PERMA PURE

INSTRUCTION MANUAL

BALDWIN™ - Series

THERMO-ELECTRIC COOLER

SO_3 AEROSOL REMOVAL SERIES

MODEL 10410

Version 4.05

Perma Pure LLC
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A: SPECIFICATIONS

Physical Description

2 x 10” Durinert® (inert coated stainless steel) heat exchangers connected in series (passive / active)
2 x 10” packed Kynar heat exchangers (active / active)
3 LCD displays w/ associated LED indicators

Operating Specifications

Standard Sample Gas Flow Rate	5-10 LPM 10.6-21 SCFH
Maximum Inlet Dew Point at Rated Flow	173°F @ 43% H_2O 78°C
Maximum Cooling Rate	898 BTU/Hr 952 kJ/Hr
Dimensions	14.55 x 12.62 x 12.32 in. HWD 37.0 x 32.1 x 29.5 cm
Weight	35 lbs 15.9 kg
Maximum Inlet Sample Temperature	400°F (200°C) Durinert® Impingers 280°F (138°C) Kynar Impingers
Maximum Inlet Pressure	45 psig 3 bar /5 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	19.4°F -7°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
Power Supply	740W

B: LIMITED WARRANTY

Perma Pure LLC
WARRANTY and DISCLAIMERS

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

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

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C: PRINCIPLE OF OPERATION

Thank you for purchasing a Baldwin™ Model 10410 SO_3 Aerosol Removal Series Thermo-Electric Cooler. Perma Pure's Baldwin SO_3 Aerosol Removal Series Thermo-Electric Coolers are specifically designed to remove SO_3 and condensate from sample streams in high ambient temperature & high water volume applications. Each model in our SO_3 Aerosol Removal Series feature an oversized heat sink and high performance thermoelectric devices for high heat removal capacity. Heat sinks used in Baldwin-Series Thermo-Electric Coolers are made out of high heat transfer extruded aluminum with large 3/4" thick end plates. Each model also incorporates a special controller specifically designed to run at high ambient temperatures.

Perma Pure's SO_3 Aerosol Removal Series is specifically designed for gas sample applications with relatively high SO_3 content (>10 ppm). The SO_3 Aerosol Removal Series has special timing circuits that alternate freeze and thaw the precisely packed heat exchangers. Before an active heat exchanger thaws, the alternate active heat exchanger reaches the -7°C set-point to ensure uninterrupted operation. This sub zero temperature forms a thin ice layer that captures and removes SO_3 aerosol from the sample stream.

The two heat exchangers located on the left side of the sample cooler are connected in series. The sample stream first passes through an inactive (i.e., not cooled with thermoelectric elements) Durinert® coated heat exchanger used for removing gross amounts of water. The sample then passes to an active Durinert® coated heat exchanger. The exit dew point from this heat exchanger is controlled to +4°C, thereby reducing the moisture concentration to less than 1%. The gas sample then flows through the gas sample pump where it first alternately passes through the freezing Kynar® packed heat exchangers, located on the right side of the cooler, then to three-way Teflon® solenoid control valve, and finally to the remainder gas sampling system. Condensate is pumped from each heat exchanger by a dedicated peristaltic drain pump head.

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 Thermo-Electric Cooler is an ideal way to decrease the dew point of combustion gases to a repeatable, stable, constant low dewpoint. The Baldwin-Series 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 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.

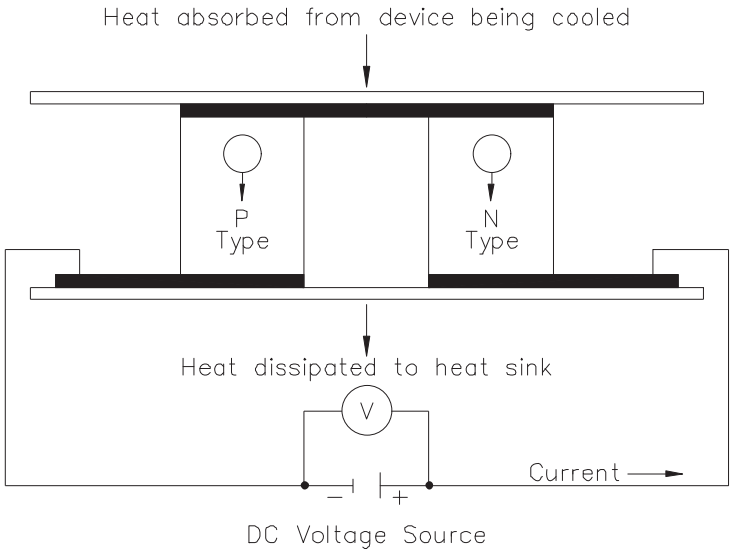

Figure 1: Thermo-electric element (Peltier)

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 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 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.

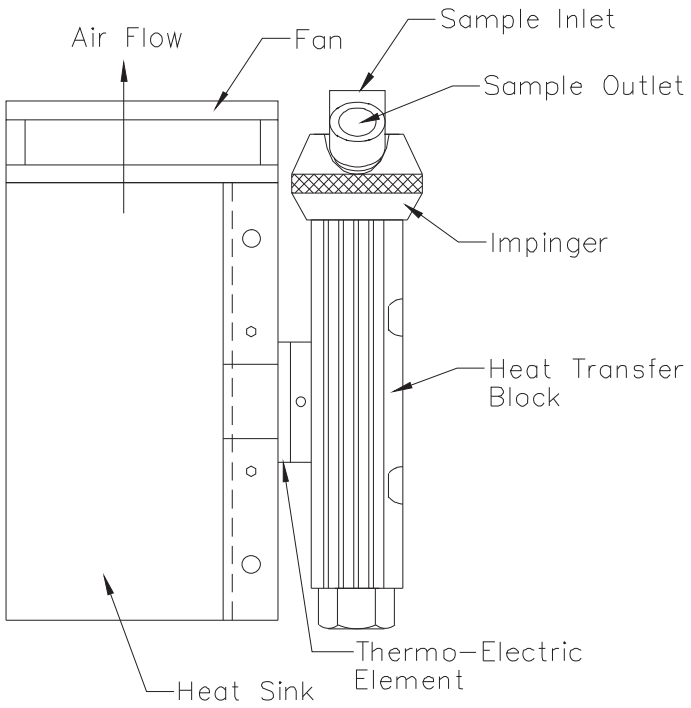

Figure 2: Heat Exchanger, Impinger and Heat Sink Assembly

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 which passes 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 10410 thermoelectric sample cooler should be installed away from heat sources in a well ventilated area of an instrument rack or enclosure.

Sample tubing connections to the Model 10410 depend on the heat exchanger material of construction. A stainless steel fitting is used on the first heat exchanger (sample line inlet) if the heat exchanger is stainless steel or Durinert® coated stainless steel, otherwise a Kynar® fitting is used. All other inlets and outlets are Kynar® standard compression type tube fittings with Teflon® ferrules. PVDF (Kynar®) heat exchangers use all Kynar® standard compression type tube fittings with Teflon® ferrules. Perma Pure cannot warrantee against damage to the Peltier elements or heat exchangers if our supplied Kynar® tube fittings are not used.

The inlet and outlet tubing of 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, tube connector fitting to mate with most standard 3/8” sample lines.

The condensate drain connections are Kynar® elbows, 3/8” MNPT x 1/4” barbed tube fittings. An automatic condensate drain, Perma Pure Model 3KPB-003 dual-head peristaltic drain pump 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 ready temperature (10°C) has been achieved on Channel 1 and the gas sample flow can begin. After approximately 3 minutes, the set point of +5°C (41°F) will be achieved. The SLIP Green LED is always on unless, (1) moisture is detected by the water slip sensor (optional upgrade), (2) the cooler was ordered without a relay board, or (3) there is a malfunction (e.g., shorted water slip sensor leads or a bad relay board). Channels 2 and 3 alternate in temperature between -7°C and ambient.

The Baldwin™-Series Model 10410 Thermo-Electric Cooler 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.

The Baldwin-Series Model 10410 has 10 dip switches located at SW1. These dipswitches control the time duration that Channel 2 or Channel 3 is cooled. While one heat exchanger is frozen at –7 degrees C, the other heat exchanges is thawing and draining. Each dip switch turned ON adds 2 hours to the channel ON duration. I.e. 4 dipswitches turned ON equals approximately 8 hours per channel. The optimal time duration is the maximum amount of time without freezing the heat exchanger closed. Typical applications are 12 hour durations = 6 dip switches ON.

F: LED SUMMARY

The Model 10410 has 3 LCD temperature displays and three LED status displays for each active channel (2 green, 1 red per channel). Channel 1 is a standard active channel (4°C). Channels 2 and 3 alternate on a freeze / thaw cycle between -7°C and ambient.

The “Ready” Green LED’s come on when the relay set point temperature is reached for each channel.

The “Slip” Green LED on Channel 1 lights up immediately upon power-on, indicating that the water slip relay (optional upgrade) is not actuated, which is the expected normal condition. 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.

The “Failure” red LED’s come on if the thermocouple or an electronic controller component has failed.

You can determine whether Channel 1 or Channel 2 is currently the frozen impinger since the “Active” green LED will light on the active channel.

READY LED On = Relay set point temperature is reached
SLIP LED On = Safe operating condition
SLIP LED Off = Water slip sensor alarm (unsafe operating condition)
Red LED On = Thermocouple or electronic failure alarm
ACTIVE On = Indicates whether Channel 1 or 2 is operating in freeze cycle

When all Green LED's are lit, the Model 10410 is operating at proper cooling block temperature, producing a stable, repeatable dewpoint, sample effluent. If a green LED fails to light, it can indicate several problems. The first and most obvious is overload. Check the incoming sample gas temperature, moisture content, and flowrate through the heat exchangers to be sure all conditions are within published specifications. Overload requires more cooling power from the Model 10410 than is available. If all conditions are correct, then the problem is an electrical malfunction, which can be traced using the troubleshooting in this manual.

