Instruction Manual

1000 Series

Thermoelectric Gas Cooler
(Units sold prior to 07-01-2015)

AMETEK®

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MAN.1000.REVH.06302015

Contents

Receiving and Storage

The Universal Analyzers 1000 Series Thermoelectric Cooler is a complete pre-installed unit. No assembly is necessary when received on-site.

Carefully inspect the product and any special accessories included with it immediately on arrival by removing them from the packing and checking for missing articles against the packing list.

Check the items for any damage in transit and, if required, inform the shipping insurance company immediately of any damage found.

Storage Location should be protected from the elements. Although all components provided are designed to resist corrosion, additional protection from heat (>140°F/ 60°C) and humidity is recommended.

Definition of Symbols

WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR HAZARDOUS AREA INSTALLATION.

THE SUPPLY POWER CIRCUIT MUST INCLUDE AN OVERPROTECTION DEVICE WITH A MAXIMUM RATING OF 20A. A DISCONNECT SWITCH MUST BE LOCATED IN CLOSE PROXIMITY TO THE PROBE.

IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED PER CLAUSE 5.4.4(i) IN STANDARD EN 61010-1

CAUTION, RISK OF DANGER SYMBOL INDICATES INJURY MAY OCCUR IF MANUFACTURER'S INSTRUCTIONS ARE NOT ADHERED TO. PLEASE READ MANUAL CAREFULLY WHEN SYMBOL IS DISPLAYED

CAUTION, HOT SURFACE SYMBOL INDICATES EXPOSED SURFACE TEMPERATURE CAN CAUSE BURNS OR PERSONAL INJURY. CARE SHOULD BE TAKEN WHEN CONTACT IS REQUIRED.

CAUTION, RISK OF ELECTRICAL SHOCK SYMBOL INDICATES ELECTRICAL SHOCK MAY OCCUR. CAUTION SHOULD BE TAKEN BEFORE DISCONNECTING OR CONTACTING ANY ELECTRICAL CONNECTIONS.

PROTECTIVE CONDUCTOR TERMINAL SYMBOL INDICATES THE TERMINAL LOCATION FOR THE PROTECTIVE CONDUCTOR. FAILURE TO CONNECT TO THE PROTECTIVE CONDUCTOR TERMINAL MAY RESULT IN A SHOCK HAZARD.

Product Identification

Lead Time	Cooler (Part Number Configurator: 1000)	
2 wks	**1040**	One (1) Sample Point - One 10" Heat Exchanger, (1) Active
	1050	One (1) Sample Point - Two 10" Heat Exchangers, (1) Passive, (1) Active
	1060	One (1) Sample Point - Two 10" Heat Exchangers, (2) Active
	1080	Two (2) Sample Points - Two 10" Heat Exchangers, (2) Active
	1090	One (1) or Two (2) Sample Points - Four 10" Heat Exchangers, (2) Passive, (2) Active
4 wks	**1390**	Three (3) Sample Points - Three 10" Heat Exchangers, (3) Active
	1490	One (1), Two (2) or Four (4) Sample Point(s) - Four 10" Heat Exchangers, (4) Active

10" Heat Exchanger Material (Price per Heat Exchanger)	
SS	316SS
PV	Glass/Kynar
C	Hastelloy C276
ST (+1 wk)	Teflon Coated 316SS
SW (+1 wk)	316 Welded SS (High Pressure)
SN (+1 wk)	SilcoNert™ 2000 Coated 316SS
KK	Kynar/Kynar
N	No Heat Exchangers Included

Voltage & Area Location Classification	
115	115VAC 50/60 Hz; General Purpose (GP) Area
230	230VAC 50/60 Hz; General Purpose (GP) Area
115FM	115VAC 50/60 Hz Class I, Div. 2 Hazardous Location (HL) (1090 Only)
230FM	230VAC 50/60 Hz Class I, Div. 2 Hazardous Location (HL) (1090 Only)

Stream Configuration	
DS	Dual Sample Stream (Options for Models 1080 & 1090 only)
TS	Tri Stream Mode - 1390 Only
QS	Quad Stream Mode - 1490 Only
N	Single Sample Stream

Condensate Drain		
+1 wk	**LD**	Liquid Drainer
		1040 Cooler - One Heat Exchanger
		1050, 1060 & 1080 Cooler - Two Heat Exchangers
		1390 Cooler - Three Heat Exchangers
		1090 & 1490 Cooler - Four Heat Exchangers
	A	Aspirated Drainer
		1040 Cooler - One Heat Exchanger
		1050, 1060 & 1080 Cooler - Two Heat Exchangers
		1390 Cooler - Three Heat Exchangers
		1090 & 1490 Cooler - Four Heat Exchangers
	N	None Selected

Options (Select all that apply)		
TCK		New Jersey Option - Type K T/C - Stand alone option
TCJ		New Jersey Option - Type J T/C - Stand alone option
N		No Options Included
+1 wk	**SPE**	Stacked Peltier Elements - Stand alone option
	N	No Options Included

1040	-SS	-115	-N	-N	-SPE	Sample Part #

NOTE: LEAD TIMES ARE NOT COMPOUNDED. LEAD TIME IS COOLER + LONGEST OPTION

Specifications

OPERATING SPECIFICATIONS	
Sample Flow Rate	0 to 8 l/m (at STP)
Maximum Inlet Temperature	
Stainless Steel Heat Exchanger	700°F (351°C)
Kynar/Glass Heat Exchanger	280°F (138°C)
Maximum Inlet Gas Dew Point	178°F (81°C)*
Maximum Inlet Water Concentration	50%*
Minimum Ambient Temperature	34°F (1°C)
Maximum Ambient Temperature	105°F (41°C)*
Maximum Cooling Power	126 BTUs per hour (120 kJ/hr)
Outlet Sample Dew Point	41°F (5°C)
Gas Sample Inlet Fittings	3/8" tubing fittings
Gas Sample Outlet Fittings	1/4" tubing fittings
Bottom Water Drain Fittings	3/8" tubing fittings
Maximum Input Power	
Model 1050	400 watts
Model 1060	740 watts
Model 1080	740 watts
Model 1090	740 watts
Voltage	90-132/180-264VAC, 50/60 Hz
Electrical Classification	General purpose, NEMA 1
Dimensions	15" H x 10" W x 12" D
Weight	38 lbs (17 kg)
Soluble Gas Removal Rates	NO 0% loss NO_2 <10% loss SO_2 < 2% loss CO 0% loss CO_2 < 2% loss

* AT REDUCED FLOW RATE.

COOLER CAPACITY DATA												
	Ambient 77°F/25°C Water Vapor				**Ambient 90°F/25°C Water Vapor**				**Ambient 105°F/25°C Water Vapor**			
	12%	**15%**	**30%**	**50%**	**12%**	**15%**	**30%**	**50%**	**12%**	**15%**	**30%**	**50%**
1040	5 l/m	4 l/m	2 l/m	1 l/m	4 l/m	3.5 l/m	1.8 l/m	0.9 l/m	3 l/m	2.5 l/m	1.3 l/m	0.7 lm
1050	8 l/m	8 l/m	8 l/m	8 l/m	7 l/m	7 l/m	7 lm	7 l/m	4 l/m	4 l/m	4 l/m	4 l/m
1060	8 l/m	8 l/m	5 l/m	3 l/m	8 l/m	8 l/m	4 l/m	2 l/m	6 l/m	6 l/m	3 l/m	1.5 l/m
1080	2x5.0 l/m	2x4.0 l/m	2x2.0 l/m	2x1.0 l/m	2x4.0 l/m	2x3.5 l/m	2x1.8 l/m	2x0.9 l/m	2x3.0 l/m	2x2.5 l/m	2x1.3 l/m	2x0.7 l/m
1090	15 l/m	15 l/m	15 l/m	15 l/m	11 l/m	11 l/m	11 l/m	11 l/m	6 l/m	6 l/m	6 l/m	6 l/m
1390	3x4.6 l/m	3x4.3 l/m	3x6.6 l/m	3x3.1 l/m	3x4.3 l/m	3x4.0 l/m	3x3.3 l/m	3x2.6 l/m	3x2.3 l/m	3x2.1 l/m	3x1.7 l/m	3x1.4 l/m
1490	20 l/m	16 l/m	8 l/m	4 l/m	16 l/m	14 l/m	7 l/m	3.6 l/m	9.2 l/m	8 l/m	4.4 l/m	2.2 l/m

Description and Principle of Operation

APPLICATION

The Universal Analyzers 1000 Series Gas Sample Coolers are designed to be installed in a sample system where the gas sample contains moisture to be removed. The model 1090 has the option to be installed in hazardous locations or unclassified locations. The remainder of the models may only be installed in non-hazardous locations.

