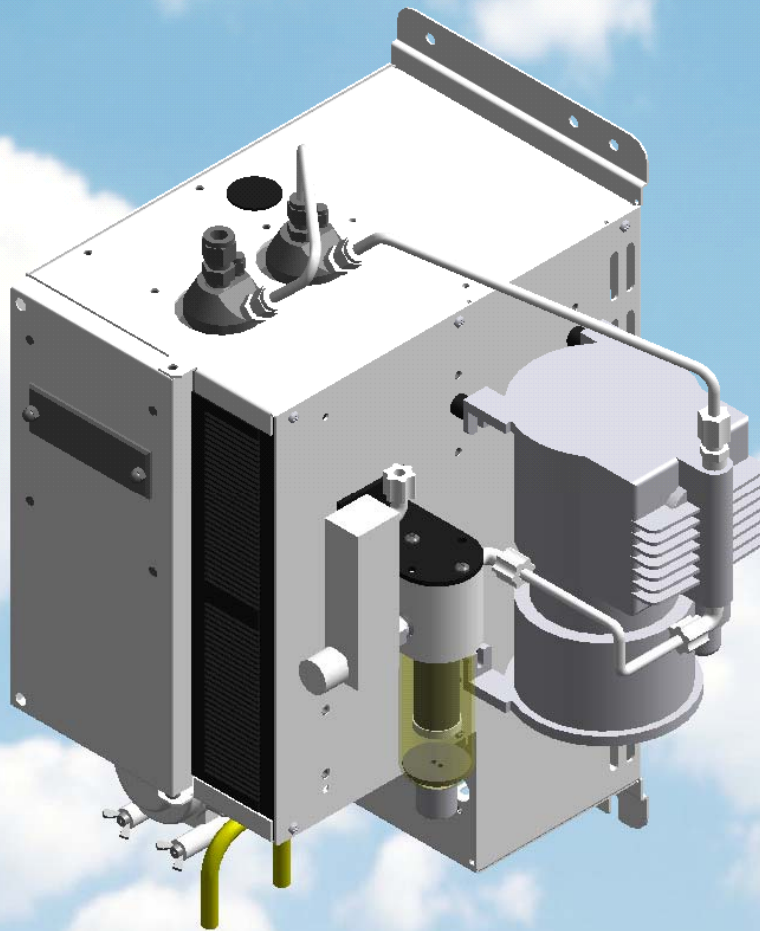




5200 Convair Dr  
Carson City, NV 89706  
775.883.2500 Fax 775.883.6388  
[www.universalanalyzers.com](http://www.universalanalyzers.com)

# MODEL 3080

## SAMPLE COOLER



See us on the WEB at <http://www.universalanalyzers.com>  
e-mail address: [sales@universalanalyzers.com](mailto:sales@universalanalyzers.com)  
MAN3080 Rev J



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## **LIMITED WARRANTY**

ALL PRODUCTS MANUFACTURED BY UNIVERSAL ANALYZERS INC. ARE WARRANTED TO BE FREE OF MANUFACTURING DEFECTS FOR A PERIOD OF ONE YEAR FROM THE DATE OF RECEIPT AT THE CUSTOMER'S RECEIVING AREA AND FOR AN ADDITIONAL PERIOD OF UP TO 90 DAYS IF THE PRODUCT IS PLACED IN SERVICE AFTER BEING IN STORAGE. THIS WARRANTY COVERS MATERIALS AND LABOR TO RESTORE ANY PRODUCTS TO ORIGINAL FACTORY SPECIFICATIONS IF A DEFECT IS FOUND WITHIN THE WARRANTY PERIOD.

THE DEFECTIVE PRODUCT SHOULD BE SENT, FREIGHT PREPAID, TO THE FACTORY IN CARSON CITY, NEVADA. REPAIRS WILL BE PERFORMED AT THE FACTORY AND RETURNED, PREPAID, BY THE SAME SHIPPING METHOD USED TO SEND THE PRODUCT TO THE FACTORY.

THIS WARRANTY DOES NOT APPLY WHERE THE EQUIPMENT HAS SUSTAINED DAMAGE DUE TO NEGLIGENCE, MODIFICATION, CORROSION, OR OTHER REASON BEYOND THE SCOPE OF THE NORMAL DEFINITION OF "MANUFACTURING DEFECT".

FURTHER, THIS WARRANTY IS LIMITED TO REPLACING THE DEFECTIVE COMPONENTS AND RETURNING THE EQUIPMENT MANUFACTURED BY UNIVERSAL ANALYZERS INC. TO THE CUSTOMER IN WORKING CONDITION. ANY OTHER CLAIMS ARE OUTSIDE THE SCOPE OF THIS WARRANTY. NO WARRANTIES ARE MADE AS TO THE SUITABILITY OF THE USE OF THE EQUIPMENT IN ANY PARTICULAR APPLICATION OR LOCATION. THE SUITABILITY OF THE USE OF THE EQUIPMENT IS THE RESPONSIBILITY OF THE CUSTOMER AND THE INSTALLING CONTRACTOR.

**UNIVERSAL ANALYZERS MODEL 3080 SAMPLE COOLER**

**SPECIFICATIONS**

SAMPLE FLOW RATE, BOTH SIDES: AFTER OPTIONAL PRECOOLER:	0 to 10 L/M (at STP) 0 to 16 L/M (at STP)
MAXIMUM INLET TEMPERATURE: STAINLESS STEEL HEAT EXCHANGER: KYNAR/GLASS HEAT EXCHANGER:	700° F. (371° C.) 280° F. (138° C.)
MAXIMUM INLET GAS DEW POINT: WITH OPTIONAL PRECOOLER:	180° F. (82° C.) 194° F. (90° C.)
MAXIMUM INLET WATER CONCENTRATION: WITH OPTIONAL PRECOOLER:	50%* 70%*
MINIMUM AMBIENT TEMPERATURE:	32° F. (0° C.)
MAXIMUM AMBIENT TEMPERATURE:	105° F. (41° C.)*
MAXIMUM COOLING POWER:	252 BTU'S/Hr. (240 kJ/Hr.)
OUTLET SAMPLE DEW POINT:	41° F. (5° C.), adjustable
MAXIMUM INPUT POWER:	700 WATTS
VOLTAGE:	95-125 VAC, 50/60 Hz or 190-250 VAC, 50/60 Hz
ELECTRICAL CLASSIFICATION:	NEMA 1 Class I, Grps. A, B, C, & D, Division 2 (FM Approved)
DIMENSIONS:	18" x 7 1/2" x 11", HWD
WEIGHT:	33 LB's., (15 KG)
SOLUBLE GAS REMOVAL RATES:	NO 0% LOSS NO <sub>2</sub> <2 % LOSS** SO <sub>2</sub> < 2% LOSS CO 0% LOSS CO <sub>2</sub> < 2% LOSS

\* at reduced flow rates. See capacity chart.

\*\* With Kynar/Glass Impingers

## **MODEL 3080 SAMPLE COOLER OPERATING INSTRUCTIONS**

### **APPLICATION**

In order to analyze combustion products or incinerator effluents utilizing a direct extractive sampling technique, it is important to remove the water vapor without removing the water soluble fraction(s) from the gas sample. The heat exchangers (impingers) used in the Universal Analyzers gas sample coolers are designed to minimize the gas/condensate area **and** time of contact to reduce to a minimum, the amount of mass transfer of those water soluble components from the gas phase into the liquid phase. The result is a dry gas sample which has the same composition on a dry basis before and after passing through the chiller.

A gas sample is usually taken from a stack with a probe extending into the center of the stack mounted onto or adjacent to a heated filter. The heated filter is maintained at a temperature above the dew point of the stack gas, usually 300<sup>o</sup> to 400<sup>o</sup> F. in order to avoid cementing the filtered particulates to the filter medium with condensate. A means is usually provided to automatically blow the particulates trapped by the filter, back into the stack on a periodic basis.

The stack gas sample is clean but "wet" after passing through the filter assembly. The moisture in the gas sample comes from the fuel as a product of combustion, from the humidity in the air which supports the combustion and from the water content which was trapped in the fuel. This latter source of water in the sample can be from burning moist coal, wet garbage, or from water injected into the fire box. Water from all of these sources will remove the water soluble gasses from the sample stream if allowed to condense in the sample line prior to the controlled separation within the Universal Analyzers' heat exchangers in the sample cooler.

In order to maintain the temperature of the gas sample above the dew point as it is transported to the gas sample cooler, a heat traced sample line is usually employed. The heat traced sample line can be very short if the gas sample cooler is located close to the heated stack filter or it could be several hundred feet long if the gas sample cooler is located in the analyzer shack some distance from the stack.

The Universal Analyzers gas sample cooler contains the special impinger type heat exchanger(s). These are mounted within heat transfer blocks which are cooled by thermoelectric elements utilizing the "Peltier Effect" discovered in France over half a century ago. Where high water contents are encountered, it is efficient to remove the condensate in two stages, one at the temperature of the air in the vicinity of the "Precooler" and then by passing the sample into a heat exchanger cooled by the thermoelectric elements. The precooler can remove water which will condense at the temperature of the environment. In high water content samples, this could be as much as 80% of the water in the sample.

The thermoelectrically cooled stage is temperature controlled at a factory setting of 5° C. This temperature can be adjusted with a set point potentiometer easily as described below.

The gas sample conditioning system should contain additional components to insure that a clean, dry sample is presented to the analyzer panel for minimum analyzer maintenance. A sensor should be provided to sense the presence of condensate, should any exist in the tubing following the chiller. This is the optional WCO (Water Carry-Over) sensor which can be provided with a Universal Analyzers chiller. A visible coalescing filter which collects particulates on the outside of the cylindrical filter, surrounded by a transparent bowl will allow the operator to inspect the condition of the heated stack filter. The WCO sensor can be provided with the sensing elements in the bottom of the filter bowl to provide an early warning if the coalescing filter removes liquid from the sample stream. This combination filter/moisture sensor is called the "WCOF".

The location of the sample pump (usually an oil-less diaphragm pump) within the sampling system is the subject of much debate. If the pump is located upstream from the chiller, it should have a heated head to avoid the presence of a two phase mixture which shortens the life of a diaphragm and causes maintenance problems. It can be shown that passing the gas sample through the chiller under a slight positive pressure will result in a lower gas dew point than if the gas were at a slight vacuum. A common location for the sample pump is in the sample line after the chiller. This allows the sample pump to handle a cool, dry sample with much reduce maintenance problems. Some design engineers have taken the approach to use a sample cooler having two chilled heat exchangers. The pump is placed in the sample line between the two heat exchangers. The first chilled heat exchanger takes enough of the water vapor from the sample to protect the pump. The second heat exchanger is under a slight pressure and the dew point is at it's minimum because it is on the discharge side of the pump. The sample pump location within the sample system is a matter of choice and good engineering.

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 steam 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 to 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.

Finally, a means of controlling the flow of the sample to the analyzers must be considered. This can be as simple as providing a flow meter with a flow control needle valve to pinch off the sample flow causing the sample pump to pump higher on the pump curve. One option which is used is to provide an adjustable back-pressure regulator between the inlet and outlet of the sample pump to allow a portion of the gas pumped to be recirculated back to the inlet if discharge pressure exceeds the back-pressure control point. Some analyzers have their own sample pump which may be sufficient to supply the analyzer but insufficient to pull the sample through the chiller, sample line, and heated stack filter. These can be supplied by piping the sample from the external sample pump into the run of a tee with a flow meter which registers the flow of excess sample from the branch of the tee to atmosphere. The internal analyzer sample pump can then withdraw sample from the opposite run of the tee which is essentially at atmospheric pressure and unaffected by pressure changes within the sample line due to changes in filter pressure drop or sample pump efficiency.

### **DESCRIPTION**

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 hot wet sample is brought to the bottom of the cylinder through an insulated tube and 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 cylindrical condensation surface of the heat exchanger is maintained through intimate contact with an aluminum heat transfer block. In the Model 3080 Sample Cooler, the heat transfer block is cooled by the use of four Thermoelectric Elements at a controlled temperature. The factory temperature setting is 5° C. The

temperature sensor is an AD592 semiconductor device. The controller is a proportional controller with a proportional band of about 1° C. The set point is field adjustable by opening the door on the front of the chiller, moving a jumper (J3) with needle nose pliers, and adjusting a trim-pot to a new temperature value shown on the display. The jumper needs to be placed in the original position to, again, indicate the temperature of the heat transfer block.

The heat which is removed from the gas sample (and that which is created by the Thermoelectric Elements) is discharged by a heat sink which is cooled with a centrifugal drum blower. The turbulence and velocity provided by the high static pressure capability of the blower allows for efficient cooling of the heat sinks. The heat sinks are fabricated from solid blocks of aluminum which eliminates the epoxy joints in more conventional heat sink designs which are barriers to heat conduction. The result is a heat removal system with superior performance under all conditions.

Universal Analyzers Thermoelectric Sample Coolers have a digital display as a front panel indication of the of the operating temperature, (° C.) of the heat exchangers. In addition, there are two green LED lamps to indicate the status of the cooler. The "COOL" lamp lights when the operating temperature is between 0° C and 10°. If the operating temperature is above or below this range, the light will be out and the alarm relay will be in the alarm position. The "DRY" lamp indicates that there is no water in contact with the moisture sensor listed as the "WCO" or "WCOF" options. If the "DRY" lamp is out, the alarm relay will be in the alarm position.

The alarm relay is a single relay activated by either of the above alarm conditions. The alarm relay is energized in the "safe" condition and will relax into the de-energized, alarm position if a fault is detected. If a broken thermocouple occurs, the result will be that the temperature indication is out of range and the alarm relay will indicate a fault.

A thermal switch is mounted on the heat sink to serve as a safety device to turn off power to the thermoelectric elements if the heat sink approaches 160° F. This protects the thermoelectric elements from melting in the event high temperature conditions are encountered for any reason.

The 3080 Series thermoelectric sample coolers are designed to incorporate a peristaltic pump for condensate removal within the enclosure to reduce the total volume required for the system installation. Alternatively, it also has provisions for incorporating an eductor, air filter, and dual heat sample pump with the second head used for generating the necessary compressed air for the eductor.

Electrical connections are made to external wiring which will enter conduit fittings on the bottom of the chiller. Internal conduit tubes direct the wires as they are pushed into the chiller into the vicinity of the terminal strips. All of the terminal strips are easily accessible from the front of the chiller.

If it is desired to connect conduit to the chiller, a conduit coupling can be screwed onto the 1/2" male conduit threads which extend from the bottom.

"PEM Nuts" are provided on the right hand side to mount accessories such as a sample pump, visible filter, condensate alarm sensor, and flow meter. These options can be user or factory installed.

The chiller can be changed from 115 VAC to 230 VAC operation with the movement of a circuit card on the power supply. Accessories such as the sample pump or peristaltic pump must be rated for the correct supplied line voltage.

### **INSTALLATION INSTRUCTIONS**

Thermoelectric Sample Coolers should be installed away from heat sources in a well ventilated area of an instrument rack or enclosure. Completely enclosing any instrument which consumes as much power as a thermoelectric chiller will cause the temperature of the interior of an unventilated enclosure to rise to too great a level for the sample cooler to perform reliably. Where it is necessary for the enclosure to be tightly gasketed, a water cooled thermoelectric chiller should be used. Contact the factory for recommendations. Air purging an enclosure does not provide enough ventilation to remove the heat which will be generated internally by the sample chiller. On the other hand, there are air conditioners and vortex coolers which can provide the necessary cooling for enclosing thermoelectric chillers.

The 3080 series sample cooler has a flange 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.

If the two heat exchangers in the Model 3080 are to be used to cool two samples, each sample should be brought to the 3/8" tubing fitting which is provided at the top of the heat exchanger as the sample inlet. The dry sample outlet from the cooler is the 1/4" Kynar tubing fitting coming out at an angle from the top of each heat exchanger. If the two heat exchangers are to be used for a single sample, a tee should be provided at the inlet and outlet fittings from the heat exchangers to split the sample and bring it back into a single tube. The gas sample should be further conditioned with an additional filter as a safety measure before it enters the analyzer(s). The WCOF visible filter which incorporates a safety moisture sensor is designed for this purpose. A similar filter without the moisture sensor is also available from Universal Analyzers. A separate moisture sensor, the WCO, can also be provided where the user prefers that form factor. Contact the factory for drawings.

A sample pump is normally required to pull the sample through the sample cooler and to force it through the visible filter. The moisture sensor, if not a part of the visible filter should be located ahead of the visible filter.

Some have preferred to locate the sample pump in the sample line between the two heat exchangers. The theory is that the first heat exchanger reduces the water content to the point that water will not condense in the sample pump. A controlled portion of the sample can be discharged to atmosphere to reduce the sample lag in the sample line



before the final cooling/dehydration stage. The final cooling stage then only handles the sample which is required by the analyzer(s). This location of the sample pump also allows the final stage of cooling to be performed at a slightly higher pressure which is theoretically more efficient.

There must be a method to remove the condensate from the heat exchangers. Several methods are discussed above. 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 6 amps at 115 VAC or 3 amps at 230 VAC 50/60 HZ should be supplied. Installation shall be in accord with the manufacture's instructions and the National Electrical Code (ANSI/NFPA 70). Tampering and replacement with nonfactory components may adversely affect the safe use of the system. For the 115 VAC case, a power cord is supplied. It can be replaced with conduit wiring easily. See the electrical installation Drawing P0093. The alarm relay has two sets of "Form C" contacts brought out to the center terminal strip, TB2. One set are totally dry contacts. The other set are MOV protected and designed to interrupt power to the sample pump when in the alarm condition. When the pump is powered through the connector on the power supply board, the MOV protected contacts are hot, with line power supplied.

The moisture sensor can be connected to the "Viking" connector mounted on the exterior of the cabinet below the heat exchangers or, alternatively, connected to TB3 on the power supply board.

### **START UP PROCEDURE**

Apply power to the 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<sup>o</sup> C. of the control set point.

Start the sample gas flow by turning on the sample pump and adjusting 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.

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.

The green "DRY" LED light will be on. If an optional moisture is installed, the light will go out and the alarm relay de-energized when the sensor detects condensate. A test can be performed by putting water on the moisture sensor. If the sample pump is powered through the alarm relay contacts, it will cease running. When the moisture sensor is wiped dry, the sample pump will start.

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

### **TROUBLE SHOOTING**

Tampering and replacement with nonfactory components may adversely affect the safe use of the system.

The presence of water in liquid form after the sample cooler is an indication of a fault in the system. Reasons for the presence of condensate in the system after the sample cooler could be one or more of the following:

1. Overloading of the cooling capacity of the cooler due to too much water vapor in the sample or due to too great a sample flow rate.
2. The condensate removal equipment (peristaltic pump, eductor, or drain pot) may be faulty. The heat exchanger(s) may be full of condensate.
3. An air leak may be in the condensate removal system allowing air to enter and blow the condensate back into the heat exchanger. (This assumes the heat exchanger is under a slight vacuum.)
4. The temperature of the air passing through the cooler to cool the heat sink is too high. This could be due to placement of the cooler in a tightly sealed box.
5. The sample cooler could have failed.