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G: RELAY BOARD

The water slip alarm 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.

H: TROUBLESHOOTING

If the front panel LCD digital indicators fail to show proper operating temperatures for all controlled heat exchangers as described above, refer to the following troubleshooting procedures:

The first problem to check is cooler overload. Check the incoming sample gas temperature, moisture content, and flow rate through the heat exchanger to be sure all conditions are within our published specifications. Overload requires more cooling power from the Model 10410 than is available. If all conditions are correct, then the problem is an electrical malfunction, which can be traced using the troubleshooting table below. Overload to the Model 10410 will not cause damage to the unit.

An optional Water Slip Relay Alarm Board is available to provide a relay (DPDT) contact for remote alarm sensing. This contact closure can be used to stop and start a sample pump, alarm enunciator, or computer mal-function alarm input. This relay is supplied integral within the Model 10410 enclosure via terminal strip connections.

If the sample cooler is plugged in at normal room ambient temperature, with no load on the heat exchangers, the cooler will idle at an indicated temperature of 4.0 to 4.7°C, on the Channel 1 LCD display.

If SO_3 is carrying through the sample cooler as evidenced by liquid accumulation in a high pressure drop device, such as the needle valve on a rotameter, or in the glass tube of the rotameter, then:

1. Ambient temperature is too high.
2. Sample gas flow rate is too high.
3. Sample gas inlet dew point is too high.
4. Heat not properly dissipated from the Model 10410 due to improper installation, cooling fan failure, or change in ambient temperature air flow.
5. Cooling fan not operating at proper RPM.
6. Thermoelectric Element burned out.
7. Water in the water overflow sensor holder.

Check the following:

1. Voltage on the Power Supply terminal strip sites 1 and 2 should be below 14.58 VDC at full load. If you measure greater than 14.8 VDC, a thermoelectric cooling element may be defective.

2. Using a external digital display multimeter with thermocouple input module, such as a Fluke multimeter, remove the thermocouple leads from the main relay control card, located in the power supply section of the cooler, and test with the multimeter to check thermocouple continuity.

For further assistance in troubleshooting cooler malfunctions, refer to the troubleshooting table below and electrical diagrams in the Appendix.

Symptom	*Check*	*Action*
No LED(s) and no fan.	AC power input.	Ensure that AC power is connected.
No LED(s) and both fans on.	AC input fuse (2A) on control board. DC output fuse (1A) on control board. VCC on control board. (+5VDC and –5VDC).	Replace fuse as necessary. Replace fuse as necessary. Replace control board.
LED(s) on and no power supply fan.	AC input fuse (15A) on power supply. +13.5VDC at P13 and P14 on control board. If Peltier elements are cooling the heat exchangers.	Replace fuse as necessary. Replace power supply. Replace fan
Impinger remains at ambient temperature.	Voltage at P13 & P14 Should be at +13.5VDC Peltier current draw. Should be above 6 amps.	Replace power supply Replace Peltier element.
Thermocouple failure LED is on.	Thermocouple connections TB1 2 & 3.	Ensure proper connection. Replace thermocouple.
Impinger frozen and cooler indicates ambient temperature.	Thermocouple placement in heat exchanger block. Peltier current draw (>6A) for both elements on that channel.	Ensure proper placement. Replace bad Peltier element.
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. Ch2/3 should be alternating at -7°C.	Ensure system loading is not exceeding cooler capacity.
Slip LED does not come on *(alarm relay/water slip option installed)*.* *Slip light will not be on if no relay board is 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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Toms River, NJ 08755
Tel: 800-337-3762 (toll free U.S.)
Tel: 732-244-0010
Fax: 732-244-8140
Email: info@permapure.com
or your local representative

I: SPARE PARTS

Model 10410

Part No.	Description
3CCB-009E*	Control Board, Model 545 & 10410
2FAN-010	Fan: Muffin, 4" x 1 ½", 120 VAC
2FAN-007	Fan: Muffin. 6" x 1 ½". 120 VAC
3CXD-022	Heat Exchanger: 10" Durinert®
3CXG-006	Heat Exchanger: 10" Glass
3CXK-005	Heat Exchanger: 10" Kynar, Aerosol-packed
3KPE-004*	Peltier Element Kit, 40 mm
1PSD-034*	Power Supply: 600W. 13.5VDC
3CCB-020A	Temperature Display Board, Model 10410, 2nd Generation
1TTC-003	Thermocouple, Temperature Control, Type K 36"
2VS3-001*	Valve: Solenoid, 3 way, 120V/60HZ

* Recommended Spares

Sample Conditioning Systems w/ Model 10410 Thermo-Electric Cooler

Model -5 (Models 4S-10410-9B5, 4S-10410-9E5)

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-005	Peristaltic Pump: Triple, 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
3KPA-018	Sample Pump: Assembly, Dual Hastelloy Headd w/ Check Valve, 115V
2PAD-006	Sample Pump: Dual Head, Mini-Dia-Vac, 115V (bare)
2PAD-007	Sample Pump: Dual Hastelloy Head, Mini-Dia-Vac, 115V (bare)
2PAM-002*	Sample Pump: Repair Kit, Dual
3KMC-001*	SO3 Safety Scrubber Replacement Marble Chips
3CWS-001	Water Slip Sensor (Hastelloy/SS Pins)
3KCW-002	Water Slip Sensor (SS Pins) w/ Holder Assembly

* Recommended Spares **Consumables

APPENDIX A: MODEL 10410

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
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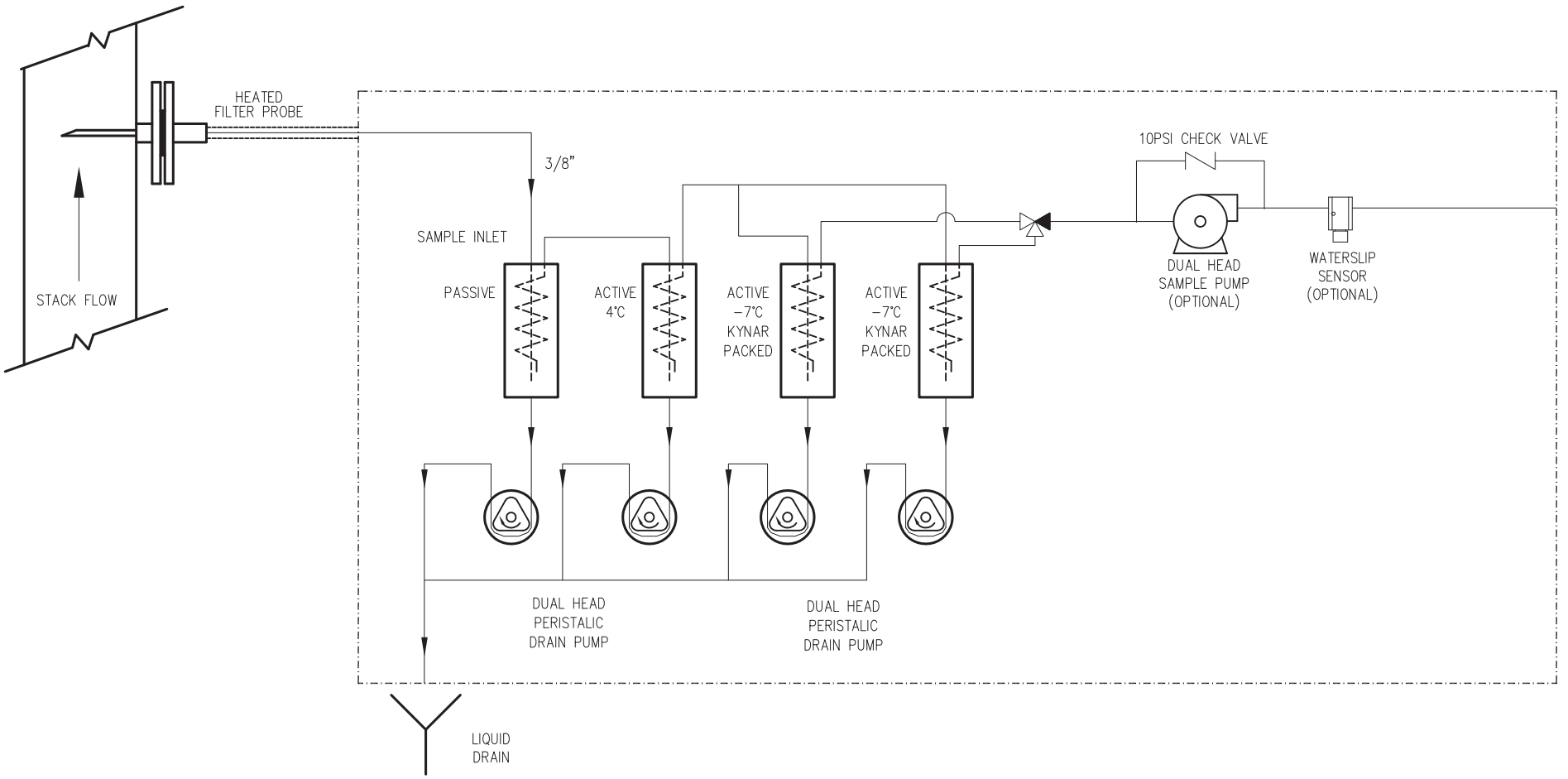
A	06/29/09	GENERAL DRAWING CORRECTIONS	TJA	RM



ITEM	QTY	DESCRIPTION	MANUF.
USED FOR:	MODEL NUMBER: 10410		
	DESCRIPTION: SO3 Aerosol Removal Cooler w/ Options		