The 1000 Series Coolers are designed as standalone equipment that does not require integration onto a panel. However, many options do require integration. Standard integration options can be configured on plates or U-Brackets. The 1000 Series Gas Sample Coolers are also designed for minimal maintenance.

The 1000 Series Coolers have mounting holes for 1/4" hardware and may be installed into a protected shelter or enclosures that are designed to remove the exhaust heat.

Ambient temperature, required flow rate, and moisture content will determine the specific model required for a specific application.

The use of a Heated Filter and Heated Sample Line are highly recommended to be installed between the sample extraction location and the input to the 1000 Series Gas Sample Cooler. They are recommended to keep the temperature of the sample above the boiling point of water or above the dew point of any chemical reactions that would skew the desired analytical results.

DESCRIPTION

The 1000 Series Gas Sample Coolers are Thermoelectric Coolers consisting of Peltier Elements, control electronics, a heatsink, and fan assembled as a NEMA 1 device. The optional equipment consists of certain drain options, voltage options, stream configurations, direct stream temperature sensors, as well as different materials for the impingers (water removal columns) depending on the application.

The 1000 Series Coolers operate by condensing the water from a wet gas sample to a dewpoint of 4°C with a minimal loss of water soluble gas fraction due to the design of the impingers. The impinger is composed of an insulated tube enclosed in a highly polished cylinder that is then cooled. The hot wet sample is brought to the bottom of the cylinder through the insulated tube and is then allowed to rise through a narrow annular area at a relatively high Reynolds number to insure the entire sample is influenced by the cold surface. The condensate falls down the cold polished surface in the form of a sheet (as opposed to droplets or the bubbling of the gas sample through the condensate) which minimizes the surface area in contact with the gas sample.

The temperature of the impinger is maintained through contact with a heat transfer block. Depending on the model the heat transfer block will either be ambient temperature or be actively cooled to 4°C through the use of Thermoelectric (Peltier) elements. A model 1040 has a single active transfer block with two thermoelectric elements, a model 1050 has an ambient temperature transfer block and an active transfer block with two thermoelectric elements, and a model 1060 has two active transfer blocks for a total of four thermoelectric elements. A model 1080 also has two active transfer blocks with a total of four thermoelectric elements, however it is designed to cool two independent streams at one time. Additionally the model 1090 is designed to have a pair of ambient temperature transfer blocks and a pair of active transfer blocks for a total of four thermoelectric elements. The 1090 can be configured to either be a single stream or for two independent streams. The model 1090 is the only model in the series to be certified for use in hazardous locations. The temperature is measured using a Type K thermocouple located in the transfer blocks. This temperature is controlled to 4°C with a variance of one degree.

Description and Principle of Operation

The Thermoelectric Elements are devices that when power is supplied the element creates a temperature differential between the two sides of element. This creates a cool side that cools the impinger and a hot side where the heat is discharged through a heatsink with a fan forcing air through the heatsink for dissipation.

1000 Series Sample Coolers have a digital display on the front panel indicating the operating temperature (°C) of the heat exchangers. In addition, there are two green and one red LED lights to indicate the status of the cooler. The 'COOL' light will shine yellow when the operating temperature is between 0°C and 10°C (32°F and 50°F) and otherwise be unlit. The "DRY" light will shine if there is no moisture sensor installed or if the installed moisture sensor sees water carry over past the impingers. The T/C light will shine red if the thermocouple is broken or has a bad connection to the control board. On a dual stream cooler there are two sets of lights, one for each stream. There is also a switch that can be moved to trigger the display to show the current temperature of either stream 1 or stream 2.

There are four Type C alarm relays in the 1000 Series Gas Sample Coolers and eight Type C alarm relays in the dual stream 1000 Series Gas Sample Coolers. Two of the relays are activated when the temperature is above 10°C and the other two are activated when a moisture alarm is triggered. The dual stream has additional Type C alarm relays for the second stream that function in an identical fashion. In most applications one set of temperature and moisture alarms are wired together to turn off a sample pump when triggered. The other set of relays are wired to the data acquisition or control system.

The standard drain is a peristaltic pump is a positive displacement pump that allows for use in either a pressure or vacuum sample. However, it is not available as a standard option but instead needs to be part of a sample conditioning system or purchased separate. A secondary drain option is the use of a float drain trap. This can only be used if the heat exchangers are at a slight positive pressure in relation to atmosphere. Condensate collects in the trap until the float rises and allows for the condensate to drain. An eductor (aspirator) is another standard option for condensate removal. This option requires an instrument air source to create a vortex with the drain and draw the condensate out of the eductor. The direct stream temperature sensors, also referred to as 'New Jersey' option are thermocouples and available as Type J or Type K.

Installation

Universal Analyzers 1000 Series Sample Coolers should be installed away from heat sources in a well ventilated area of an instrument rack or enclosure. The Cooler performance is proportional to ambient temperature, too high a temperature will degrade performance. Contact the factory for recommendations. Air purging an enclosure generally requires more flow than is available to remove the heat which will be generated internally by the sample chiller. There are air conditioners and vortex cabinet coolers designed to provide the necessary cooling for enclosing thermoelectric chillers.

The 1000 series sample cooler has mounting taps on the brackets extending to each side of the cooler. The mounting holes are located past the heat blocks to allow for ease of tool access when mounting.

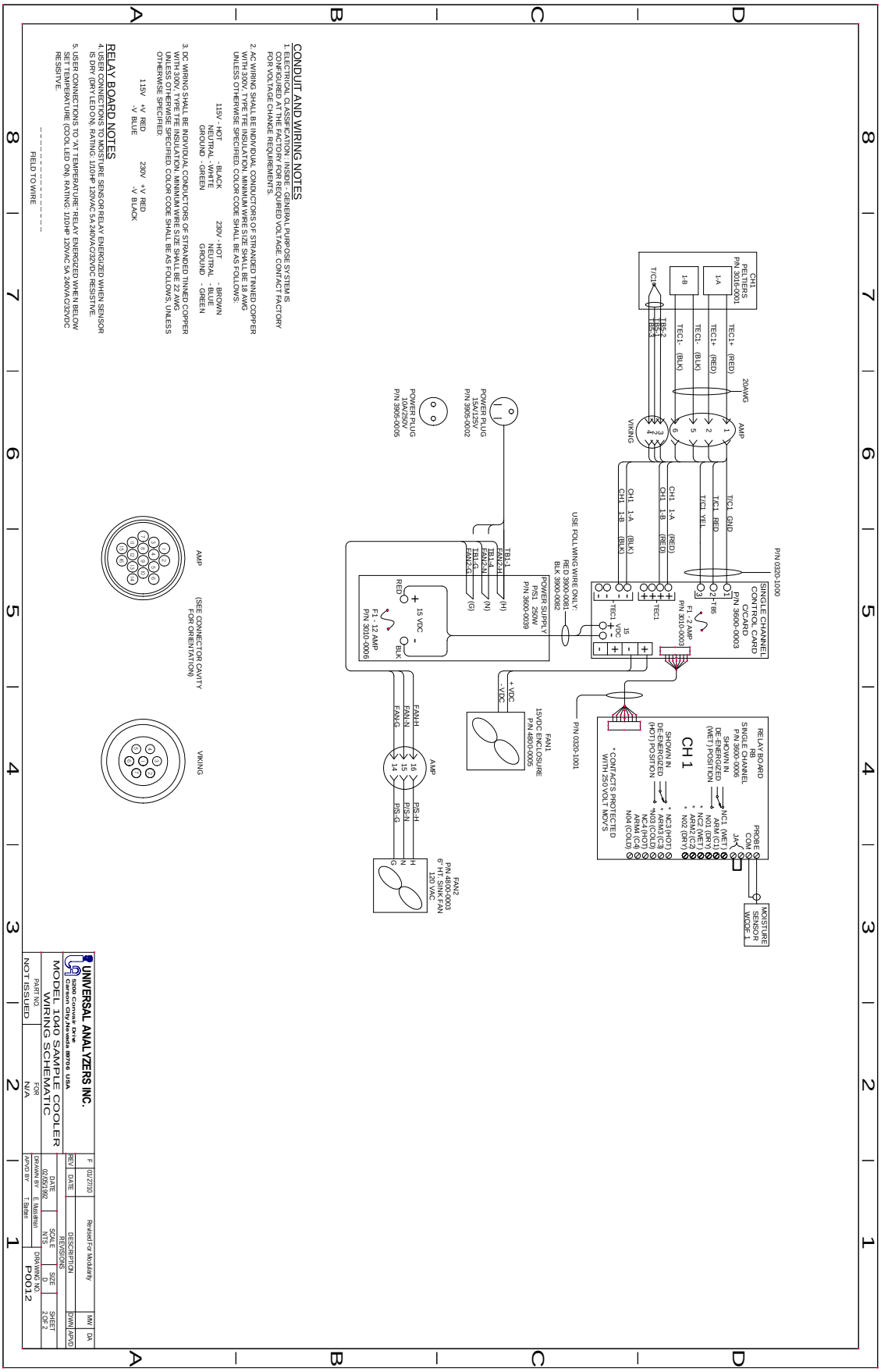
Sample tubing should be brought to the back left heat exchanger. In most cases this will be an ambient impinger with no foam surrounding it. Dual Stream coolers will have one sample tube connected to the back left side and a second sample tube connected to the back right side. A 3/8” tubing fitting is provided at the top of the first heat exchanger as the sample inlet. The dry sample outlet from the cooler is the 1/4” Kynar tubing fitting coming out of the top of the exit heat exchanger at an angle.

