



# *Instruction Manual*

## **1100 Series** *Vortex Gas Cooler*



**AMETEK**<sup>®</sup>

5200 Convair Drive Carson City, NV 89706 • Phone: 775-883-2500 • Fax: 775-883-6388 • [www.universalanalyzers.com](http://www.universalanalyzers.com)

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# Receiving and Storage

The Universal Analyzers 1100 Series Vortex Gas Coolers are a complete assembly. No assembly is necessary when received on-site.

Carefully inspect the product and any special accessories included with it immediately upon arrival by removing them from the packing and checking for missing components 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



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.

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

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SURFACE OF A VORTEX TUBE CAN BECOME HOT AND COLD AFTER PROLONGED USE. ALLOW TUBE TO COME TO ROOM TEMPERATURE BEFORE TOUCHING.

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AS WITH ANY PRESSURIZED DEVICE, ENSURE THE COMPRESSED AIR HAS BEEN SHUT OFF AND PRESSURE DISSIPATED BEFORE ANY MAINTENANCE PROCEDURES.

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

# Specifications

<b>OPERATING SPECIFICATIONS</b>	
<b>Sample Flow Rate</b>	
Model 1140	0 to 5 l/m total (at STP)
Model 1160	0 to 8 l/m total (at STP)
Model 1190	Two Impingers: 0 to 15 l/m total (at STP) One Impingers: 0 to 8 l/m total (at STP)
<b>Maximum Inlet Temperature</b>	
Stainless Steel Heat Exchanger	700°F (351°C)
Kynar/Glass Heat Exchanger	280°F (138°C)
<b>Maximum Inlet Gas Dewpoint</b>	178°F (82°C)*
<b>Maximum Inlet Water Concentration</b>	50%*
<b>Minimum Ambient Temperature</b>	34°F (1°C)
<b>Maximum Ambient Temperature</b>	105°F (41°C)*
<b>Maximum Cooling Power</b>	
Model 1140	110 BTUs per hour (105 kJ/Hr.) (at 100 to 150 psig air pressure)
Model 1160	260 BTUs per hour (247 kJ/Hr.) (at 100 to 150 psig air pressure)
Model 1190	400 BTUs per hour (380 kJ/Hr.) (at 100 to 150 psig air pressure)
<b>Outlet Sample Dew Point</b>	41°F (5°C)
<b>Gas Sample Inlet Fitting</b>	3/8" tubing fitting
<b>Gas Sample Outlet Fitting</b>	1/4" tubing fitting
<b>Bottom Water Drain Fitting</b>	3/8" tubing fitting
<b>Compressed Air Requirement</b>	
<b>Maximum Pressure</b>	250 psig (17.2 bar)
Model 1140	4 CFM @ 100 psig
Model 1160	10 CFM @ 100 psig
Model 1190	15 CFM @ 100 psig
<b>Dimensions</b>	
Model 1140	16" H x 12" W x 8" D
Model 1160	16" H x 14" W x 8" D
Model 1190	16" H x 14" W x 8" D
<b>Weight</b>	20 lbs (9kg)
<b>Soluble Gas Removal Rates</b>	NO            0% loss NO <sub>2</sub> <10% loss SO <sub>2</sub> < 2% loss CO            0% loss CO <sub>2</sub> < 2% loss

\* AT REDUCED FLOW RATE

# Description and Principle of Operation

## DESCRIPTION

The Universal Analyzers 1100 Series Vortex Gas Coolers cools the sample through the use of a vortex tube. Clean dry compressed air, preferably Instrument Air, supplied by the plant passes through a "generator" within the vortex tube which separates the high velocity molecules from the low velocity molecules to provide cold air within the sample cooler to remove the heat from the sample. Three square feet of heat transfer surface, inside the cooler transmits the heat from the gas sample, heating the cold air.

The key to the success of the Universal Analyzers Sample Cooler being able to condense the water from a wet gas sample with a minimal loss of the water soluble gas fraction, is due to the design of the heat exchanger. The separation occurs in a classical impinger which has a highly polished cylindrical surface cooled to the desired dew point temperature. The gas sample is brought to the bottom of the cylinder through an insulated tube and allowed to rise through a narrow annular area 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 internal, three square ft. heat sink is constructed from anodized pure aluminum fins which carry and transfer heat to the air which is directed at the heat sink by the vortex tube. The pure aluminum material is a far better conductor of heat than the aluminum alloys which are normally used for extruded heat sinks. The result is an assembly which has superior heat exhausting capabilities.

A thermal valve is supplied as a control valve to limit the air supply when the heat transfer block containing the sample heat exchangers approached freezing. The thermal valve is operated with a thermal bulb located within the heat transfer block and connected with a capillary tube. The control valve is a non electric valve which is actuated by the fluid within the thermal bulb. Since it is non electric, it can be used in Division 1 or 2 hazardous areas.

# Description and Principle of Operation

## APPLICATION

In order to sample combustion product stack gas or exhaust from Internal Combustion (IC) engines, a method to remove moisture from the sample without removing gas components of interest is a must. The Universal Analyzers 1100 Series Vortex Gas Coolers is an ideal way to decrease the dew point of combustion gasses to a repeatable, stable, constant low dew point. The 1100 Series Coolers prevent water condensation in sample prefilters, sample pumps, and gas analyzers. For gas analyzers where water vapor is an interferent, a stable, repeatable dew point becomes a part of the gas analyzer's performance specification. The 1100 Series Cooler provides this constant water concentration resulting in an accurate analysis of the components of interest.

