



Instruction Manual

3000 Series **Thermoelectric Gas Cooler** *(Units sold prior to 07-01-2015)*



AMETEK®

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Receiving and Storage

The Universal Analyzers 3000 Series Dual Channel or Single Channel Dual Stage Sample 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 20 A. 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

[illegible]

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

Specifications

OPERATING SPECIFICATIONS	
Sample Flow Rate	
Model 3040	0 to 6 l/m total (at STP)
Model 3050	0 to 8 l/m total (at STP)
Model 3080	Single sample mode: 0 to 10 l/m total (at STP) Dual sample mode: 0 to 12 l/m total (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	
Model 3040	180°F (82°C)
Model 3050	194°F (90°C)
Model 3080	Single sample mode: 194°F (90°C) Dual sample mode: 180°F (82°C)
Maximum Inlet Water Concentration	
Model 3040	50%
Model 3050	70%
Model 3080	Single stream mode: 70% Dual sample mode: 50%
Minimum Ambient Temperature	
Maximum Ambient Temperature	
32°F (0°C)	
105°F (41°C)*	
Maximum Cooling Power	
Model 3040	126 BTUs per hour (120 kJ/hr.)
Model 3050	126 BTUs per hour (120 kJ/hr.)
Model 3080	252 BTUs per hour (240 kJ/hr.)
Outlet Sample Dew Point	
39°F (4°C) adjustable	
Gas Sample Inlet Fitting	
3/8" tubing fitting	
Gas Sample Outlet Fitting	
1/4" tubing fitting	
Bottom Water Drain Fitting	
3/8" tubing fitting	
Dimensions (Without Accessories)	
Model 3040	18" H x 7.5" W x 11" D
Model 3050	18" H x 7.5" W x 11" D
Model 3080	18" H x 7.5" W x 11" D
Weight	
33 lbs (15kg)	
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 ABOVE 77°F. (25°C.) AMBIENT.

COOLER CAPACITY DATA												
	Ambient 77°F/25°C Water Vapor				Ambient 90°F/32°C Water Vapor				Ambient 105°F/41°C Water Vapor			
	12%	15%	30%	50%	12%	15%	30%	50%	12%	15%	30%	50%
3040	5 l/m	4 l/m	2.8 l/m	1.4 l/m	5 l/m	4 l/m	2 l/m	1 l/m	2.8 l/m	2.4 l/m	1.2 l/m	0.6 lm
3050	8 l/m	8 l/m	7 l/m	6 l/m	6 l/m	6 l/m	5.5 lm	4.5 l/m	3 l/m	3 l/m	2.5 l/m	2 l/m
3080	10 l/m	8 l/m	4 l/m	2 l/m	8 l/m	7 l/m	3.5 l/m	1.8 l/m	4.6 l/m	4 l/m	2.2 l/m	1.1 l/m

(Flow Rate, Water Vapor % and the Ambient Temperature are the three main factors to consider when sizing a gas cooler.)

Description and Principle of Operation

APPLICATION

The Universal Analyzers 3000 Series Gas Sample Coolers are designed to be installed in a sample system where the gas sample contains moisture to be removed. They have an option to be installed in hazardous locations or unclassified locations.

The 3000 Series Coolers are designed as standalone equipment that does not require integration onto a panel. They are also designed for minimal maintenance.

The 3000 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 3000 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 3000 Series Gas Sample Coolers are Thermoelectric Coolers consisting of Peltier Thermoelectric Elements, control electronics, a heat sink, peristaltic pump motor, and blower fan assembled in a NEMA Type 1 Enclosure designed for mounting of optional equipment. The optional equipment consists of drain options, water carry over sensor, sample pump, flow meters, as well as different materials for the impingers (water removal columns) depending on the application.

The 3000 Series Coolers operate by condensing the water from a wet gas sample to a dew point of 4°C with a minimal loss of water soluble gas 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 3040 has a single transfer block with two thermoelectric elements, a model 3050 has an ambient temperature transfer block and an active transfer block with two thermoelectric elements, and a model 3080 has two active transfer blocks for a total of four Thermoelectric Elements. The temperature is measured using an AD592 semiconductor temperature sensing device. This temperature is controlled to 4°C with a variance of one degree.

The Thermoelectric Elements create a temperature differential between the two sides of element when power is applied. This creates a cool side that cools the impinger and a hot side where the heat is discharged through a heat sink with a centrifugal drum blower forcing air through the heat sink.

The 3000 Series Sample Coolers have a digital display on the front panel indicating the operating temperature (in degrees C) of the heat exchangers. In addition, there are two green 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.

Description and Principle of Operation

There are two alarm relays in the 3000 Series Sample Coolers. There is a relay with wetted contacts that will have the system voltage present and a relay with dry contacts for customers to provide their own signals. They are both triggered by either the moisture alarm or the temperature alarm.

The optional water carry over sensor with filter (WCSF) provides the opportunity to detect if moisture has traveled past the cooler and alarms to indicate a problem with a part of the sample system (possibly but not limited to the cooler). The WCSF consists of a coalescing filter (ceramic standard), transparent bowl, and capacitive sensor. The capacitive sensor allows for detection of any liquid or solid that has passed into the transparent bowl, including distilled water with no ions present.

The standard drain, a peristaltic pump, is a positive displacement pump that allows for use in either a pressure or vacuum sample. It provides for easy leak detection but does require periodic maintenance in replacement of the tubing. 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.

A Sample Pump is offered as an option that is recommended for most applications to draw the sample from the point of extraction. Universal Analyzers uses a diaphragm pump for this purpose that is designed for reliability and minimal maintenance. The pump will draw the amount of sample required for the analyzer plus any bypass flow that may be desired to increase response time. When chosen as an option the pump has a sample pressure controller that is set at 10 PSI. When the ATEX option and the sample pump option is chosen an internal 140°C over-temperature switch in the pump is wired to shut power off to the pump to prevent damage. Operation will resume once the temperature has lowered to a safe level.

The final option in the sample stream offered is a flow meter with a flow control needle valve. This is offered in a variety of common desired flow ranges.

Installation



TO COMPLY WITH HAZARDOUS AREA STANDARDS, UNIT MUST BE INSTALLED IN A MINIMUM IP54 ENCLOSURE AND PROTECTED FROM DUST/ WATER INGRESS. ADEQUATE VENTILATION MUST BE PROVIDED FOR DISSIPATION OF A MINIMUM OF 1200 BTU/hr (1265 kJ/hr)

Universal Analyzers 3000 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 3000 series sample cooler has mounting taps on the top and bottom to allow it to be wall mounted or mounted to rails in an instrument rack. Accessories mounted on the side can be supported by the mounting flange on the cooler.

Sample tubing should be brought to the front heat exchanger. 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. Unless integrated options are ordered.

The flow path option is a flow meter with adjustable needle valve. The customer connection is a 1/4" Kynar tubing fitting on the exit (top) of the flow meter.