A drain line from the peristaltic pump, eductor, or drain pot must be run to sewer, a container, or to the ground outside the instrument enclosure to avoid collecting water (condensate) on the floor.

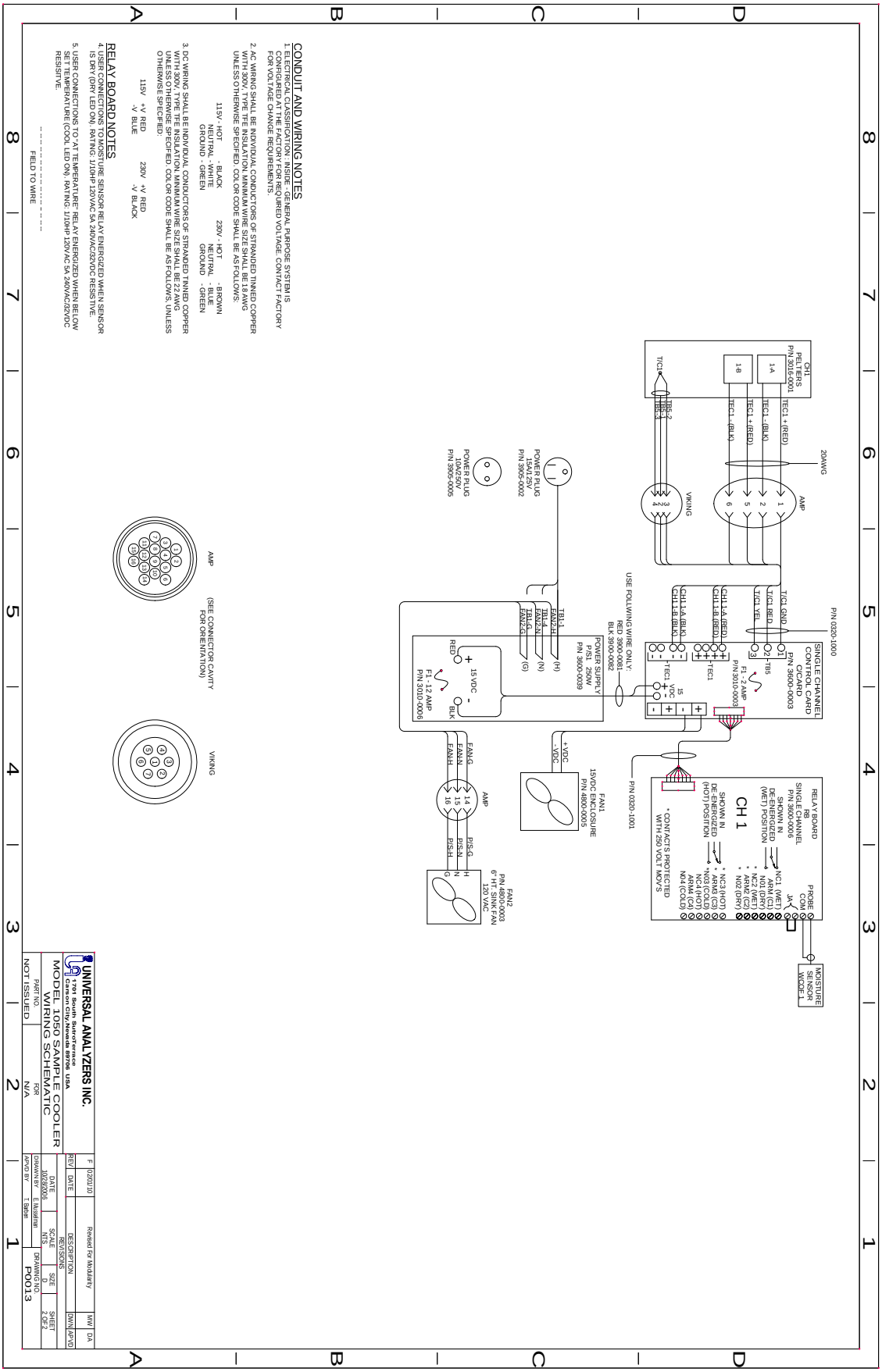
If an eductor is utilized to remove the condensate, the outlet tube length should be no longer than two feet in order to keep too much back pressure from the outlet of the eductor. The outlet tube can be placed in a larger pipe to channel the condensate to a drain.

The electrical power, about 3 amps at 115VAC or 1.5 amps at 230VAC 50/60 Hz should be supplied. Installation shall be in accord with the manufacturer’s instructions and the National Electrical Code (ANSI/NFPA 70). Tampering and replacement with non-factory components may adversely affect the safe use of the system. For the 115VAC case, a power cord is supplied. It can be replaced with conduit wiring easily.