The gas sample to be analyzed is brought to the sample cooler, first through a sample probe which usually contains a heated filter, and then through a heated sample line which keeps the sample above its dew point. The 1100 Series Cooler then condenses water from the sample which lowers the dew point to 5°C (41°F). Particulate matter which escaped being filtered by the heated stack filter and which passes through the sample cooler can be removed by a visible sample prefilter, available from Universal Analyzers, located downstream from the sample cooler.

A gas sample pump should be provided as part of the sampling system. If the sample pump is placed ahead of the sample cooler, it should be provided with a heated head to avoid the condensation of water vapor due to the pump being below the dew point temperature of the sample. More commonly, the sample pump will be placed after the sample cooler in order to draw the sample through the cooler so that it has been dehydrated before the sample passes through the pump. The sample pump should either be located in an area which is not classified as hazardous or should be suitable for the hazardous area. Sample pumps with "explosion proof" or air driven motors are available.

A means to control the flow of the sample through the system should be available and visible to the operator. This could be accomplished through the use of pressure regulators with gauges, flowmeters, and/or flow control needle valves.

The condensate must be removed from the heat exchanger(s) using one of the following methods:

1. A continuously running peristaltic tubing pump can be used with the heat exchanger either under pressure or vacuum. This is an easy solution which lends itself to leak testing because of the positive displacement nature of the peristaltic pump. It is, however, a device which requires periodic maintenance to replace the tubing.
2. Condensate can be removed from the heat exchanger using an eductor with a flow limiter to draw some of the hot, wet sample through the heat exchanger along with the condensate. This method utilizes the heat exchanger as a bypass condenser and serves the purpose of reducing the time lag in the sample line without loading the chiller with the water vapor in the bypassed sample.
3. A float drain trap can be used to collect the condensate running out of the bottom of the heat exchanger(s) if the heat exchangers are at a slight positive pressure with respect to the atmosphere. The float drain trap functions like a stream trap. The float rises to discharge the condensate when there is enough to lift the float.
4. A small drain tank can be provided with a dual level, conductivity type level control to collect the condensate. When the tank is full, the level controller will start a pump to remove the condensate until it reaches the lower electrode. When contact is lost, the pump stops and the condensate is again allowed to fill the tank. Typically, a peristaltic pump is used to remove the condensate. The advantage is that the pump only runs occasionally and bypasses no gas sample. The peristaltic pump requires less maintenance because it does not run continuously.

# Installation

Mount the Universal Analyzers 1100 Series Vortex Gas Cooler on a vertical surface away from the weather. If it is needed to be located in the weather, an enclosure should be provided.

Pipe a source of clean, dry compressed air to the control valve on the side of the chiller. The pressure during operation should be between 80 and 120 psig at the control valve for most efficient operation. The optimum pressure is between 80 and 110 psig. At 80 psig, the cooling capacity of the vortex tube is reduced about 30% below that available at 100 psig. The supply air line should be sized to avoid significant pressure drop due to the flow of air during operation (~4 SCFM to ~15 SCFM) depending on model. See operating specifications.

Compressed air lines should be sized to hold pressure drops to a minimum. Do not use restrictive fittings such as quick connects. They can "starve" the vortex tube by causing excessive pressure drops.

Assuming no fluctuation of inlet pressure or temperature, a vortex tube will reliably maintain temperature within +/- 1°F.

Sample tubing should be brought to the each heat exchanger inlet. A 3/8" tubing fitting is provided at the top of the heat exchanger as the sample inlet. The dry sample outlet is a 1/4" tubing fitting coming out of the top at an angle.

The gas sample should flow through an additional filter (with a clear bowl for checking the condition of the filter) as a safety measure before entering the analyzer(s).

A 3/8" NPT female connection is provided as the condensate drain connection at the bottom of the heat exchanger. Equipment to remove the condensate must be installed. Several methods are discussed on previous page.

There must be a method to remove the condensate from the heat exchanger. Several methods are discussed on previous page. A drain line from 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.

# Start-Up

Open the valve from the dry compressed air supply to the Universal Analyzers 1100 Series Vortex Gas Coolers. The temperature will start to drop immediately. A thermocouple can be inserted in the port on the right hand side of the chiller to follow the temperature drop of the chiller. The Chiller is factory set to 4°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.

Turn on the analyzer(s) and calibrate as required.

# Shutdown

Stop sample gas flow to the Universal Analyzers 1100 Series Vortex Gas Coolers by turning off the sample pump. Allow the drain pump to run for several minutes to remove any remaining condensate from the heat exchangers.

Close valve from the dry compressed air supply to the Universal analyzers 1100 series vortex sample cooler.

# Maintenance



**BEFORE PERFORMING ANY MAINTENANCE ON THE UNIVERSAL ANALYZERS 1100 SERIES VORTEX GAS COOLERS, ENSURE THAT ALL PLANT SAFETY PROCEDURES ARE FOLLOWED. AS WITH ANY PRESSURIZED COMPRESSED AIR DEVICE, ENSURE PRESSURE HAS DISSIPATED BEFORE PERFORMING ANY MAINTENANCE PROCEDURES.**

**THE COOLER IS DESIGNED FOR MAINTENANCE FREE OPERATION BUT IF ANY IS REQUIRED, ENSURE COMPRESSED AIR HAS BEEN SHUT OFF 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
Diaphragm sample pump	Replace diaphragm every 6 months
Clean heat exchanger(s)	Annually

## CLEANING INSTRUCTIONS

Should the Heat Exchangers require cleaning, disconnect the tubing and remove the Exchangers from the Heat Transfer Blocks. Wipe off the white heat sink compound with a clean rag. Disassemble the Exchanger. Refer to Drawing Numbers P0147 through P0149 for an illustration on the assembly of the exchanger. Wipe off all surfaces with a clean rag.