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

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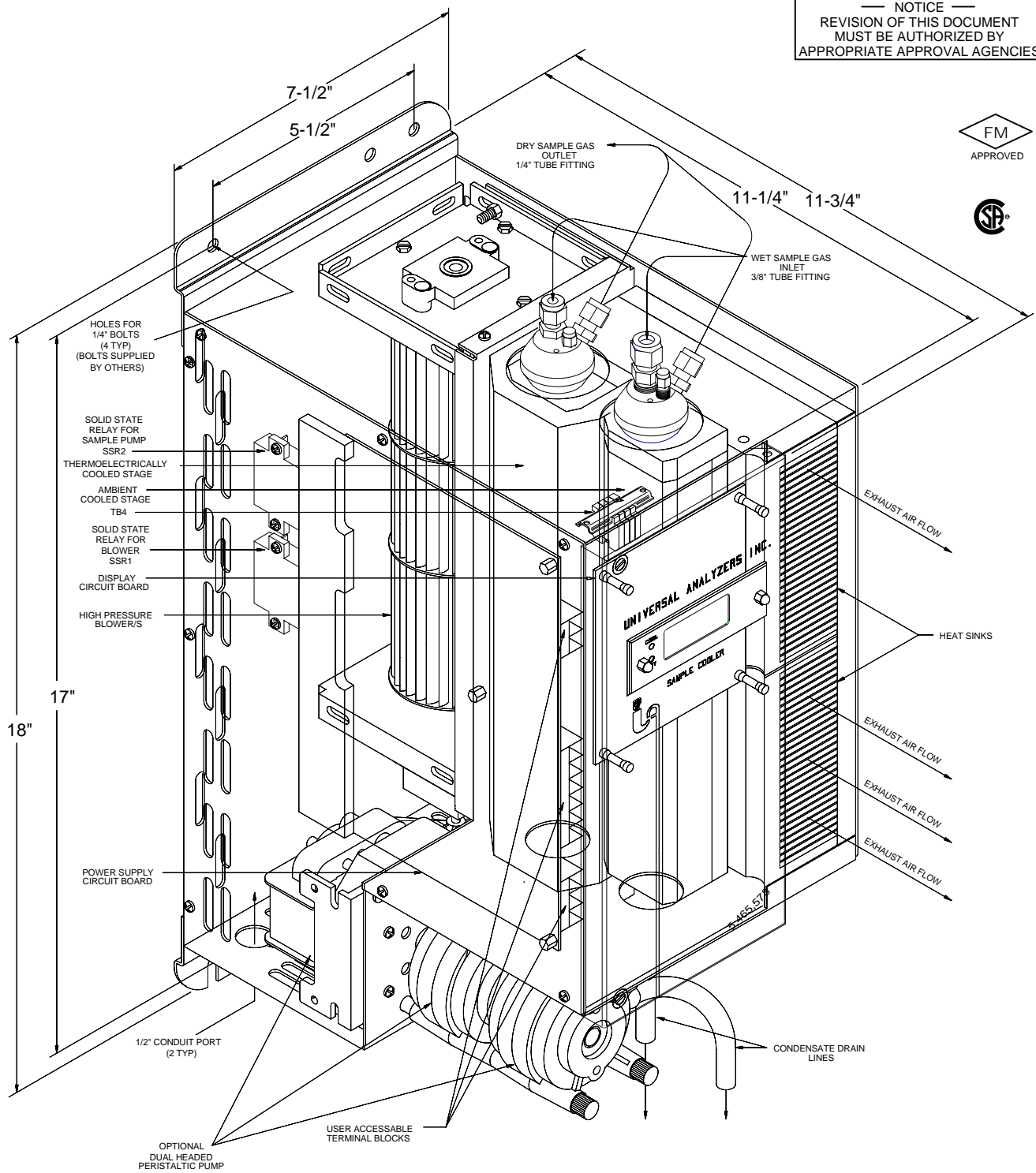
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— NOTICE —  
REVISION OF THIS DOCUMENT  
MUST BE AUTHORIZED BY  
APPROPRIATE APPROVAL AGENCIES



# DUAL (OR SINGLE) SAMPLE THERMOELECTRIC SAMPLE COOLER

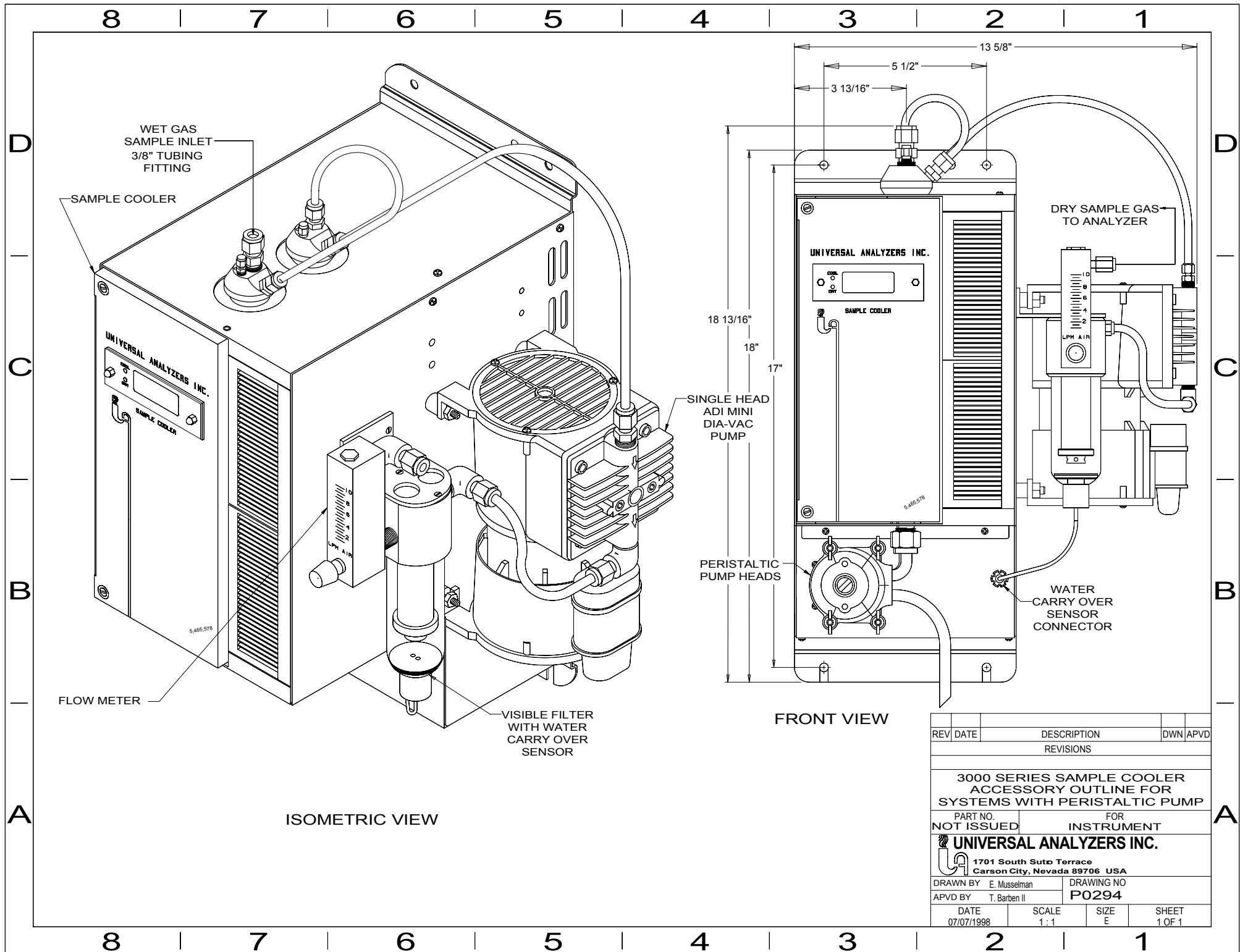
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MODEL 3080 SAMPLE COOLER OUTLINE				
PART NO.		FOR		
<b>UNIVERSAL ANALYZERS INC.</b> 1701 S. Sutro Terrace Carson City, Nevada 89706 USA				
DRAWN BY HARVEY MITCHELL		DRAWING NO P0083		
APVD BY TED BARBEN				
DATE	SCALE	SIZE	SHEET	
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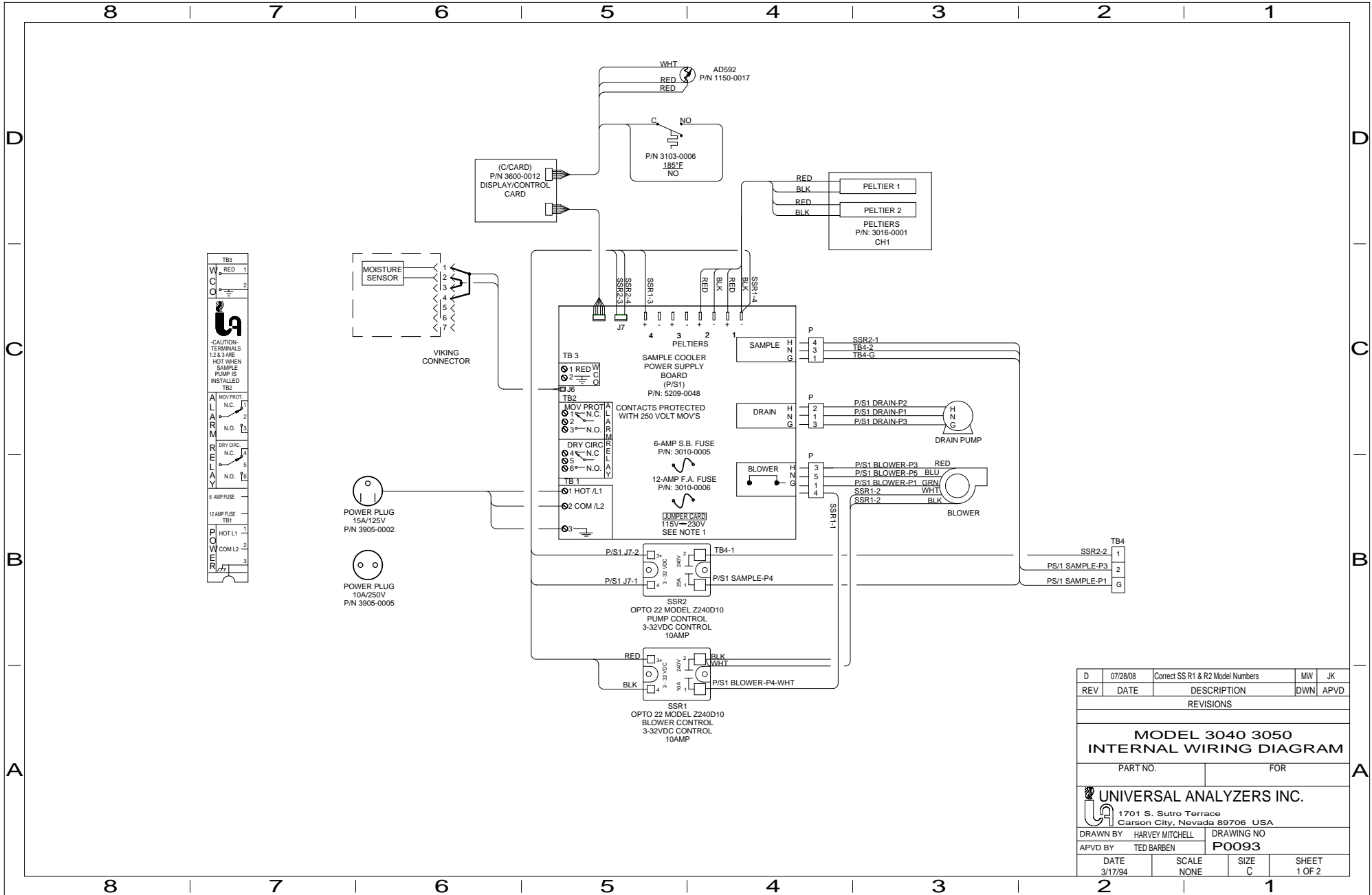
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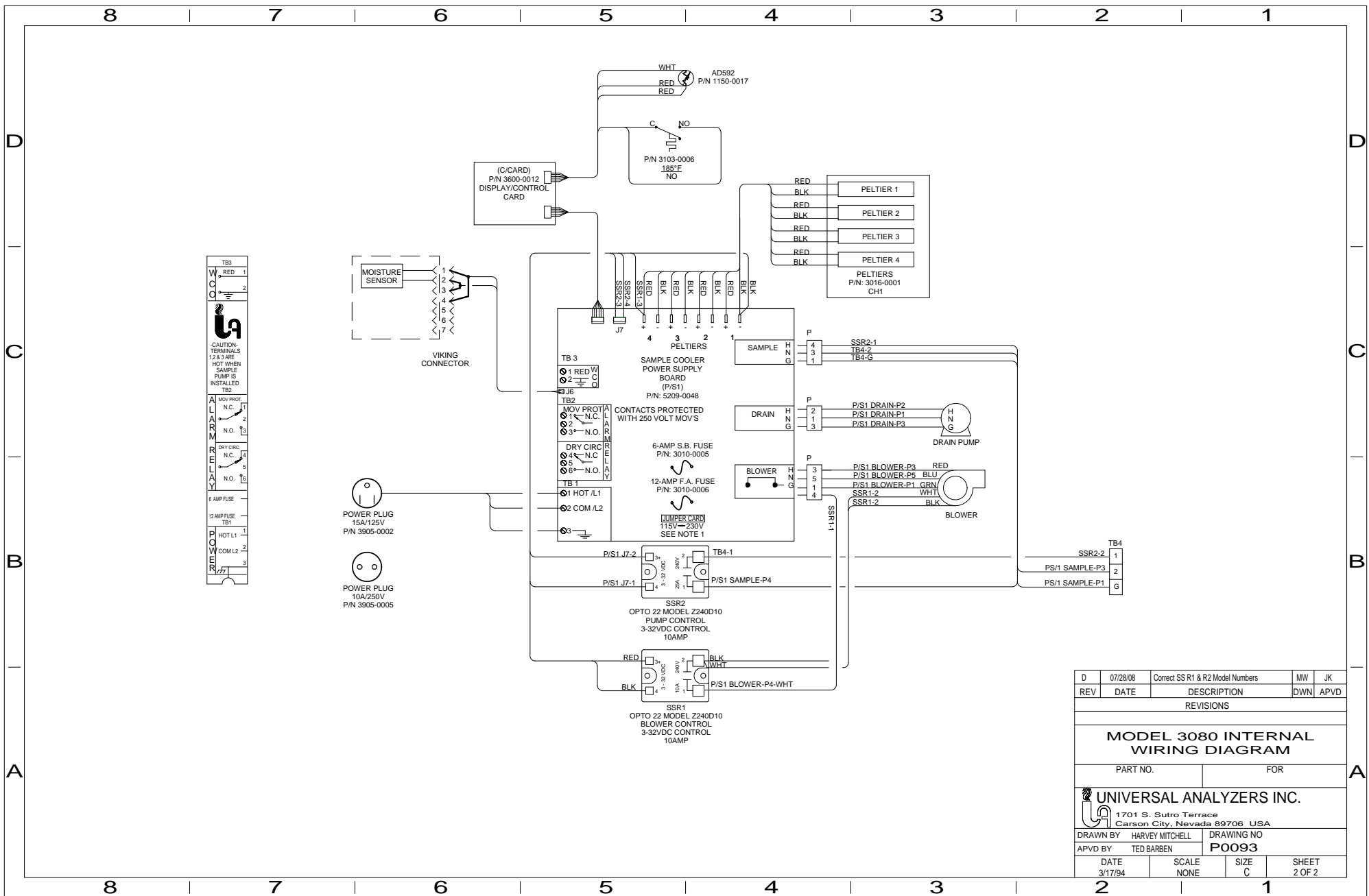


REV	DATE	DESCRIPTION	DWN	APVD
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3000 SERIES SAMPLE COOLER ACCESSORY OUTLINE FOR SYSTEMS WITH PERISTALTIC PUMP				
PART NO.		FOR		
NOT ISSUED		INSTRUMENT		
<b>UNIVERSAL ANALYZERS INC.</b>				
1701 South Suto Terrace Carson City, Nevada 89706 USA				
DRAWN BY E. Musselman		DRAWING NO		
APVD BY T. Barben II		P0294		
DATE 07/07/1998		SCALE 1:1	SIZE E	SHEET 1 OF 1



**CAUTION-TERMINALS 1, 2 & 3 ARE HOT WHEN SAMPLE PUMP IS INSTALLED**  
**W** TB3 RED 1  
**C** 2  
**A** MOV PROT 1  
**L** N.C. 2  
**A** 3  
**R** N.O. 4  
**M** 5  
**R** DRY CIRC 1  
**E** N.C. 2  
**L** 3  
**A** 4  
**Y** N.O. 5  
**6 AMP FUSE**  
**12 AMP FUSE**  
**TB1**  
**HOT L1** 1  
**COM L2** 2  
**GND** 3  
**POWER PLUG** 15A/125V P/N 3905-0002  
**POWER PLUG** 10A/250V P/N 3905-0005

D	07/28/08	Correct SS R1 & R2 Model Numbers	MW	JK
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
<b>MODEL 3040 3050</b>				
<b>INTERNAL WIRING DIAGRAM</b>				
PART NO.		FOR		
<b>UNIVERSAL ANALYZERS INC.</b>				
1701 S. Sutro Terrace Carson City, Nevada 89706 USA				
DRAWN BY HARVEY MITCHELL		DRAWING NO P0093		
APVD BY TED BARBEN				
DATE	SCALE	SIZE	SHEET	
3/17/94	NONE	C	1 OF 2	



TB3  
 W RED 1  
 C 2  
 CAUTION-TERMINALS 1,2 & 3 ARE HOT WHEN SAMPLE PUMP IS INSTALLED  
 TB2  
 MOV PROT 1  
 A N.C. 2  
 L N.O. 3  
 ARM 4  
 R N.C. 5  
 E L N.O. 6  
 L A Y 7  
 6 AMP FUSE  
 12 AMP FUSE  
 TB1  
 P HOT L1 1  
 O COM L2 2  
 W J7 3

POWER PLUG  
 15A/125V  
 P/N 3905-0002

POWER PLUG  
 10A/250V  
 P/N 3905-0005

D	07/28/08	Correct SS R1 & R2 Model Numbers	MW	JK
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
<b>MODEL 3080 INTERNAL WIRING DIAGRAM</b>				
PART NO.		FOR		
<b>UNIVERSAL ANALYZERS INC.</b>				
1701 S. Sutro Terrace Carson City, Nevada 89706 USA				
DRAWN BY HARVEY MITCHELL		DRAWING NO P0093		
APVD BY TED BARBEN				
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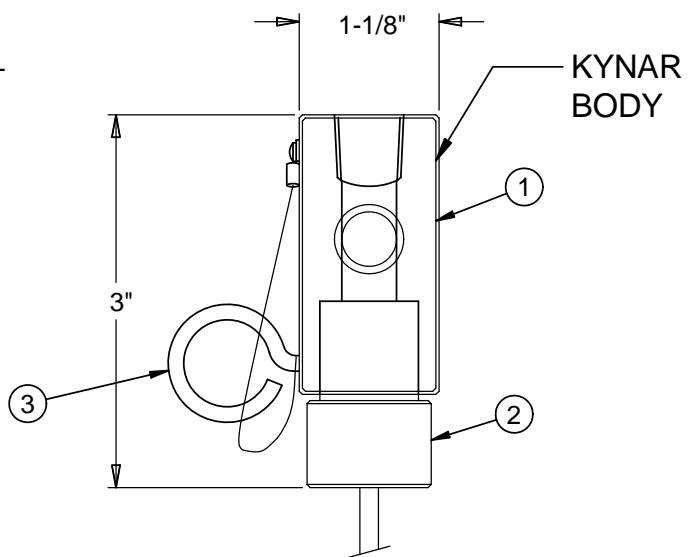
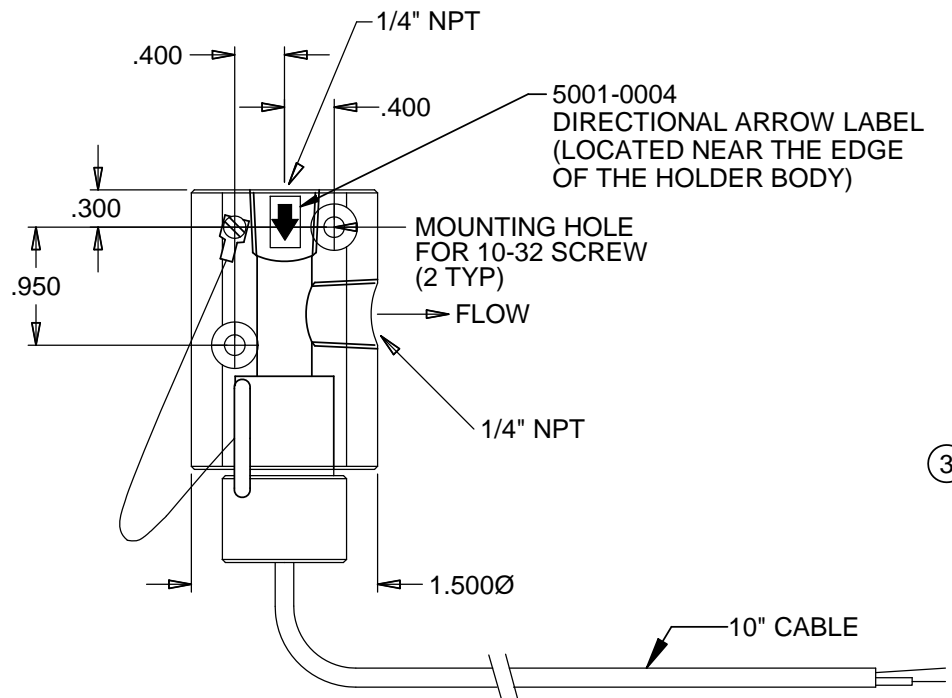
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FINAL ASSEMBLY PART NUMBER TABLE			
SHEET	PART NUMBER	MATERIAL	MODEL
1 OF 2	6020-0001	KYNAR	W.C.O.
2 OF 2	6020-0002	316SS	W.C.O.S.S.