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.

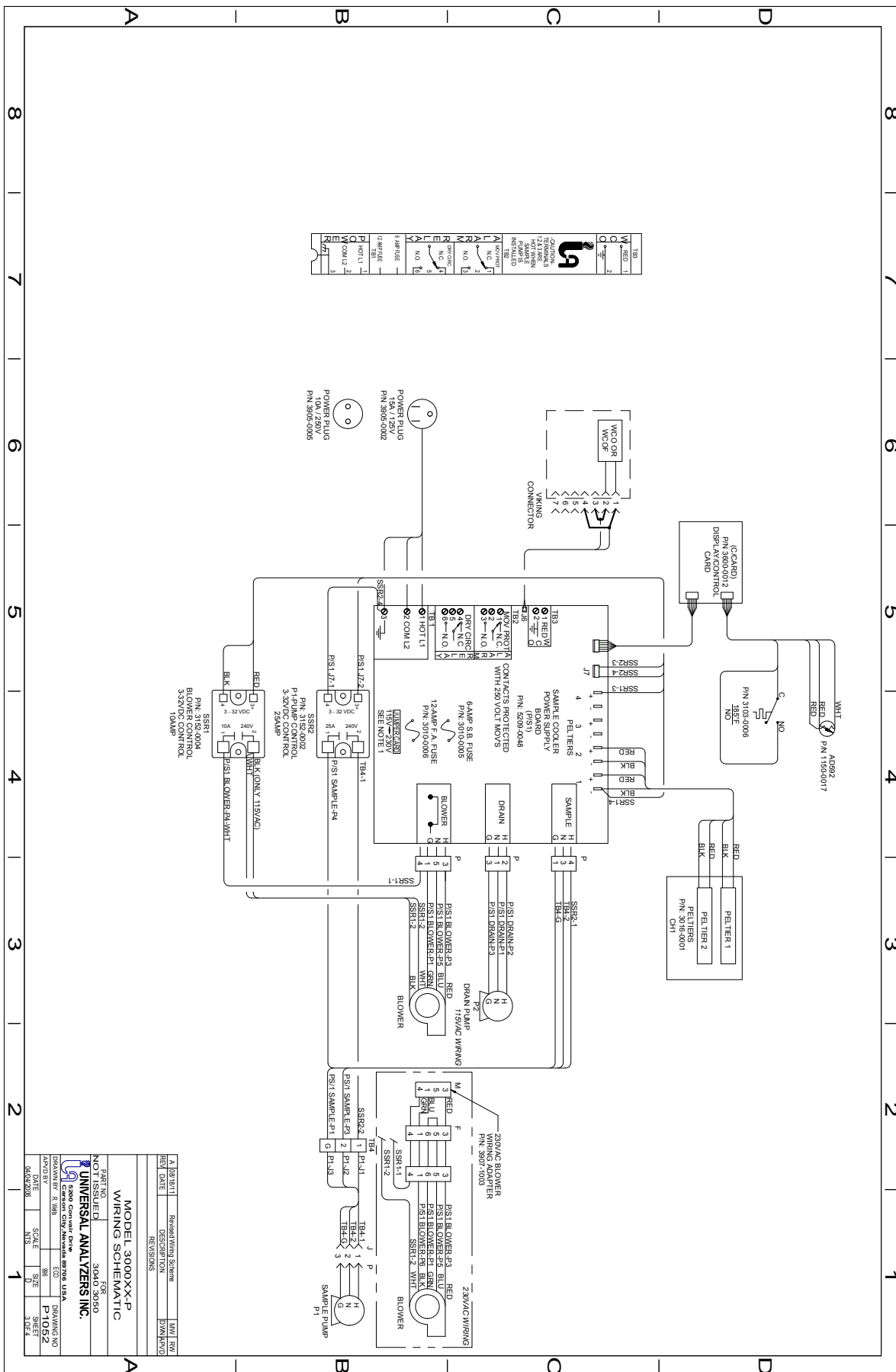
If an eductor is utilized to remove the condensate, the outlet tube length should be no longer than two feet in order to keep too much back pressure from the outlet of the eductor. The outlet tube can be placed in a larger pipe to channel the condensate to a drain.

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.