### STAINLESS STEEL EXCHANGER (IF REQUIRED)

- Soak in soap and water solution, or
- Soak in Solvent such as MEK, Acetone, etc. or
- Soak in a 10% HNO<sub>3</sub> solution

### PV (GLASS & KYNAR) (IF REQUIRED)

- Soak in Alcohol to remove hydrocarbons

## DO NOT USE MEK, ACETONE OR SIMILAR SOLVENTS ON PV EXCHANGERS

Reassemble Exchangers with new O-Ring(s). Apply an even coat of Heat Sink Paste to the exterior of the exchanger tube only. Re-install into Heat Transfer Block and reconnect tubing.

## INSTALLING OR REPLACING HEAT EXCHANGERS

### REMOVING THE HEAT EXCHANGER

- 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.
- 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

- 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.
- Smear the outer diameter of the heat exchanger with heat transfer paste.
- Gently push the heat exchanger into the heat transfer block until the head is fully seated against the insulation on top.
- 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.
- Reconnect 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).

<b>Error</b>	<b>Possible reason</b>	<b>Check/Repair</b>
The presence of water at sample outlet/water carry over	<p>Overloading of the cooling capacity of the cooler due to too much water vapor or too great a sample flow rate</p> <p>Excessive flow rate</p> <p>A fault in the condensate removal equipment. The heat exchanger has become full of condensate</p> <p>Inadequate drain apparatus</p> <p>An air leak in the condensate removal tubing</p> <p>Sample flow rate/water content too high</p> <p>The pressure of the compressed air driving the vortex tube has dropped below 60 psig at the inlet of the thermal valve</p> <p>Defective cooler</p>	<p>Reduce the flow rate</p> <p>Verify drain tubing is unobstructed and equipment is functioning satisfactory</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>Verify air flow to control valve</p> <p>The cooler is not cold enough and needs to be calibrated. See calibration procedure on pg.12</p>
No sample gas flow	<p>Heat exchanger plugged</p> <p>No power on pump</p>	<p>Check for an obstruction</p> <p>Remove heat exchanger from unit and disassemble</p> <p>Ensure pump has power supplied</p>
High oxygen readings/ low pollutant readings	Leak	<p>Loose connection</p> <p>Verify all fittings are leak free</p> <p>Defective peristaltic pump tubing</p> <p>Replace tubing</p> <p>Broken or leaking heat exchanger</p> <p>Remove heat exchanger and replace if broken or repair (replace O-Ring) if leaking</p>

# Troubleshooting

## CALIBRATION PROCEDURE

1. Connect an airline to the vortex unit. The compressed air pressure should be a minimum of 90 psig. The compressed air temperature should be about 20°C.
2. Insert a thermocouple into the top left vent hole of the heat sink approximately 6 inches.
3. Insert a second thermocouple into the hole on the right side of the heat transfer block.
4. Completely open the temperature control valve by turning the adjustment screw on top of the valve clockwise.
5. Close the vortex airflow adjustment screw located on the bottom of the vortex (the hot air discharge tube). Then open the screw approximately 1-1/4 turns (\*See below).
6. Turn on the air line.
7. Move the thermocouple in the heat sink up and down until the location of the lowest observed temperature is found. This should be in the center of the cold air discharge tube on the vortex.
8. Adjust the vortex airflow screw until the cold air temperature is 25°F (-4.0°C).
9. Allow the heat transfer block to reach 4.5°C. Note: as the heat transfer block temperature drops the cold air temperature will also drop. The final temperature of the cold air should be -9.5°C.
10. Adjust the temperature control valve until the valve closes when the heat sink is 4.0°C. Then open the valve 1/2 turn.

\* 4 CFM = approximately 3/4 turns - Model 1140

\* 10 CFM = approximately 1-1/2 turns - Model 1160

Low inlet pressure supply will cause poor performance. Check supply line for restrictions.

A vortex tube provides a temperature drop on the cold end and a temperature rise on the hot end from the supply air temperature. Elevated inlet temperatures will produce a corresponding rise in both the cold and hot temperatures.

Dimensional drawings, installation drawings, and schematics are included as part of this manual. If additional information is required, assistance can be obtained by calling (775) 883-2500 or (800) 993-9309 or FAX request to (775) 883-6388.