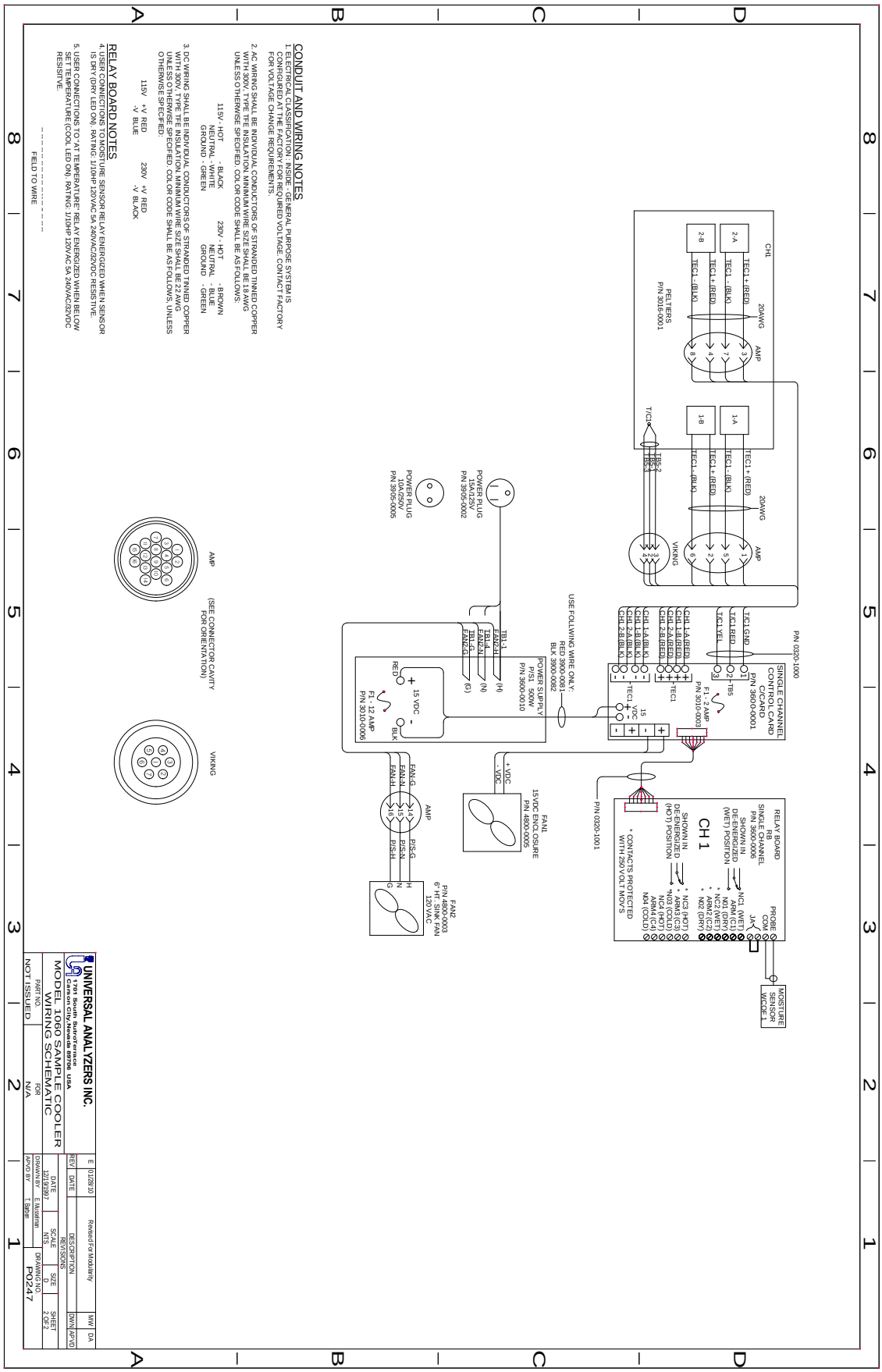
Electrical Connections Model 1040



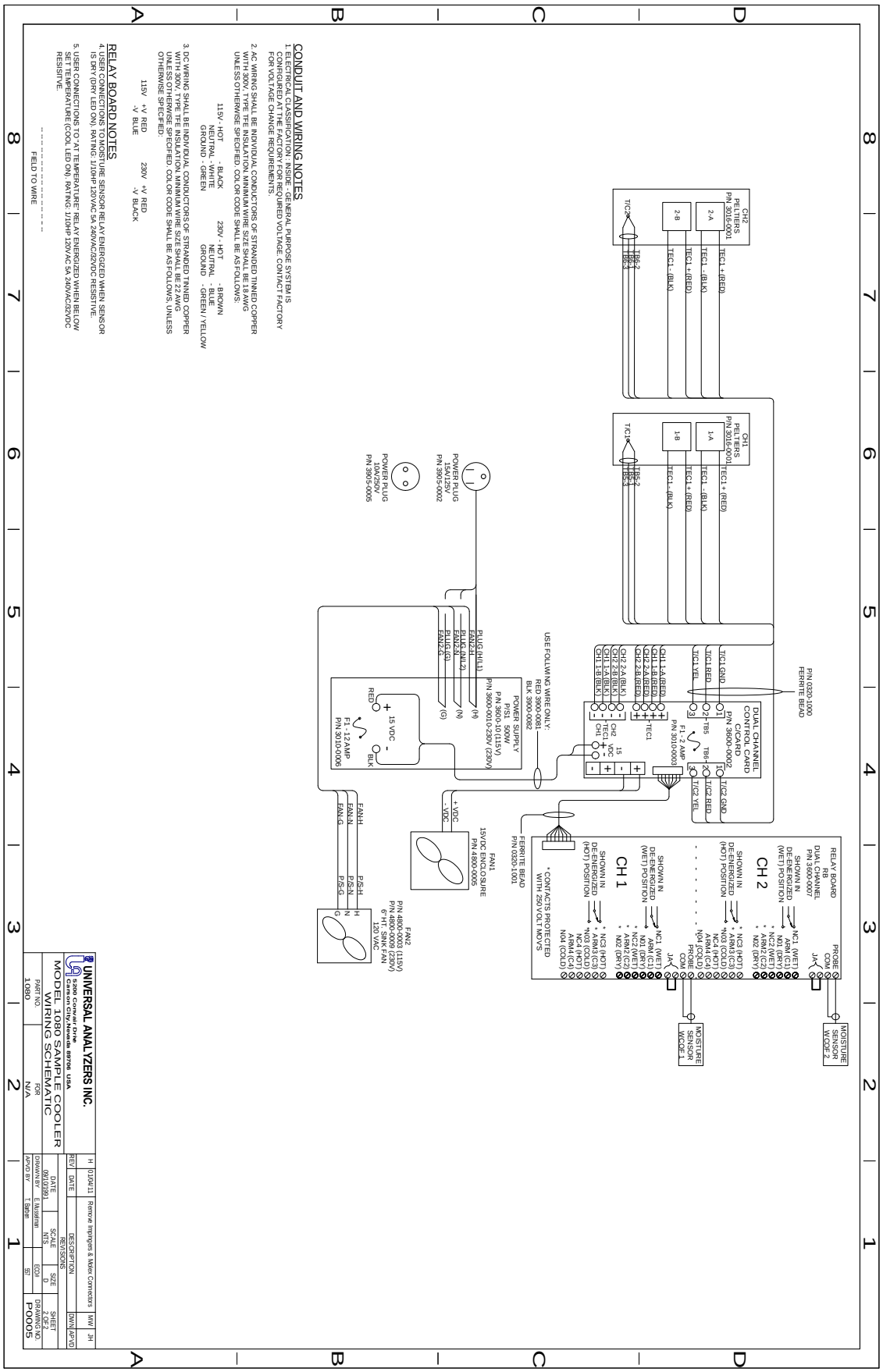
Electrical Connections Model 1050



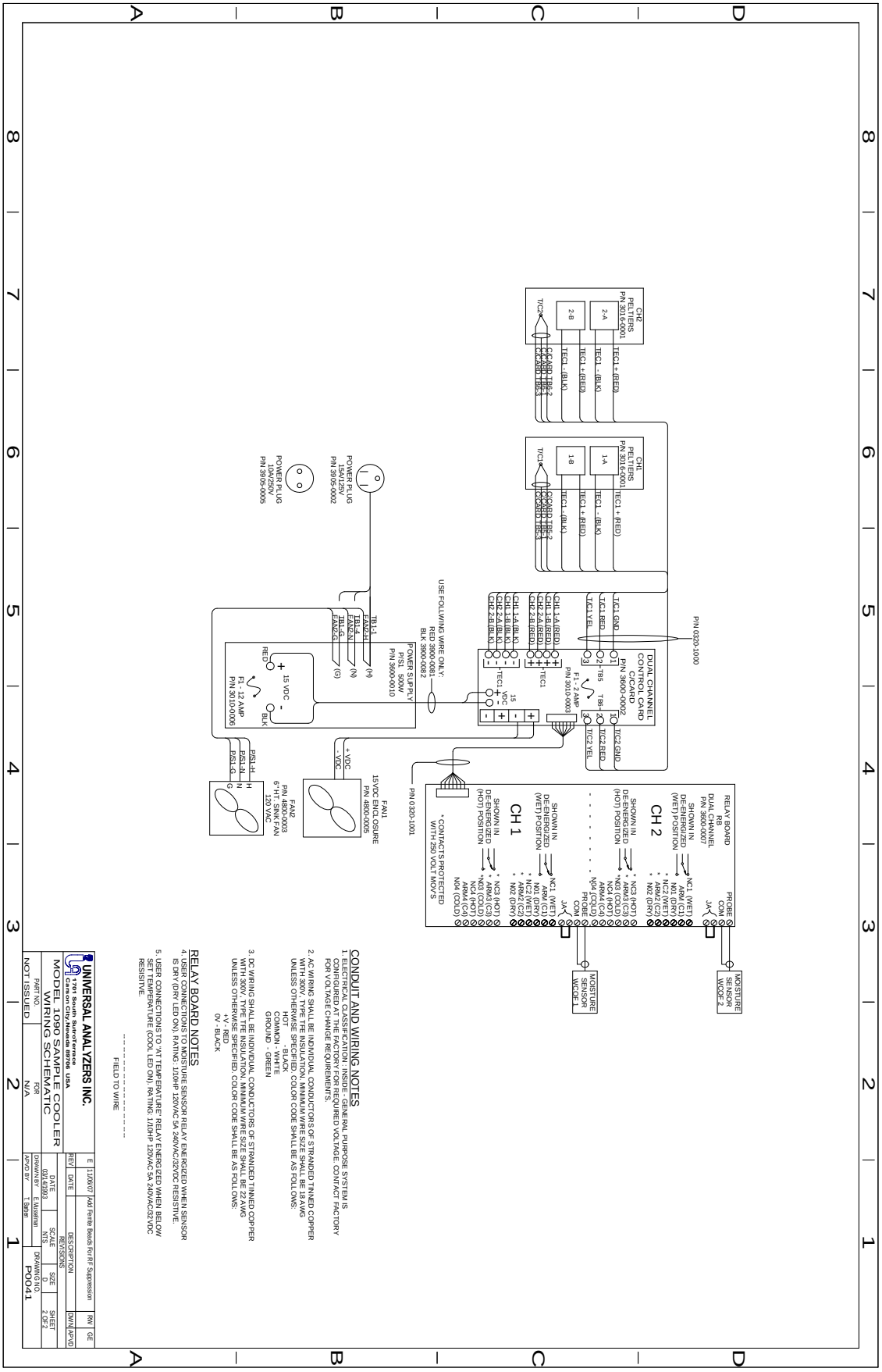
Electrical Connections Model 1060



Electrical Connections Model 1080



Electrical Connections Model 1090



Start-Up

Apply power to the sample cooler. The indicated temperature will start to drop immediately. It should be below the over-temperature set point in approximately four minutes and the “COOL” green LED lamp should light. When the temperature reaches the control point (set at 5°C), the rate at which the temperature drops will be reduced. It will stabilize between 4° and 5°C.