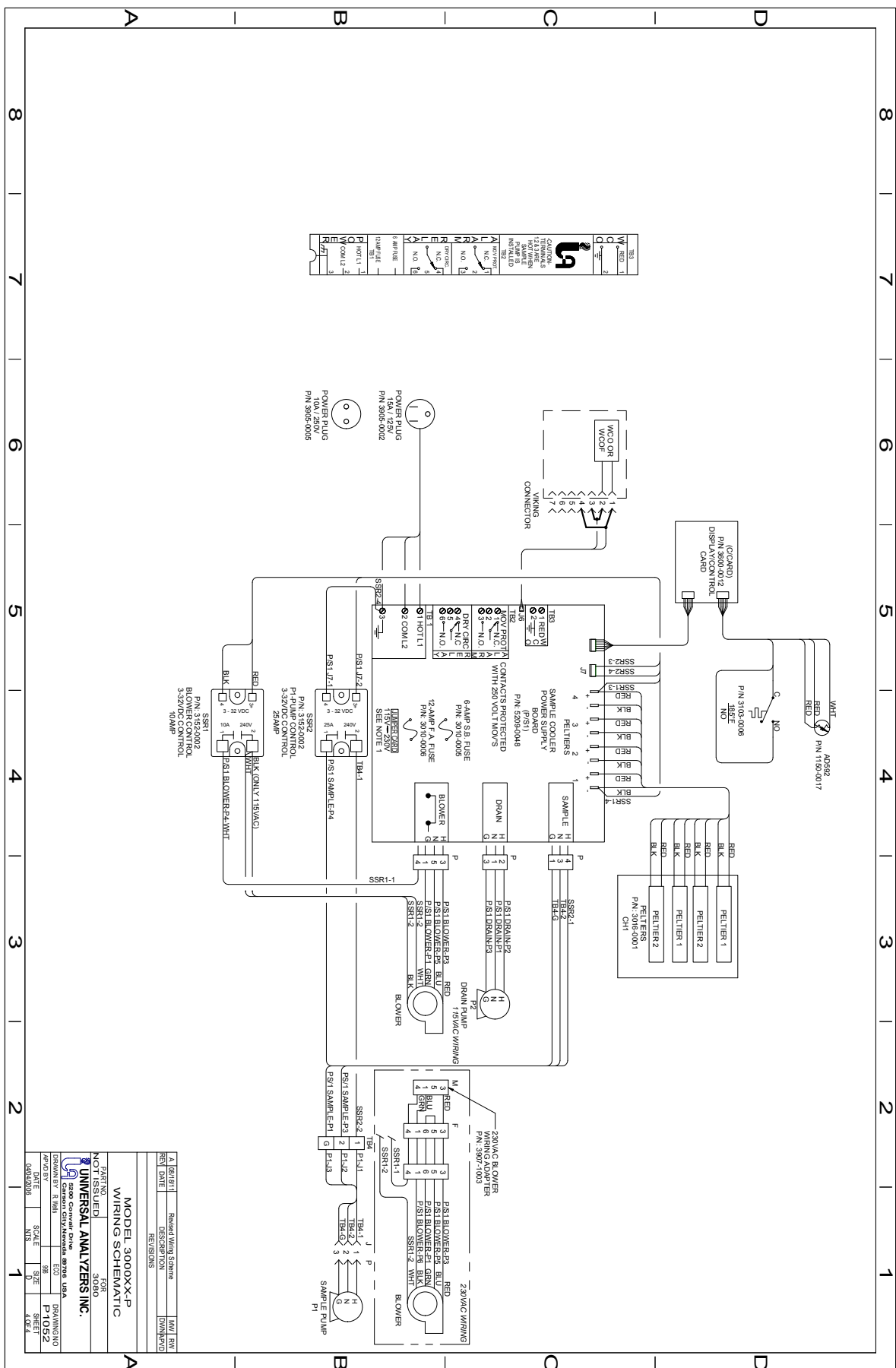


NOTE: THE SUPPLY POWER CIRCUIT MUST INCLUDE AN OVERPROTECTION DEVICE WITH A MAXIMUM RATING OF 20A. A DISCONNECT SWITCH MUST BE LOCATED IN CLOSE PROXIMITY TO THE COOLER. IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED PER CLAUSE 5.4.4(I) IN STANDARD EN 61010-1.

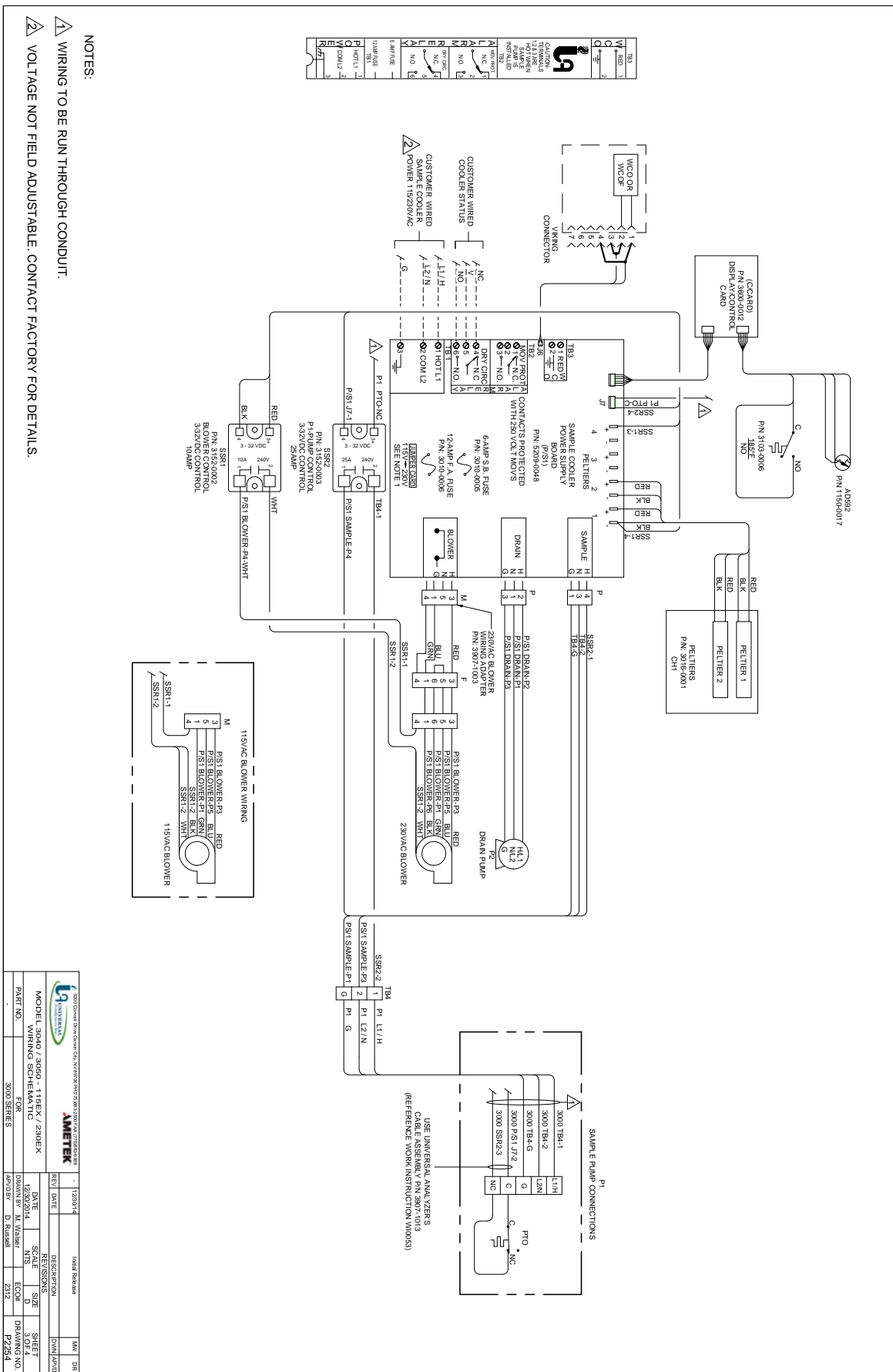
Electrical Connections Models 3040, 3050, 3080