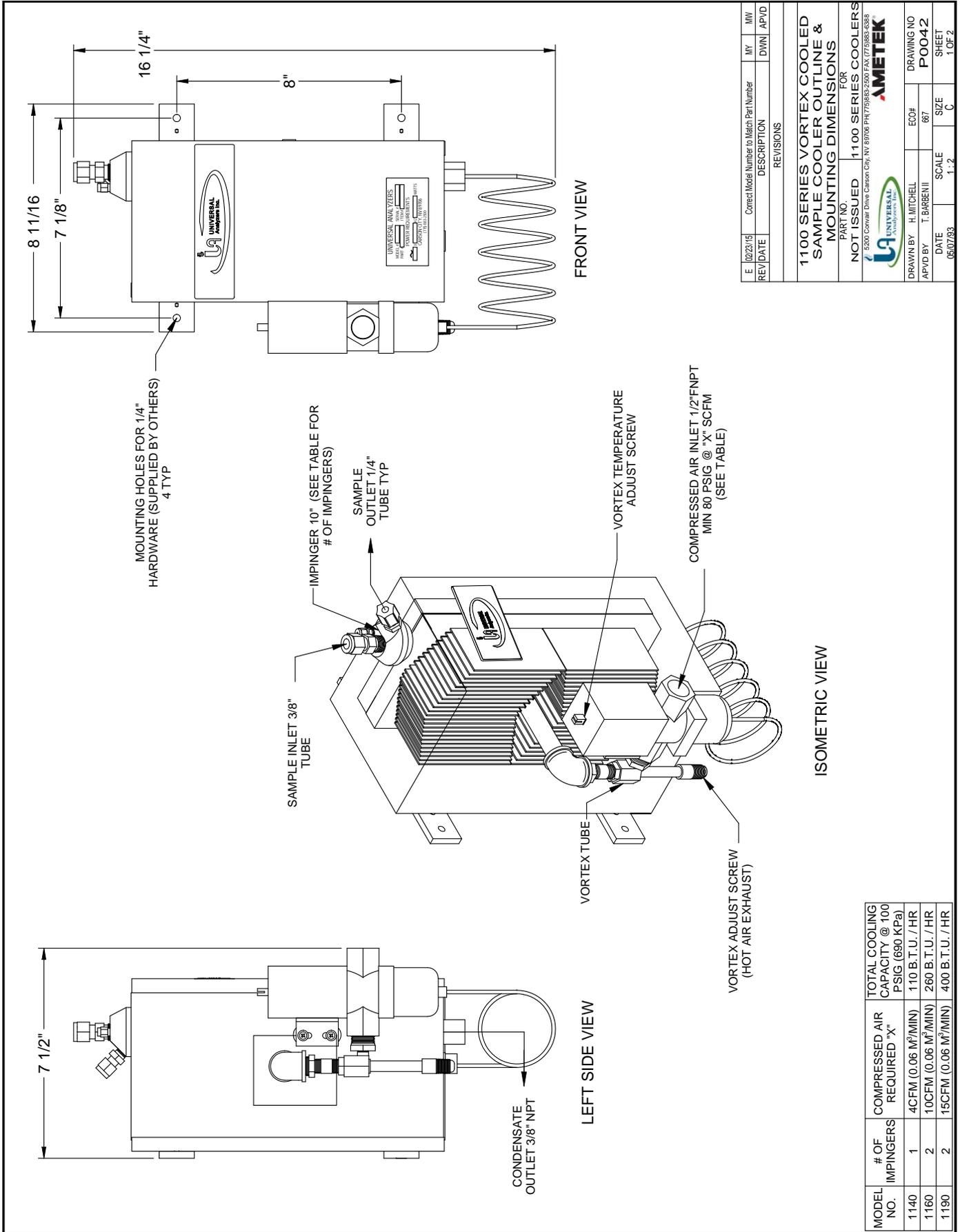
# Spare Parts

<b>For Metallic Heat Exchanger Chillers</b>	
<b>Part</b>	<b>P/N</b>
316SS Separable Heat Exchanger/Impinger, 10"	5200-S010
Hastelloy C276 Separable Heat Exchanger/Impinger	5200-C010
316SS Replacement Condensation Sleeve, 10"	5201-0013
Hastelloy C276 Replacement Condensation Sleeve, 10"	5201-0021
O-Ring, 2-013, Viton, for Sealing Metallic Heat Exchangers	4904-0013

<b>For Glass/Kynar Heat Exchanger Chillers</b>	
<b>Part</b>	<b>P/N</b>
Glass/Kynar Heat Exchanger/Impingers, 10"	5200-K010
O-Ring, 2-018, Viton, Glass Heat Exchanger, Bottom	4904-0003
O-Ring, 2-120, Viton, Glass Heat Exchanger, Top	4904-0004

<b>For all 1100 Series Sample Chillers</b>	
<b>Part</b>	<b>P/N</b>
Paste, Heat Sinking - 0.1 Ounce Container	8010-0001
Temperature Control Valve with Thermal Bulb	4955-0009
Vortex Tube, 4 SCFM (Model 1140)	4960-0002
Vortex Tube, 10 SCFM (Model 1160)	4960-0004
Vortex Tube, 15 SCFM (Model 1190)	4960-0003