Start the sample gas flow. Water should be observed to be removed from the bottom of the heat exchanger when steady state conditions are established.

If moisture sensors are installed, the (DRY) light should remain on as dry gas is transported to the analyzer(s). Turn on the analyzer(s) and calibrate as required. If an eductor is utilized to remove the condensate, a strong flow of air should be felt to be flowing from the eductor outlet tube.

Shutdown

Stop sample gas flow to the cooler by turning off the sample pump. Allow the drain pump to run for several minutes to remove any remaining condensate from the heat exchangers. After all condensate has been drained, turn off power to the cooler.

Maintenance

Before performing any maintenance on the cooler, ensure that all plant safety procedures are followed. As with any electrical device, ensure power is removed before performing any procedures.

The cooler is designed for maintenance free operation but if any is required, ensure power has been removed before maintenance or repair is performed.

For the best performance of the cooler, the following maintenance schedule is recommended:

Maintenance Activity	Frequency
Clean heat exchanger	Annually
Inspect heat sink fins	Monthly

INSTALLING OR REPLACING HEAT EXCHANGERS

REMOVING THE HEAT EXCHANGER

1. Remove the inlet and outlet tubes by loosening the compression fittings. Always use a backup wrench on the fitting body to ensure no damage to the heat exchanger occurs.
2. Remove the drain fitting using the same procedure as the inlet/outlet. Remove the drain fittings from the exchanger. Use a backup wrench on the lower heat exchanger hex to prevent damage to the exchanger.

REPLACING THE HEAT EXCHANGER

1. Dry and clean the heat exchanger opening in the heat transfer block using a dry, lint-free cloth (If reusing the heat exchanger, clean the outside as well.) Dried heat transfer paste can be removed by using a very fine abrasive pad wrapped around a drill bit.
2. Apply a thin layer of heat transfer paste onto the outer diameter of the heat exchanger.
3. Gently push the heat exchanger into the heat transfer block until the head is fully seated against the insulation on top.
4. Reinstall the drain fitting. Ensure pipe tape is used on the pipe threads before installation. Use a backup wrench on the heat exchanger lower hex to prevent damage to the exchanger.
5. Reconnected the drain, inlet and outlet tubes.

Troubleshooting

The following table should give an overview of possible errors and an instruction to check and to repair them (is not valid for the starting-up period of cooler).

Error	***Possible reason***	***Check/Repair***
No sample gas flow	Heat exchanger plugged	Check for an obstruction Remove heat exchanger from unit and disassemble
	Alarm shutoff	Verify Cool & Dry Indicators are illuminated
	No power on cooler	Ensure cooler has power supplied
Water carry over	Overloading of the refrigeration capacity of the cooler due to too much water vapor or too great a sample flow rate	Reduce flow rate
	An air leak in the condensate removal tubing	Verify moisture content of sample and compare to operating specifications on page 6
	Failure of the sample cooler	
	The cooler is not cold enough	
	Inadequate drain apparatus or a fault in the condensate removal equipment.	Verify drain tubing is unobstructed and equipment is functioning satisfactory
	The heat exchanger has become full of condensate	
	Excessive flow rate	Reduce the flow rate
	High ambient temperature	Reduce the ambient temperature (Increase ventilation or relocate cooler)
	Defective cooler	Verify air flow across the heat sink Hold hand in front

Troubleshooting

High oxygen readings/ low pollutant readings	Leak	Loose connection Verify all fittings are leak free.
	Defective peristaltic pump tubing	Replace tubing
	Broken or leaking heat exchanger	Remove heat exchanger and replace if broken or repair (replace O-Ring) if leaking
'Dry' light is not Illuminated	Water carry over	See "water carry over' error
	Faulty water carry over IC	Disconnect/Unplug the 2 wire cable from the WCO terminals, located on the power supply board. If the dry light does not illuminate, consult the factory
'Cool' light is not illuminated	Ambient temperature too high	Reduce the ambient temperature (Increase ventilation or relocate cooler)
	Flow rate/ water content too high	Lower the flow rate through the cooler and observe the results. If condition corrects itself, consult the factory for further troubleshooting
	Failed Peltier element	Measure resistance between the red & black Peltier leads. A failed Peltier element will read high resistance or 'open'. Consult wiring diagram for wire location details
Power only on drain pump	Blown fuse (F1)	Replace fuse
	Defective transformer (T1)	Replace power supply board

Spare Parts

Consumable Parts	
Part	***P/N***
Fuse, Control Board – 2 Amp Slow Blow	3010-0003
Fuse, Power Supply Board – 6 Amp Slow Blow (Model 1050)	3010-0005
Fuse, Power Supply Board – 12 Amp Slow Blow	3010-0006

Basic Parts	
Part	***P/N***
Heat Exchanger/Impinger – 316SS 5"	5200-S010
Heat Exchanger/Impinger – Glass/Kynar 5"	5200-K010
O-Ring, Glass/Kynar Heat Exchanger – Viton 2-018	4904-0003
O-Ring, Glass/Kynar Heat Exchanger – Viton 2-120	4904-0004
O-Ring, 316SS Heat Exchanger – Viton 2-021	4904-0013
Paste, Heat Sinking - 0.1 Ounce Container	8010-0001
Glass Tube, Outer – Heat Exchanger Replacement 5"	5201-0001

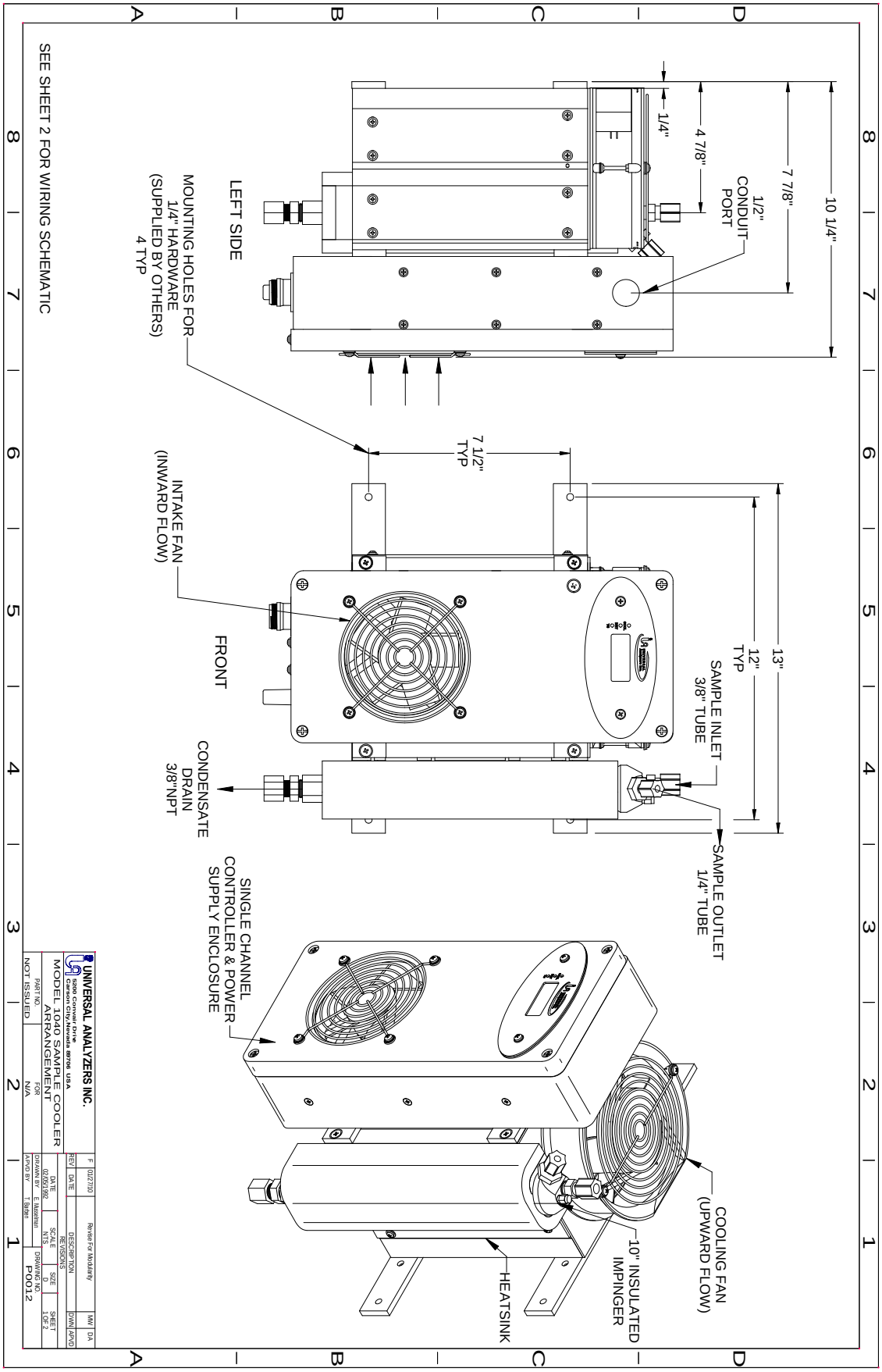
Critical Repair Parts	
Part	***P/N***
Peltier Element, 15VDC 8.5 Amp 40mm Sq.	3016-0002
Insulation Kit for Heat Transfer Block	9515-0098
Thermocouple, Type “K” - Peltier Control	1150-0016
Fan, Heat Sink Cooling	3103-0006
Fan, Power Supply Cooling	4800-0005