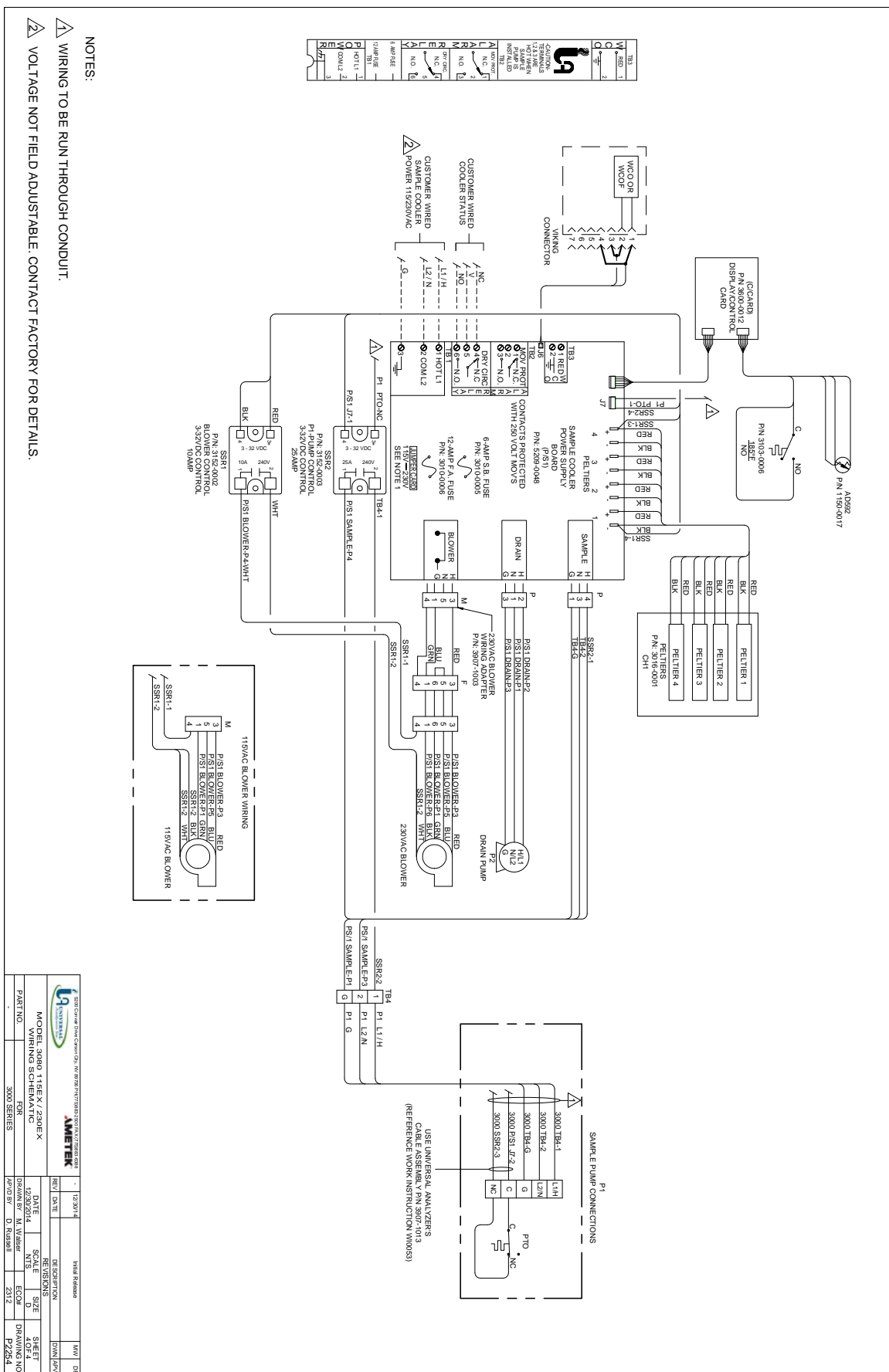
Electrical Connections Models 3040, 3050, 3080



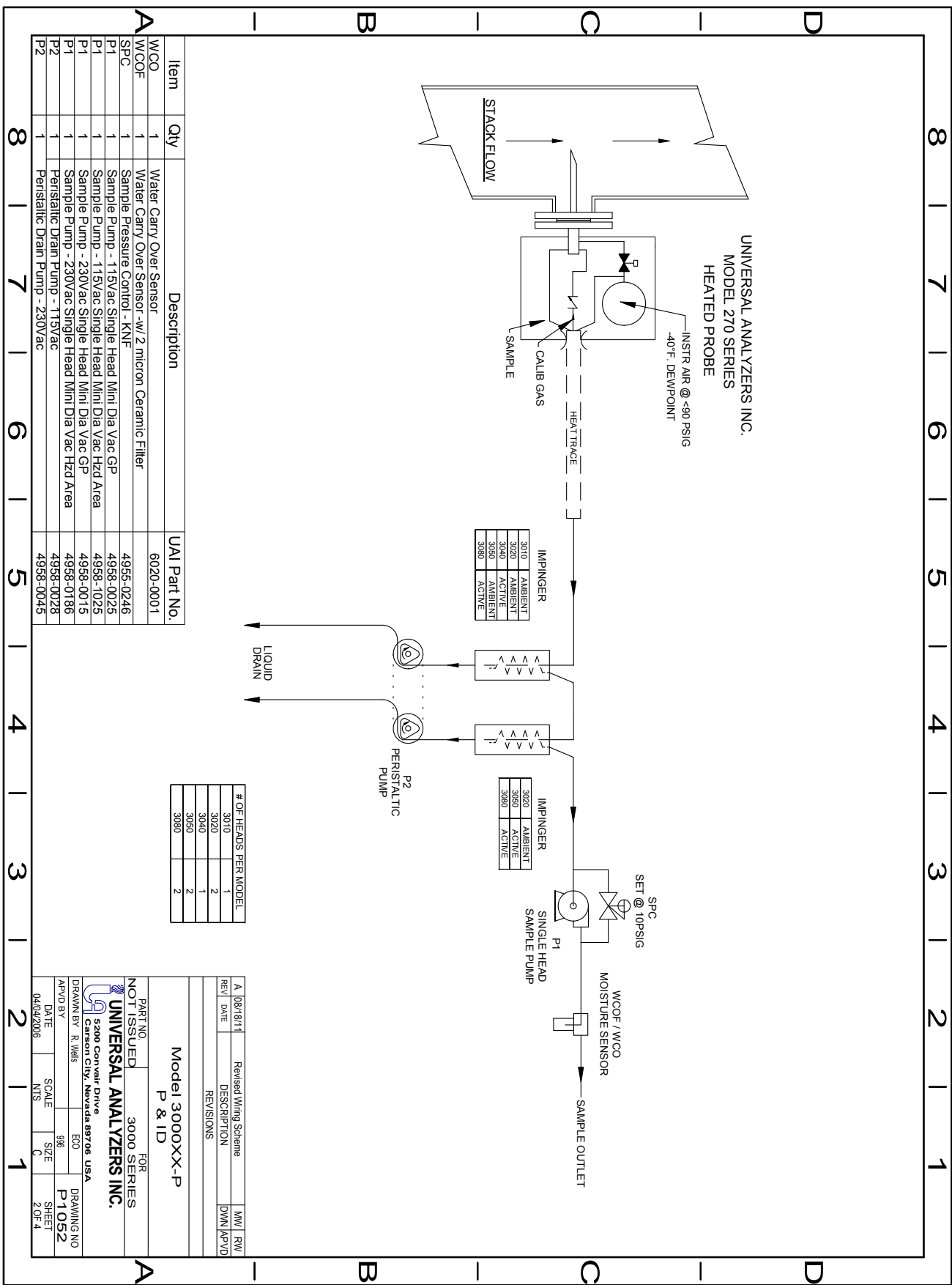
Electrical Connections Models 3040, 3050, 3080