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: 03/13/03
APP'D:	DATE:
MATERIAL	
FINISH	

PERMA PURE LLC

PART DESCRIPTION
10410 FLOW DIAGRAM

SIZE	SCALE:	DRAWING/PART NO.:
A	N/A	4C−10410−05−01

SHEET 1 OF 1

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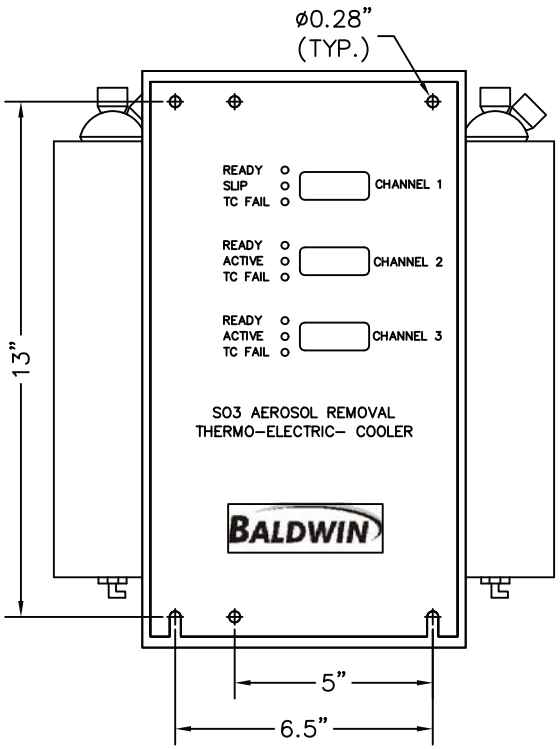
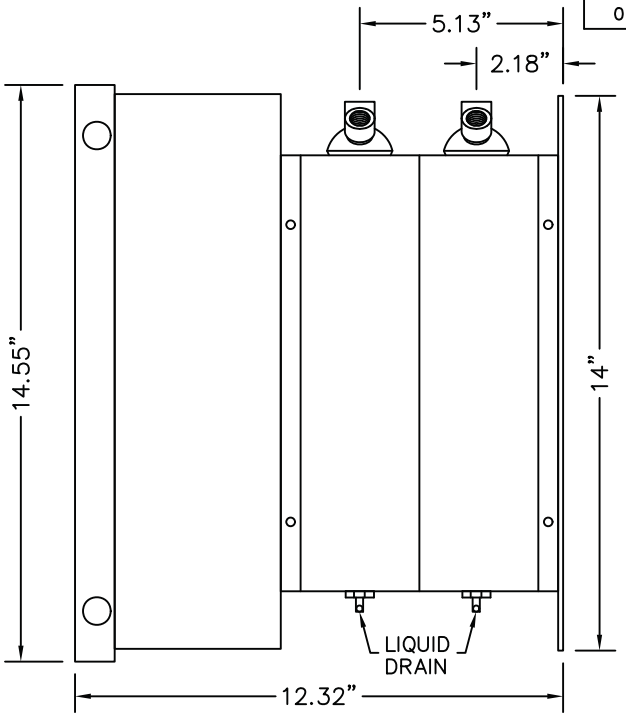
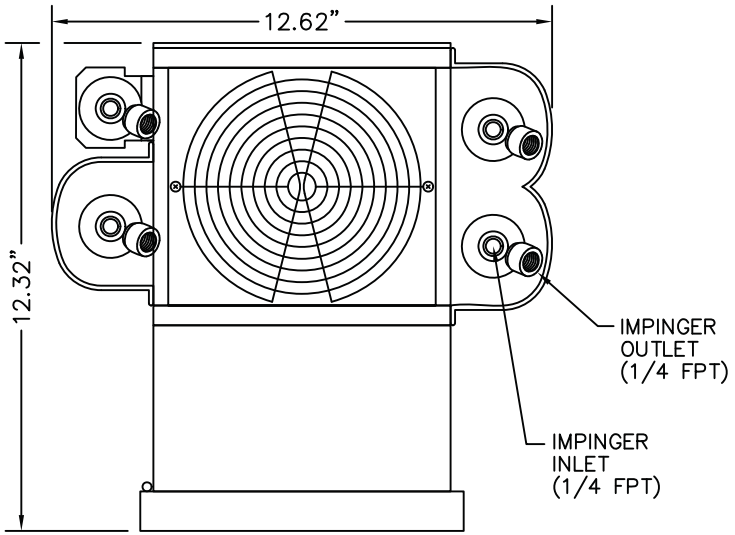


FRONT VIEW



RIGHT SIDE VIEW



TOP VIEW

ITEM	QTY	DESCRIPTION	MANUF.
USED FOR:		MODEL NUMBER: 10410	
		DESCRIPTION: SO3 Aerosol Removal Thermo-Electric Cooler	

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: RD DATE: 03/31/97
APP'D: DATE
MATERIAL
FINISH

BALDWIN, INC.

PART DESCRIPTION
MODEL 10410 SAMPLE COOLER ARRANGEMENT DRAWING

SIZE	SCALE:	DRAWING/PART NO.:
A	1/1	MODEL 10410

CAD DIR: S:\S&M\DWGS\T.E. COOL\SO3 REMOVAL | SHEET 1 OF 1

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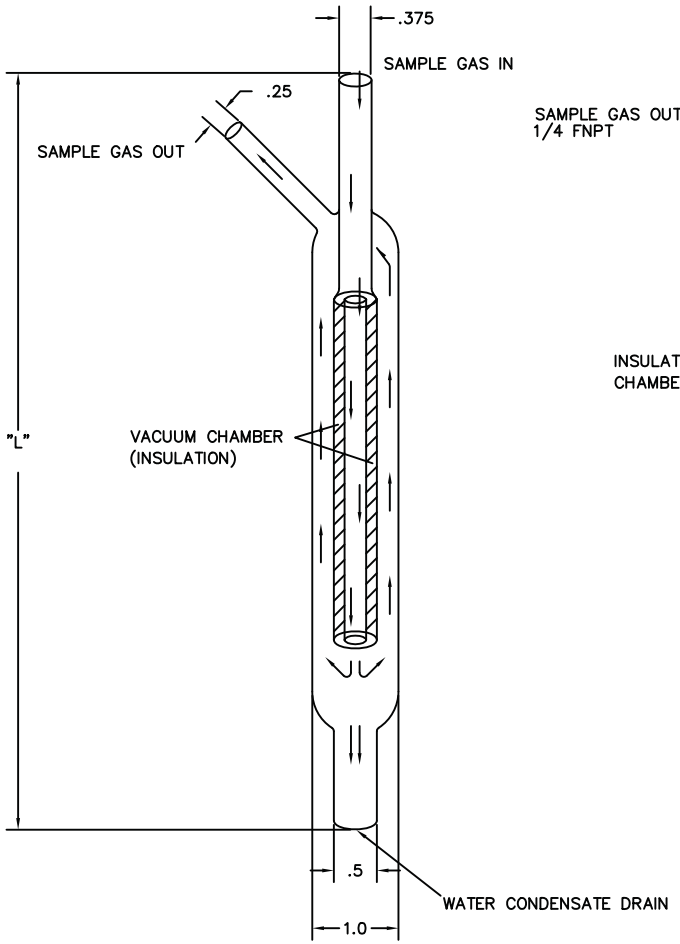
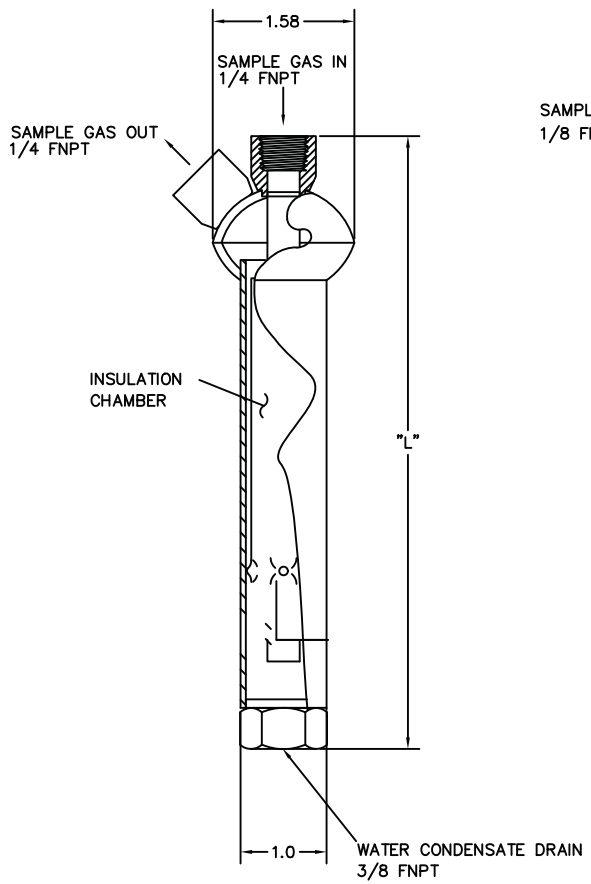
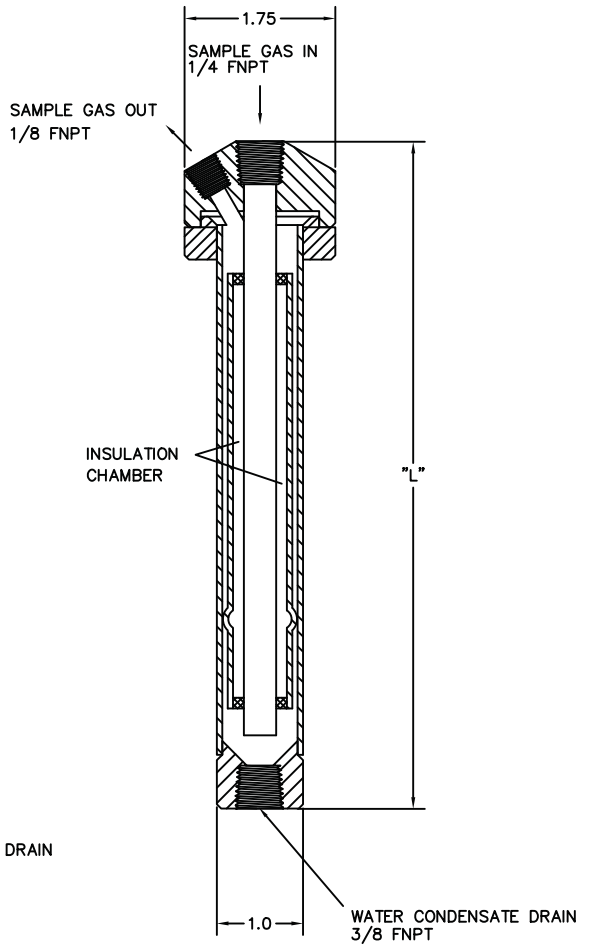