In-Depth Parts	
Part	***P/N***
Controller Circuit Board - Single Channel	3600-0001
Controller Circuit Board - Dual Channel (1080, 1090)	3600-0002
Alarm Relay Circuit Board - Single Channel	3600-0006
Alarm Relay Circuit Board - Dual Channel (1080, 1090)	3600-0007
Power Supply Board - 15VDC 500 Watt 115VAC (Model 1060, 1080, 1090)	3600-0010
Power Supply Board - 15VDC 250 Watt (1040, 1050)	3600-0039
Power Supply Board - 15VDC 500 Watt 230VAC	3600-0010-230V

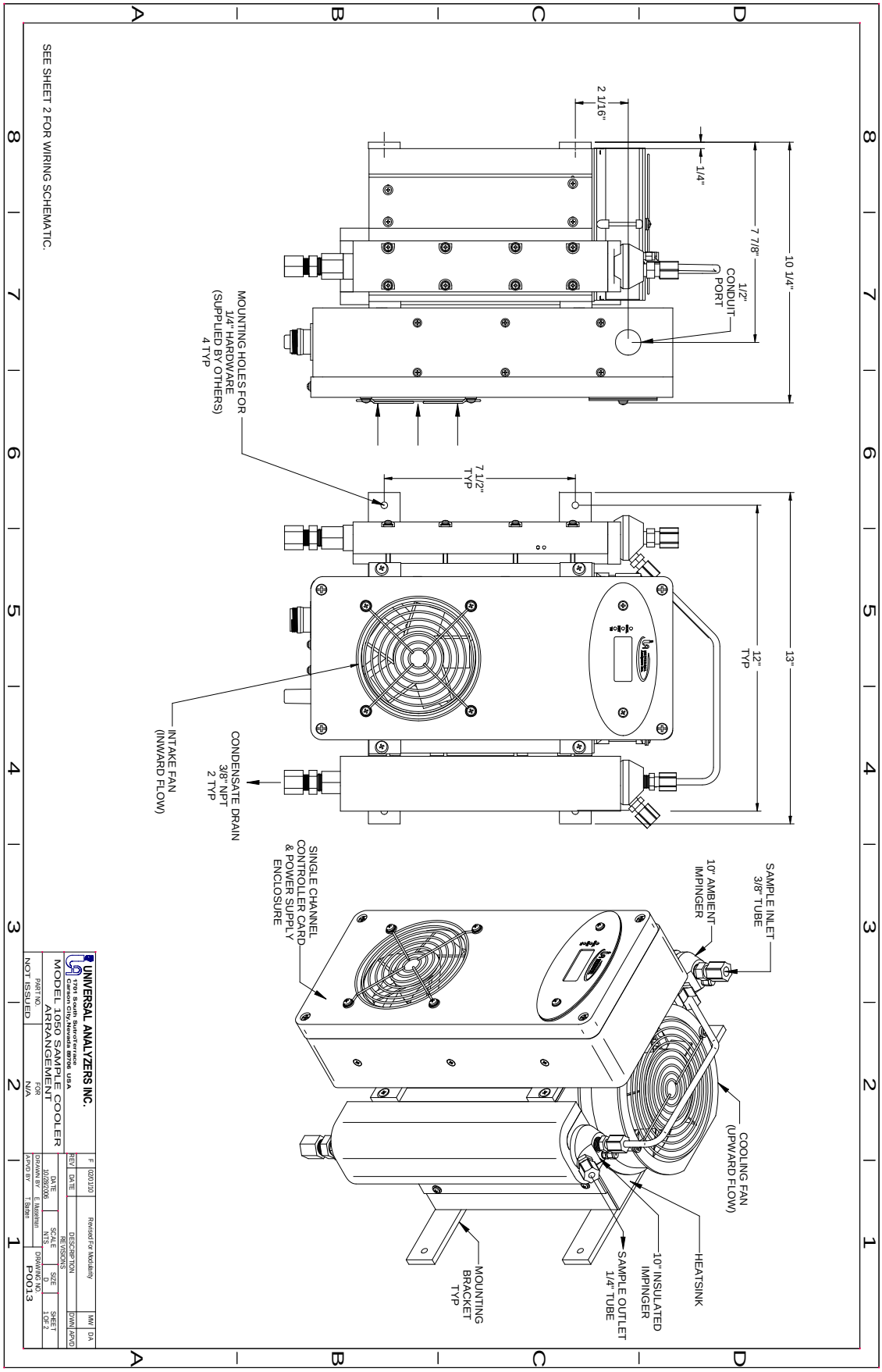
Spare Parts

Optional Parts	
Part	***P/N***
Motor, Peristaltic Pump - 120VAC 6 RPM	4958-0003
Head, Peristaltic Pump - For #15 Tubing	4958-0006
Sample Pump - 120VAC Mini Dia-VAC Alum/Teflon Single Head	4958-0025
Sample Pump - 120VAC Mini Dia-VAC Alum/Teflon Dual Head	4958-0026
WCOF Assembly - Visible Moisture Sensor/2 µm Ceramic Filter	WCOF-4980-0007
Bowl, WCOF Filter - Replacement with Cable	5205-0006
Filter Element - 2 µm Ceramic (WCOF)	4980-0007
Tube, Peristaltic Pump - 5 Feet Length #15	9216-0002
Sample Pump Rebuild Kit - Mini Dia-VAC	9515-0018
Thermocouple Kit, Heat Exchanger - “New Jersey” Type “K”	9515-0046