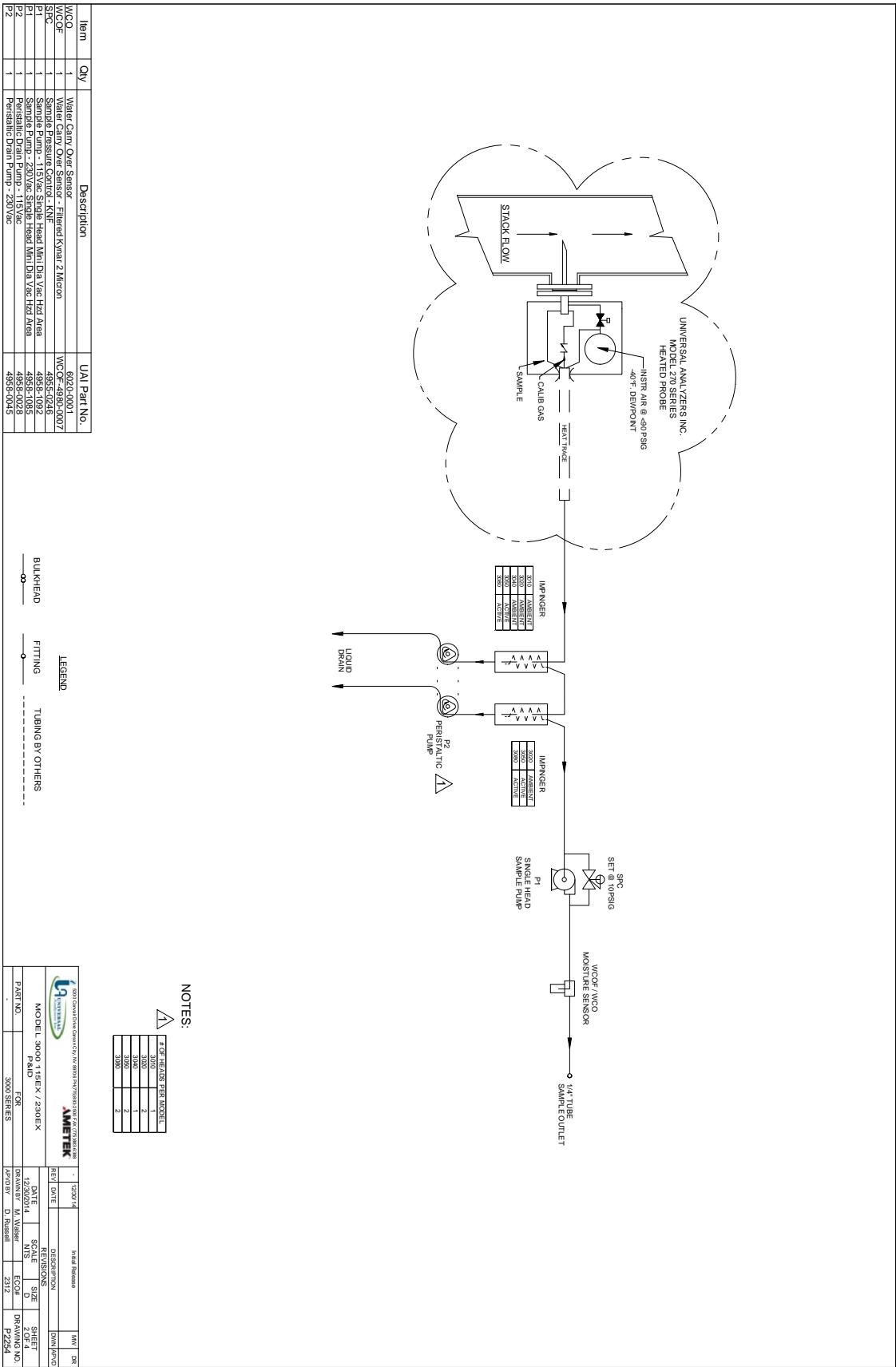
Electrical Connections Models 3040, 3050, 3080



Process and Piping Connections Models 3040, 3050, 3080



Process and Piping Connections Models 3040, 3050, 3080



Start-Up



NOTE: IT IS IMPORTANT THAT THE HEATED PROBE AND HEATED SAMPLE LINE SHOULD BE AT OPERATING TEMPERATURE BEFORE STARTING THE CHILLER AND SAMPLE PUMP

Apply power to the Universal Analyzers 3000 Series Sample Cooler. The indicated temperature will start to drop immediately. It should be below the over-temperature alarm point in approximately four minutes and the "COOL" green LED lamp should light. When the temperature reaches the control set point, the rate at which the temperature drops will be reduced. The temperature will stabilize within 1°C of the control set point.

If the optional sample pump is ordered, it will activate once the temperature has reached <10°C. If the optional flow meter is ordered, adjust the flow control valve to the desired flow rate. Water should be observed to be removed from the bottom of each heat exchanger when steady state conditions are established. The green "DRY" LED light will be active.

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. The outlet tube length should be no longer than two feet. The outlet tube can be placed in a larger pipe to channel the condensate to a drain.

Turn on the analyzer(s) and initiate the calibration cycle.

Shutdown

Disconnect the heated sample line. Allow the cooler to run for several minutes to remove any remaining possibly hazardous condensate from the impingers. 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
Peristaltic Pump	Replace Tubing every 3 months
Clean Heat Exchanger	Annually
Inspect Heat Sink Fins	Monthly

REPLACEMENT OF PERISTALTIC TUBING (IF EQUIPPED)

1. Please refer to manufacturer's website for instructions: <http://bit.ly/1zfmrzt>
2. YouTube: <http://bit.ly/1MPLUJO>

REPLACEMENT OF SAMPLE PUMP DIAPHRAGM

Please refer to manufacturers website for instructions: <http://www.airdimensions.com>

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 (not valid for the starting-up period of cooler).

Error	Possible reason	Check/Repair
Water carry over	<p>Overloading of the refrigeration capacity of the cooler due to too much water vapor or too great a sample flow rate</p> <p>An air leak in the condensate removal tubing</p> <p>Failure of the sample cooler</p> <p>The cooler is not cold enough</p> <p>Inadequate drain apparatus or a fault in the condensate removal equipment. The heat exchanger has become full of condensate</p> <p>Excessive flow rate</p> <p>High ambient temperature</p> <p>Defective cooler</p>	<p>Reduce flow rate</p> <p>Verify moisture content of sample and compare to operating specifications on page 6</p> <p>Verify drain tubing is unobstructed and equipment is functioning satisfactory</p> <p>Reduce the flow rate</p> <p>Reduce the ambient temperature (Increase ventilation or relocate cooler)</p> <p>Verify air flow across the heat sink</p> <p>Hold hand in front of heat sink fins and ensure air movement</p>
No sample gas flow	<p>Heat exchanger plugged</p> <p>Alarm shutoff</p> <p>No power on cooler</p>	<p>Check for an obstruction</p> <p>Remove heat exchanger from unit and disassemble</p> <p>Verify cool & dry indicators are illuminated</p> <p>Ensure cooler has power supplied</p>
High oxygen readings/ low pollutant readings	<p>Leak</p> <p>Defective peristaltic pump tubing</p> <p>Broken or leaking heat exchanger</p>	<p>Loose connection</p> <p>Verify all fittings are leak free</p> <p>Replace tubing</p> <p>Remove heat exchanger and replace if broken or repair (replace O-Ring) if leaking</p>
'DRY' light is not illuminated	<p>Water carry over</p> <p>Faulty water carry over IC</p>	<p>See "water carry over" error</p> <p>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</p>