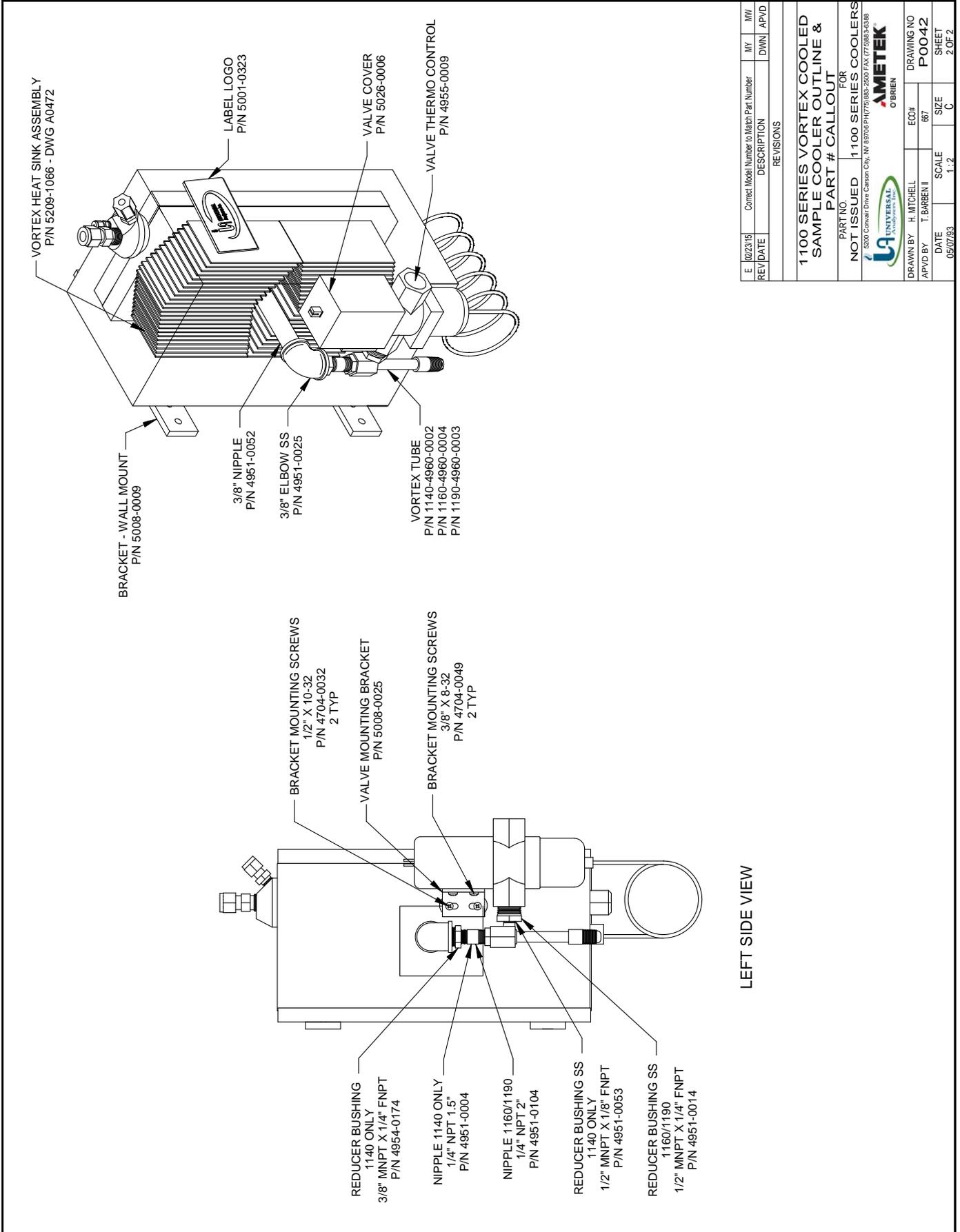
# Drawings Models 1140, 1160, 1190



REV	DATE	DESCRIPTION	BY	CHK	APVD
E	10/23/15	Correct Model Number to Match Part Number	MY		MW
REVISIONS					
<b>1100 SERIES VORTEX COOLED SAMPLE COOLER OUTLINE &amp; MOUNTING DIMENSIONS</b>					
PART NO. 1100 SERIES COOLERS FOR					
NOT ISSUED					
5200 Conover Drive Clifton City, NJ 08706 PH: 759-832-5000 FAX: 759-883-6388					
DRAWN BY		H. MITCHELL		ECHK	
APVD BY		T. BARRELL		667	
DATE		05/07/83		SCALE	
		1:2		SIZE	
		C		SHEET	
				1 OF 2	

MODEL NO.	# OF IMPINGERS	COMPRESSED AIR REQUIRED "X"	TOTAL COOLING CAPACITY @ 100 PSIG (690 KPa)
1140	1	4CFM (0.06 M <sup>3</sup> /MIN)	110 B.T.U. / HR
1160	2	10CFM (0.06 M <sup>3</sup> /MIN)	260 B.T.U. / HR
1190	2	15CFM (0.06 M <sup>3</sup> /MIN)	400 B.T.U. / HR

# Drawings Models 1140, 1160, 1190



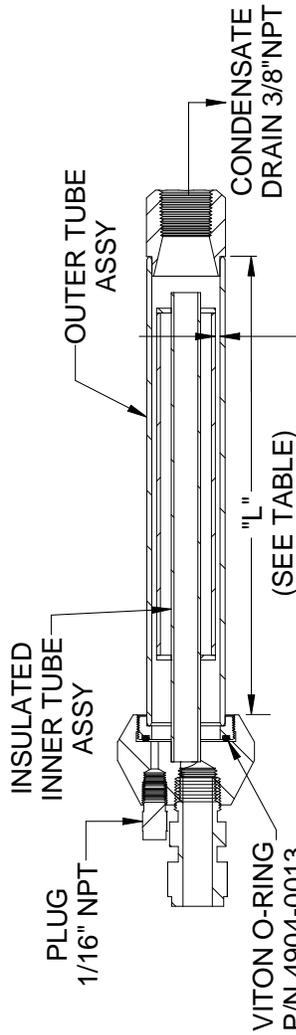
LEFT SIDE VIEW

REV	DATE	DESCRIPTION	BY	CHKD	APVD
E	02/23/15	Correct Model Number to Match Part Number	MW		
REVISIONS					
<b>1100 SERIES VORTEX COOLED SAMPLE COOLER OUTLINE &amp; PART # CALLOUT</b>					
PART NO. 1100 SERIES COOLERS FOR NOT ISSUED					
5500 Coward Drive, Carson City, NV 89706 P/N 7919383-5000 FAX 775985-6038 					
DRAWN BY H. MITCHELL		ECOF 667		DRAWING NO P0042	
APVD BY T. BARREN II				SHEET 2 OF 2	
DATE 05/07/93		SCALE 1:2		SIZE C	