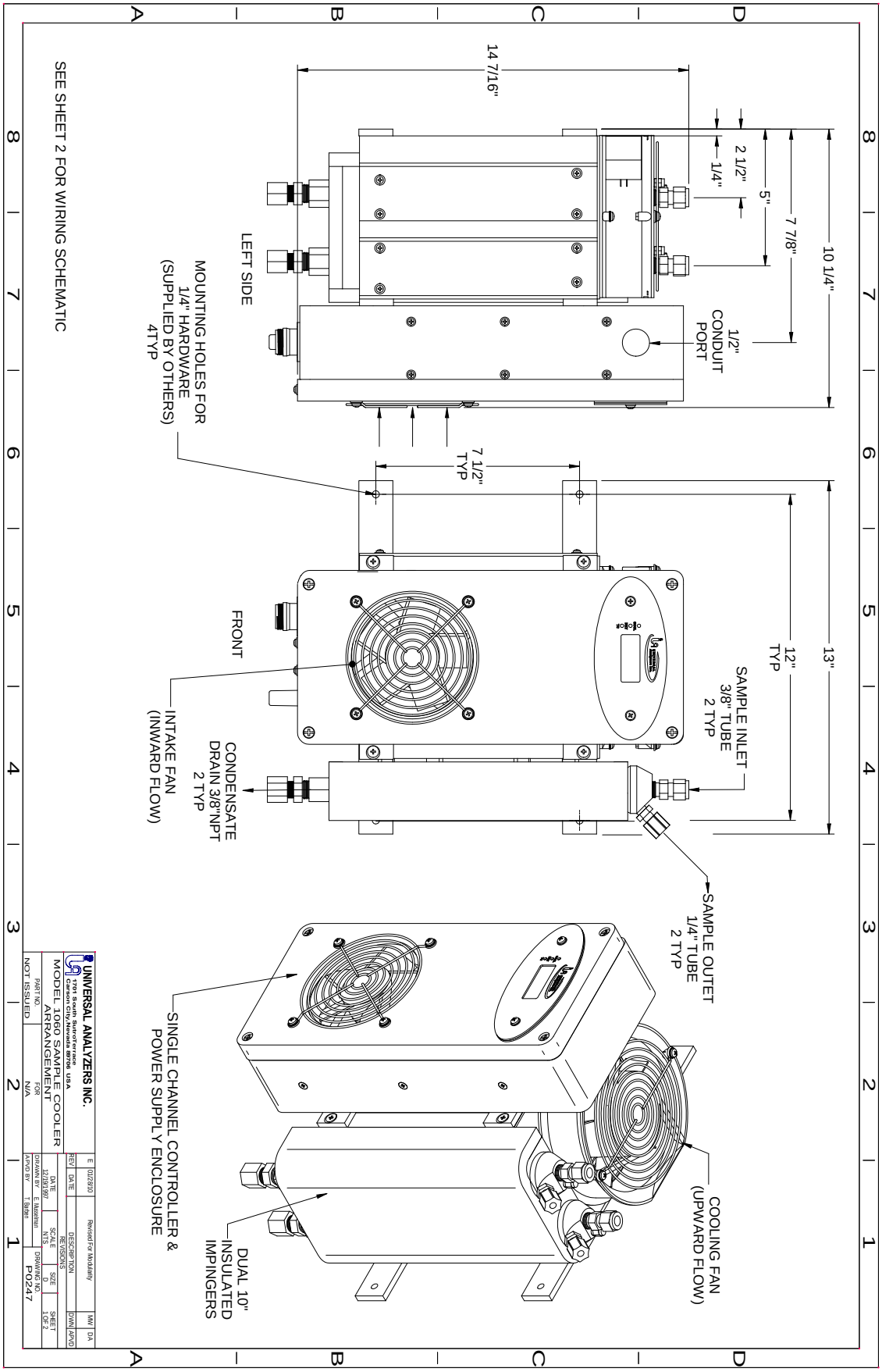
Drawings Model 1040



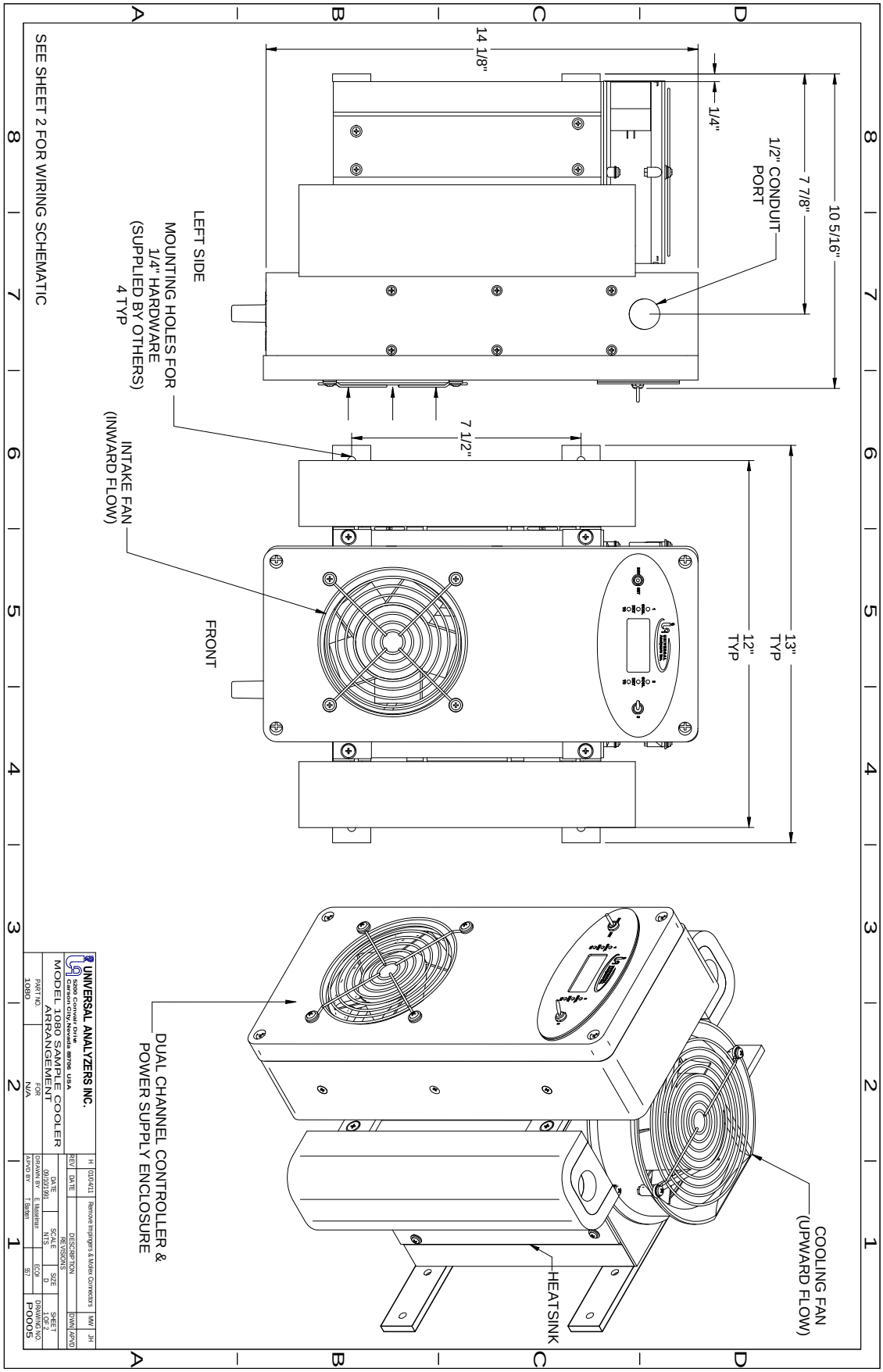
Drawings Model 1050



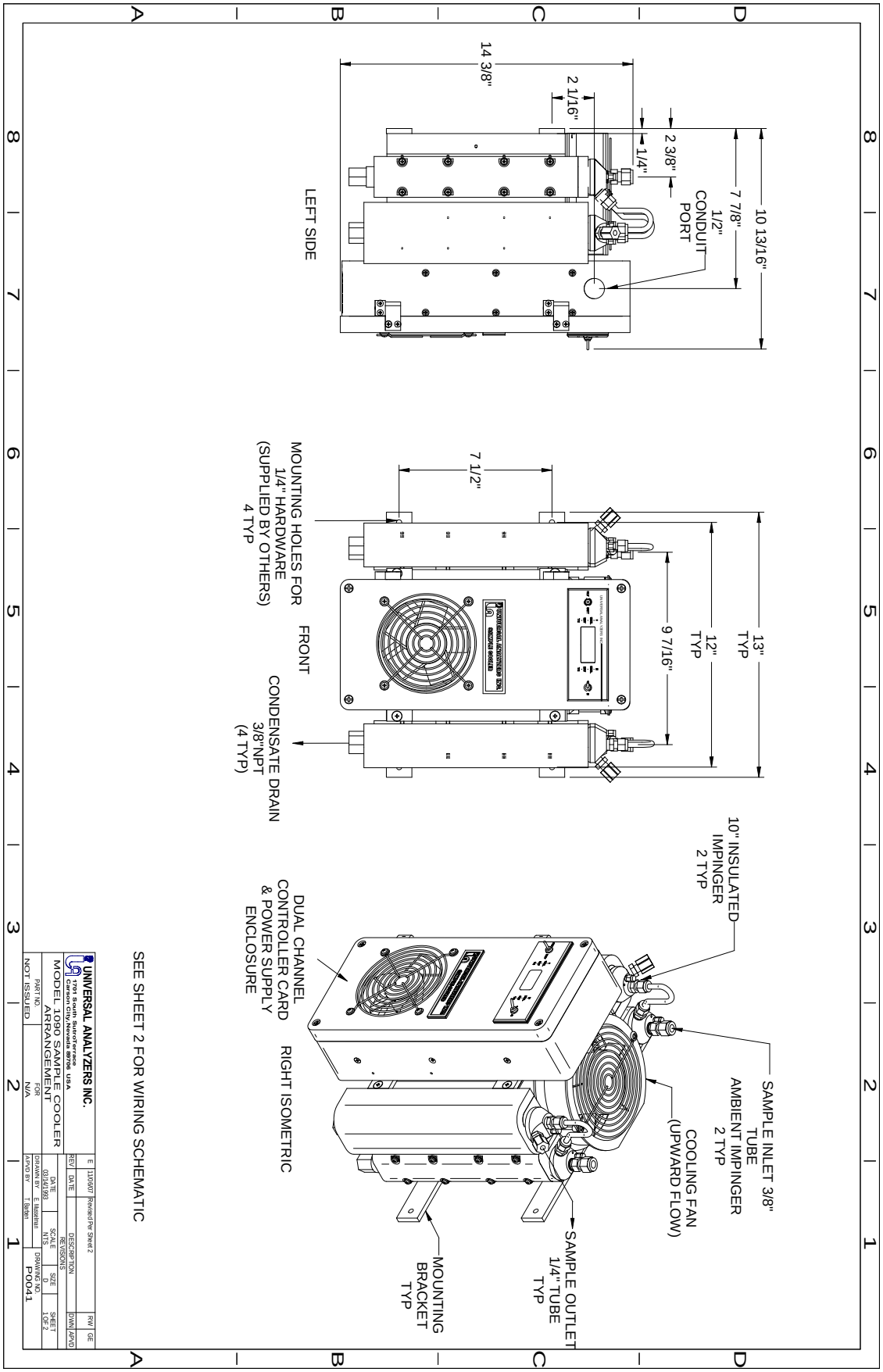
Drawings Model 1060



Drawings Model 1080



Drawings Model 1090



Limited Warranty

I. Limited Warranty

1. Limited Warranty. Universal Analyzers, Inc (UAI) offers a limited warranty on each of its products against failure due to defects in material and workmanship for a period ending the earlier of (i) fifteen (15) months from the date of the invoice relating to the sale of the product and (ii) twelve (12) months from the date of installation of the product (collectively, the "Initial Warranty"). During the Initial Warranty, UAI offers a limited warranty against failure due to defects in material and workmanship on each part of a product repaired or replaced by an authorized service person for a period ending the later of (a) the remaining term of the Initial Warranty of the product and (b) ninety (90) days from the date of such repair or replacement. After expiration of the Initial Warranty, UAI offers a limited warranty against failure due to defects in material and workmanship on each part of a product repaired or replaced by an authorized service person for a period ending ninety (90) days from the date of such repair or replacement. UAI further offers a limited warranty that the products and parts it sells will conform to UAI's written specifications therefor. The foregoing limited warranties cover parts and labor only and UAI does not warrant and will not reimburse the buyer of its products ("Buyer") for any costs relating to the access by service persons of UAI to the product at issue. The foregoing limited warranties cover only the repair or replacement of defective parts and such determination will be in the sole discretion of UAI. In its sole discretion, UAI may make repairs or replacements under these limited warranties with either new or refurbished parts. To the extent Buyer's product cannot be remedied under these limited warranties through repair or replacement of parts, Buyer may return the product for a refund of the purchase price, less a reasonable reduction in such purchase price equal to the depreciation expense incurred by Buyer relating to such product. The limited warranties of this Section I.1. are further subject to those warranty exclusions set forth below in Section I.2.

2. Limited Warranty Exclusions. Excluding the warranties provided for in Section I.1., UAI provides all products to Buyer "as-is," without any other warranty of any kind. UAI disclaims any and all express or implied warranties of merchantability, fitness for a particular purpose and non-infringement of the intellectual property of others. UAI makes no warranty, express or implied, as to the design, sale, installation or use of its products. UAI's warranties will not be enlarged by, nor will any obligation or liability of UAI arise due to UAI providing technical advice, facilities or service in connection with any product. There is no warranty by UAI with respect to any product's: (i) uninterrupted or error-free operation; (ii) actual performance, other than the product's capability to meet UAI's specifications therefor; (iii) removal or installation from a worksite or process; (iv) electronic components or associated accessories (including without limitation circuit boards and integrated circuits); (v) maintenance (including without limitation gasket and seal replacements, adjustments, minor repairs and other inspection requirements, preventative or otherwise); (vi) use under inappropriate conditions or not in accordance with operating instructions; or (vii) use in connection with the operation of a nuclear facility. There is no warranty for labor expenses associated with field repairs or the repair or replacement of defective parts in the engine or power unit of any product if such product has been in the possession of the owner or operator for greater than twelve (12) months. There is no warranty for products determined to be, in UAI's sole discretion, damaged as a result of (a) misuse, neglect or accident; (b) improper application, installation, storage or use; (c) improper or inadequate maintenance or calibration; (d) operation outside of the published environmental specification; (e) improper site preparation or maintenance; (f) unauthorized repairs or replacements; (g) modifications negligently or otherwise improperly made or performed by persons other than UAI; (h) Buyer-supplied software or supplies; (i) use in conjunction