Troubleshooting

'COOL' light is not illuminated	<p>Ambient temperature too high flow rate/ water content too high</p> <p>Failed peltier element</p>	<p>Reduce the ambient temperature (Increase ventilation or relocate cooler)</p> <p>Lower the flow rate through the cooler and observe the results. If condition corrects itself, consult the factory for further troubleshooting</p> <p>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</p>
Power only on drain pump	<p>Blown fuse (F1)</p> <p>Defective transformer (T1)</p>	<p>Replace fuse</p> <p>Replace power supply board</p>

Spare Parts

Consumable Parts	
Part	P/N
Peristaltic Pump Tubing, #15, 5 ft. length	9216-0002
6 amp Slow Blow Fuse for 3000 Series Power Supply	3010-0005
12 amp Fast Acting Fuse for 3000 Series Power Supply	3010-0006

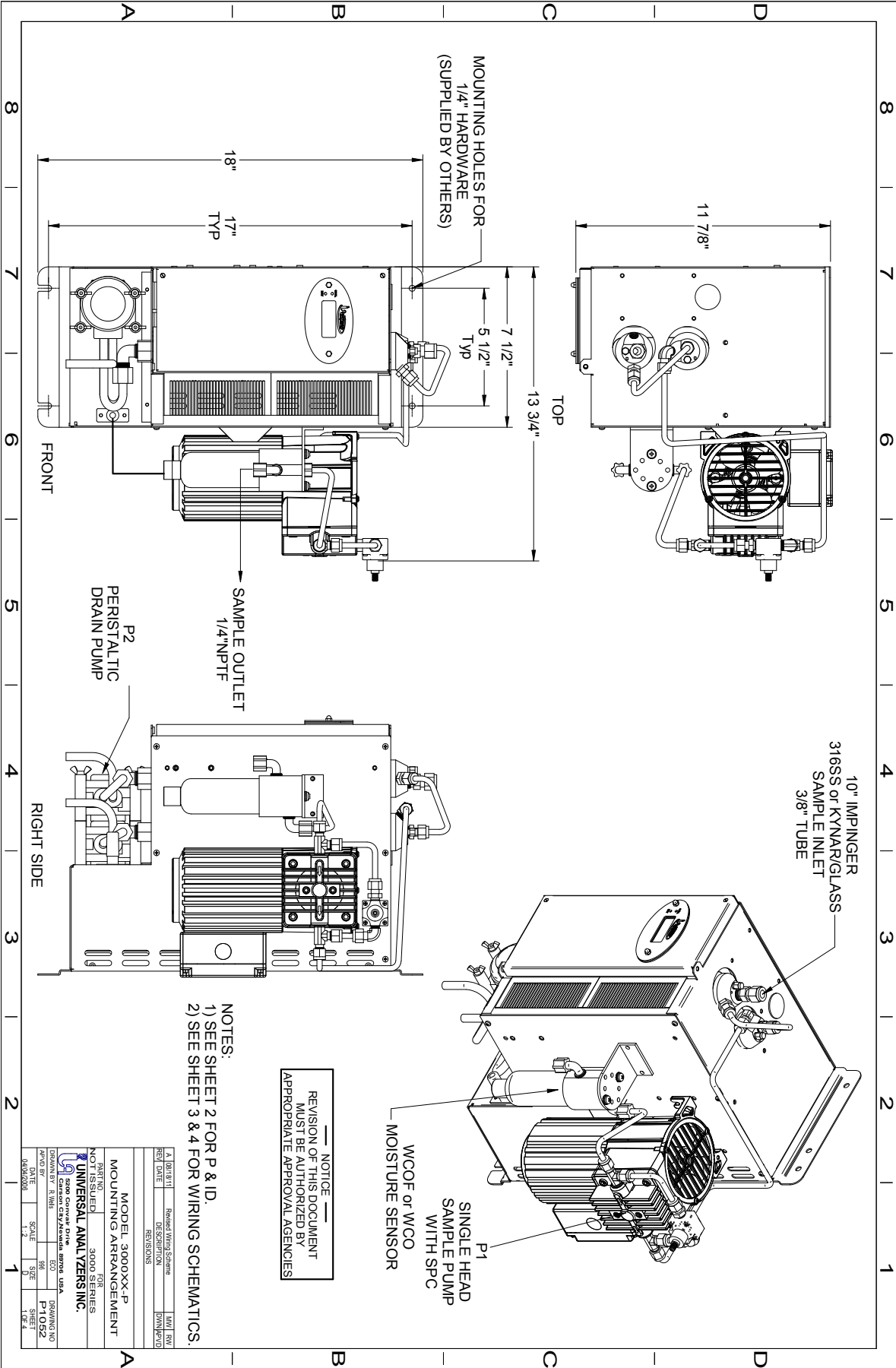
Basic Parts	
Part	P/N
Heat Exchanger/Impinger - 316SS 10"	5200-S010
Heat Exchanger/Impinger - Glass/Kynar 10"	5200-K010
Glass Tube, Outer - Heat Exchanger Replacement 10"	5201-0001
O-Ring, 316SS Heat Exchanger - Viton 2-021	4904-0013
O-Ring, Glass/Kynar Heat Exchanger - Viton 2-018	4904-0003
O-Ring, Glass/Kynar Heat Exchanger - Viton 2-120	4904-0004
Paste, Heat Sinking - 0.1 Ounce Container	8010-0001

Critical Parts	
Part	P/N
Peltier Element, Pair - 15VDC 8.5 Amp 40mm Sq.	3016-0002
Temperature Limit Switch, 185°F	3103-0006
Solid State Relay, 3-32VDC / 240VAC 10 Amp (Blower Motor)	3152-0004
Power Supply Board - 15VDC 500 Watt	3600-0011
Controller Circuit Board	3600-0012
Peristaltic Pump Head, #15	4958-0006
Peristaltic Pump Motor, 115VAC 6 RPM	4958-0028
Peristaltic Pump Motor, 230VAC 12 RPM	4958-0045
Blower & Motor - Squirrel Cage 115VAC	5209-0049
Blower & Motor - Squirrel Cage 230VAC	5209-0099
Insulation Kit - Heat Transfer Block (Model 3040 & 3050)	9515-0042
Insulation Kit - Heat Transfer Block (Model 3080)	9515-0023
Temperature Sensor Assembly, AD592	1150-0017