# Drawings - Heat Exchangers

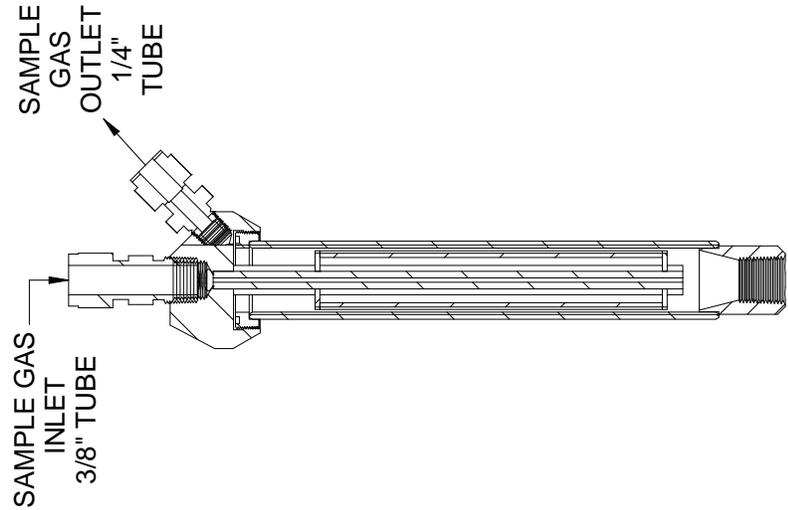
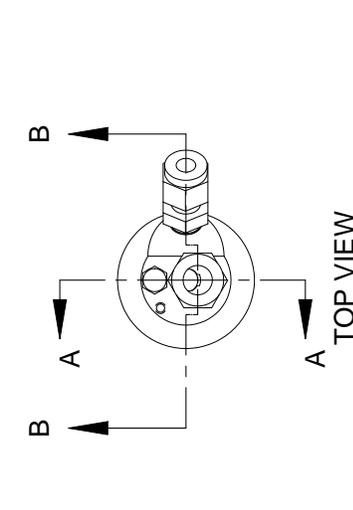
Metallic Heat Exchangers (Non-Temperature Sensing)

Models 1140, 1160, 1190



SECTION A-A

ANNULAR SPACE .060" WIDE  
(GAS TO BE DRIED RISES IN THIS SPACE)



SECTION B-B

APPROX LENGTH "L"	HEAT EXCHANGER P/N	OUTER TUBE MATERIAL	UNIVERSAL ANALYZERS SERIES
5"	5200-S050	316 S.S.	400/500
5"	5200-C050	HASTELLOY C-276	400/500
5"	5200-S05T	TEFLON COATED 316 S.S.	400/500
10"	5200-S010	316 S.S.	800/1000/1100/3000
10"	5200-C010	HASTELLOY C-276	800/1000/1100/3000
10"	5200-S01T	TEFLON COATED 316 S.S.	800/1000/1100/3000

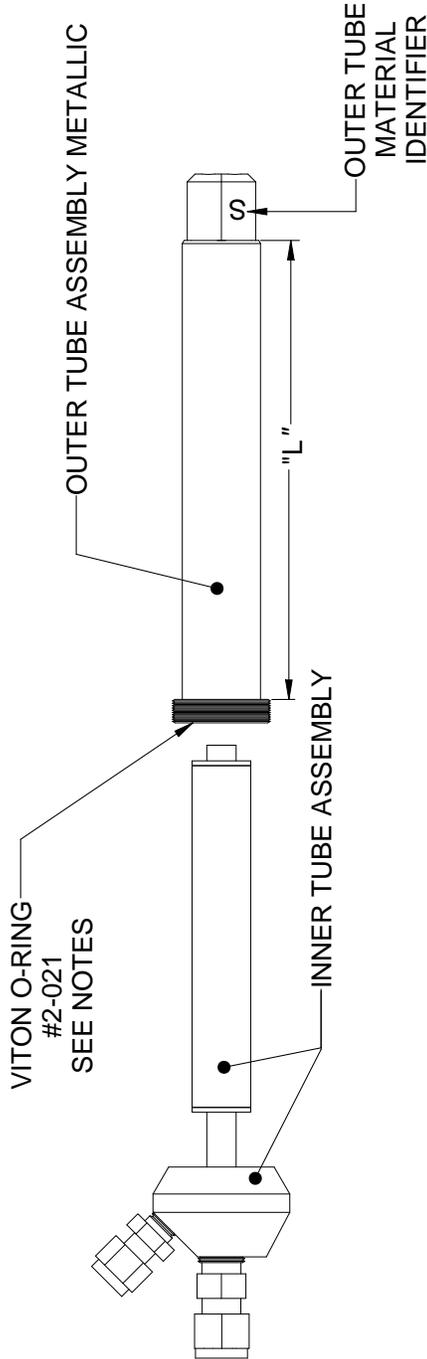
REV	DATE	DESCRIPTION	DWGN	AP/VD
C	01/08/13	Revise Assy Notes	WC	GE
		REVISIONS	DWGN	AP/VD
HEAT EXCHANGER METALLIC NON-TEMPERATURE SENSING OUTLINE				
PART NO		FOR		
SEE TABLE		SEE TABLE		
5200 Cowart Drive Carrol, NY 8096 PH:793883-2500 FAX: (793)883-0388				
O'BRIEN				
DRAWN BY		ECO		DRAWING NO
EVIUSSELLMAN		1531		PO147
AP/VD BY		H. MITCHELL		SIZE
DATE		SCALE		SHEET
12/11/95		NONE		C
				1 OF 2

1). SEE SHEET 2 FOR ASSEMBLY INSTRUCTIONS.