PART NUMBER TABLE		
ITEM	DESCRIPTION	PART
1	HOLDER FLOW THRU BODY-KYNAR	5101-0002
2	KYNAR MOISTURE SENSOR ASSY	5101-0001
3	SENSOR LOCK ASSY KIT	5205-0007

D	10/01/08	Revised P/N & Material Of Item 1, & Cable Length	MW	DA
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				

**WATER CARRY OVER  
MOISTURE SENSOR WITH  
FLOW THRU ADAPTER**

PART NO. FOR  
SEE TABLE W.C.O.

**UNIVERSAL ANALYZERS INC.**  
5200 Convir Drive  
Carson City, Nevada 89706 USA

DRAWN BY H. MITCHELL DRAWING NO  
APVD BY TED BARBEN II P0006

DATE 10/08/1991	SCALE 1:1	SIZE B	SHEET 1 OF 2
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8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

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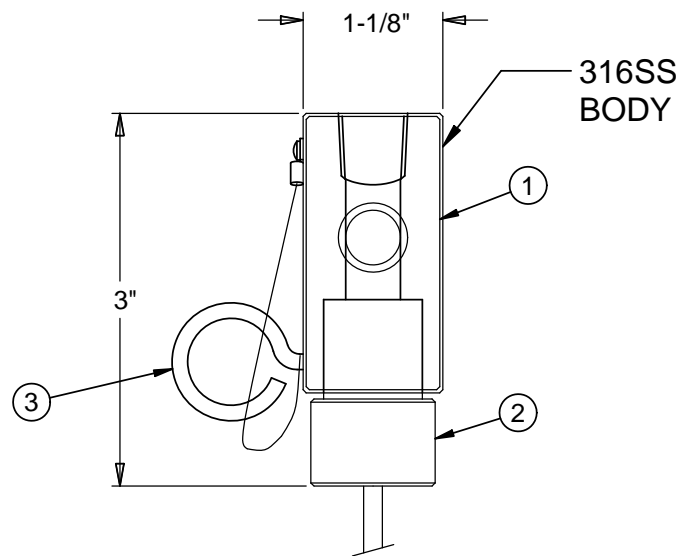
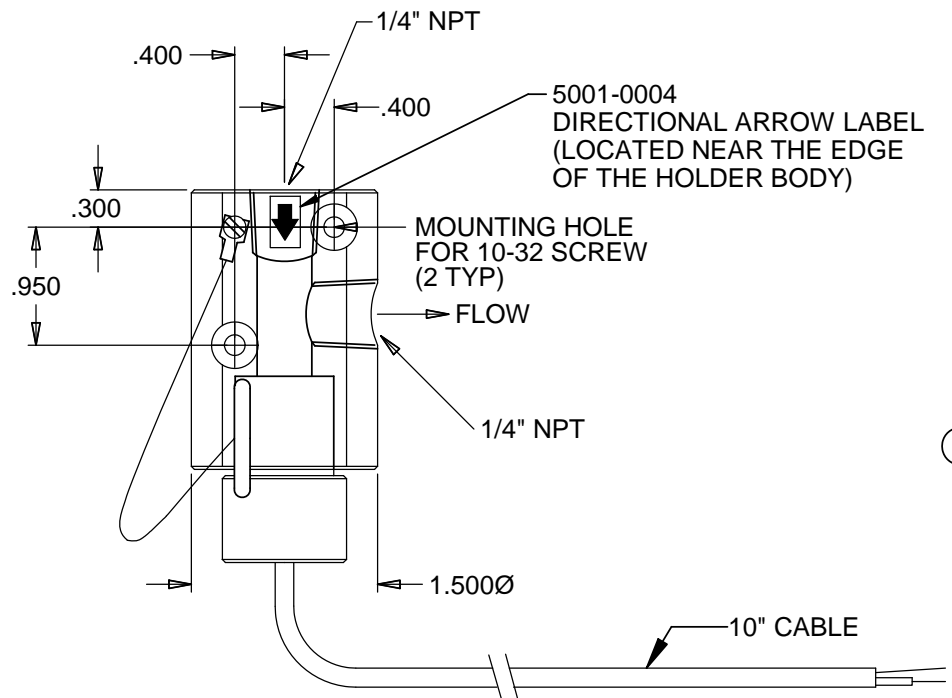
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D

C

B

A



FINAL ASSEMBLY PART NUMBER TABLE			
SHEET	PART NUMBER	MATERIAL	MODEL
1 OF 2	6020-0001	KYNAR	W.C.O.
2 OF 2	6020-0002	316SS	W.C.O.S.S.

PART NUMBER TABLE		
ITEM	DESCRIPTION	PART
1	HOLDER FLOW THRU BODY-316SS	5150-1016
2	KYNAR MOISTURE SENSOR ASSY	5101-0001
3	SENSOR LOCK ASSY KIT	5205-0007

D	10/01/08	Revised P/N & Material Of Item 1, & Cable Length	MW	DA
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				

**WATER CARRY OVER  
MOISTURE SENSOR WITH  
FLOW THRU ADAPTER**

PART NO. FOR  
SEE TABLE W.C.O.S.S.

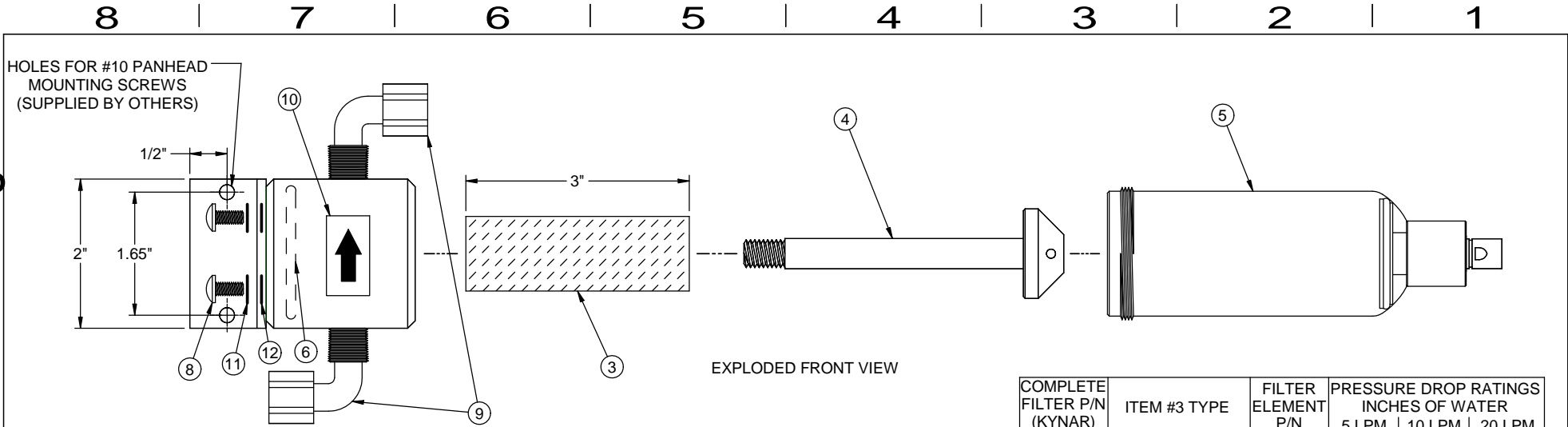
**UNIVERSAL ANALYZERS INC.**  
5200 Convir Drive  
Carson City, Nevada 89706 USA

DRAWN BY	H. MITCHELL	DRAWING NO	
APVD BY	TED BARBEN II	P0006	

DATE	SCALE	SIZE	SHEET
10/08/1991	1:1	B	2 OF 2

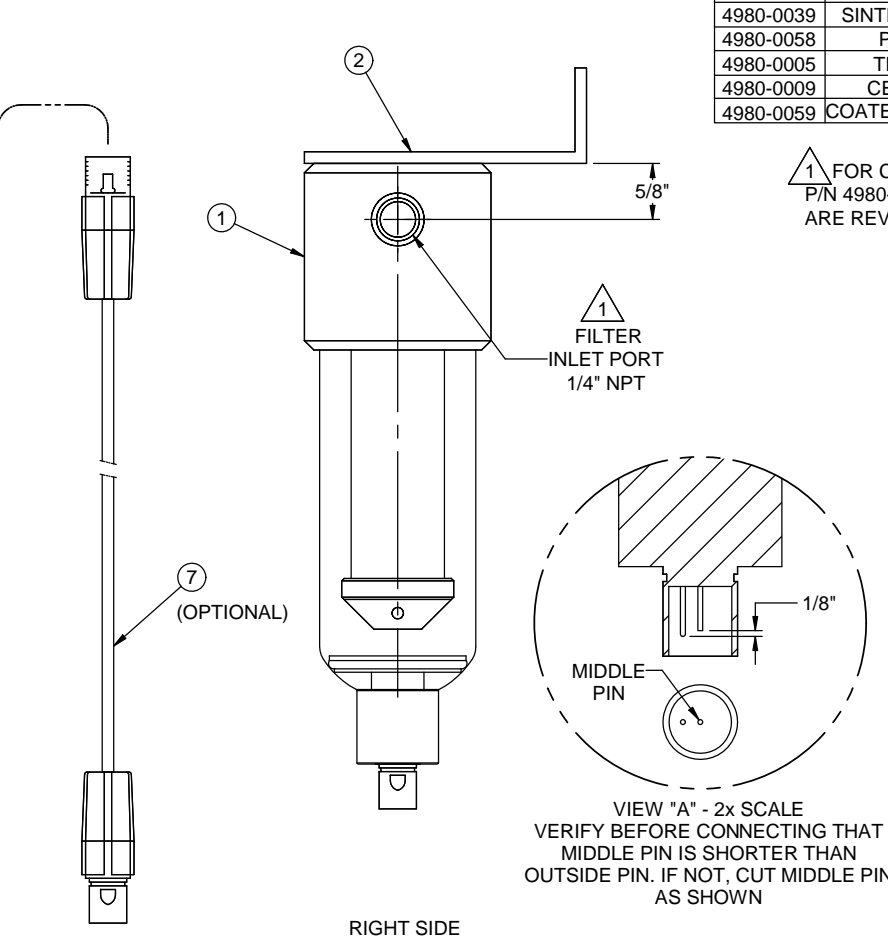
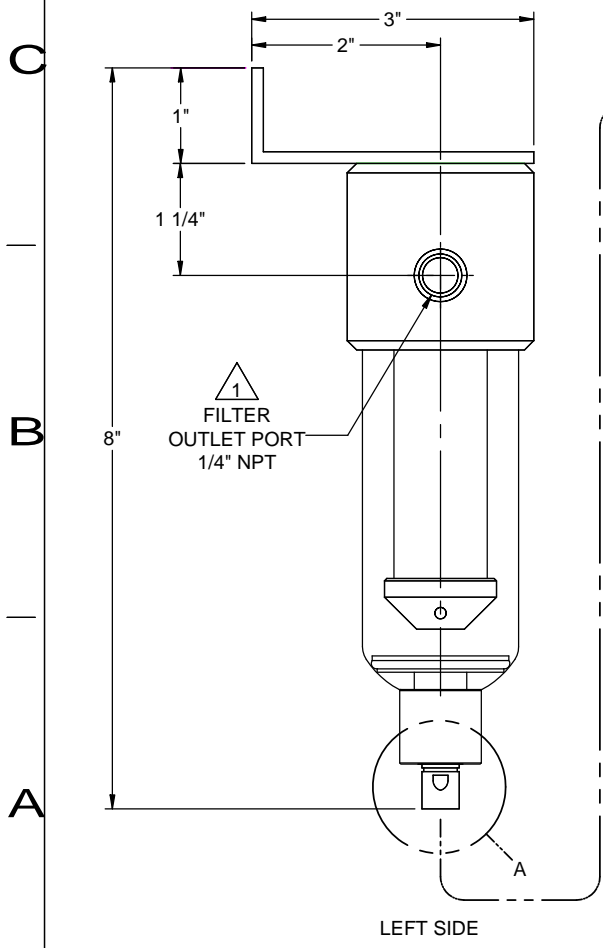
8 | 7 | 6 | 5 | 4 | 3 | 2 | 1





COMPLETE FILTER P/N (KYNAR)	ITEM #3 TYPE	FILTER ELEMENT P/N	PRESSURE DROP RATINGS INCHES OF WATER		
			5 LPM	10 LPM	20 LPM
4980-0039	SINTERED S.S.	4980-0023	10	14	24
4980-0058	PAPER	4980-0022	8	12	20
4980-0005	TEFLON	4980-0006	4	6	10
4980-0009	CERAMIC	4980-0007	4	6	10
4980-0059	COATED CERAMIC	4980-0018	6	8	12

△ 1 FOR COALESCING (COATED CERAMIC WCOF) P/N 4980-0059 SAMPLE INLET & OUTLET PORTS ARE REVERSED.

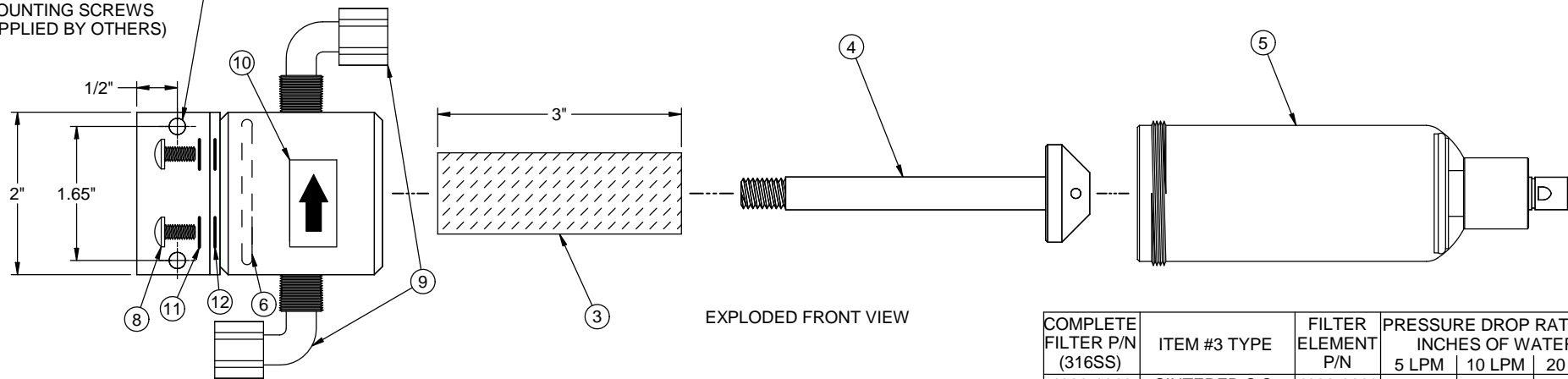


J	09/22/08	UPDATE PART LIST	MW	DA
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
12	2	-	4710-0008	FLAT WASHER
11	2	-	4710-0016	STAR WASHER
10	1	-	5001-0004	RED DIRECTIONAL LABEL
9	2	-	4953-0001	ELBOW 1/4"X1/4" TUBE
8	2	-	4704-0024	10-32X1/2" FLAT HEAD
7	1	-	3907-0052	14" EXT. CABLE
6	1	-	4904-0006	O-RING 2-030
5	1	-	5205-0038	BOWL ASSEMBLY
4	1	-	5110-0012	RETAINER
3	1	-	SEE TABLE	FILTER ELEMENT
2	1	-	5008-0004	BRACKET
1	1	-	5110-0011	KYNAR HEAD
ITEM	QTY	DWG NO.	PART NO.	DESCRIPTION

VISIBLE GAS FILTER WITH MOISTURE SENSOR (W.C.O.F.)

PART NO. SEE TABLE		FOR INSTRUMENT	
<b>UNIVERSAL ANALYZERS INC.</b>			
5200 Convar Drive Carson City, Nevada 89706 USA			
DRAWN BY HARVEY MITCHELL		DRAWING NO P0018	
APVD BY TED BARBEN II			
DATE 04/14/92	SCALE 1:1	SIZE C	SHEET 1 OF 2

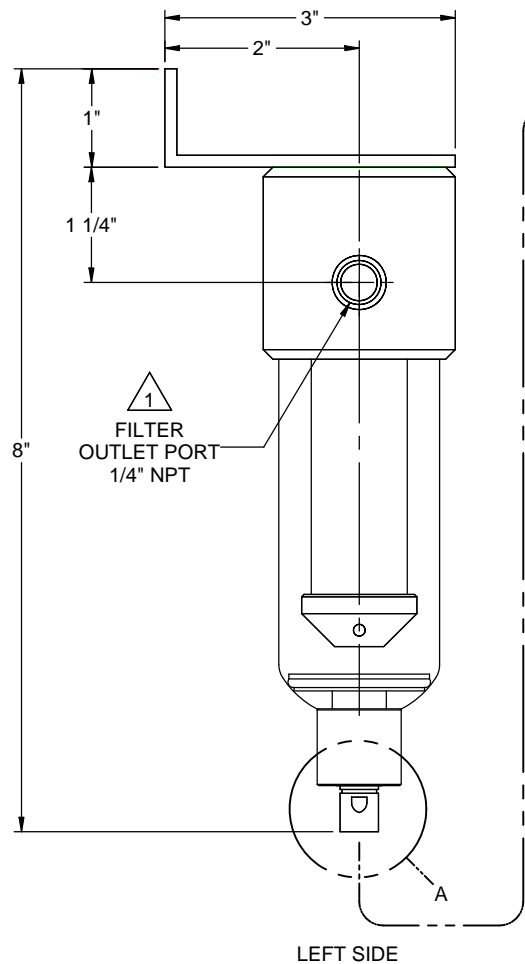
HOLES FOR #10 PANHEAD MOUNTING SCREWS (SUPPLIED BY OTHERS)



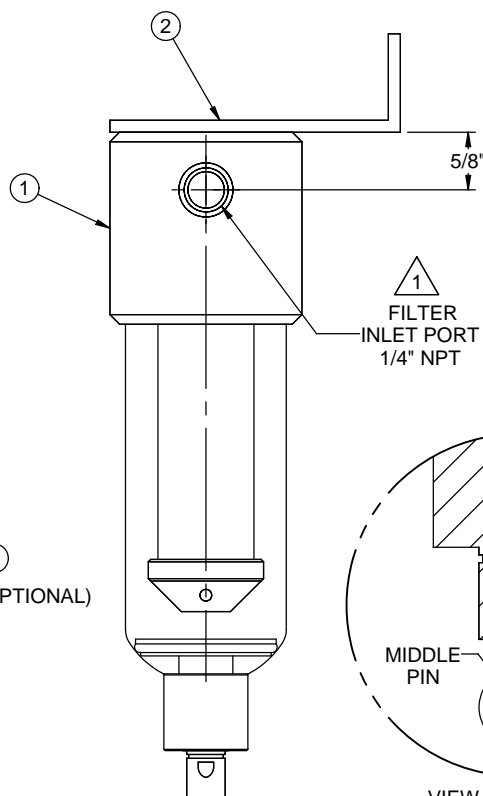
EXPLODED FRONT VIEW

COMPLETE FILTER P/N (316SS)	ITEM #3 TYPE	FILTER ELEMENT P/N	PRESSURE DROP RATINGS INCHES OF WATER		
			5 LPM	10 LPM	20 LPM
4980-1012	SINTERED S.S.	4980-0023	10	14	24
4980-1013	PAPER	4980-0022	8	12	20
4980-1014	TEFLON	4980-0006	4	6	10
4980-1015	CERAMIC	4980-0007	4	6	10
4980-1016	COATED CERAMIC	4980-0018	6	8	12