BOROSILICATE GLASS



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
BALDWIN
www.baldwinUSA.com

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

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

MATERIAL

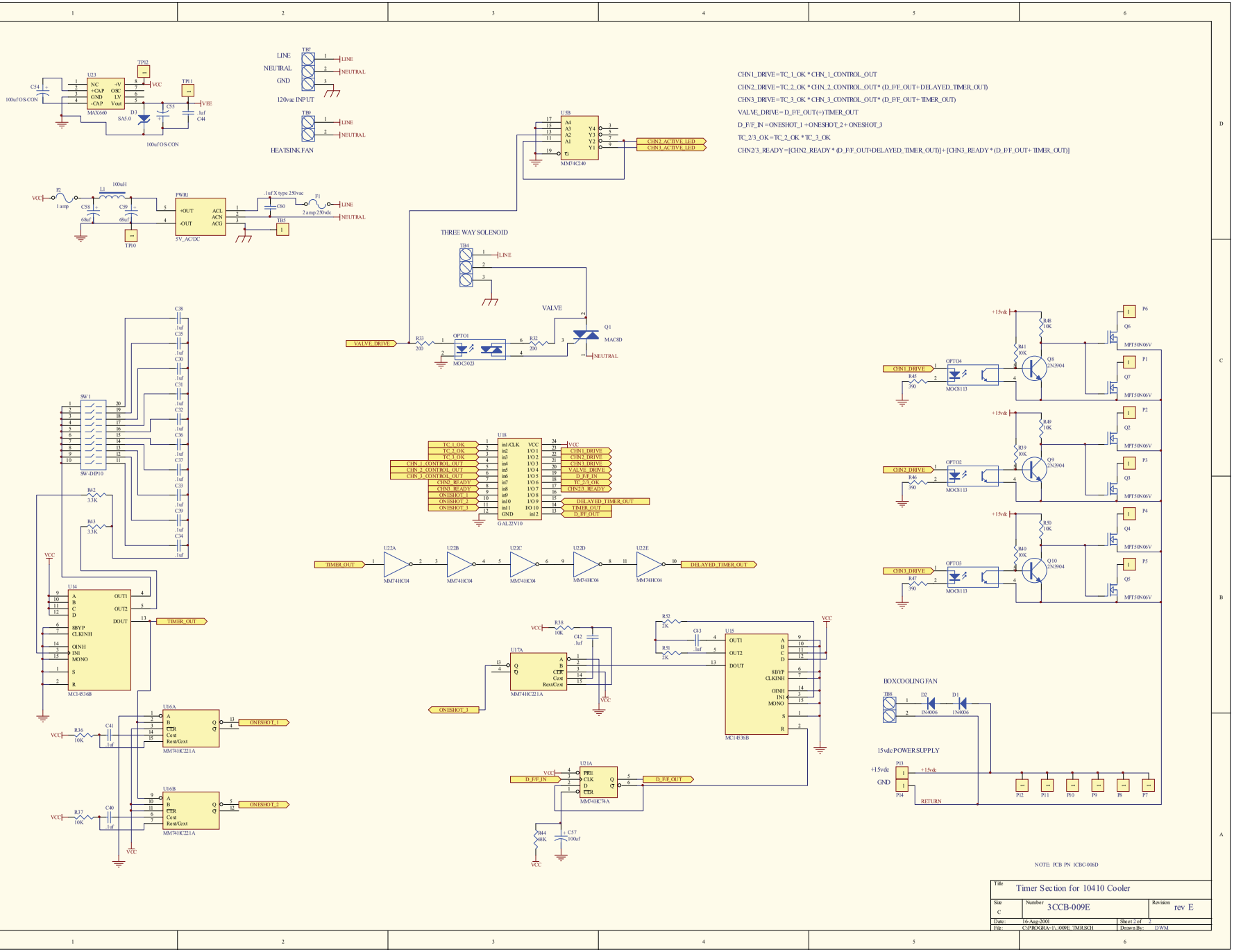
FINISH

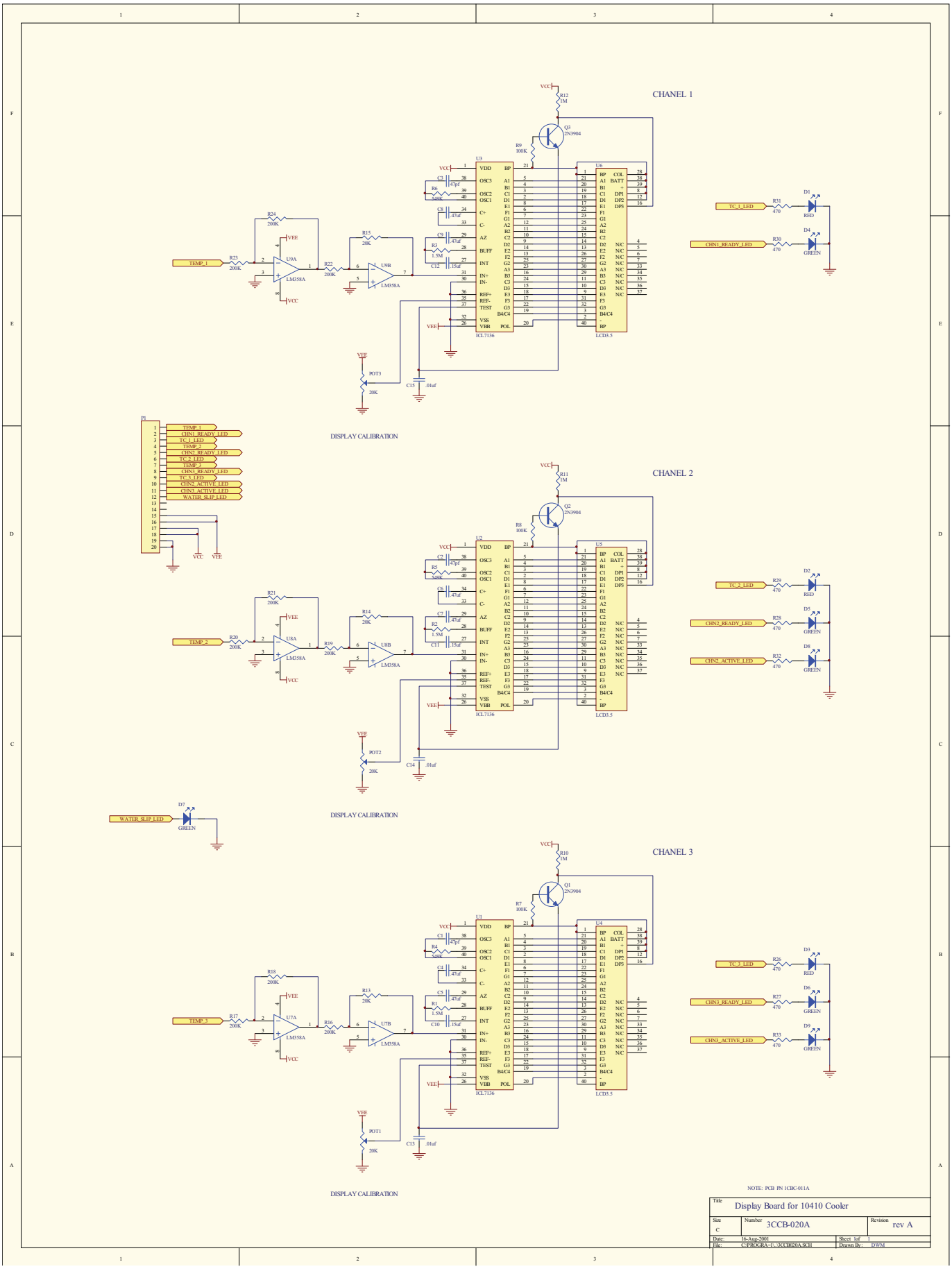
BALDWIN, INC.