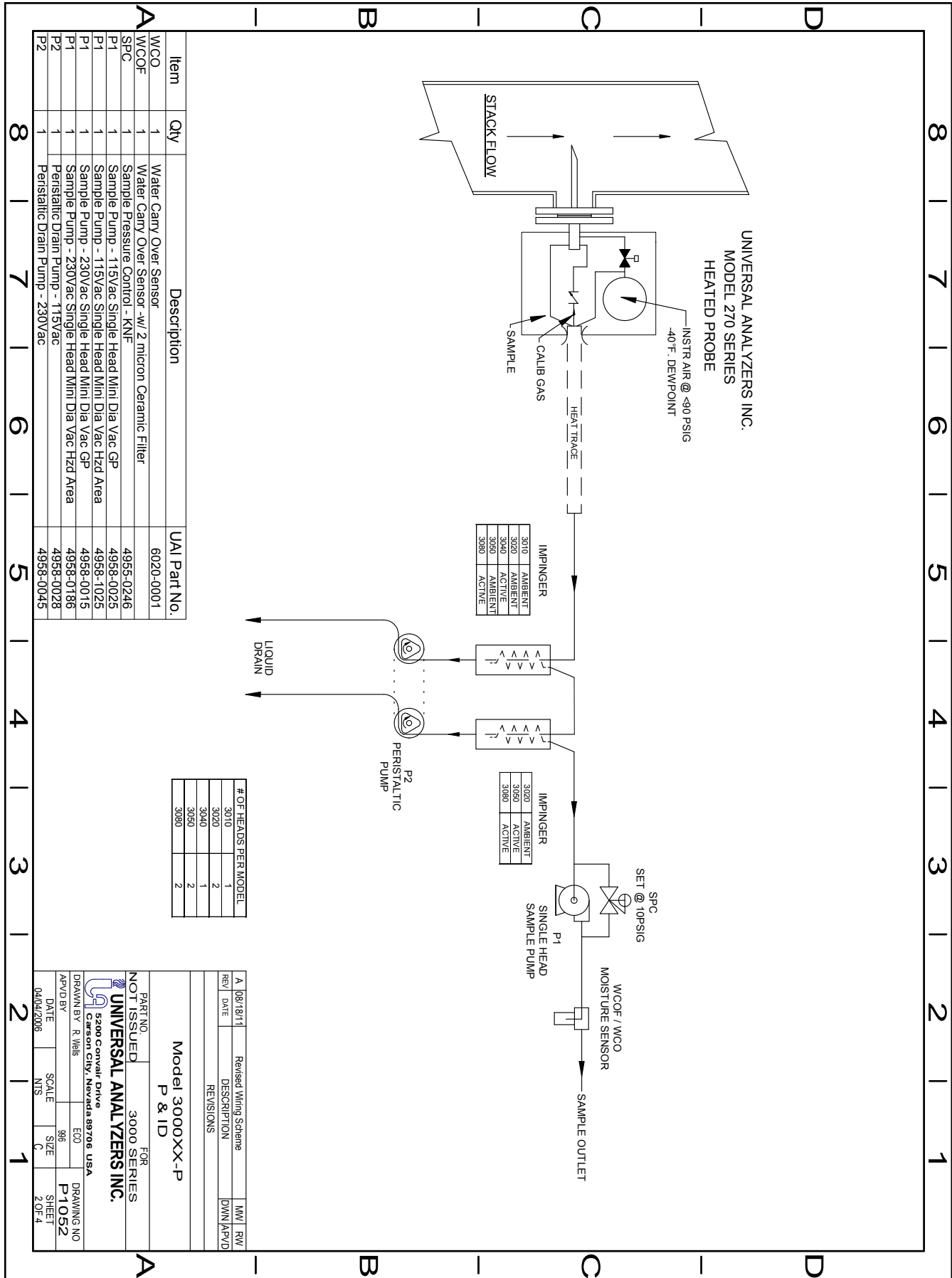
Spare Parts

Optional Parts/Accessories	
<i>Part</i>	<i>P/N</i>
Solid State Relay, 3-32VDC / 240VAC 25 Amp (Sample Pump)	3152-0002
WCOF Assembly - Moisture Sensor/2 µm Ceramic Filter	WCOF-4980 0007
O-Ring, WCOF Bowl - Viton 2-030	4904-0006
Sample Pump - 115VAC Mini Dia-VAC Alum/Teflon Single Head	4958-0025
Sample Pump - 230VAC Mini Dia-VAC Alum/Teflon Single Head	4958-0015
Sample Pump - 115VAC Mini Dia-VAC Alum/Teflon Dual Head	4958-0026
Sample Pump - 230VAC Mini Dia-VAC Alum/Teflon Dual Head	4958-0016
Sample 1 Head Teflon coated Aluminum/FM 115V Class I, Div. 2 Approved	4958-1025
Sample Pump Rebuild Kit - Mini Dia-VAC (for Single Head)	9515-0018
Sample Pressure Control, 3-36 PSI Adjustable	4955-0246
Filter Element - 2 µm Ceramic (WCOF)	4980-0007
Thermocouple Kit, Heat Exchanger - "New Jersey" Type "K"	9515-0046
Thermocouple Kit, Heat Exchanger - "New Jersey" Type "J"	9515-0047
Thermocouple Kit, Heat Exchanger - "New Jersey" Type "T"	9515-0048
Condensate Drain Kit - Automatic (Models 3050 & 3080)	9515-0100
Condensate Drain Kit - Automatic (Models 3040)	9515-0101
Portable Leg Kit (3000 Series)	9515-0019

