast. C
A08021	Head, Hast. C TFE Co.
A08080	Head, Kynar (PVDF)
A16001	Plate, Dia. 316 SS
A16002	Plate, Dia. Alum.
A16003	Plate, Dia. Carp. 20
A16005	Plate, Dia. 316 SS TFE Co.
A16006	Plate, Dia. Alum. TFE Co.
A16019	Plate, Dia. Carp. 20 TFE Co.
A16020	Plate, Dia. Hast. C
A16021	Plate, Dia. Hast. C TFE Co.
A16080	Plate, Dia. Kynar (PVDF)

ITEM	QTY	NAME	Note
1	2	A02005	VALVEBODY
2	1	A02303	FRONT CASTING
3	1	A02304	DOUBLE REAR CASTING
4	1	A02307	BUSHING–LONG
5	1	A02309	BUSHING–SHORT
6	4	A02311	BEARING
7	2	A03301	CAP
8	2	A03302	COUNTERWEIGHT
9	1	A03309	CAPACITOR BOOT
10	1	A03311	CAPACITOR
11	4	A04004	VALVE DISC
12	2	A04301	DIAPHRAGM
13	2	A05301	ECCENTRIC
14	1	A06302	FAN, FRONT
15	1	A06303	FAN, REAR
16	2	A07001	VALVE GASKET
17	2	A08003	HEAD
18	1	A13303	MOTOR, 115v 50/60
19	2	A16001	PLATE
20	2	A18301	CONNECTING ROD
21	8	A19005	SCREW, HEAD/BASE
22	4	A19006	SCREW, VALVE
23	2	A19008	SET SCREW
24	2	A19301	SCREW, PLATE
25	2	A19309	SCREW, CWGT.
26	2	A19321	SCREEN
27	6	A19322	SCREW, SCREEN
28	3	A19324	SCREW, HOUSING
29	2	A23001	TEFLON SEAL
30	4	A18302	TOLERANCE RING