PART DESCRIPTION
HEAT EXCHANGER
SCHEMATIC

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

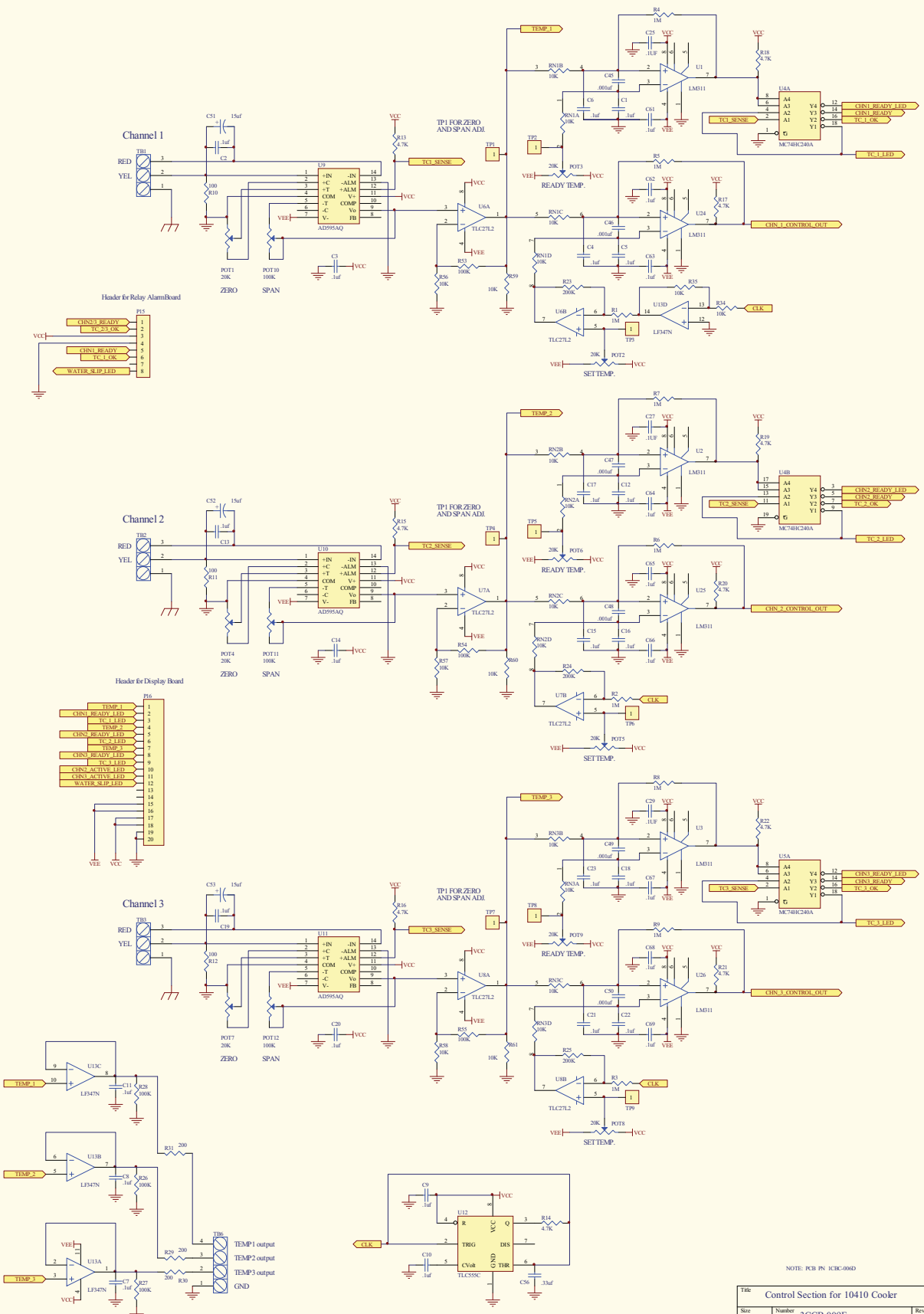
CAD DIR: S:\DRAW\MRKT. & SALES\O&M\COOLERS | SHEET 1 OF 1


CHN1_DRIVE = TC_1_OK * CHN_1_CONTROL_OUT
CHN2_DRIVE = TC_2_OK * CHN_2_CONTROL_OUT * (D_F/F_OUT + DELAYED_TIMER_OUT)
CHN3_DRIVE = TC_3_OK * CHN_3_CONTROL_OUT * (D_F/F_OUT + TIMER_OUT)
VALVE_DRIVE = D_F/F_OUT(+)TIMER_OUT
D_F/F_IN = ONESHOT_1 + ONESHOT_2 + ONESHOT_3
TC_2/3_OK = TC_2_OK * TC_3_OK
CHN2/3_READY = [CHN2_READY * (D_F/F_OUT+DELAYED_TIMER_OUT)] + [CHN3_READY * (D_F/F_OUT + TIMER_OUT)]
LINE
NEUTRAL
GND
120vac INPUT
HEATSINK FAN
THREE WAY SOLENOID
VALVE
MAC9D
MOC3023
MM74C240
GAL22V10
MM74HC04
MM74HC221A
MM74HC74A
MC14536B
MPT50N06V
2N3904
MOC8113
BOX COOLING FAN
15vdc POWER SUPPLY
NOTE: PCB PN ICBC-006D
Title
Timer Section for 10410 Cooler
Size
C
Number
3CCB-009E
Revision
rev E
Date: 16-Aug-2001
Sheet 2 of 2
File: C:\PROGRA~1\...009E.TMR.SCH
Drawn By: DWM



NOTE: PCB PN 1CBC-011A

Title: Display Board for 10410 Cooler		
Size: C	Number: 3CCB-020A	Revision: rev A
Date: 16-Aug-2001	Sheet 1of 1	
File: C:\PROGRA~1\..\3CCB020A.SCH	Drawn By: DWM	


Channel 1
Channel 2
Channel 3
TP1 FOR ZERO AND SPAN ADJ.
READY TEMP.
SET TEMP.
ZERO
SPAN
Header for Relay AlarmBoard
Header for Display Board
TEMP1 output
TEMP2 output
TEMP3 output
GND
NOTE: PCB PN 1CBC-006D
Control Section for 10410 Cooler
3CCB-009E
rev E
16-Aug-2001
C:\PROGRA~1\..009E_CTL.SCH

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
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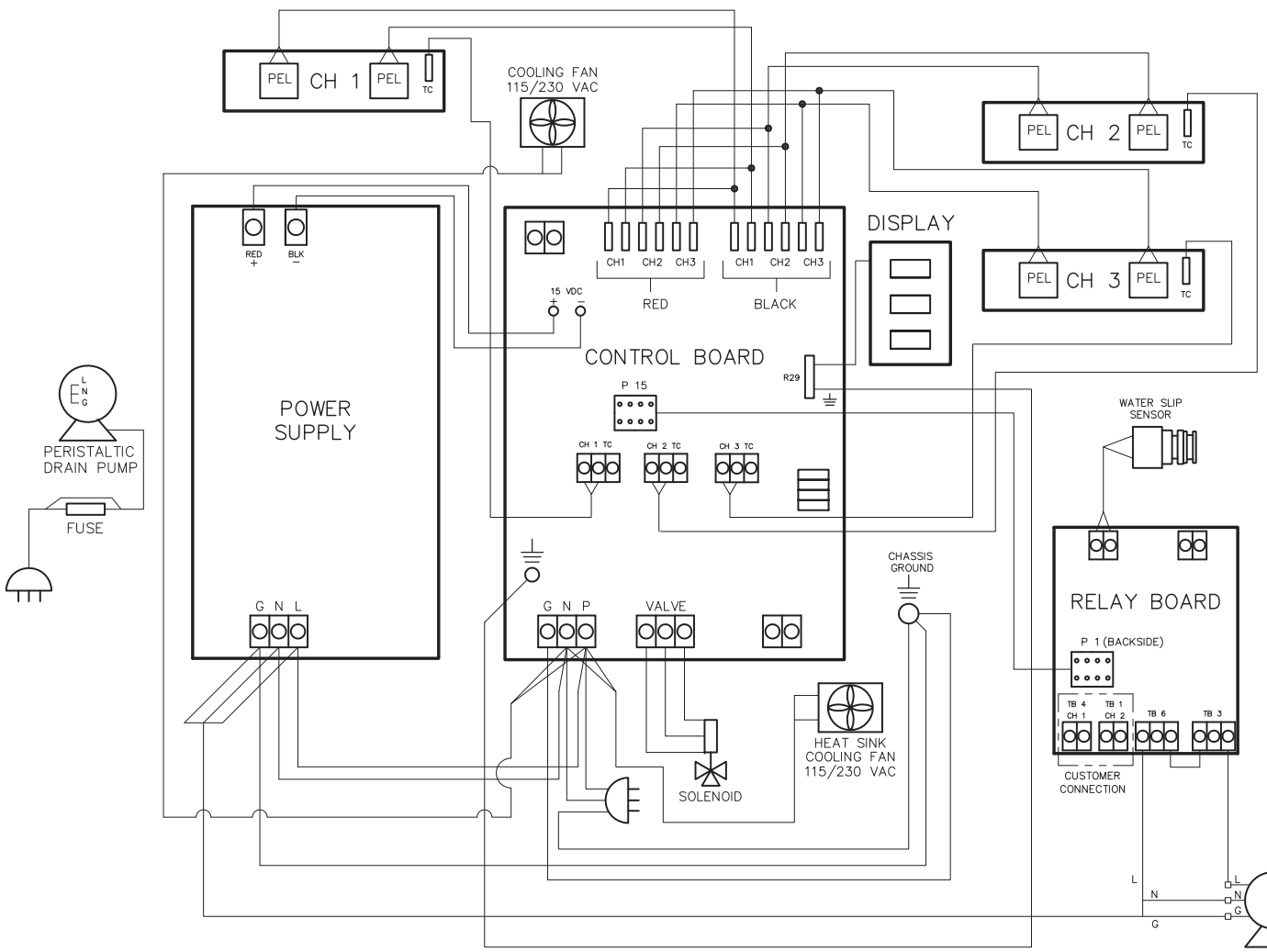
A	11/04/08	ECR # 081104-2	TJA	RM



NOTES:

1. 3–4 ON ALL JUMPERS.

CUSTOMER CONNECTION

TB 4
CH 1

TB 1
CH 2

PLC INTERFACE

WATER SLIP
SENSOR CONTACT

CLOSED:

– WATER NOT DETECTED

– POWER ON

– CH1 < 10° C

PLC INTERFACE

POWER ON
CONTACT

CLOSED:

– POWER ON

– CH. 2 or 3 (ACTIVE)
< 10° C

ITEM	QTY	DESCRIPTION	MANUF.