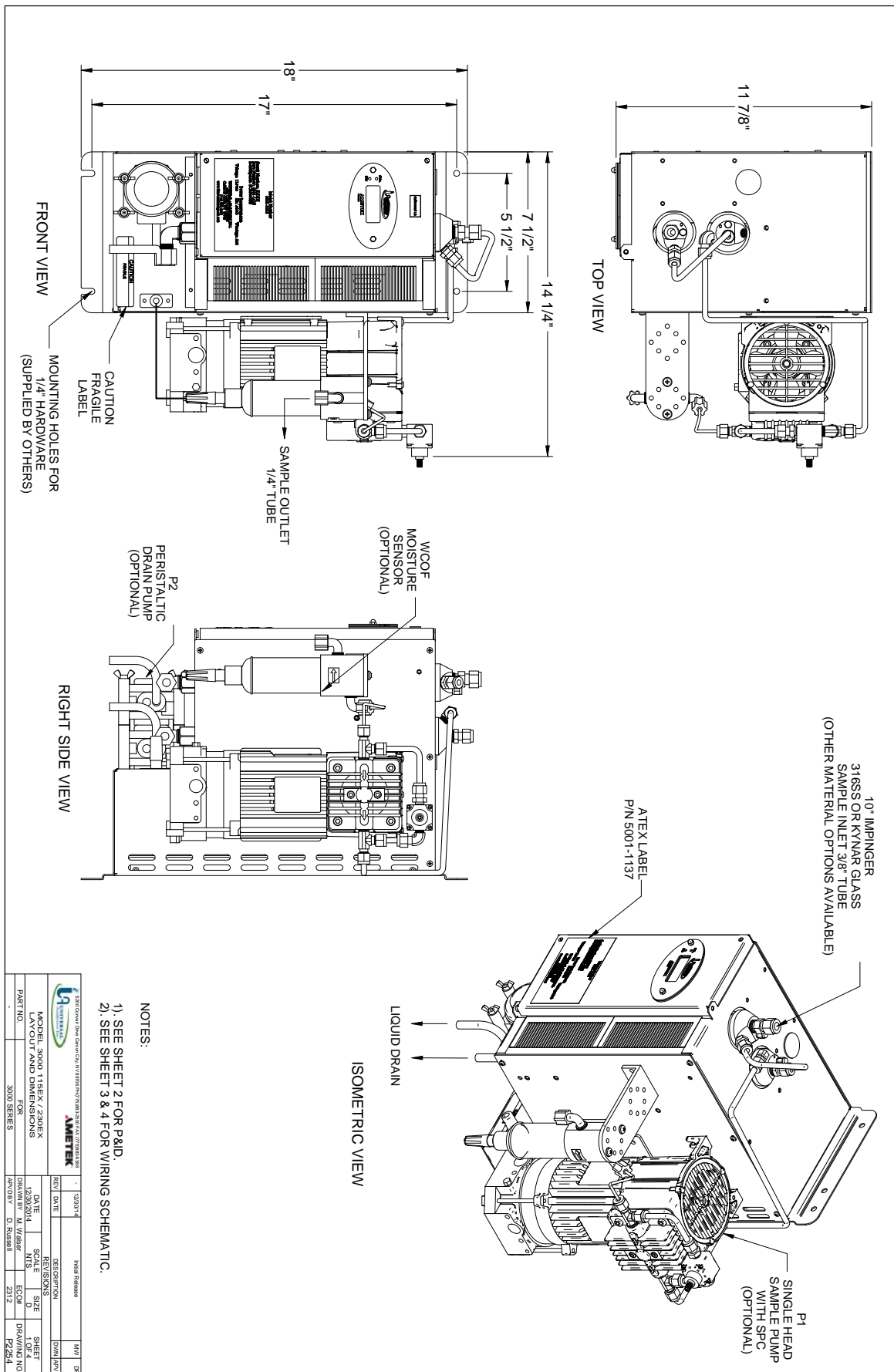
Drawings Models 3040, 3050, 3080



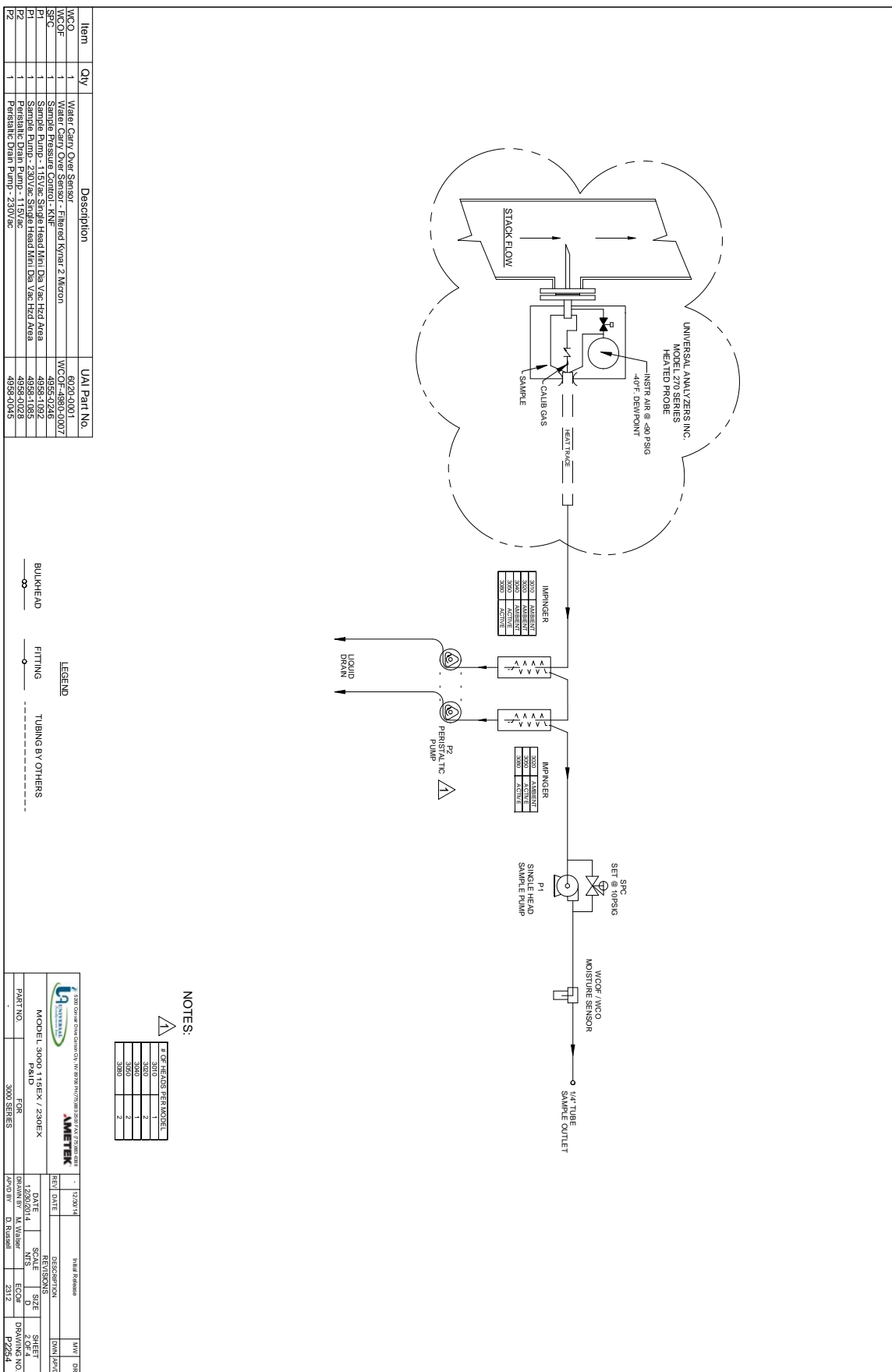
Drawings Models 3040, 3050, 3080



Drawings Models 3040, 3050, 3080



Drawings Models 3040, 3050, 3080



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



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