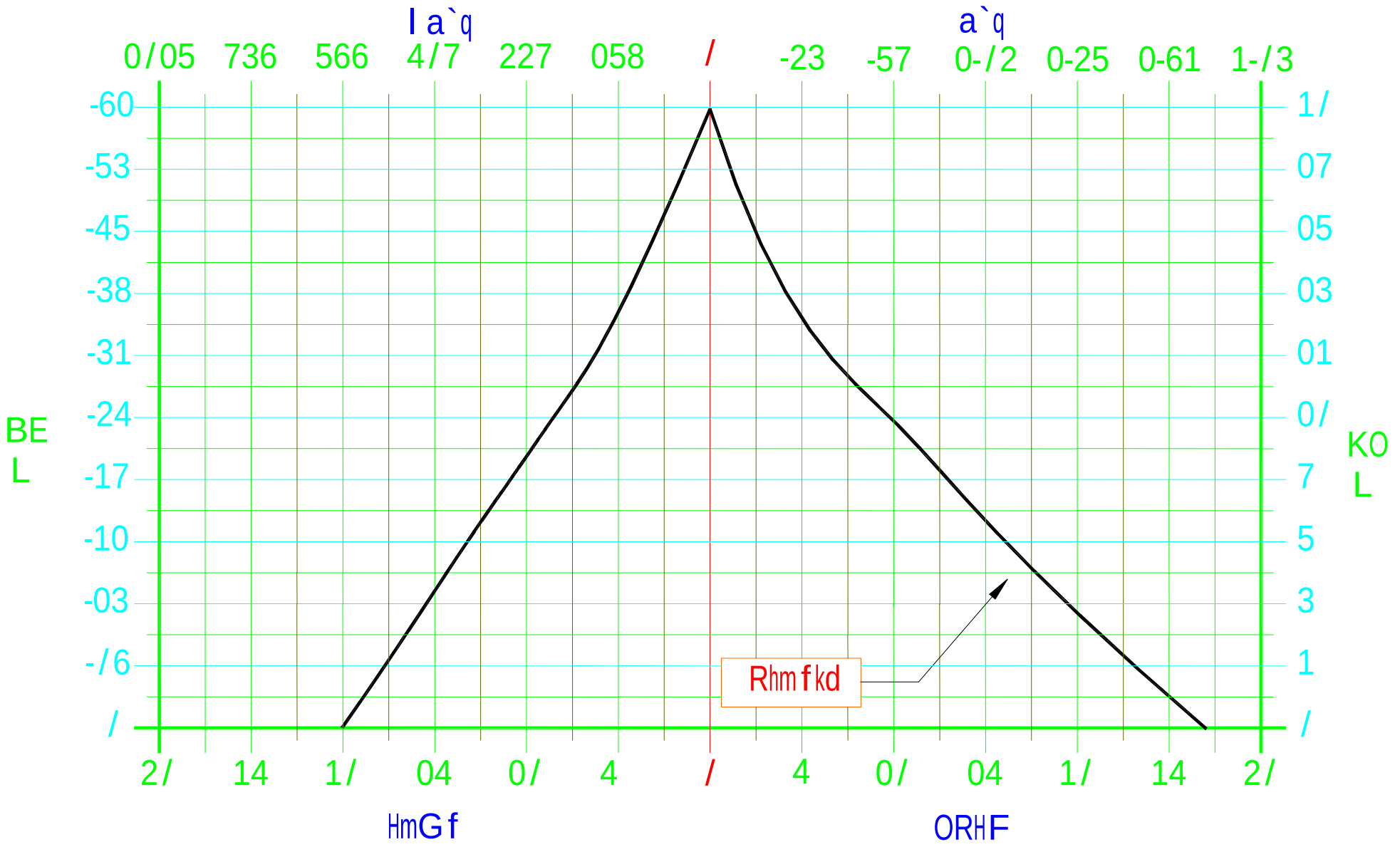
PUMP NAME
DOUBLE HEAD MINI PUMP

AIR DIMENSIONS INC.
1015 W. NEWPORT CENTER DRIVE
DEERFIELD BEACH, FL. 33442
PH(954)428–7333, (800)423–6464 FAX (954)360–0987

TOLERANCES	DATE	DRAWN
± 1/4"	11/15/99	MIKE L.

MODEL #	DWG. #
M19320T	M19320T–E

L hmh Ot I oĂ-04/ Dbb-



PUMP NAME
MINI PUMP-.150

AIR DIMENSIONS INC.
1015 W. NEWPORT CENTER DRIVE
DEERFIELD BEACH, FL. 33442
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TOLERANCES	DATE	DRAWN
	11/10/99	MIKE L.

MODEL #	DWG. #
M150	M150

1. Single Pump Head Loading

Note: *Use only MASTERFLEX Precision Tubing with MASTERFLEX Pumps to insure optimum performance. Use of other tubing may void applicable warranties.*

Contents: One pump head, one 15 in (38 cm) length of silicone tubing, one mounting hardware package, manual and tubing loading key.

Supplied tubing loading key required for assembly.

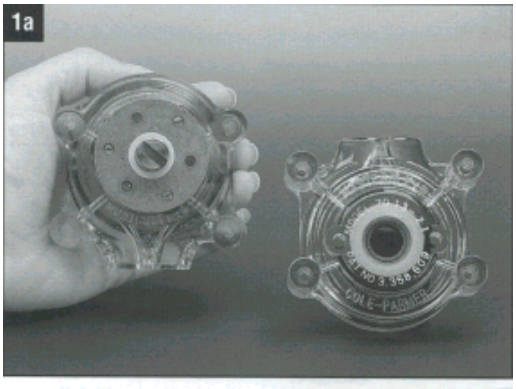
a) Separate the end bells (the pump head halves). Hold the end bell containing the rotor as shown with the tubing retainer grooves facing down.

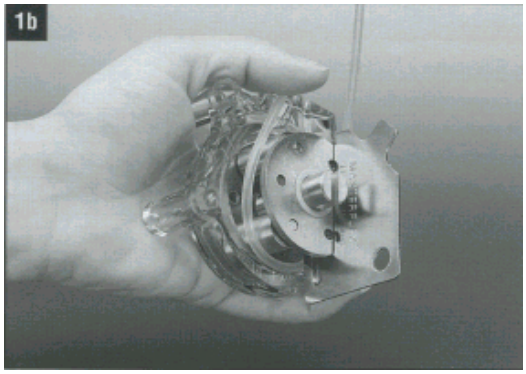
b) Place tubing in the right groove and against the first two rollers. Hold tubing with thumb. Near groove, insert smaller prong of loading key between the top of the rotor and tubing. Push key in as far as possible.