1 FOR COALESCING (COATED CERAMIC WCOF) P/N 4980-0059 SAMPLE INLET & OUTLET PORTS ARE REVERSED.



LEFT SIDE



RIGHT SIDE

VIEW "A" - 2x SCALE  
VERIFY BEFORE CONNECTING THAT MIDDLE PIN IS SHORTER THAN OUTSIDE PIN. IF NOT, CUT MIDDLE PIN AS SHOWN

J	09/22/08	UPDATE PART LIST	MW	DA
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
12	2	-	4710-0008	FLAT WASHER
11	2	-	4710-0016	STAR WASHER
10	1	-	5001-0004	RED DIRECTIONAL LABEL
9	2	-	4953-0001	ELBOW 1/4"X1/4" TUBE
8	2	-	4704-0024	10-32X1/2" FLAT HEAD
7	1	-	3907-0052	14" EXT. CABLE
6	1	-	4904-0006	O-RING 2-030
5	1	-	5205-0038	BOWL ASSEMBLY
4	1	-	5110-0012	RETAINER
3	1	-	SEE TABLE	FILTER ELEMENT
2	1	-	5008-0005	BRACKET
1	1	-	5150-1015	CHAMBER UPPER 316SS
ITEM	QTY	DWG NO.	PART NO.	DESCRIPTION

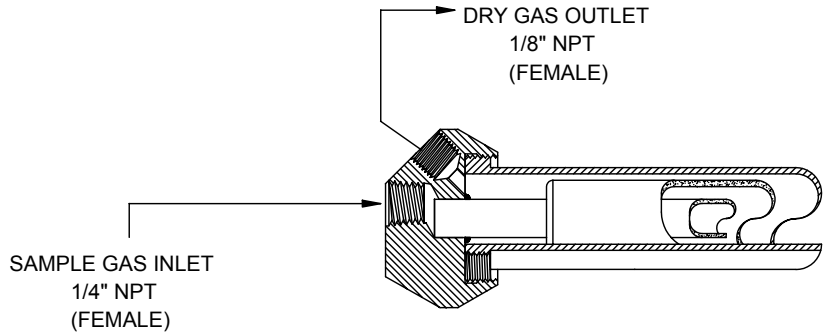
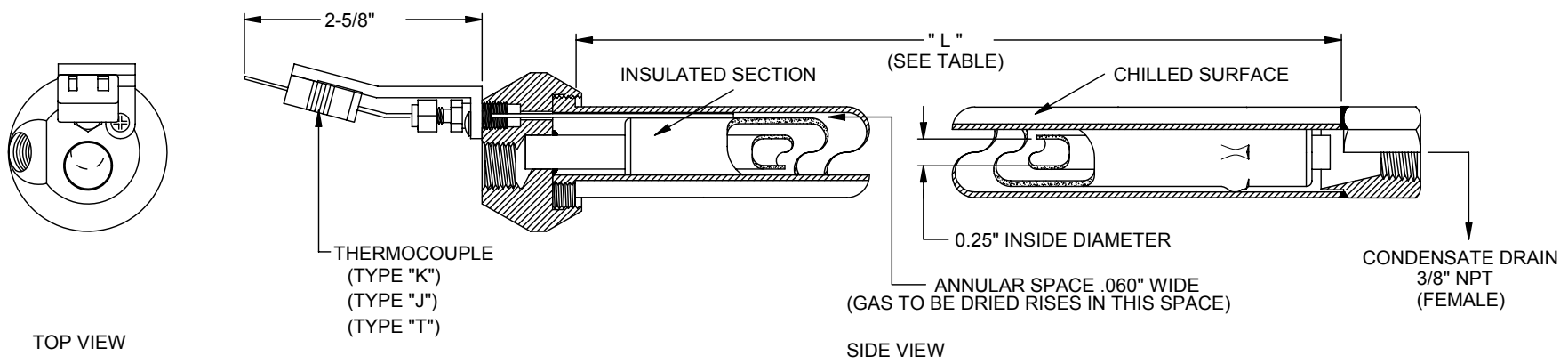
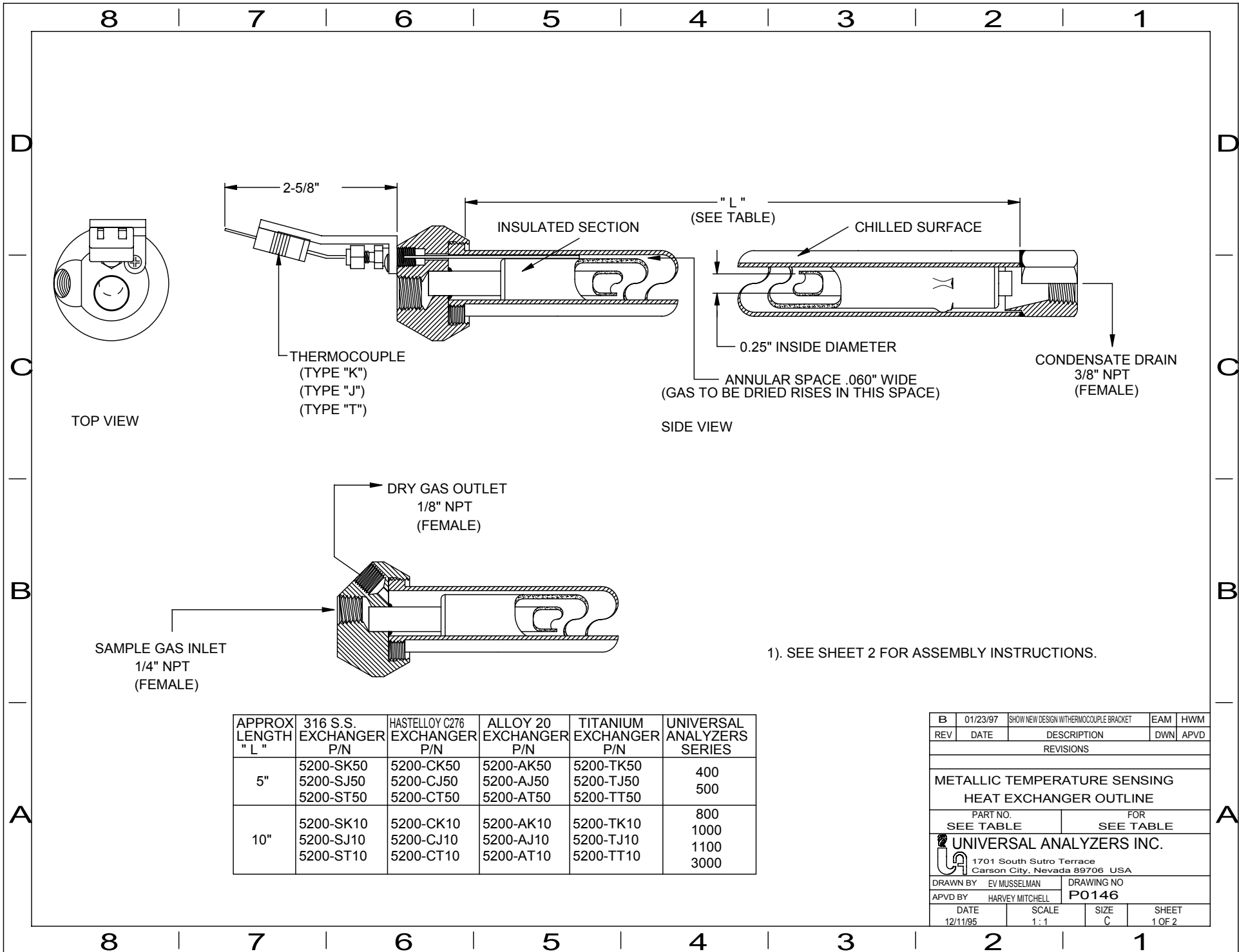
VISIBLE GAS FILTER WITH MOISTURE SENSOR (W.C.O.F.S.S.)

PART NO. SEE TABLE FOR INSTRUMENT

**UNIVERSAL ANALYZERS INC.**  
1701 South Sutro Terrace  
Carson City, Nevada 89706 USA

DRAWN BY HARVEY MITCHELL DRAWING NO P0018  
APVD BY TED BARBEN II

DATE 04/14/92 SCALE 1:1 SIZE C SHEET 2 OF 2



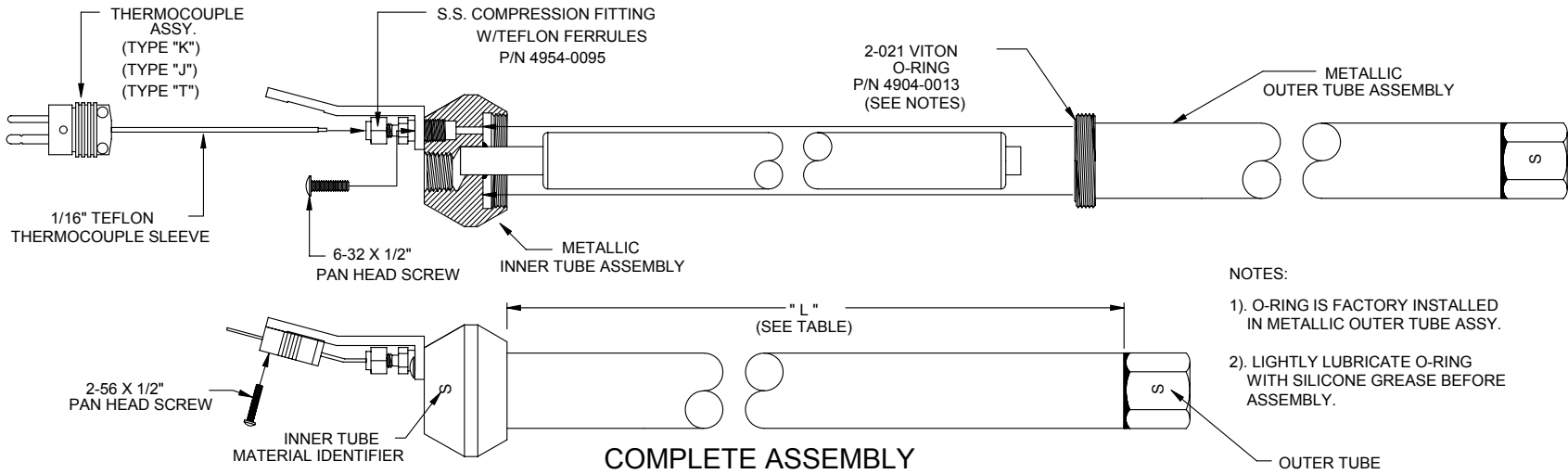
1). SEE SHEET 2 FOR ASSEMBLY INSTRUCTIONS.

APPROX LENGTH "L"	316 S.S. EXCHANGER P/N	HASTELLOY C276 EXCHANGER P/N	ALLOY 20 EXCHANGER P/N	TITANIUM EXCHANGER P/N	UNIVERSAL ANALYZERS SERIES
5"	5200-SK50	5200-CK50	5200-AK50	5200-TK50	400
	5200-SJ50	5200-CJ50	5200-AJ50	5200-TJ50	500
	5200-ST50	5200-CT50	5200-AT50	5200-TT50	
10"	5200-SK10	5200-CK10	5200-AK10	5200-TK10	800
	5200-SJ10	5200-CJ10	5200-AJ10	5200-TJ10	1000
	5200-ST10	5200-CT10	5200-AT10	5200-TT10	1100
					3000

B	01/23/97	SHOW NEW DESIGN WITH THERMOCOUPLE BRACKET	EAM	HWM
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
METALLIC TEMPERATURE SENSING HEAT EXCHANGER OUTLINE				
PART NO. SEE TABLE		FOR SEE TABLE		
UNIVERSAL ANALYZERS INC.				
1701 South Sutro Terrace Carson City, Nevada 89706 USA				
DRAWN BY EV MUSSELMAN		DRAWING NO P0146		
APVD BY HARVEY MITCHELL				
DATE 12/11/95	SCALE 1:1	SIZE C	SHEET 1 OF 2	

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

### EXPLODED METALLIC HEAT EXCHANGER



- NOTES:
- 1). O-RING IS FACTORY INSTALLED IN METALLIC OUTER TUBE ASSY.
  - 2). LIGHTLY LUBRICATE O-RING WITH SILICONE GREASE BEFORE ASSEMBLY.

### COMPLETE ASSEMBLY

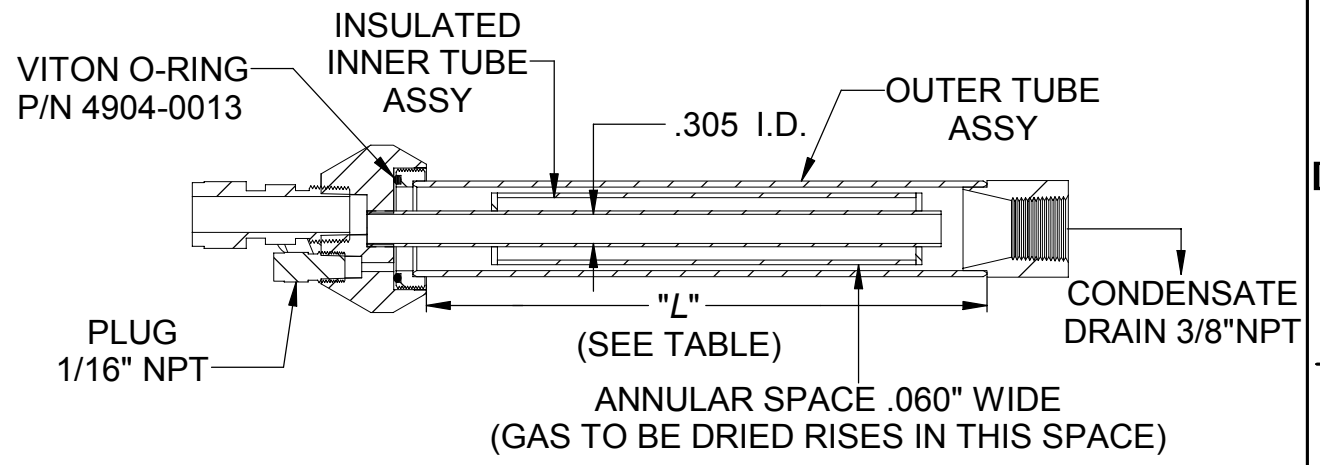
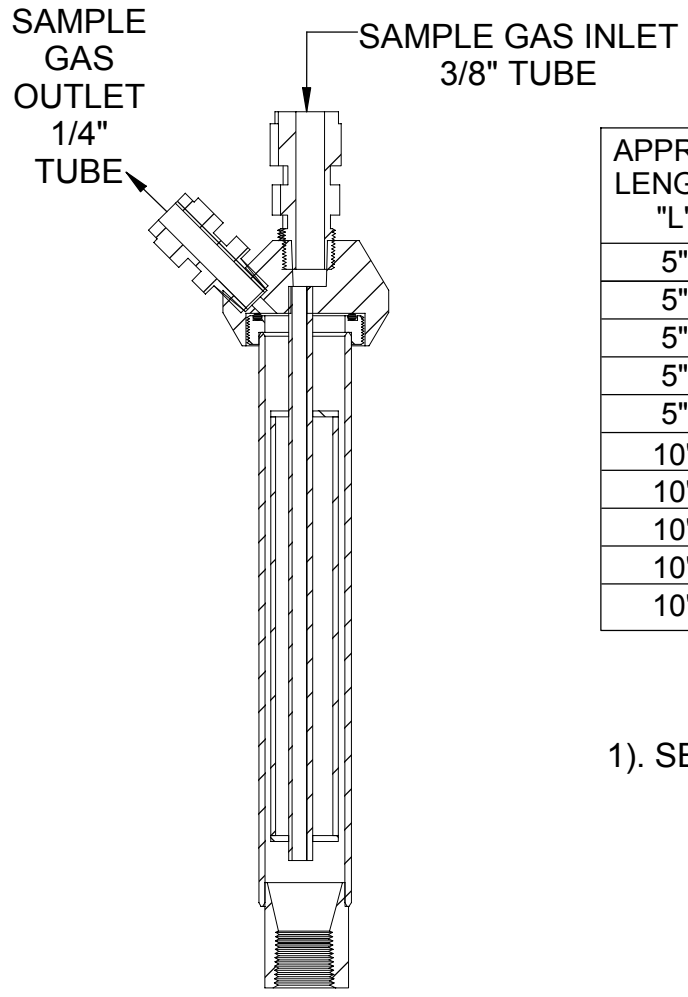
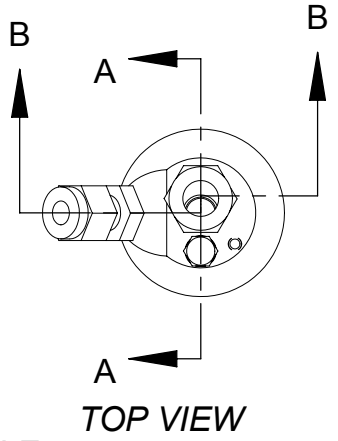
#### SPARE PARTS LIST

"L" LENGTH	MATERIAL DESC.	COMPLETE ASSY P/N	OUTER TUBE ASSY P/N	INNER TUBE ASSY P/N	TYPE "K" THERMOCOUPLE ASSEMBLY P/N	TYPE "J" THERMOCOUPLE ASSEMBLY P/N	TYPE "T" THERMOCOUPLE ASSEMBLY P/N
5"	316 S.S.	5200-SK50	5201-0012	5201-0015	1150-0011	X	X
5"	"	5200-SJ50	"	"	X	1150-0012	X
5"	"	5200-ST50	"	"	X	X	1150-0013
5"	ALLOY 20	5200-AK50	5201-0022	"	"	X	X
5"	"	5200-AJ50	"	"	X	"	X
5"	"	5200-AT50	"	"	X	X	"
5"	HASTELLOY C276	5200-CK50	5201-0020	"	"	X	X
5"	"	5200-CJ50	"	"	X	"	X
5"	"	5200-CT50	"	"	X	X	"
5"	TITANIUM	5200-TK50	5201-0024	5201-0028	1150-0018	X	X
5"	"	5200-TJ50	"	"	X	1150-0019	X
5"	"	5200-TT50	"	"	X	X	1150-0014
10"	316 S.S.	5200-SK10	5201-0013	5201-0016	1150-0011	X	X
10"	"	5200-SJ10	"	"	X	1150-0012	X
10"	"	5200-ST10	"	"	X	X	1150-0013
10"	ALLOY 20	5200-AK10	5201-0023	"	"	X	X
10"	"	5200-AJ10	"	"	X	"	X
10"	"	5200-AT10	"	"	X	X	"
10"	HASTELLOY C276	5200-CK10	5201-0021	"	"	X	X
10"	"	5200-CJ10	"	"	X	"	X
10"	"	5200-CT10	"	"	X	X	"
10"	TITANIUM	5200-TK10	5201-0025	5201-0029	1150-0018	X	X
10"	"	5200-TJ10	"	"	X	1150-0019	X
10"	"	5200-TT10	"	"	X	X	1150-0014