PROJECT:

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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DRAWN BY: JD DATE: 10/02/01
APP'D: Bob MacRae DATE:
MATERIAL:
FINISH:
DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

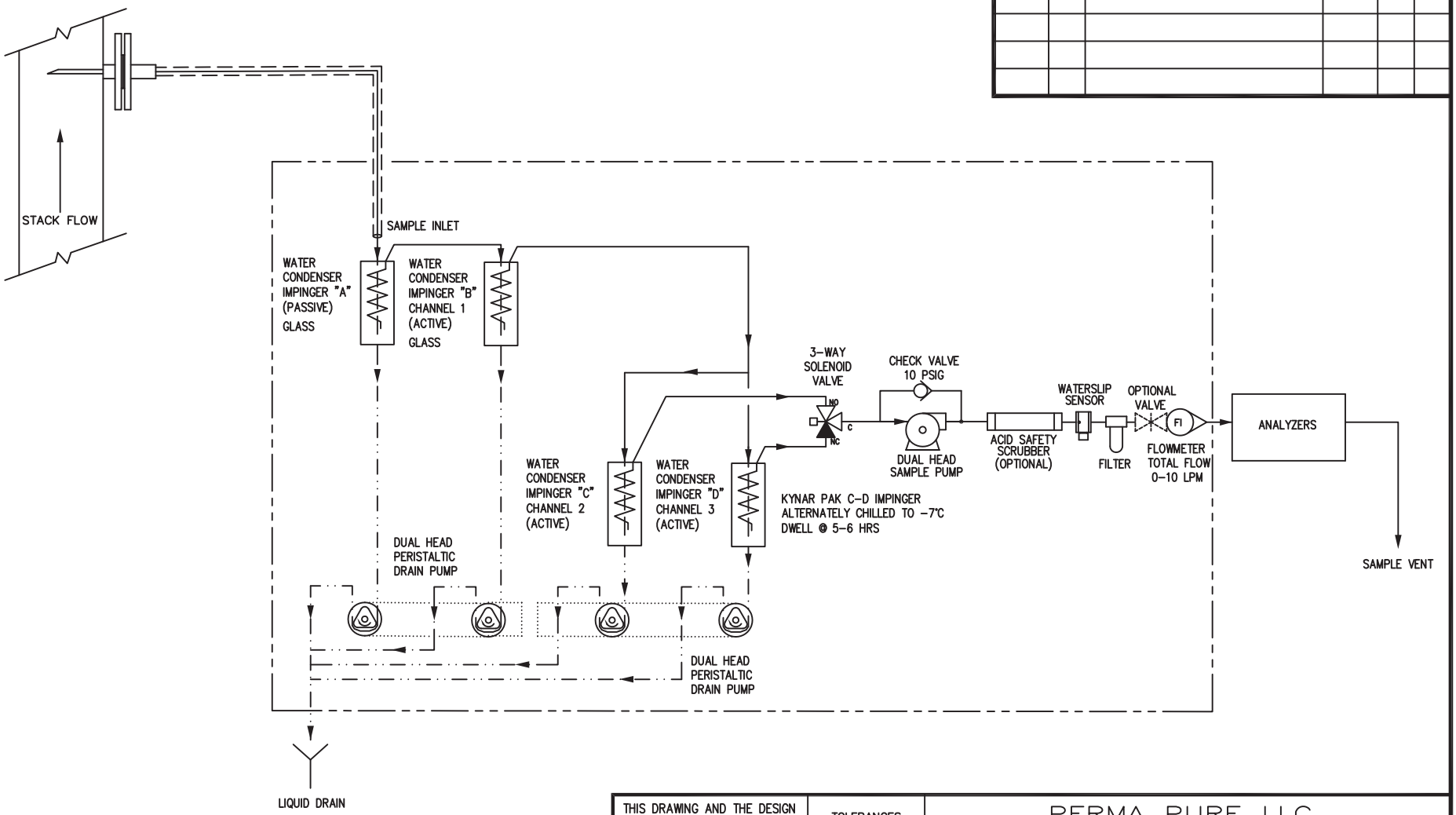
BALDWIN ENVIRONMENTAL, INC.

PART DESCRIPTION
10410 WIRING DIAGRAM
WITH RELAY

SIZE: B | SCALE: N/A | DRAWING/PART NO.: 4C-10410-04-01
CAD DIR:
SHEET 1 OF 1

APPENDIX B: SAMPLE CONDITIONING SYSTEM

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



NOTES:

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

TOLERANCES (EXCEPT AS NOTED)

DECIMAL .XX ± .01" .XXX ± .005"

FRACTIONAL ±1/64"

ANGULAR ±1/2°

JOB REF.

PERMA PURE LLC
8 EXECUTIVE DRIVE, TOMS RIVER N.J. 08754

REFERENCE	SCALE	DRAWN BY	DATE
		TJA	5/17/11
		APPROVED BY	DATE

TITLE

SO3 AEROSOL REMOVAL FLOW DIAGRAM

DATE	SIZE	DRAWING NUMBER	REV.
5/17/11	A	4C-10410-05-02	-

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
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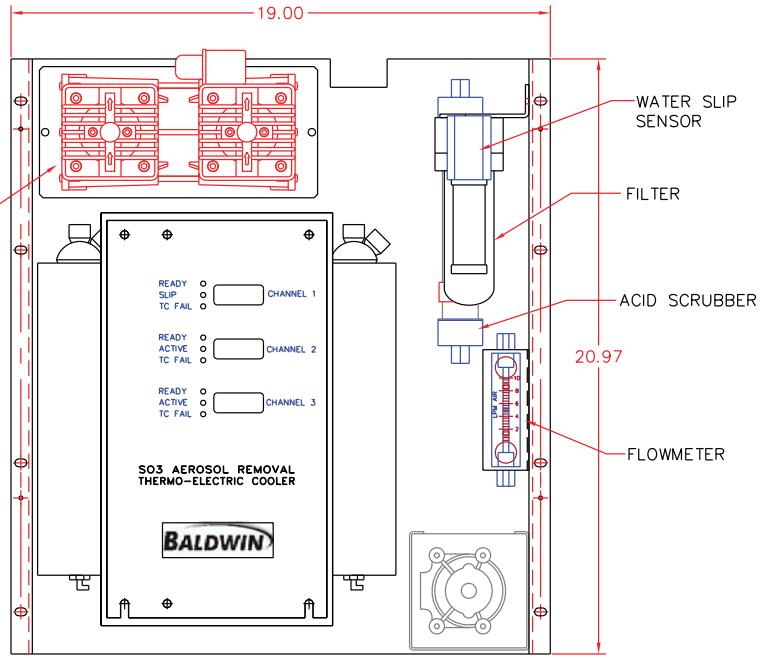
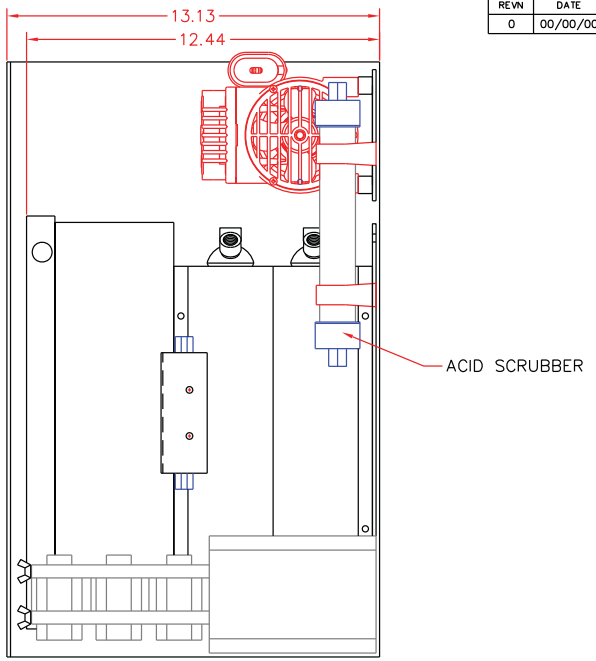
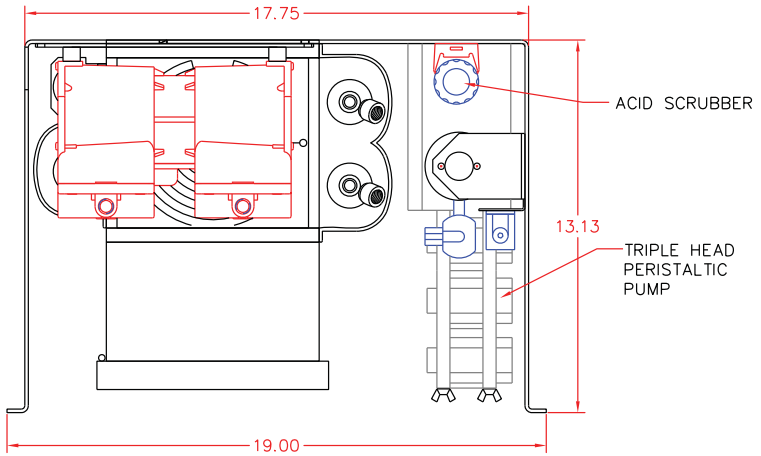


FRONT VIEW



SIDE VIEW



TOP VIEW

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

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

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

DRAWN BY: RAW DATE 05/12/03
APP'D: DATE
MATERIAL
FINISH

BALDWIN, INC.