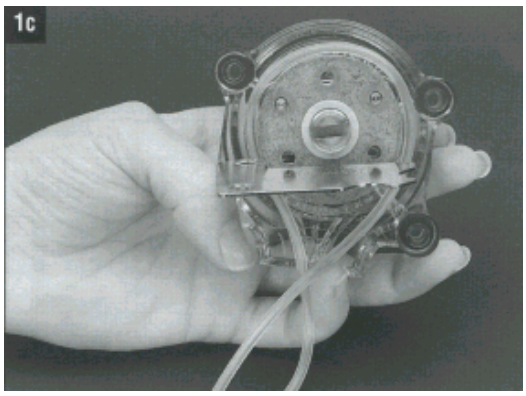
c) Push down and turn key counterclockwise (ccw) completely around the rotor. The key will push the tubing uniformly into the end bell assembly. Hold the second end of tubing. Remove key.

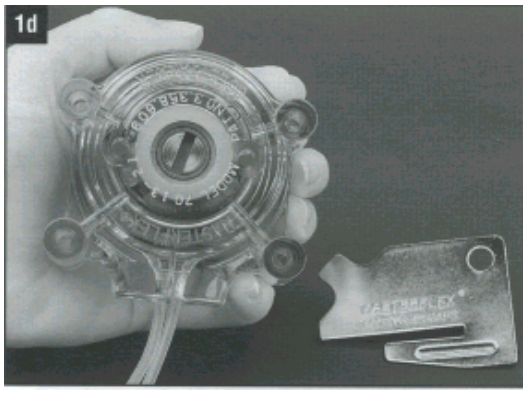
d) Position the other end bell on top and press the end bells together. Be careful not to pinch the tubing. If end bells do not snap tightly together, reload tubing. If necessary, turn key in slot on rotor shaft to adjust tubing (as in Step e).

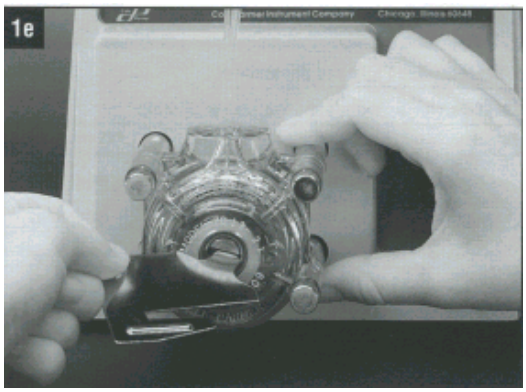
e) With key in slot on rotor shaft, turn key to align tang on rotor shaft with slot in motor drive shaft. Point tubing retainer grooves up. Shift the pump head slightly till it snaps on the alignment pins (if present). Secure with four provided screws. Tighten with fingers only.

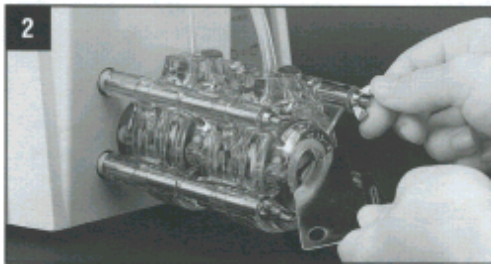












2. Multi-Channel Mounting

Flat bladed screwdriver required for mounting.

Tubing loading key required for mounting.

Note: Other special mounting hardware for multi-channel pumping. See " 3. Replacement Parts and Accessories".

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 four flat washers onto screws and secure with the four wingnuts. Tighten with fingers only.

g) A support bracket is supplied with 3 and 4 channel mounting hardware for additional support. Mount over bottom two screws. Inert one of the three different adjustments screws depending upon drive height.

3. Replacement Parts and Accessories

A. End Bells (order two end bells for a complete head assembly).

Pump Head #	**PC Order number**	Pump Head #	**PC Order number**
07013-00, -20 07013-10, -21	**MN-07013-81** **MN-07013-91**	- 07013-50, -52	- **MN-07013-92**
07014-00, -20 07014-10, -21	**MN-07014-81** **MN-07014-91**	- 07014-50, -52	- **MN-07014-92**
07015-00, -20 07015-10, -21	**MN-07015-81** **MN-07015-91**	- 07015-50, -52	- **MN-07015-92**
07016-00, -20 07016-10, -21	**MN-07016-81** **MN-07016-91**	- 07016-50, -52	- **MN-07016-92**
07017-00, -20 07017-10, -21	**MN-07017-81** **MN-07017-91**	- 07017-50, -52	- **MN-07017-92**
07018-00, -20 07018-10, -21	**MN-07018-81** **MN-07018-91**	- 07018-50, -52	- **MN-07018-92**
07024-00, -20 07024-10, -21	**MN-07024-81** **MN-07024-91**	- 07024-50, -52	- **MN-07024-92**
07035-02, -20 07035-12, -21	**MN-07035-81** **MN-07035-91**	- -	- -