B	01/23/97	SHOW NEW DESIGN W/THERMOCOUPLE BRACKET	EAM	HWM
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
<b>METALLIC TEMPERATURE SENSING HEAT EXCHANGER ASSEMBLY</b>				
PART NO. SEE TABLE		FOR 400 500 800 1000 1100 3000 SERIES		
<b>UNIVERSAL ANALYZERS INC.</b>				
1701 South Sutro Terrace Carson City, Nevada 89706 USA				
DRAWN BY EV MUSSELMAN		DRAWING NO <b>P0146</b>		
APVD BY HARVEY MITCHELL		DATE 12/11/95	SCALE 1:1	SHEET B 2 OF 2

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1



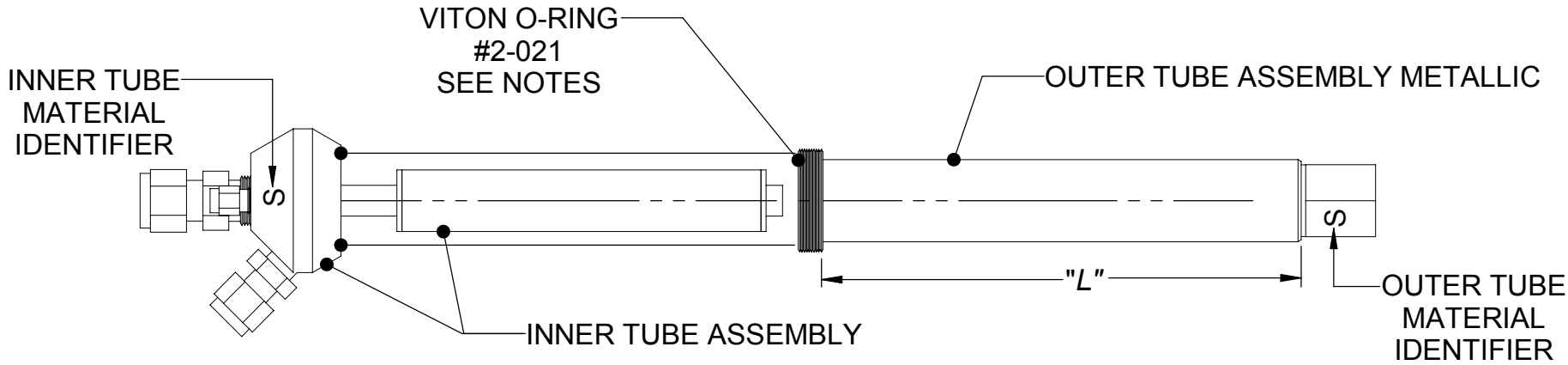
APPROX LENGTH "L"	HEAT EXCHANGER P/N	OUTER TUBE MATERIAL	UNIVERSAL ANALYZERS SERIES
5"	5200-S050	316 S.S.	400/500
5"	5200-T050	TITANIUM	400/500
5"	5200-A050	ALLOY 20	400/500
5"	5200-C050	HASTELLOY C-276	400/500
5"	5200-S05T	TEFLON COATED 316 S.S.	400/500
10"	5200-S010	316 S.S.	800/1000/1100/3000
10"	5200-T010	TITANIUM	800/1000/1100/3000
10"	5200-A010	ALLOY 20	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

1). SEE SHEET 2 FOR ASSEMBLY INSTRUCTIONS.

A	02/09/99	REVISE P/N TABLE FOR TEFLON COATED	EAM	RD
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
<b>HEAT EXCHANGER METALLIC NON-TEMPERATURE SENSING OUTLINE</b>				
PART NO. SEE TABLE		FOR SEE TABLE		
<b>UNIVERSAL ANALYZERS INC.</b>				
1701 South SutroTerrace Carson City, Nevada 89706 USA				
DRAWN BY EV MUSSELMAN		DRAWING NO <b>P0147</b>		
APVD BY H. MITCHELL				
DATE 12/11/95	SCALE NONE	SIZE C	SHEET 1 OF 2	

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

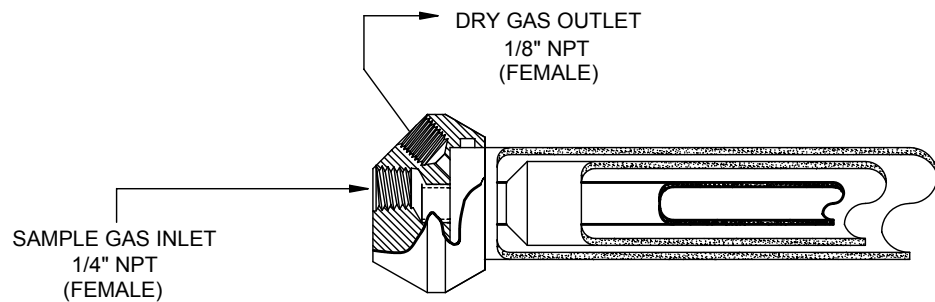
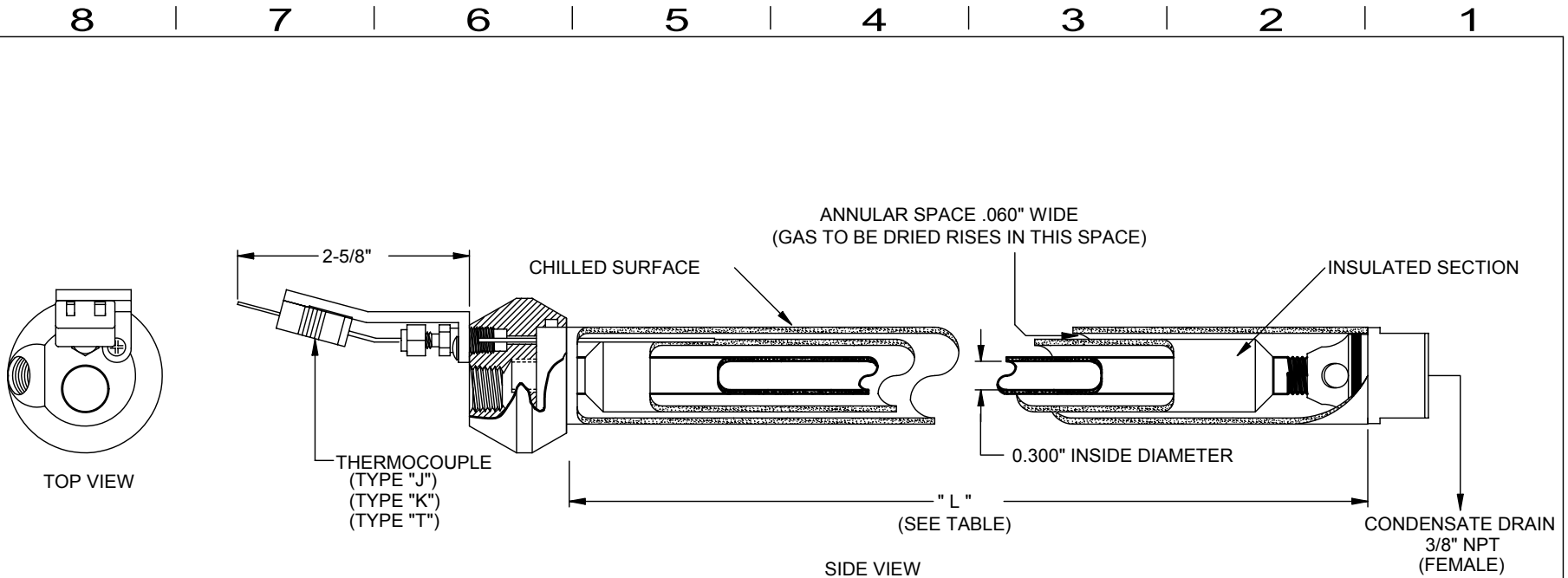


HEAT EXCHANGER SEPERABLE		SPARE PARTS LIST			
APPROX "L" LENGTH	P/N	INNER TUBE ASSY P/N	OUTER TUBE ASSY P/N	VITON O-RING #2-021 P/N	PLUG 1/16"NPT P/N
5"	5200-S050	5201-0015	5201-0012	4904-0013	4951-0058
5"	5200-T050	"	5201-0024	"	"
5"	5200-A050	"	5201-0022	"	"
5"	5200-C050	"	5201-0020	"	"
5"	5200-S05T	5201-0041	5201-0043	"	"
10"	5200-S010	5201-0016	5201-0013	4904-0013	4951-0058
10"	5200-T010	"	5201-0025	"	"
10"	5200-A010	"	5201-0023	"	"
10"	5200-C010	"	5201-0021	"	"
10"	5200-S01T	5201-0042	5201-0044	"	"

NOTES:  
 1). O-RING IS FACTORY INSTALLED IN METALLIC OUTER TUBE.  
 2). LIGHTLY LUBRICATE O-RING WITH SILICONE GREASE BEFORE ASSEMBLY.

A	02/09/99	REVISE TABLE TO INCLUDE TEFLON PARTS	EAM	RD
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
HEAT EXCHANGER ASSEMBLY NON-TEMPERATURE SENSING METALLIC				
PART NO. SEE TABLE		FOR INSTRUMENT		
<b>UNIVERSAL ANALYZERS INC.</b>				
1701 South Sutro Terrace Carson City, Nevada 89706 USA				
DRAWN BY EV MUSSELMAN		DRAWING NO		
APVD BY H. MITCHELL		P0147		
DATE 12/11/95		SCALE NONE		SIZE C
				SHEET 2 OF 2

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1



1). SEE SHEET 2 FOR ASSEMBLY INSTRUCTIONS.

LENGTH "L"	GLASS KYNAR HEAT EXCHANGER ASSEMBLY P/N	UNIVERSAL ANALYZERS SAMPLE COOLER MODELS
5"	5200-KK50	520
	5200-KJ50	530
	5200-KT50	540
		570
10"		1040
	5200-KK10	1050
	5200-KJ10	1060
	5200-KT10	1080
		1090
15"	5200-KK15	FGA2
	5200-KJ15	
	5200-KT15	

C	10/02/01	Add 15" Heat Exchanger Data To Table	EM	JK
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
<b>Glass Kynar Temperature Sensing Heat Exchanger Outline</b>				
PART NO. SEE TABLE		FOR SEE TABLE		
<b>UNIVERSAL ANALYZERS INC.</b>				
1701 South Sutro Terrace Carson City, Nevada 89706 USA				
DRAWN BY E. Mussleman		DRAWING NO P0148		
APVD BY H. Mitchell				
DATE	SCALE	SIZE	SHEET	
12/11/95	1:1	C	1 OF 2	

8

7

6

5

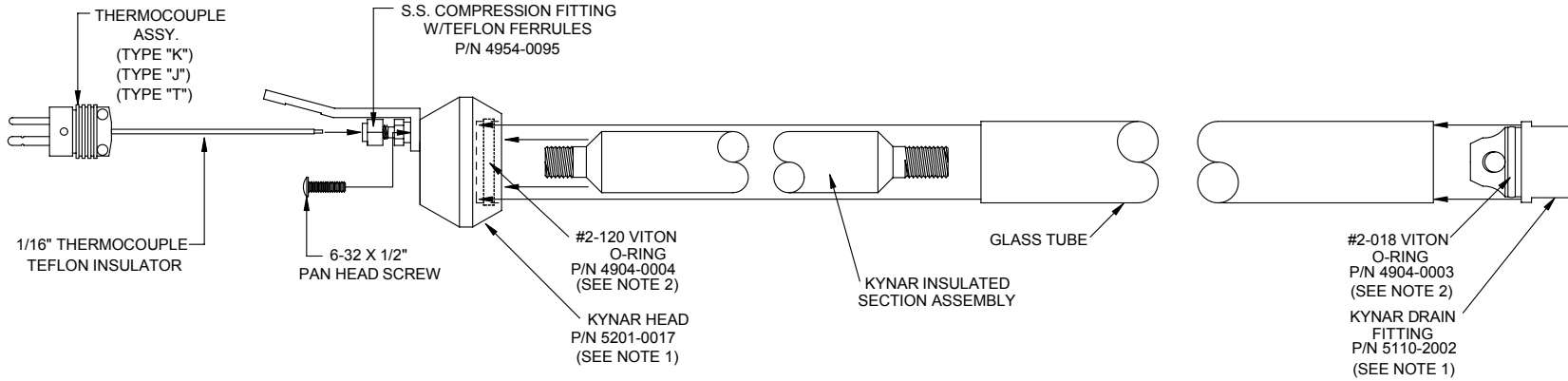
4

3

2

1

### EXPLODED GLASS KYNAR HEAT EXCHANGER



SPARE PARTS LIST						
GLASS KYNAR HEAT EXCHANGER ASSEMBLY		KYNAR INSULATED SECTION ASSEMBLY	GLASS TUBE	TYPE "K" THERMOCOUPLE	TYPE "J" THERMOCOUPLE	TYPE "T" THERMOCOUPLE
LENGTH "L"	P/N	P/N	P/N	P/N	P/N	P/N
5"	5200-KK50	5110-2003	5201-0002	1150-0011	1150-0012	1150-0013
5"	5200-KJ50	"	"	"	"	"
5"	5200-KT50	"	"	"	"	"
10"	5200-KK10	5110-2004	5201-0001	"	"	"
10"	5200-KJ10	"	"	"	"	"
10"	5200-KT10	"	"	"	"	"
15"	5200-KK15	5110-2006	5201-0078	"	"	"
15"	5200-KJ15	"	"	"	"	"
15"	5200-KT15	"	"	"	"	"

NOTES:

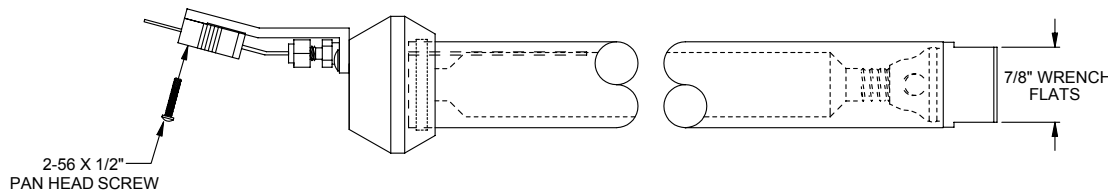
- O-RINGS ARE FACTORY INSTALLED IN KYNAR HEAD AND KYNAR DRAIN FITTING.
- LIGHTLY LUBRICATE O-RINGS WITH SILICONE GREASE BEFORE ASSEMBLY.

C	10/02/01	Add 15" Data To Parts List Table	EM	JK
REV	DATE	DESCRIPTION	DWN	APVD

REVISIONS

### Glass Kynar Temperature Sensing Heat Exchanger Spare Parts List Exploded Assembly

PART NO. SEE TABLE		FOR SAMPLE COOLERS	
UNIVERSAL ANALYZERS INC.			
1701 South Sutro Terrace Carson City, Nevada 89706 USA			
DRAWN BY E. Musselman		DRAWING NO P0148	
APVD BY H. Mitchell		DATE 12/11/95	SCALE 1:1
		SIZE B	SHEET 2 OF 2



### COMPLETE GLASS KYNAR HEAT EXCHANGER ASSEMBLY

8

7

6

5

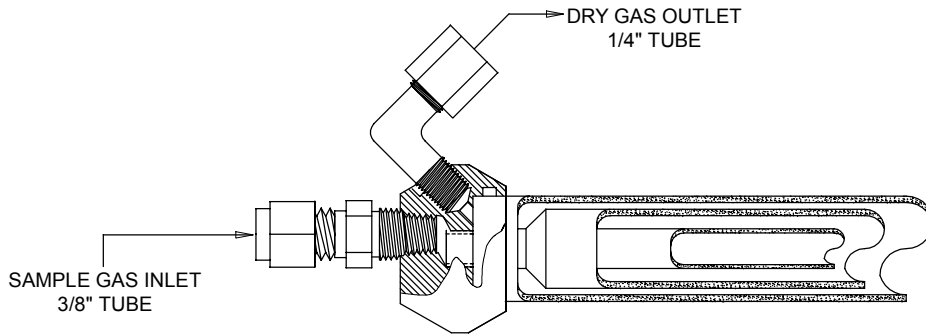
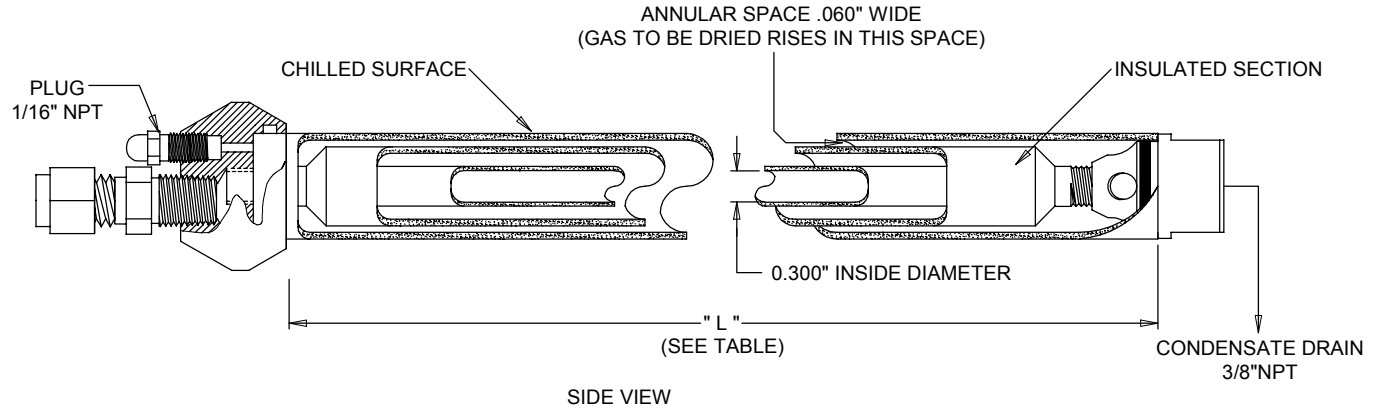
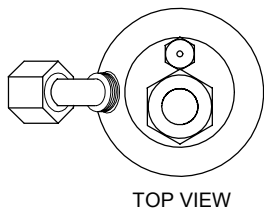
4

3

2

1



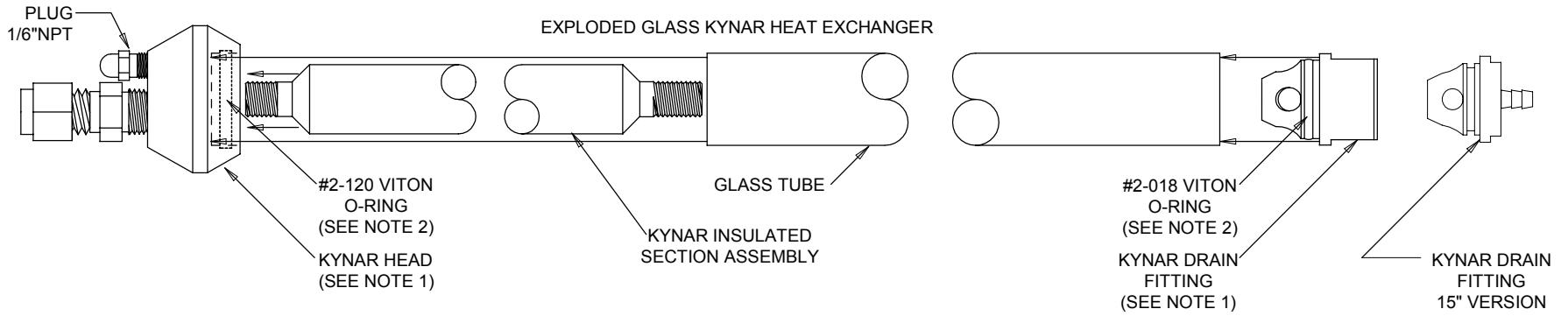


1). SEE SHEET 2 FOR ASSEMBLY INSTRUCTIONS.