PART DESCRIPTION
MODEL 4S-10410DK-9B5
SAMPLE CONDITIONING SYSTEM

SIZE	SCALE:	DRAWING/PART NO.:
B	NTS	4S-10410DK-9B5

CAD DIR: S:\DRAW_WK_PRO\45-10410DK | SHEET 1 OF 1

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
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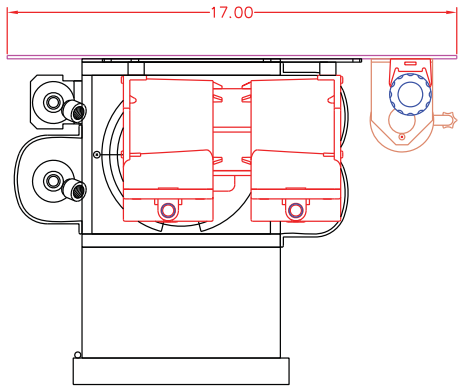
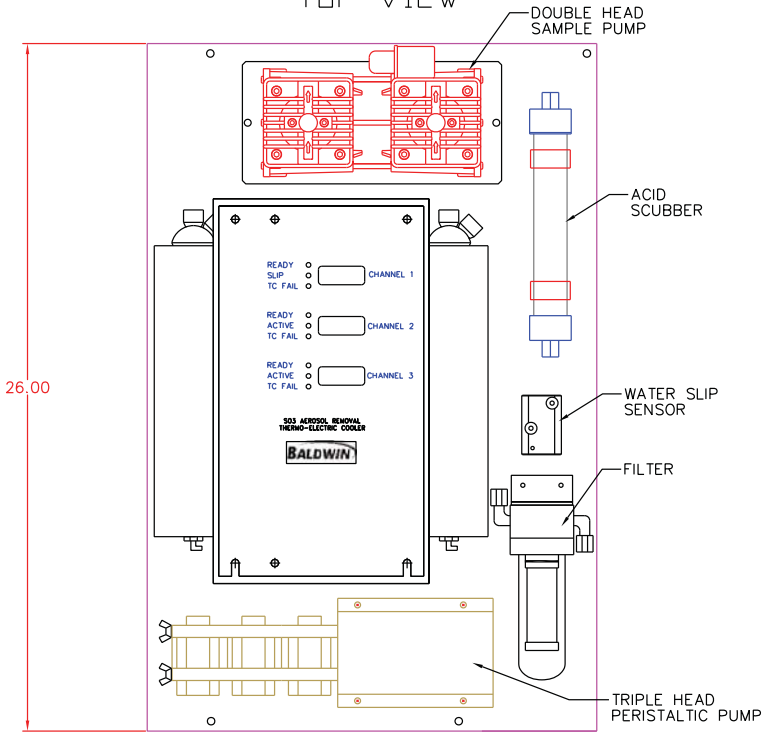
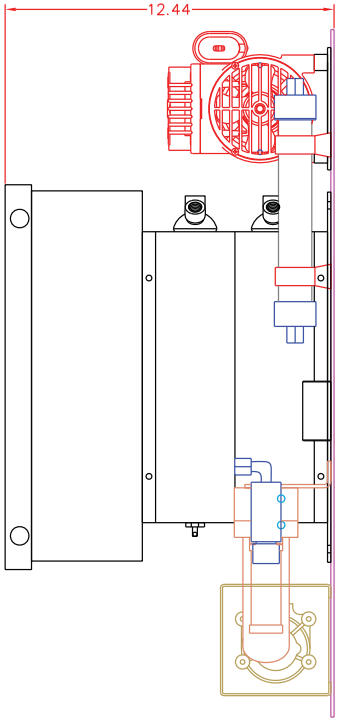


TOP VIEW



FRONT VIEW



RIGHT SIDE VIEW

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

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

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APP'D: DATE
MATERIAL
FINISH
DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

BALDWIN, INC.

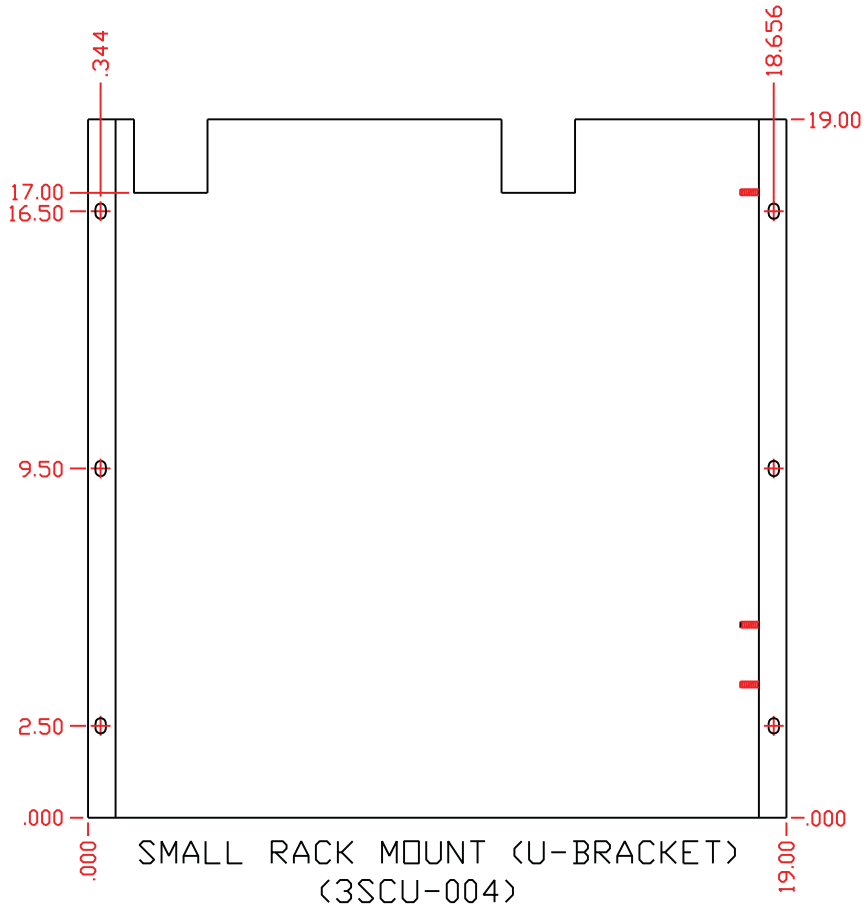
PART DESCRIPTION
MODEL 10410
SAMPLE CONDITIONING SYSTEM

SIZE	SCALE:	DRAWING/PART NO.:
B	NTS	4S-10410-9E5

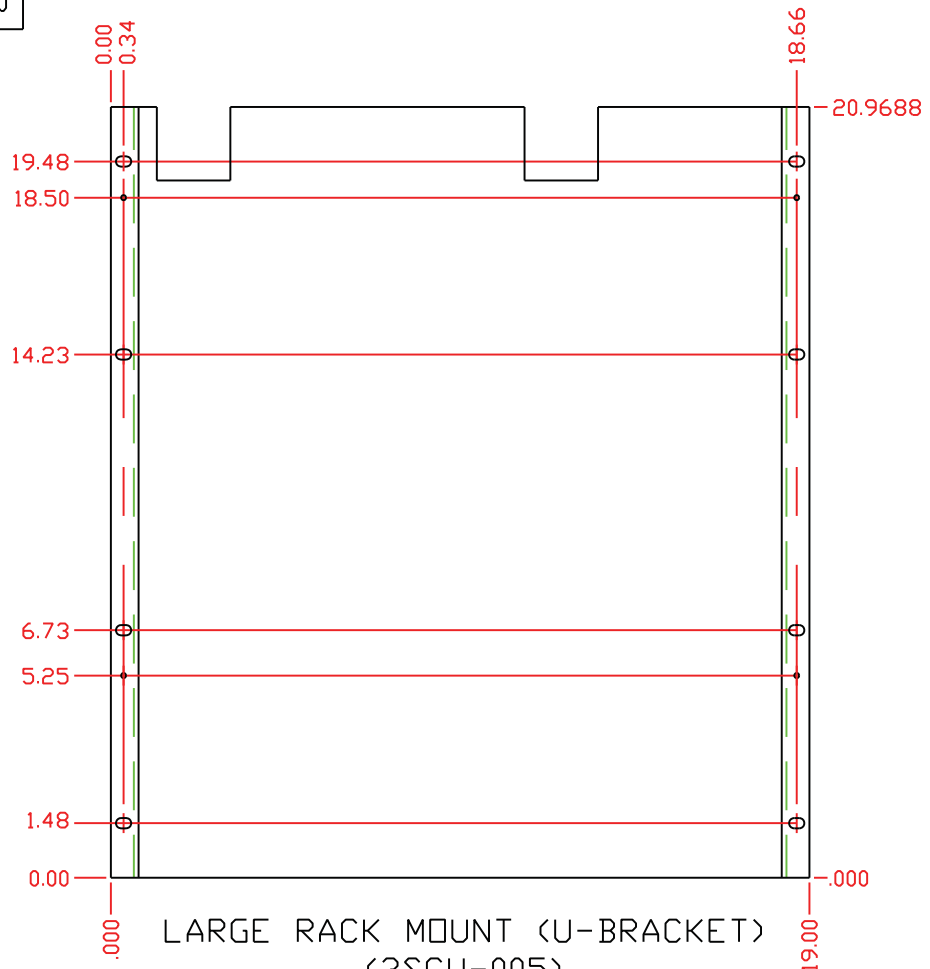
CAD DIR: S:\DRAW\SALES\DWG\S_C_S\10410-9E5 SHEET 1 OF 1

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	JD	



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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DRAWN BY: JD 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	SCALE:	DRAWING/PART NO.:
A	3/16	RACK MOUNT