# Drawings - Heat Exchangers

Metallic Heat Exchangers (Non-Temperature Sensing)

Models 1140, 1160, 1190



**NOTES:**

1. O-RING IS FACTORY INSTALLED IN METALLIC OUTER TUBE.
2. LIGHTLY LUBRICATE O-RING WITH SILICONE GREASE BEFORE ASSEMBLY.
3. ANTI-SEIZE ON OUTER TUBE THREADS.

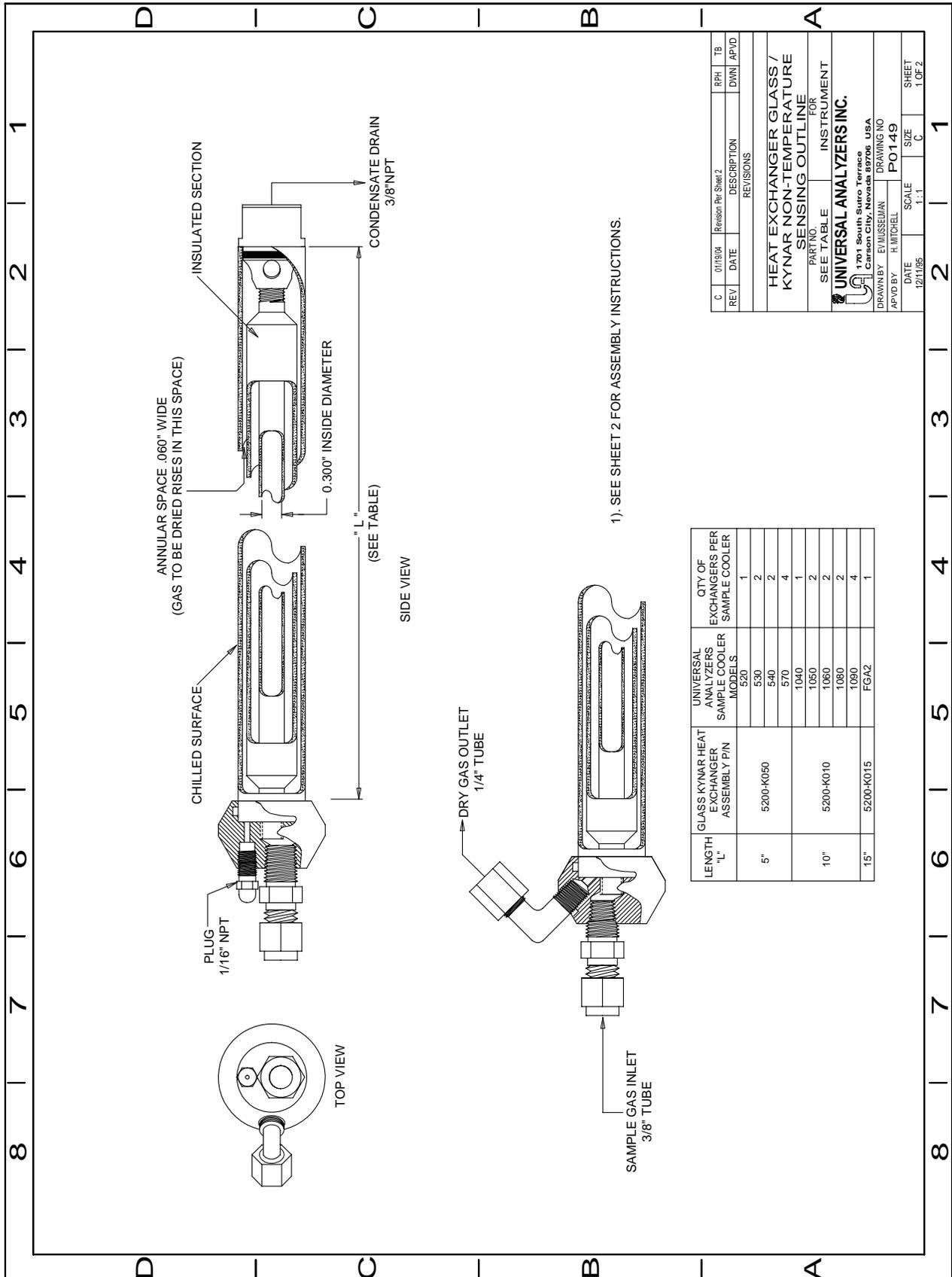
HEAT EXCHANGER SEPERABLE		SPARE PARTS LIST				
APPROX "L" LENGTH	P/N	INNER TUBE ASSY P/N	OUTER TUBE ASSY P/N	VITON O-RING #2-021 P/N	PLUG 1/16" NPT P/N	
5"	5200-S050	5201-0015	5201-0012	4904-0013	4951-0058	
5"	5200-C050	"	5201-0020	"	"	
5"	5200-S05T	5201-0041	5201-0043	"	"	
10"	5200-S010	5201-0016	5201-0013	4904-0013	4951-0058	
10"	5200-C010	"	5201-0021	"	"	
10"	5200-S01T	5201-0042	5201-0044	"	"	
15"	5200-S015	5201-0107	5201-0055	"	"	