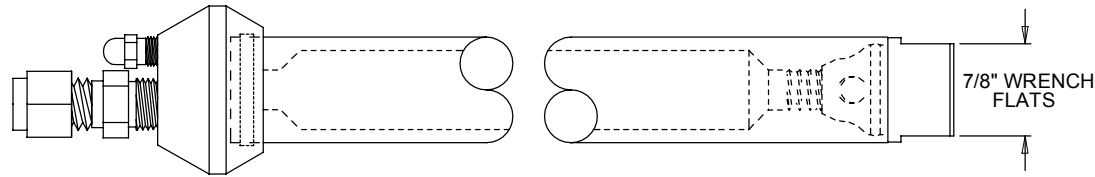
LENGTH "L"	GLASS KYNAR HEAT EXCHANGER ASSEMBLY P/N	UNIVERSAL ANALYZERS SAMPLE COOLER MODELS	QTY OF EXCHANGERS PER SAMPLE COOLER
5"	5200-K050	520	1
		530	2
		540	2
		570	4
10"	5200-K010	1040	1
		1050	2
		1060	2
		1080	2
		1090	4
15"	5200-K015	FGA2	1

REV	DATE	DESCRIPTION	DWN	APVD
C	01/19/04	Revision Per Sheet 2	RPH	TB
REVISIONS				
HEAT EXCHANGER GLASS / KYNAR NON-TEMPERATURE SENSING OUTLINE				
PART NO. SEE TABLE		FOR INSTRUMENT		
<b>UNIVERSAL ANALYZERS INC.</b> 1701 South Sutro Terrace Carson City, Nevada 89706 USA				
DRAWN BY EV MUSSELMAN		DRAWING NO PO149		
APVD BY H. MITCHELL				
DATE 12/11/95	SCALE 1:1	SIZE C	SHEET 1 OF 2	

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1



SPARE PARTS LIST								
GLASS KYNAR HEAT EXCHANGER ASSEMBLY		KYNAR INSULATED SECTION ASSY	GLASS TUBE	KYNAR DRAIN FITTING	#2-120 VITON O-RING	#2-018 VITON O-RING	KYNAR HEAD	1/16\" NPT PLUG
LENGTH \"L\"	P/N	P/N	P/N	P/N	P/N	P/N	P/N	P/N
5"	5200-K050	5110-2003	5201-0002	5110-2002	4904-0004	4904-0003	5201-0017	4951-0066
10"	5200-K010	5110-2004	5201-0001	"	"	"	"	"
15"	5200-K015	5110-2006	5201-0078	5201-0066	"	"	"	"



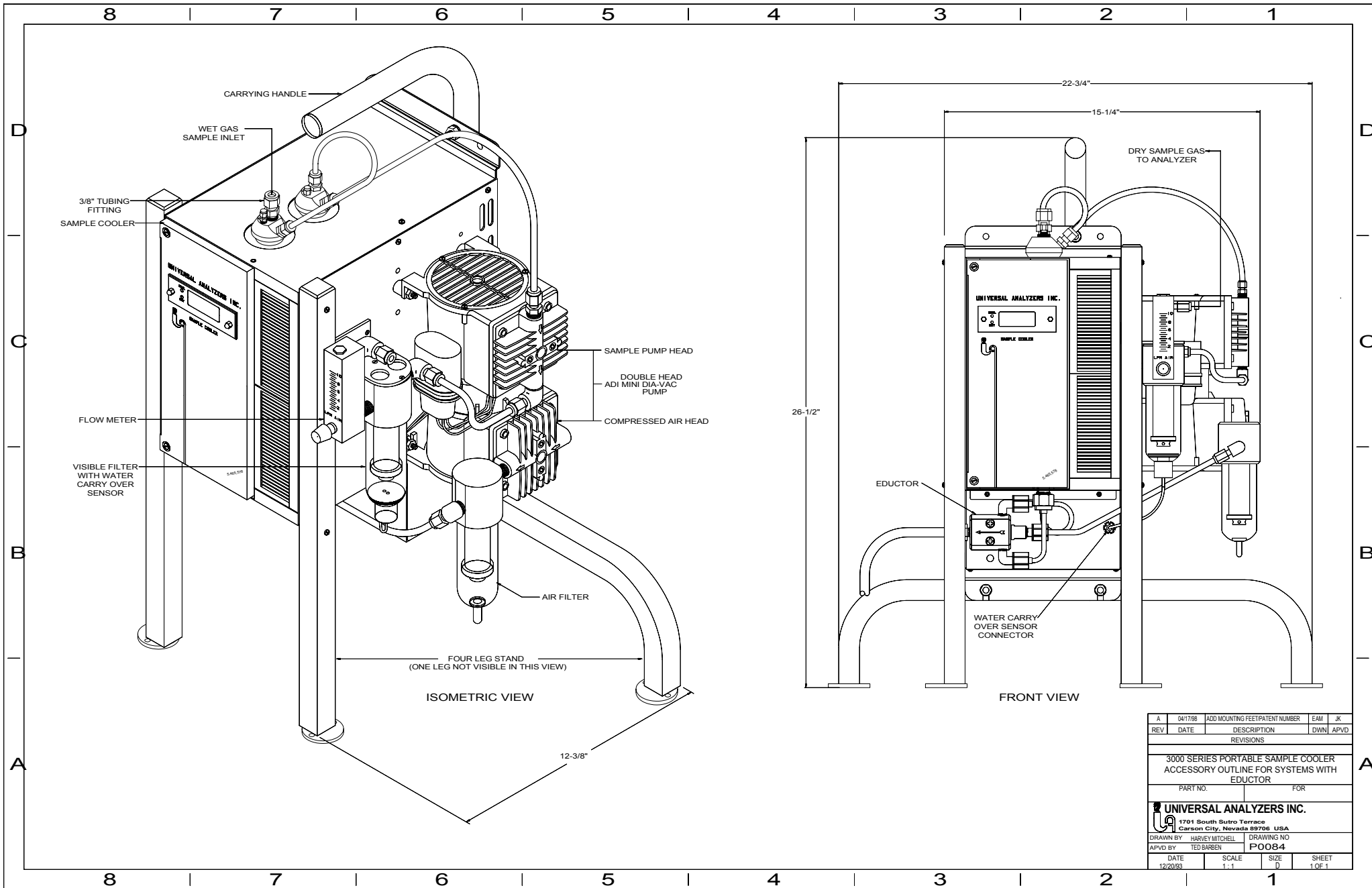
COMPLETE GLASS KYNAR HEAT EXCHANGER ASSEMBLY

NOTES:

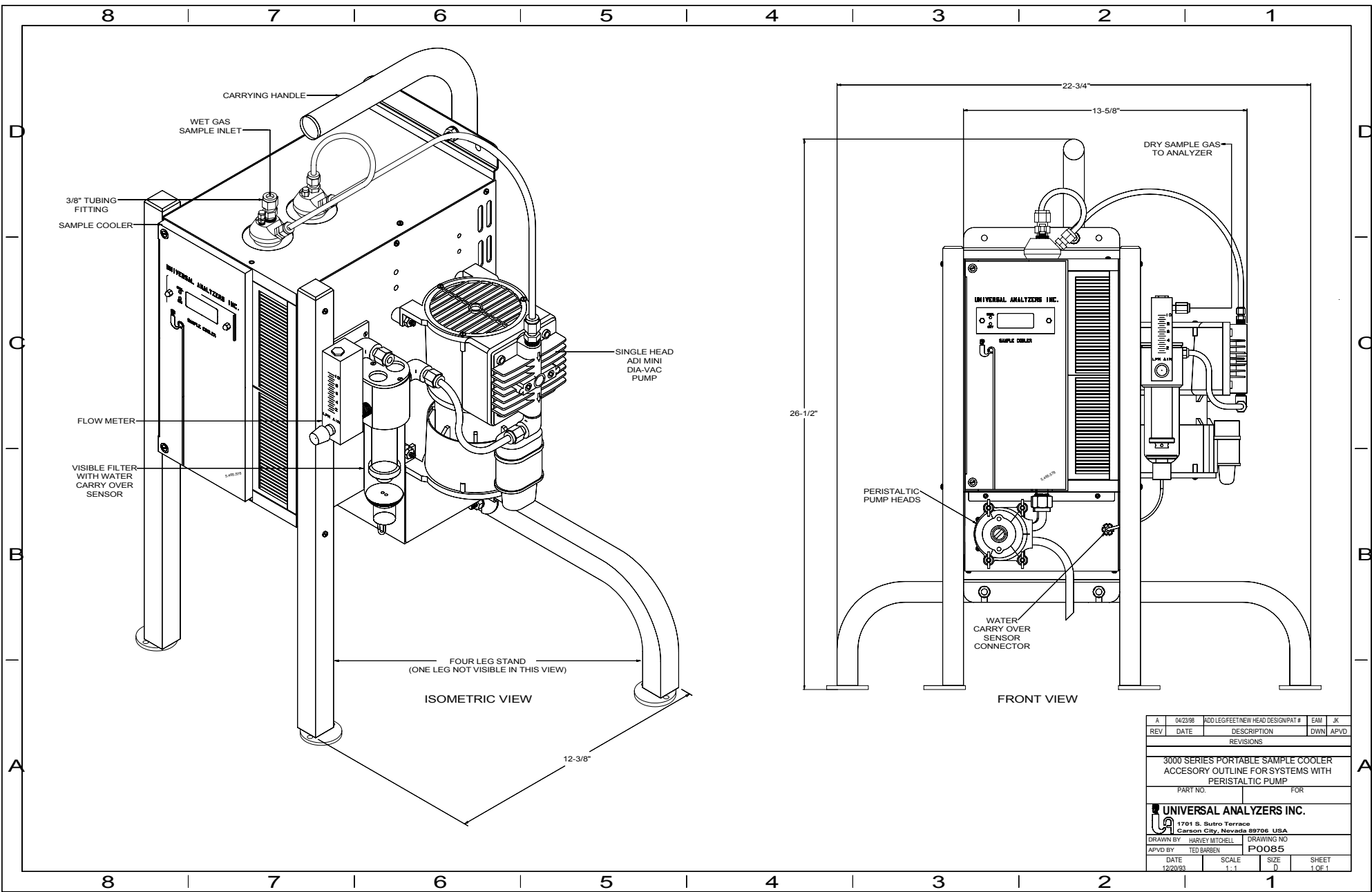
- O-RINGS ARE FACTORY INSTALLED IN KYNAR HEAD AND KYNAR DRAIN FITTINGS
- LIGHTLY LUBRICATE O-RINGS WITH SILICONE GREASE BEFORE ASSEMBLY.

C	01/19/04	Added Kynar Drain P/N for 15" Length	RPH	TB
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
<b>HEAT EXCHANGER GLASS / KYNAR NON-TEMPERATURE SENSING SPARE PART INSTALLATION</b>				
PART NO. SEE TABLE		FOR INSTRUMENT		
<b>UNIVERSAL ANALYZERS INC.</b>				
1701 South Sutro Terrace Carson City, Nevada 89706 USA				
DRAWN BY	EV MUSSELMAN	DRAWING NO		
APVD BY	H. MITCHELL	PO149		
DATE	12/11/95	SCALE	1:1	SHEET 2 OF 2

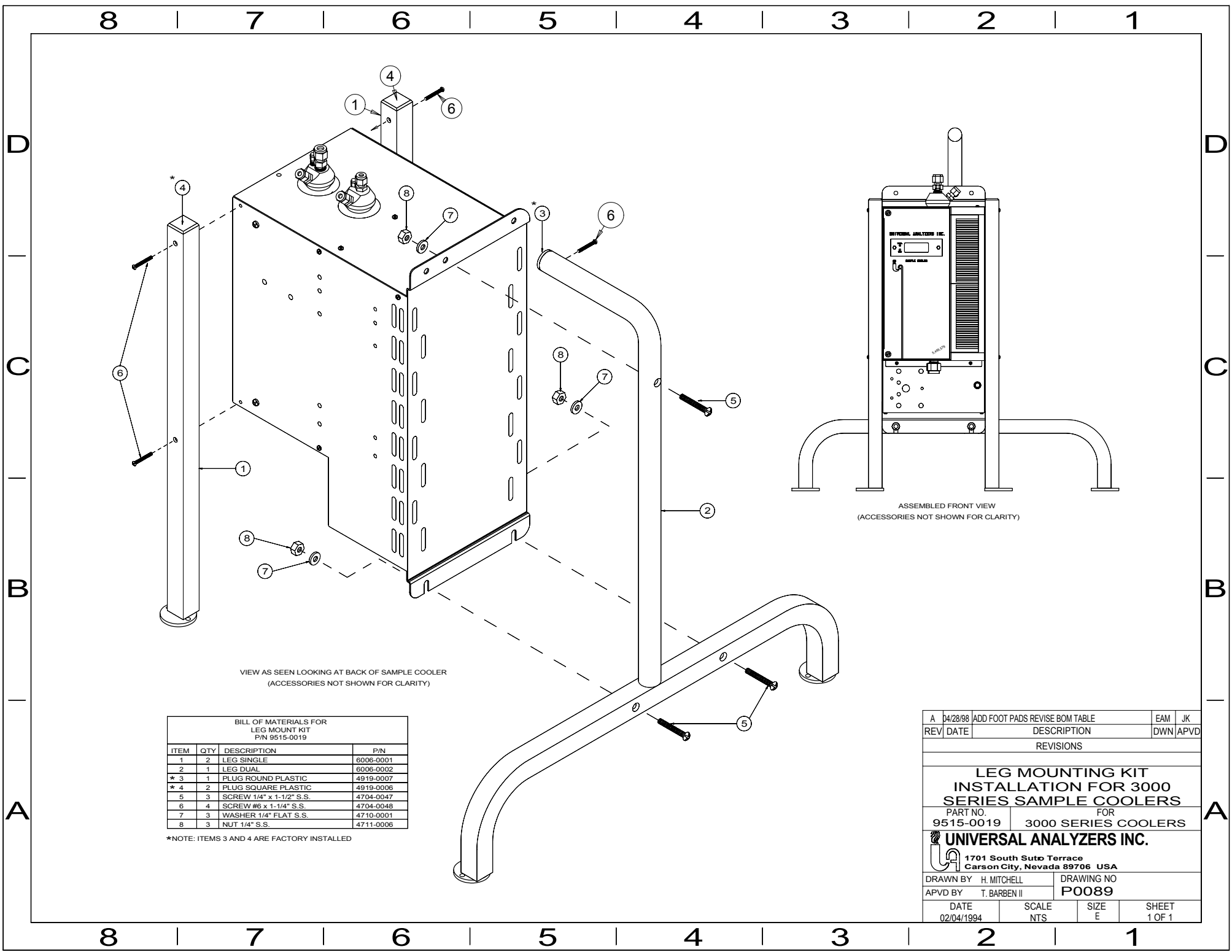
8 | 7 | 6 | 5 | 4 | 3 | 2 | 1



A	04/17/98	ADD MOUNTING FEET/PATENT NUMBER	EAM	JK
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
3000 SERIES PORTABLE SAMPLE COOLER ACCESSORY OUTLINE FOR SYSTEMS WITH EDUCTOR				
PART NO.		FOR		
<b>UNIVERSAL ANALYZERS INC.</b>				
1701 South Sutor Terrace Carson City, Nevada 89705 USA				
DRAWN BY HARVEY MITCHELL		DRAWING NO		
APVD BY TED BARBEN		P0084		
DATE	SCALE	SIZE	SHEET	
12/20/93	1:1	D	1 OF 1	



A	04/23/98	ADD LEG FEET NEW HEAD DESIGN PAT #	EAM	JK
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
3000 SERIES PORTABLE SAMPLE COOLER				
ACCESSORY OUTLINE FOR SYSTEMS WITH				
PERISTALTIC PUMP				
PART NO.		FOR		
<b>UNIVERSAL ANALYZERS INC.</b> 1701 S. Sutro Terrace Carson City, Nevada 89706 USA				
DRAWN BY HARVEY MITCHELL		DRAWING NO P0085		
APVD BY TED BARBER		DATE 12/20/98		
SCALE 1-1		SIZE D	SHEET 1 OF 1	



VIEW AS SEEN LOOKING AT BACK OF SAMPLE COOLER  
(ACCESSORIES NOT SHOWN FOR CLARITY)

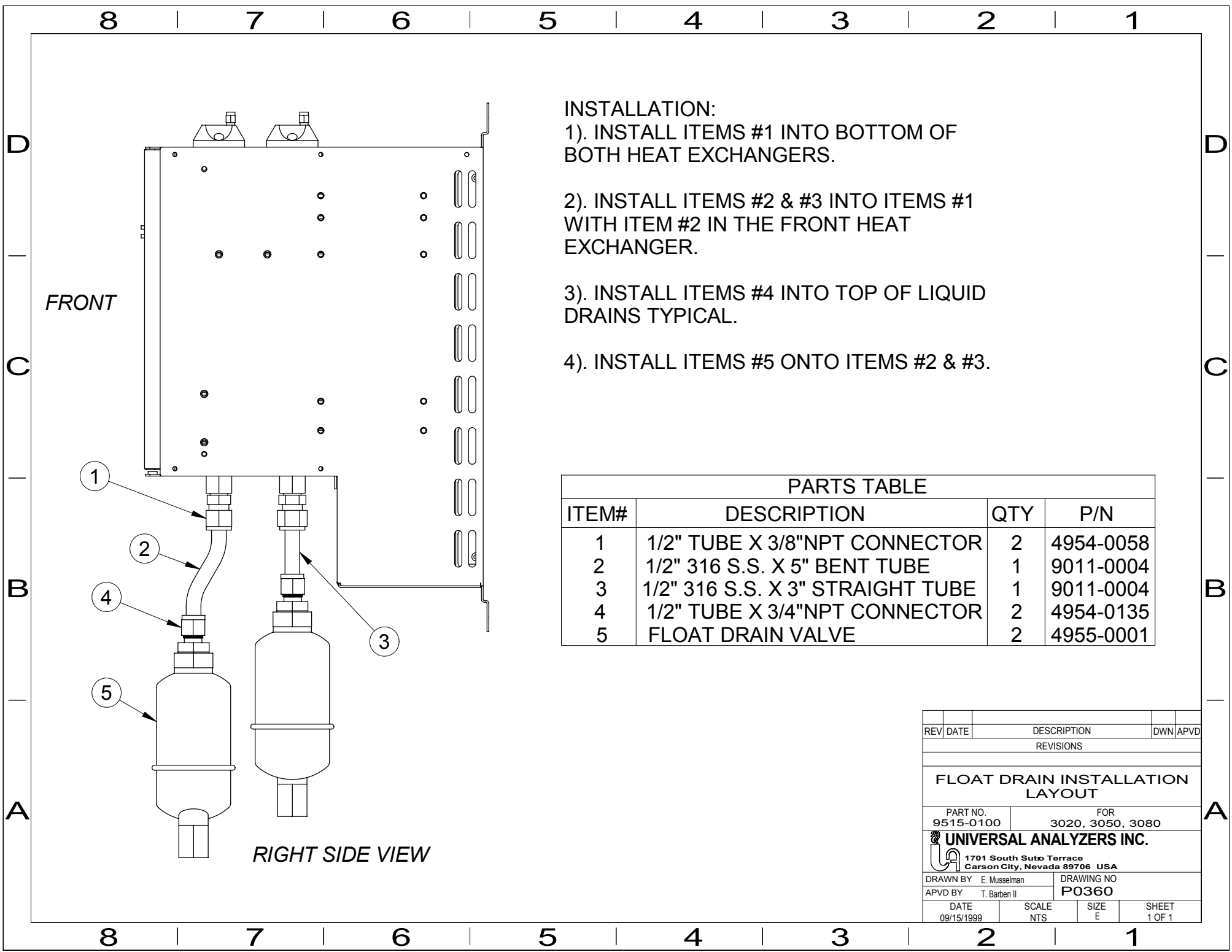
ASSEMBLED FRONT VIEW  
(ACCESSORIES NOT SHOWN FOR CLARITY)

BILL OF MATERIALS FOR  
LEG MOUNT KIT  
P/N 9515-0019

ITEM	QTY	DESCRIPTION	P/N
1	2	LEG SINGLE	6006-0001
2	1	LEG DUAL	6006-0002
* 3	1	PLUG ROUND PLASTIC	4919-0007
* 4	2	PLUG SQUARE PLASTIC	4919-0006
5	3	SCREW 1/4" x 1-1/2" S.S.	4704-0047
6	4	SCREW #6 x 1-1/4" S.S.	4704-0048
7	3	WASHER 1/4" FLAT S.S.	4710-0001
8	3	NUT 1/4" S.S.	4711-0006

\*NOTE: ITEMS 3 AND 4 ARE FACTORY INSTALLED

A	04/28/98	ADD FOOT PADS REVISE BOM TABLE	EAM	JK
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
<b>LEG MOUNTING KIT INSTALLATION FOR 3000 SERIES SAMPLE COOLERS</b>				
PART NO. 9515-0019		FOR 3000 SERIES COOLERS		
<b>UNIVERSAL ANALYZERS INC.</b>				
1701 South Suto Terrace Carson City, Nevada 89706 USA				
DRAWN BY H. MITCHELL		DRAWING NO P0089		
APVD BY T. BARBEN II				
DATE 02/04/1994	SCALE NTS	SIZE E	SHEET 1 OF 1	



**INSTALLATION:**

1). INSTALL ITEMS #1 INTO BOTTOM OF BOTH HEAT EXCHANGERS.