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

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
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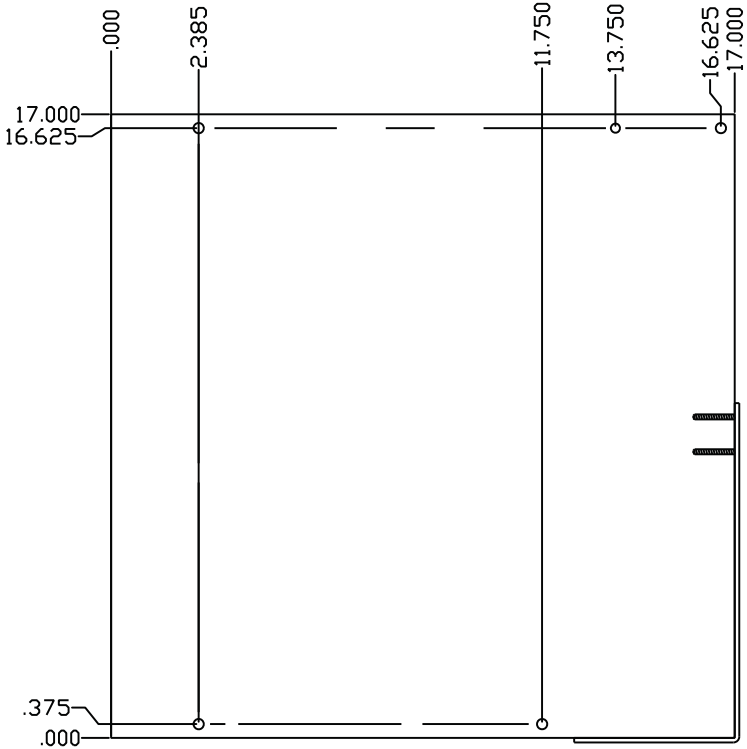
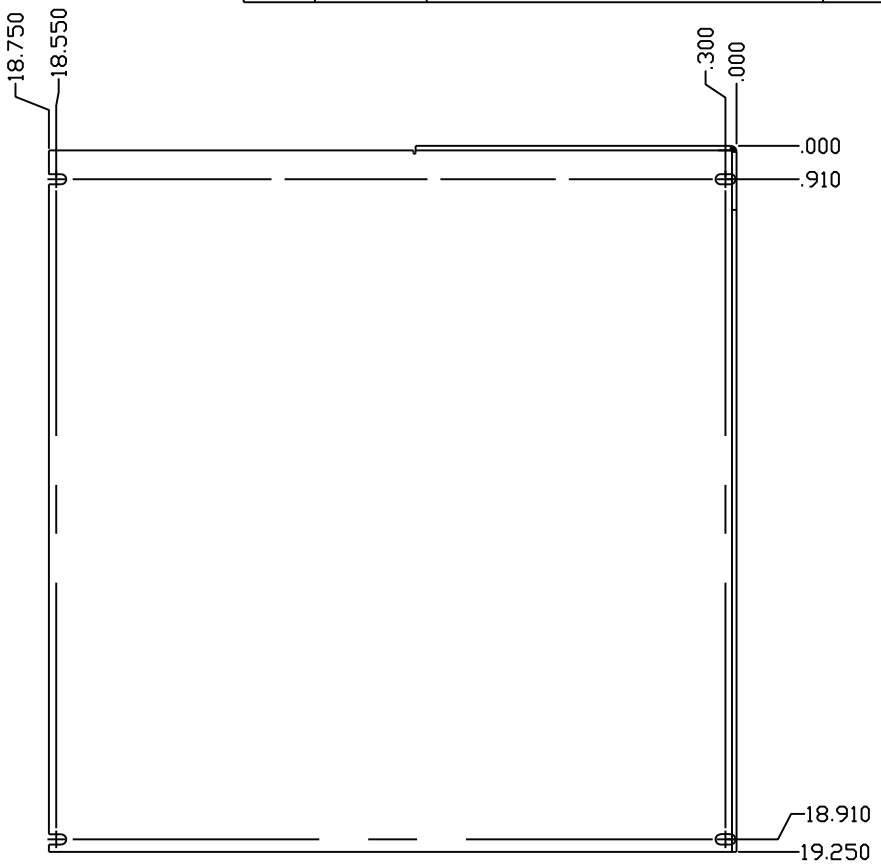


SMALL WALL MOUNT (FLAT PLATE)
(3SCP-002)



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

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DRAWN BY: JD 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 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

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

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.

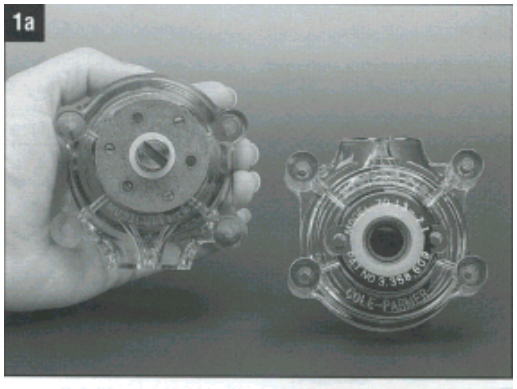
a) Separate the end bells (the pump head halves). Hold the end bell containing the rotor as shown with the tubing retainer grooves facing down.

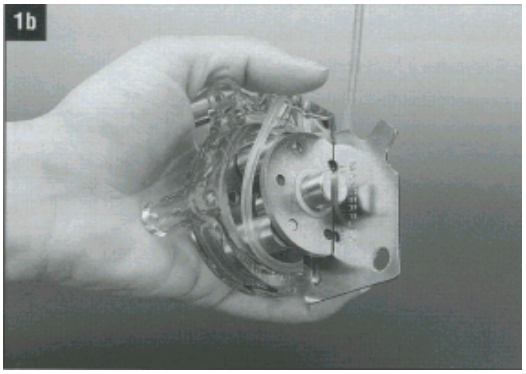
b) Place tubing in the right groove and against the first two rollers. Hold tubing with thumb. Near groove, insert smaller prong of loading key between the top of the rotor and tubing. Push key in as far as possible.

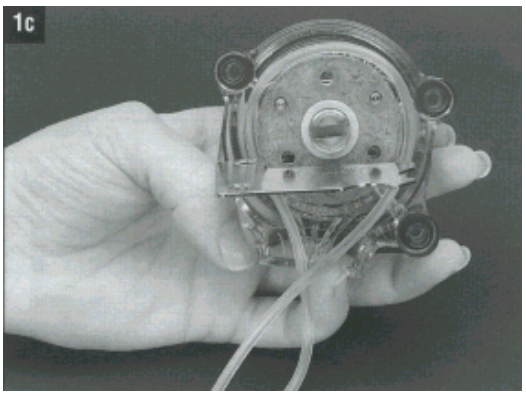
c) Push down and turn key counterclockwise (ccw) completely around the rotor. The key will push the tubing uniformly into the end bell assembly. Hold the second end of tubing. Remove key.

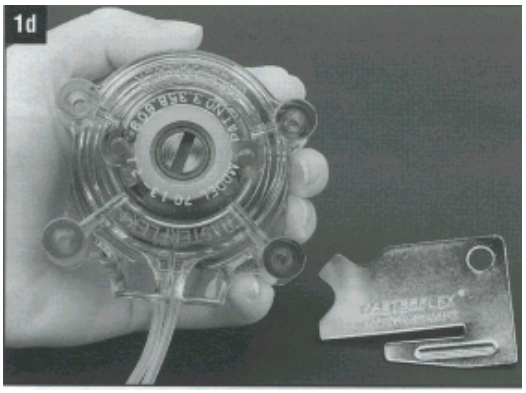
d) Position the other end bell on top and press the end bells together. Be careful not to pinch the tubing. If end bells do not snap tightly together, reload tubing. If necessary, turn key in slot on rotor shaft to adjust tubing (as in Step e).

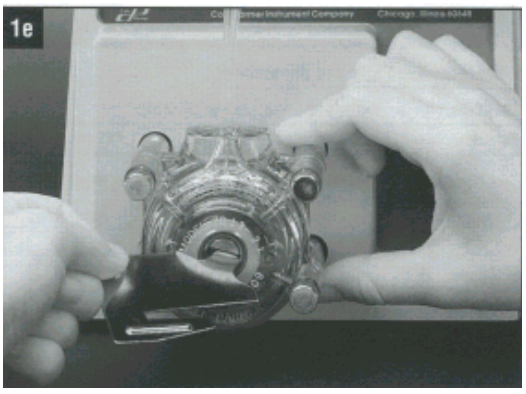
e) With key in slot on rotor shaft, turn key to align tang on rotor shaft with slot in motor drive shaft. Point tubing retainer grooves up. Shift the pump head slightly till it snaps on the alignment pins (if present). Secure with four provided screws. Tighten with fingers only.

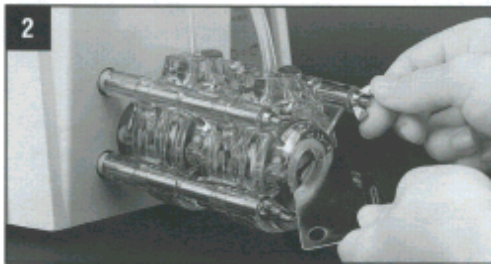












2. Multi-Channel Mounting

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**	- -	- -

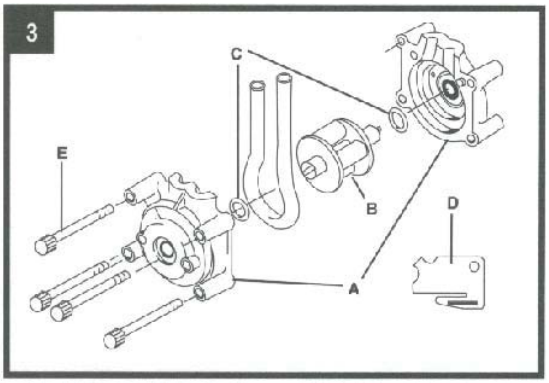
B. Rotor assemblies

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				