with or interfacing with unapproved accessory equipment; (j) use of ABC-style or dry powder fire suppression agents; or (k) leaked sample materials. To the extent a UAI product is used in connection with the operation of a nuclear power facility, Buyer agrees to indemnify and hold UAI harmless from any and all actions, claims, suits, damages and expenses arising from such use. UAI provides no warranty on the oral representations made by its personnel while they are attempting to assist Buyer in the operation of a product. This Standard Limited Warranty does not apply to items consumed by the products during their ordinary use, including but not limited to fuses, batteries, paper, septa, fittings, screws, fuses, pyrolysis, dryer or scrubber tubes, sample boats, furnaces or UV lamps.

3. Non-UAI Products. UAI does not in any way warrant products it does not manufacture except to the extent the warranty of the manufacturer of the product at issue passes through or is otherwise assigned to UAI. If a manufacturer warranty is so assigned to UAI, UAI will only be bound to comply with the length of time associated with such warranty. All other terms of such warranty will be governed by this Standard Limited Warranty and UAI's General Terms and Conditions incorporated herein by reference.

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4. Expenses on Non-Warranty Work. All repairs or replacements by UAI after the expiration of any applicable limited warranty period will be performed in accordance with UAI's standard rate for parts and labor. Further, if upon UAI's inspection and review, UAI determines the condition of the products is not caused by a defect in UAI's material and workmanship, but is the result of some other condition, including but not limited to damage caused by any of the events or conditions set forth in Section I.2., Buyer shall be liable for all direct expenses incurred by UAI to conduct the inspection and review of the product.

5. Exclusive Remedy. The foregoing limited warranty constitutes Buyer's exclusive remedy with respect to products sold by UAI and UAI's liability shall be exclusively limited to the written limited warranty specified herein. No employee, representative or agent of UAI is authorized to either expressly or impliedly modify, extend, alter or change any of the limited warranties expressed herein to Buyer.

6. Procedure and Costs. All limited warranty claims must be made in writing promptly following discovery of any defect. Buyer must hold defective products for inspection by UAI. If requested by UAI, Buyer must send the product to UAI for inspection. Any such returns by Buyer will be at Buyer's expense and Buyer will remain liable for any loss of or damage to the product during such product's transportation to UAI. No products will be sent to UAI for inspection unless UAI has authorized Buyer to do so.

7. Terms and Conditions. UAI's General Terms and Conditions are incorporated herein by reference and Buyer accordingly agrees to be bound by the terms thereof.

II. Limitations on UAI Liability

1. In General. Buyer agrees UAI shall not be liable for any direct, indirect, incidental, punitive or consequential damages, including lost profits, lost savings or loss of use, whether Buyer's claim is based in contract, tort, warranty, strict liability or otherwise, which Buyer may suffer for any reason, including reasons attributable to UAI. Buyer agrees these limitations on UAI's liability are reasonable and reflected in the amounts charged by UAI for its products.

2. Force Majeure. This Standard Limited Warranty does not cover and UAI shall not be liable for either direct or consequential damage caused, either directly or indirectly, as a result of: (i) any act of God, including but not limited to natural disaster, such as floods, earthquakes, or tornadoes; (ii) damages resulting from or under the conditions of strikes or riots, war, damages or improper operation due to intermittent power line voltage, frequency, electrical spikes or surges, unusual shock or electrical damage; or (iii) accident, fire or water damage, neglect, corrosive atmosphere or causes other than ordinary use.

3. Limitation on Warranty Claims. Prior to any obligation of UAI to perform any limited warranty service as set forth herein, Buyer must have: (i) paid all invoices to UAI in full, whether or not they are specifically related to the product at issue; and (ii) notified UAI of the limited warranty claim within sixty (60) days from the date Buyer knew or had reason to know of the defect