2). INSTALL ITEMS #2 & #3 INTO ITEMS #1 WITH ITEM #2 IN THE FRONT HEAT EXCHANGER.

3). INSTALL ITEMS #4 INTO TOP OF LIQUID DRAINS TYPICAL.

4). INSTALL ITEMS #5 ONTO ITEMS #2 & #3.

PARTS TABLE			
ITEM#	DESCRIPTION	QTY	P/N
1	1/2" TUBE X 3/8"NPT CONNECTOR	2	4954-0058
2	1/2" 316 S.S. X 5" BENT TUBE	1	9011-0004
3	1/2" 316 S.S. X 3" STRAIGHT TUBE	1	9011-0004
4	1/2" TUBE X 3/4"NPT CONNECTOR	2	4954-0135
5	FLOAT DRAIN VALVE	2	4955-0001

REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
<b>FLOAT DRAIN INSTALLATION LAYOUT</b>				
PART NO. 9515-0100		FOR 3020, 3050, 3080		
<b>UNIVERSAL ANALYZERS INC.</b>				
1701 South Suto Terrace Carson City, Nevada 89706 USA				
DRAWN BY E. Musselman		DRAWING NO P0360		
APVD BY T. Barben II				
DATE	SCALE	SIZE	SHEET	
09/15/1999	NTS	E	1 OF 1	

**SPARE PARTS RECOMMENDATIONS FOR 3000 SERIES SAMPLE COOLERS**

<b><u>Level A, Consumable Parts (All Models):</u></b>		<b><u>2 Yr Req.</u></b>
9216-0002	Peristaltic Pump Tubing, #15, 5 ft. length	9
3010-0005	6 amp Slow Blow Fuse for 3000 Series Power Supply	2
3010-0006	12 amp Fast Acting Fuse for 3000 Series Power Supply	2
<b><u>Level B, Basic Parts (3000SS Series):</u></b>		
5200-S010	Heat Exchanger/Impinger – 316S.S. 10 Inch	
4904-0013	O-Ring, 316S.S. Heat Exchanger – Viton 2-021	2
8010-0001	Paste, Heat Sinking - 0.1 Ounce Container	2
9515-0040	Ambient Heat Exchanger Conversion Kit (Converts the Model 3040SS to a Model 3050SS)	
<b><u>Level B, Basic Parts (3000PV Series):</u></b>		
5200-K010	Heat Exchanger/Impinger – Glass/Kynar 10 Inch	
5201-0001	Glass Tube, Outer – Heat Exchanger Replacement 10 Inch	1
4904-0003	O-Ring, Glass/Kynar Heat Exchanger – Viton 2-018	2
4904-0004	O-Ring, Glass/Kynar Heat Exchanger – Viton 2-120	2
8010-0001	Paste, Heat Sinking - 0.1 Ounce Container	2
9515-0041	Ambient Heat Exchanger Conversion Kit (Converts the Model 3040PV to a Model 3050PV)	
<b><u>Level C, Critical Parts (All Models):</u></b>		
3016-0002	Peltier Element, Pair - 15Vdc 8.5 Amp 40mm Sq.	
9515-0042	Insulation Kit - Heat Transfer Block (Model 3040 & 3050)	
9515-0023	Insulation Kit - Heat Transfer Block (Model 3080)	
1150-0017	Temperature Sensor Assembly, AD592	1
3103-0006	Temperature Limit Switch, 185°F	1
3152-0004	Solid State Relay, 3-32 VDC / 240VAC 10Amp (Blower Motor)	1
4800-0010	Blower & Motor – Squirrel Cage 115/230Vac	
<b><u>Level D, In-Depth Parts (All Models):</u></b>		
3600-0012	Controller Circuit Board	
3600-0011	Power Supply Board - 15Vdc 500 Watt	
4958-0028	Peristaltic Pump Motor, 115Vac 6RPM	
4958-0031	Peristaltic Pump Motor, 230Vac 6RPM	
4958-0006	Peristaltic Pump Head, #15	
<b><u>Optional Parts/Accessories:</u></b>		
4958-0025	Sample Pump - 115Vac Mini Dia-Vac Alum/Teflon Single Head	
4958-0015	Sample Pump - 230Vac Mini Dia-Vac Alum/Teflon Single Head	
4958-0026	Sample Pump - 115Vac Mini Dia-Vac Alum/Teflon Dual Head	
4958-0016	Sample Pump - 230Vac Mini Dia-Vac Alum/Teflon Dual Head	
9515-0018	Sample Pump Rebuild Kit - Mini Dia-Vac (for Single Head)	3
9515-0018	Sample Pump Rebuild Kit - Mini Dia-Vac (for Dual Head)	6
4955-0004	Sample Pressure Control, AirTrol 0-10Psig Adjustable	2
4955-0091	Sample Pressure Control, Swagelok 316SS 10-225Psig Adjustable	2

**Optional Parts/Accessories, Continued:****2 Yr Req.**

3152-0002	Solid State Relay, 3-32 VDC / 240VAC 25Amp (Sample Pump)	1
4980-0005	WCOF Assembly - Moisture Sensor/2µm Teflon Filter	
5205-0006	Bowl, WCOF Filter - Replacement with Cable & O-Ring	
4904-0006	O-Ring, WCOF Bowl – Viton 2-030	2
4980-0006*	Filter Element - 2µm Teflon (WCOF)	6
6020-0001	WCO Moisture Sensor Assembly w/ Flow Thru Adaptor	
5101-0001	WCO Moisture Sensor (for Non-Filtered Flow Thru Style)	
9515-0046	Thermocouple Kit, Heat Exchanger - “New Jersey” Type “K”	
9515-0047	Thermocouple Kit, Heat Exchanger - “New Jersey” Type “J”	
9515-0048	Thermocouple Kit, Heat Exchanger - “New Jersey” Type “T”	
9515-0100	Condensate Drain Kit - Automatic (Models 3050 & 3080)	
9515-0101	Condensate Drain Kit - Automatic (Models 3040)	
9515-0019	Portable Leg Kit (3000 Series)	

\* Commissioning Spare Part



# UNIVERSAL ANALYZERS INC.

## MOISTURE CONVERSION TABLE

DEW POINT, DEGREES C.	% WATER BY VOLUME AT SATURATION	% WATER BY WEIGHT AT SATURATION	WATER VAPOR PRESSURE, mm. Hg
-100	0.00000139	0.00000081	0.0000099
-50	0.00388	0.00241	0.0295
-20	0.102	0.0633	0.776
-10	0.256	0.1596	1.950
-5	0.396	0.229	3.014
-4	0.432	0.268	3.280
-3	0.469	0.291	3.569
-2	0.510	0.317	3.880
1	0.555	0.345	4.223
0	0.602	0.364	4.579
1	0.649	0.404	4.937
2	0.696	0.433	5.294
3	0.750	0.466	5.70
4	0.803	0.499	6.10
5	0.861	0.535	6.54
6	0.922	0.573	7.01
7	0.988	0.614	7.51
8	1.06	0.658	8.05
9	1.13	0.702	8.58
10	1.21	0.753	9.15
11	1.29	0.802	9.8
12	1.38	0.860	10.5
13	1.48	0.920	11.2
14	1.58	0.980	12.0
15	1.68	1.044	12.8
20	2.31	1.433	17.5
25	3.13	2.004	23.8
30	4.19	2.64	
35	5.55	3.54	
40	7.28	4.67	
45	9.46	6.12	
50	12.2	8.0	
55	15.5	10.3	
60	19.7	13.3	
65	24.4	16.8	
70	30.7	21.7	
75	38.0	27.8	
80	46.7	35.6	
85	57.2	45.7	
90	69.2	58.4	

# MINI DIA-VAC® DIAPHRAGM SAMPLING PUMPS

SINGLE AND DOUBLE  
STAGE DIAPHRAGM  
PUMPS AND  
COMPRESSORS



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

With the special capacitor run feature and oversized fan, the durable Mini Dia-Vac® is designed to provide you with cooler operating temperatures than many other pumps of its size on the market. You can count on the Mini Dia-Vac® for continuous operation, even under load conditions. This pump has heavy duty bearings and built in overload protection in the motor. The Mini Dia-Vac® is also available with ATEX certified EExd IIC,T4,IP65 as well as Air Driven motors for explosion proof and non-spark applications. The Mini Dia-Vac® general purpose motors are UL Listed , CSA and CE approved.

Choose either the single or dual stage design to meet your specific requirements...and let our Mini Dia-Vac® pump start to pass your gas!

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

- CE approved
- Complete field serviceability
- Continuous operation
- General Purpose, 12-24 V. Brush and Brushless DC, ATEX certified and Air Driven motor options
- Corrosion resistant options
- Wetted parts made of chemically inert material to system performance requirements
- Capacitor-run feature
- Oversized fan to keep motor cool
- Oversized bearings and motor shaft
- Exceptionally quiet at all pressures
- Low maintenance with minimal vibration
- No risk of damage even when inlet or outlet becomes blocked
- Will customize the Mini Dia-Vac® to your specific application



### **M161-BT-GB2**

Single Head Mini Dia-Vac® with ATEX Certified Motor



### **M162-BT-AA1**

Double Head Teflon® coated 316 Stainless Steel Mini Dia-Vac®



### **M161-BT-AA1**

Single Head Teflon® coated Aluminum Mini Dia-Vac®

1371 West Newport Ctr. Drive  
Suite 101  
Deerfield Beach , FL  
33442

Phone: 954-428-7333  
Fax: 954-360-0987  
Email: [info@airdimensions.com](mailto:info@airdimensions.com)  
web: [www.airdimensions.com](http://www.airdimensions.com)



**"We Pass Your Gas"**

## Specifications:

<b>Connecting Rod Material</b>	Aluminum	<b>Weight</b>	8lbs. Single, Aluminum 9lbs. Double Aluminum
<b>Motor</b>	1/15 HP, permanent split with 5 UF capacitor	<b>Port Connections</b>	1/4 NPT
<b>Ambient Temperature</b>	40° C	<b>Electrical</b>	115V, 50/60HZ 1.7 amps 230V, 50/60HZ 0.8 amps

## Mini Dia-Vac® Performance

ADI's Dia-Vac® Pumps can Pass Your Gas at the Speed of Need! Due to an increased interest in reducing the pressure, vacuum, and/or flow on the Dia-Vac® pumps, our engineers designed a modified eccentric. This allows you to customize your Dia-Vac® pump to meet your application requirements while at the same time increasing the diaphragm and bearing life. The standard eccentric size is .160 on the Mini Dia-Vac® pumps.

### Flow Average Mini Dia-Vac®

Eccentric Size	PSIG	bar	InHg	mbar	CFM	LPM
.080	6.0	0.41	7.0	237	.44	12.5
.100	17.0	1.17	17.0	575	.47	13.5
.120	21.0	1.43	18.0	600	.64	18
.150	27.0	1.86	20.0	676	.72	20.0
.160 (std)	30.0	2.07	22.0	745	.78	22.0
.160 (dbl.)	33.0	2.27	27.0	913	1.28	36.2

- Test Results are approximate.
- Tests performed with 316 stainless steel head, Teflon®/EPDM diaphragm, 3/8 in. diameter hose x 5 ft. line at 75°F, using a std. 1725 rpm motor at 60Hz.
- These test results are for reference only, and are intended to help provide information to the user when determining which pump to buy. Actual pump performance will depend upon the users application.
- Please visit the ADI website at : [www.airdimensions.com](http://www.airdimensions.com) for complete performance curves.

## How to Specify and Order Pumps from Air Dimensions Incorporated

CAPACITY		WETTED MATERIALS		POWER			OPTIONAL
STYLE	ECC. HEADS	HEAD	DIAPHRAGM	TYPE	VOLTS	Hz	OPTIONS
M=Mini	17    1 16*    2 15 14 12 10 08	A=Alum B=Alum (TFECo) F=316ss G=316ss (TFECo) H=Hast C J=Hast C (TFECo) K=Kynar (PVDF) P=Electro Polish	E=Encapsulated N=EPDM P=All Teflon *T=Tef/EPDM V=Viton	A=Gen. Pur. D=Air Driven G=XP/ATEX/IIC H=Brushless DC J=Brush DC U=XP/ATEX/IIB	A=115 B=230 H=12(DC) J=24(DC) X=N/A	0=N/A 1=60 1Ph 2=50 1Ph	L=Elevated Head M=Heated w/K Thermocouple M2=Heated 65° Thermostat M3=Heated 100° Thermostat M4=Heated 140° Thermostat M5=Heated 163° Thermostat M6=Heated 200° Thermostat
	*Std. Eccentric		*Std. Diaphragm				

### EXAMPLE:

MI61-FT-AAI : SINGLE STAGE MINI DIA-VAC® W/ SS HEADS, .160 ECC., TFE/EPDM DIAPHRAGM, 115V/60HZ MOTOR

**Note that ADI will always attempt to accommodate any custom application that you may have.  
Please contact the factory for more information.**

**954-428-7333 • 800-423-6464**

**info@airdimensions.com • www.airdimensions.com**



**"We Pass Your Gas"**



# AIR DIMENSIONS INCORPORATED

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

## MINI DIA-VAC®

### MAINTENANCE AND DISASSEMBLY INSTRUCTIONS

#### A. General Operations Characteristics

1. Normal motor coil temperatures may be 160° - 180° F. Winding insulation is Class B.
2. Surrounding temperatures of the pump should remain between 40°-104° F (5° - 40° C)
3. Match electrical power to motor - Serious damage will occur to the motor if wired to an improper voltage.
4. Do not start pump with load of pressure or vacuum on pump head. Additional motor options are available to start under load conditions. Please contact ADI or your local representative for details.
5. Pumps are intended for gaseous operation, eliminate liquids entering pump. It is recommended that the pump is installed at the highest point within the system to prevent the possibility of condensate entering the pump. Additionally pump should be installed in a location protected from moisture contact.
6. Nominal running amps for General Purpose Mini Dia-Vac® at 115/230 volts are 1.03 / 0.51  
Nominal running amps for ATEX Mini Dia-Vac® at 230 volts are 0.95
7. Ensure that your Mini Dia-Vac® pump environment and sample application do not exceed motor capabilities. Mini Dia-Vac® General Purpose motors cannot be used in explosive or flammable gas applications or be located in a hazardous environment. Please contact ADI customer service for clarification.

To check pumping efficiency, employ suitably damped gauges connected so as to dead-end either pressure or vacuum.

NOTE: Check each separately, One or the other port must be open during this test.  
Use 0-60 PSI pressure gauge.  
0-30 inch hg. vacuum gauge, (or mercury manometer.)

Maximum pressure should be 35 PSIG.  
Maximum vacuum should be 20 inches Hg.



## B. Maintenance Procedures

1. For all pump parts refer to parts illustration sheet for specific model type. When reassembling pumps it is recommended that a medium strength thread locker such as Loctite® 242® be used on all screws except A19005 and A19006.
2. Motor oiling - No oiling or other lubrication addition is necessary. All bearings are pre-lubricated and shielded from external contamination.
3. Diaphragm Replacement
  - a) Teflon® coated EPDM (part #A04301 or kit #11305) - Satisfactory operation can be attained for periods of 12 months or more under conditions of light pressure or vacuum loads.
  - b) Viton® /Nomex (part #A04303 or kit #11307) - same as *a* above.

## C. Disassembly of Head Section and Service Diaphragm

1. Remove head section by unscrewing the four large bolts (part #A19005). A flat-bladed screw driver may be needed to gently pry the head free of the service diaphragm. \*\*If you have Teflon® coating on the heads use caution not to scratch the surface.
2. The valve body can then be removed by unscrewing the two smaller screws (also accessible on the top of the head section). This part may be freed by gently tapping on these two screws after they have been loosened about three or four turns.
3. When the valve body is removed, check all internal surfaces for any accumulation of dirt. The two valve discs (part #A04004) can be wiped clean and replaced as long as they appear unaffected by usage. The valve gasket (part #A07001) can be easily removed and should be inspected. As a matter of good practice, the valve discs and valve gasket should be replaced during any routine maintenance check of the head section. A once a year routine procedure is recommended.
4. The service diaphragm is secured by the single screw (part #A19301) in its center. Remove this screw with a 5/32" Allen wrench. The diaphragm and its plate should be easily lifted off. Some slight adherence to the metal may occur if the diaphragm has been in use for a long period.
5. When replacing the service diaphragm, a Teflon washer (part #A23001) should be inserted under the head of the diaphragm cap screw. This is added insurance against small gas leaks through screw heads and may be essential in vacuum applications where outside air contamination cannot be tolerated. After tightening the screw, the excess Teflon should be trimmed away.

**NOTE:** When replacing the service diaphragm, be sure the four projecting studs of the base casting are properly located in the four outer holes provided in the diaphragm before the part is clamped in place. Be sure the diaphragm plate is firmly replaced with its center screw (refer to part E. for Related Torque Values)

## D. Disassembly and Replacement of the Connecting Rod

1. Remove head section and service diaphragm as described in (C) above. When this is done and the front screen has been removed, the connecting rod assembly may be taken out (refer to exploded view drawing). Gently pry up and remove the connecting rod cap (part #3301) which is held in place by the diaphragm screw.
2. Loosen but do not remove the counterweight screw. This is accessible from the top of the pump base casting and will require a 5/32" hex Allen wrench. The connecting rod assembly, including counterweight and fan, will then slide off the motor shaft.
3. To replace the connecting rod assembly, align the flat section on the motor shaft with the counterweight screw (part #A19309) before sliding the assembly in place. Slide the assembly onto the shaft without letting the connecting rod and housing come in contact (connecting rod should be approximately 1/16 inch from housing). Be careful to maintain the alignment of the flat on the shaft and the counterweight screw when sliding the assembly in place. Tighten the counterweight screw.
  - a) Please pay close attention when disassembling dual stage pumps as front and rear fans are not interchangeable.
  - b) After prolonged use, the connecting rod assembly may “freeze up” on the motor shaft. A wheel puller may be needed to free the part. When replacing the eccentric assembly, the motor shaft should be lightly coated with a graphite or MDS based lubricant to facilitate future removal.

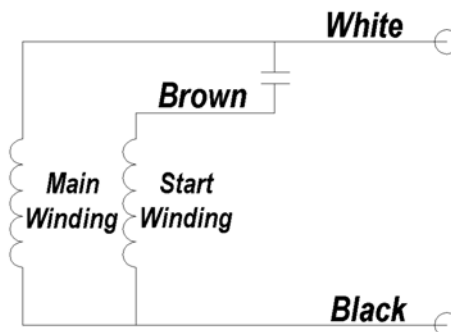
## E. Related Torque Values

1. Head bolts (A19005) - 110 inch pounds.
2. Valve body screws (A19006)- 70 inch pounds
3. Diaphragm plate screws (A19301) - 70 inch pounds

## F. Mini General Purpose Motor Amps

<b>Run. Amps</b>	115v	230v
	1.03	.51

## G. Wiring Diagram (General Purpose Motor)



Teflon® is a Registered Trademarks of E.I. Du Pont

Loctite® is a Registered Trademark of Henkel Technologies Inc.