C	01/06/13	Revise Assy Notes	IVC	GE
REV	DATE	DESCRIPTION	DWNI	APVD
REVISIONS				
HEAT EXCHANGER ASSEMBLY NON-TEMPERATURE SENSING				
PART NO.		FOR INSTRUMENT		
SEE TABLE		METALLIC		
5200 Convent Drive Carson City, NV 89706 PH: 775/883-2500 FAX: 775/883-0388				
DRAWN BY		AMETEK		
APVD BY		O'BRIEN		
DATE		ECO		
12/11/05		1531		
SCALE		SIZE		
NONE		C		
SHEET		DRAWING NO		
2 OF 2		POT47		

# Drawings - Heat Exchangers

Glass Kynar (Non-Temperature Sensing)

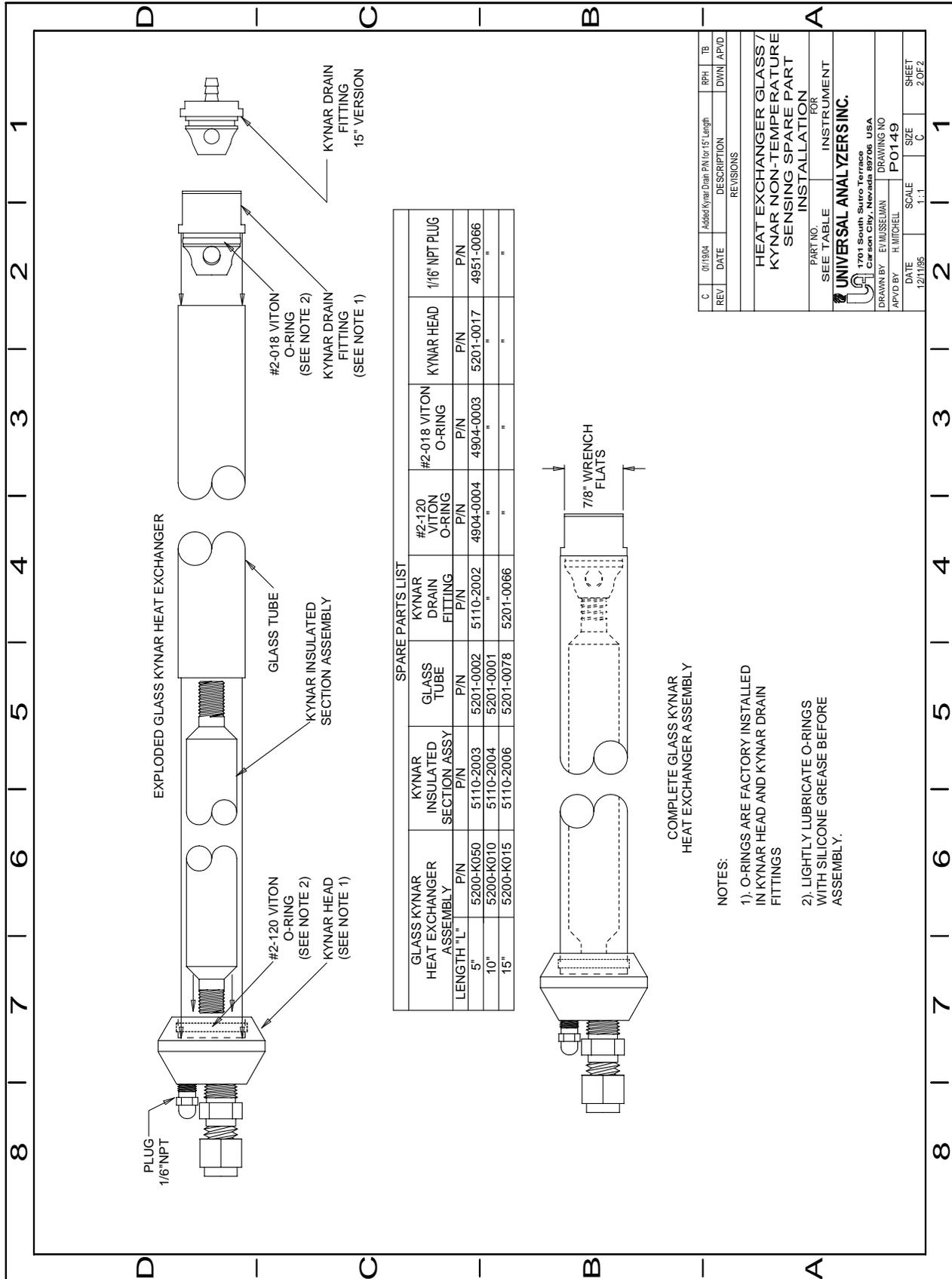
Models 1140, 1160, 1190



# Drawings - Heat Exchangers

Glass Kynar (Non-Temperature Sensing)

Models 1140, 1160, 1190



REV	DATE	DESCRIPTION	REVISED BY	DATE	DESCRIPTION	REVISED BY	DATE	DESCRIPTION
C	07/19/04	Added Kynar Drain P/N for 15" Length	DWIN					
REVISIONS								
HEAT EXCHANGER GLASS / KYNAR NON-TEMPERATURE SENSING SPARE PART INSTALLATION								
PART NO. FOR INSTRUMENT SEE TABLE								
UNIVERSAL ANALYZERS INC.								
1701 South Shuro Terrace Carson City, Nevada 89706 USA								
DRAWN BY EY/MS/ELMAN								
DRAWING NO P0149								
APVD BY H. MITCHELL								
DATE 12/11/95								
SCALE 1:1								
SHEET 2 OF 2								

- NOTES:
- O-RINGS ARE FACTORY INSTALLED IN KYNAR HEAD AND KYNAR DRAIN FITTINGS
  - LIGHTLY LUBRICATE O-RINGS WITH SILICONE GREASE BEFORE ASSEMBLY.

# 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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