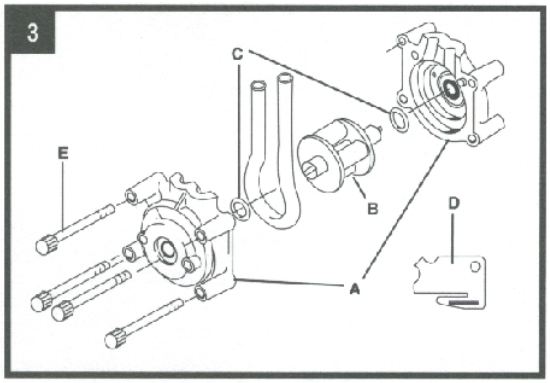
B. Rotor assemblies

Pump Head number	Pump Head suffix	**Order number**
07013, 07014, 07016 07018	-00 -10, -50 -20 -21, -52	**MN-07013-75** **MN-07013-76** **MN-07013-80** **MN-07013-95**
07015, 07024, 07035	-00, -02 -10, -50, -12 -20 -21, -52	**MN-07013-75** **MN-07013-76** **MN-07013-80** **MN-07013-90**

C. MN-07021-04 Thrust washers. Pack of 10.
D. MN-07013-90 Tubing loading key.
E. Mounting hardware for standard pump heads.

Set contains four #8-32 screws, four washers, and four wingnuts.

Number of heads To be mounted	**Cold- rolled steel Order number**	**Stainless steel Order number**
1	**MN-07013-02**	**MN-07013-04**
2	**MN-07013-03**	**MN-07013-05**
3	**MN-07013-03**	**MN-07013-08**
4	**MN-07013-07**	**MN-07013-09**



4. Specifications

	Thin wall*	Thick wall*
Maximum continuous discharge pressure-psi(bar):	20(1.4)	25(1.7)
Maximum intermittent discharge pressure-psi(bar):	35(2.4)	40(2.7)
Maximum vacuum:	660(510')m Hg	26(20')in Hg
Maximum suction lift:	8.8(6.7')m H2O	29(22')ft H2O
Number of rollers:	3	
Occlusion:	Standard fixed	
Maximum pump speed (rpm):	600	
Nominal torque load:	6.5 kg-cm(90 oz-in)	
Housing materials:	Polycarbonate (PC) all models, or Polyphenylene sulfide (PPS) all models except 07035	
Roller/rotor materials:	Cold rolled Stl (CRS) or Stainless Stl (SS)	
Operating temperature:	0 to 40° (32 to 104°F)	

*Thin wall: tubing 13, 14, 16, 17, 18 Thick wall: tubing 15, 24, 35
┼With tubing 17 & 18
╪ Use in this temperature range for continuous duty operation with no decrease in performance or product life. Pump heads will work outside this range with some possible reductions in performance or product life.

5. Warranty and Return Items

Warranty

Use only MASTERFLEX Precision Tubing with MASTERFLEX Pumps to insure optimum performance. Use of other tubing may void applicable warranties.

The manufacturer warrants this product to be free from any significant deviations from published specifications. If repair or adjustment is necessary within the warranty period, the problem will be corrected at no charge if it is not due to misuse or abuse on your part, as determined by the manufacturer. Repair costs outside the warranty period, or those resulting from product misuse or abuse, may be invoiced to you. *The* warranty period for this product is noted on the Warranty Card.

Product Return

To limit charges and delays, contact the seller or manufacturer for authorization and shipping instructions before returning the product, either within or outside the warranty period. When returning the product, please state the reason for the return. For your protection, pack the product carefully and insure it against possible damage or loss. Any damages resulting from improper packaging are your responsibility.

Technical Assistance

If you have any questions about the use of this product, contact the manufacturer or authorized dealer.

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				