Dia-Vac® is a Registered Trademark of Air Dimensions Inc.

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"We Pass Your Gas"



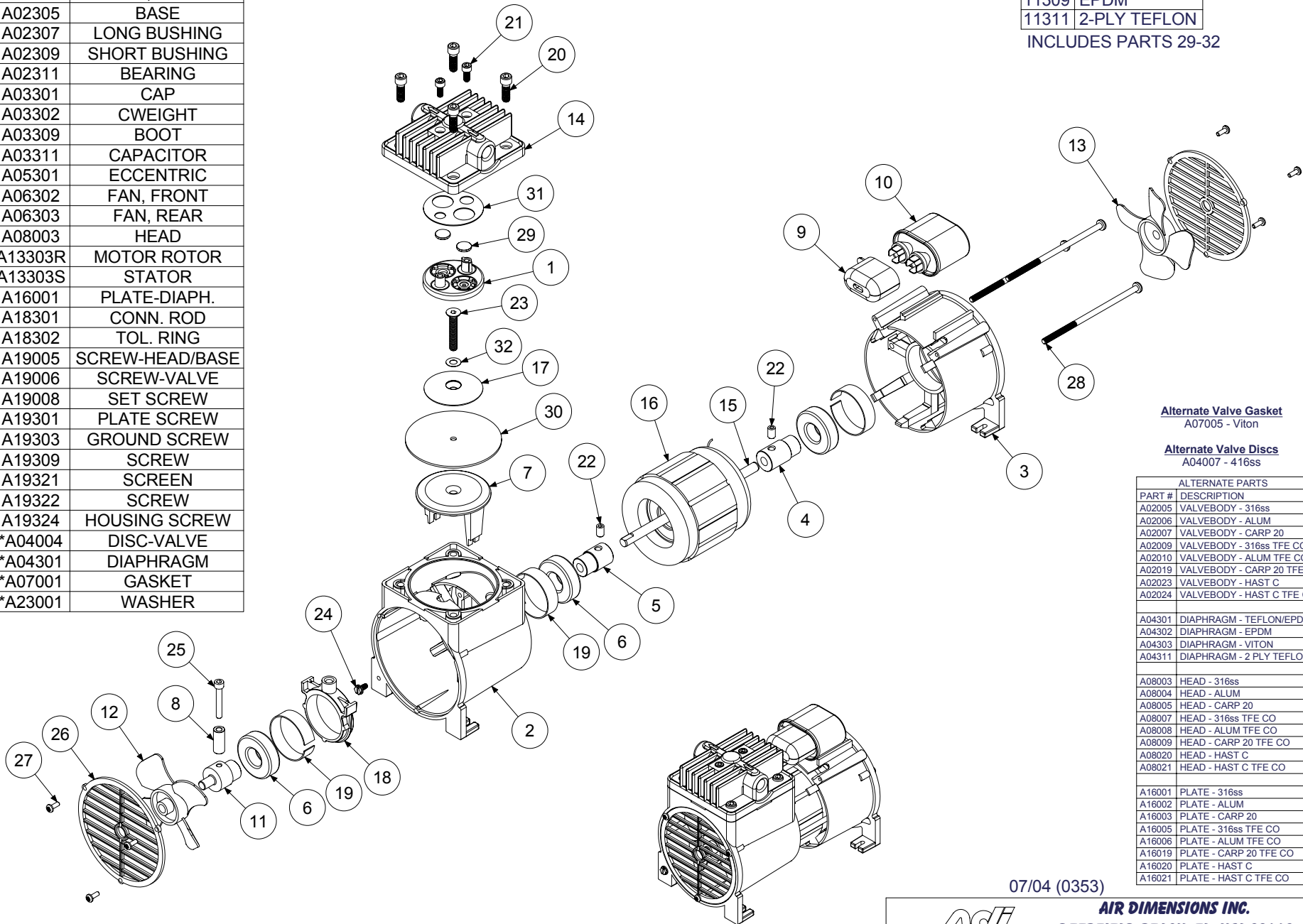
Parts List

ITEM	QTY	PART #	DESCRIPTION
1	1	A02005	VALVEBODY
2	1	A02303	BASE, FRONT
3	1	A02305	BASE
4	1	A02307	LONG BUSHING
5	1	A02309	SHORT BUSHING
6	3	A02311	BEARING
7	1	A03301	CAP
8	1	A03302	CWEIGHT
9	1	A03309	BOOT
10	1	A03311	CAPACITOR
11	1	A05301	ECCENTRIC
12	1	A06302	FAN, FRONT
13	1	A06303	FAN, REAR
14	1	A08003	HEAD
15	1	A13303R	MOTOR ROTOR
16	1	A13303S	STATOR
17	1	A16001	PLATE-DIAPH.
18	1	A18301	CONN. ROD
19	3	A18302	TOL. RING
20	4	A19005	SCREW-HEAD/BASE
21	2	A19006	SCREW-VALVE
22	2	A19008	SET SCREW
23	1	A19301	PLATE SCREW
24	1	A19303	GROUND SCREW
25	1	A19309	SCREW
26	2	A19321	SCREEN
27	6	A19322	SCREW
28	3	A19324	HOUSING SCREW
29	2	*A04004	DISC-VALVE
30	1	*A04301	DIAPHRAGM
31	1	*A07001	GASKET
32	1	*A23001	WASHER

RECOMMENDED SPARE PART KITS

DIAPHRAGM KITS	
11305	TEFLON/EPDM
11307	VITON
11309	EPDM
11311	2-PLY TEFLON

INCLUDES PARTS 29-32



**Alternate Valve Gasket**  
A07005 - Viton

**Alternate Valve Discs**  
A04007 - 416ss

ALTERNATE PARTS	
PART #	DESCRIPTION
A02005	VALVEBODY - 316ss
A02006	VALVEBODY - ALUM
A02007	VALVEBODY - CARP 20
A02009	VALVEBODY - 316ss TFE CO
A02010	VALVEBODY - ALUM TFE CO
A02019	VALVEBODY - CARP 20 TFE CO
A02023	VALVEBODY - HAST C
A02024	VALVEBODY - HAST C TFE CO
A04301	DIAPHRAGM - TEFLON/EPDM
A04302	DIAPHRAGM - EPDM
A04303	DIAPHRAGM - VITON
A04311	DIAPHRAGM - 2 PLY TEFLON
A08003	HEAD - 316ss
A08004	HEAD - ALUM
A08005	HEAD - CARP 20
A08007	HEAD - 316ss TFE CO
A08008	HEAD - ALUM TFE CO
A08009	HEAD - CARP 20 TFE CO
A08020	HEAD - HAST C
A08021	HEAD - HAST C TFE CO
A16001	PLATE - 316ss
A16002	PLATE - ALUM
A16003	PLATE - CARP 20
A16005	PLATE - 316ss TFE CO
A16006	PLATE - ALUM TFE CO
A16019	PLATE - CARP 20 TFE CO
A16020	PLATE - HAST C
A16021	PLATE - HAST C TFE CO

07/04 (0353)



**AIR DIMENSIONS INC.**  
DEERFIELD BEACH, FL. USA 33442  
WWW.AIRDIMENSIONS.COM

DATE	TITLE	APPROVED BY	DWG NO	MODEL #	SHEET	OF
8/28/2001	Single Head Mini Dia-Vac	FDM	Mxx1-xx-AAx	Mxx1-xx-AAx	2	OF 2



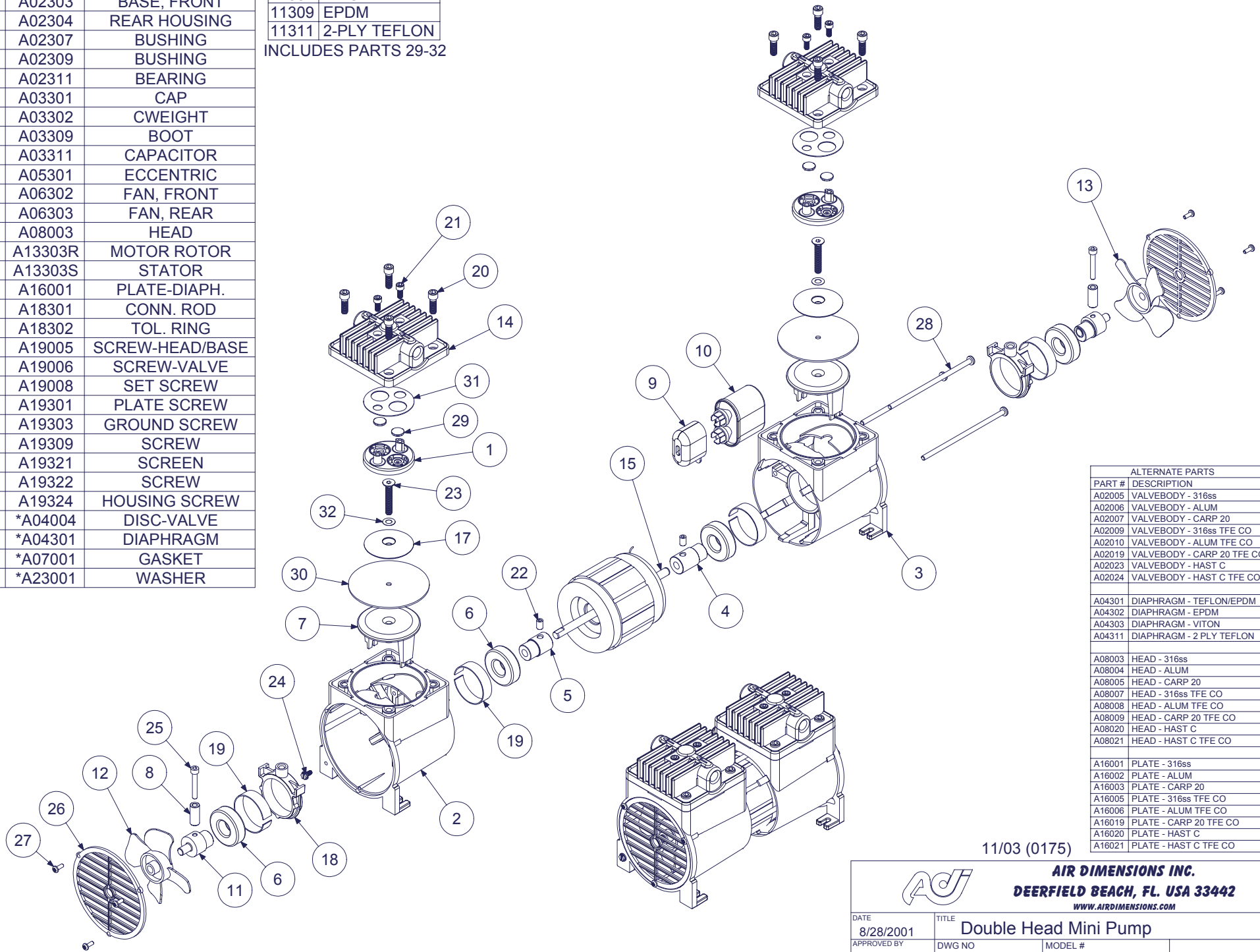
Parts List

ITEM	QT	PART #	DESCRIPTION
1	2	A02005	VALVEBODY
2	1	A02303	BASE, FRONT
3	1	A02304	REAR HOUSING
4	1	A02307	BUSHING
5	1	A02309	BUSHING
6	4	A02311	BEARING
7	2	A03301	CAP
8	2	A03302	CWEIGHT
9	1	A03309	BOOT
10	1	A03311	CAPACITOR
11	2	A05301	ECCENTRIC
12	1	A06302	FAN, FRONT
13	1	A06303	FAN, REAR
14	2	A08003	HEAD
15	1	A13303R	MOTOR ROTOR
16	1	A13303S	STATOR
17	2	A16001	PLATE-DIAPH.
18	2	A18301	CONN. ROD
19	4	A18302	TOL. RING
20	8	A19005	SCREW-HEAD/BASE
21	4	A19006	SCREW-VALVE
22	2	A19008	SET SCREW
23	2	A19301	PLATE SCREW
24	1	A19303	GROUND SCREW
25	2	A19309	SCREW
26	2	A19321	SCREEN
27	6	A19322	SCREW
28	3	A19324	HOUSING SCREW
29	4	*A04004	DISC-VALVE
30	2	*A04301	DIAPHRAGM
31	2	*A07001	GASKET
32	2	*A23001	WASHER

RECOMMENDED SPARE PART KITS

DIAPHRAGM KITS	
11305	TEFLON/EPDM
11307	VITON
11309	EPDM
11311	2-PLY TEFLON

INCLUDES PARTS 29-32



ALTERNATE PARTS	
PART #	DESCRIPTION
A02005	VALVEBODY - 316ss
A02006	VALVEBODY - ALUM
A02007	VALVEBODY - CARP 20
A02009	VALVEBODY - 316ss TFE CO
A02010	VALVEBODY - ALUM TFE CO
A02019	VALVEBODY - CARP 20 TFE CO
A02023	VALVEBODY - HAST C
A02024	VALVEBODY - HAST C TFE CO
A04301	DIAPHRAGM - TEFLON/EPDM
A04302	DIAPHRAGM - EPDM
A04303	DIAPHRAGM - VITON
A04311	DIAPHRAGM - 2 PLY TEFLON
A08003	HEAD - 316ss
A08004	HEAD - ALUM
A08005	HEAD - CARP 20
A08007	HEAD - 316ss TFE CO
A08008	HEAD - ALUM TFE CO
A08009	HEAD - CARP 20 TFE CO
A08020	HEAD - HAST C
A08021	HEAD - HAST C TFE CO
A16001	PLATE - 316ss
A16002	PLATE - ALUM
A16003	PLATE - CARP 20
A16005	PLATE - 316ss TFE CO
A16006	PLATE - ALUM TFE CO
A16019	PLATE - CARP 20 TFE CO
A16020	PLATE - HAST C
A16021	PLATE - HAST C TFE CO

11/03 (0175)



**AIR DIMENSIONS INC.**  
**DEERFIELD BEACH, FL. USA 33442**  
[WWW.AIRDIMENSIONS.COM](http://WWW.AIRDIMENSIONS.COM)

DATE 8/28/2001		TITLE Double Head Mini Pump	
APPROVED BY CK	DWG NO Mxx2-xx-AAx	MODEL # Mxx2-xx-AAx	SHEET 2 OF 2



## 1. Single Pump Head Loading

### WARNING: PRODUCT USE LIMITATION

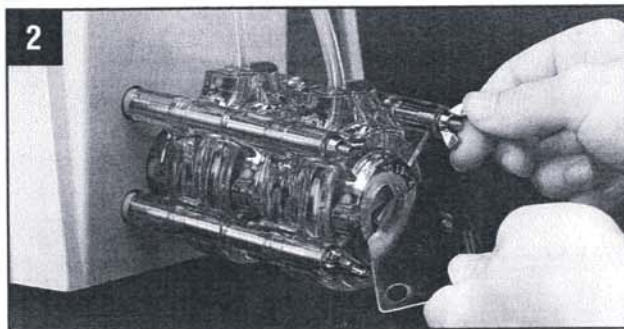
These products are not designed for, nor intended for use in patient connected applications; including, but not limited to, medical and dental use, and accordingly have not been submitted for FDA approval.

**Note:** Use only MASTERFLEX precision tubing with MASTERFLEX pumps to ensure optimum performance. Use of other tubing may void applicable warranties.

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

Supplied tubing loading key required for assembly.

- a) Separate the end bells (the pump head halves). Hold the end bell containing the rotor as shown with the tubing retainer grooves pointing down.
- b) Place tubing in the right groove and against the first two rollers. Hold tubing with thumb. Near groove, insert smaller prong of loading key between the top of the rotor and tubing. Push key in as far as possible.
- c) Push down and turn key counterclockwise (ccw) completely around the rotor. The key will push the tubing uniformly into the end bell assembly. Hold the second end of tubing. Remove the key.
- d) Position the other end bell on top and press the end bells together. Be careful not to pinch the tubing. If end bells do not snap tightly together, reload tubing. If necessary, turn key in slot on rotor shaft to adjust tubing (as in Step e).
- e) With key in slot on rotor shaft, turn key to align tang on rotor shaft with slot in motor drive shaft. Point tubing retainer grooves up. Shift the pump head slightly until it snaps on the alignment pins (if present). Secure with four provided screws. Tighten with fingers only.



## 2. Multi-channel Mounting

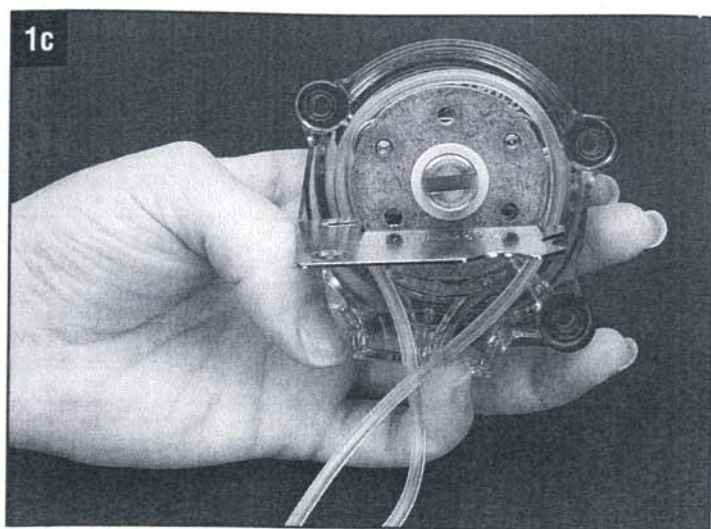
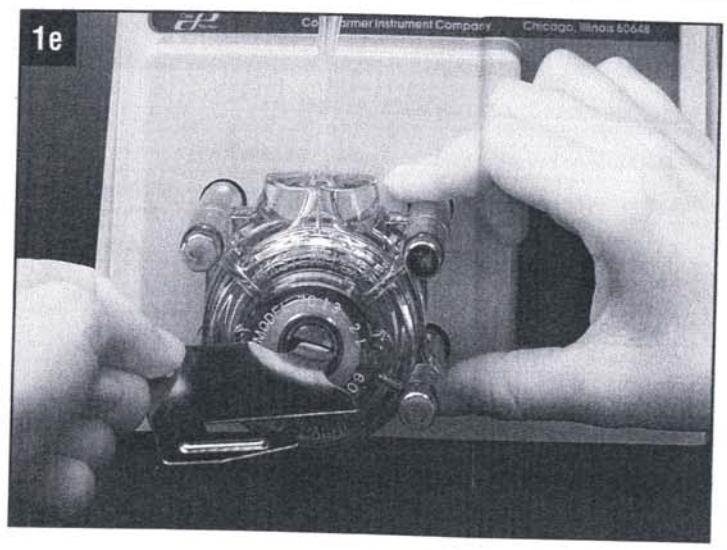
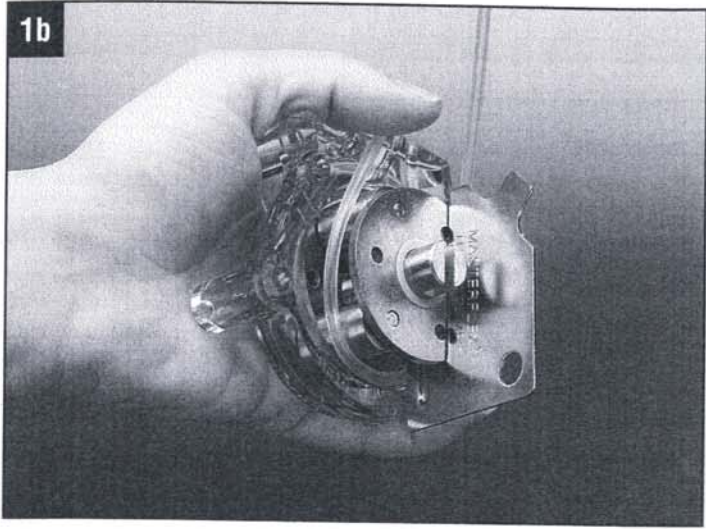
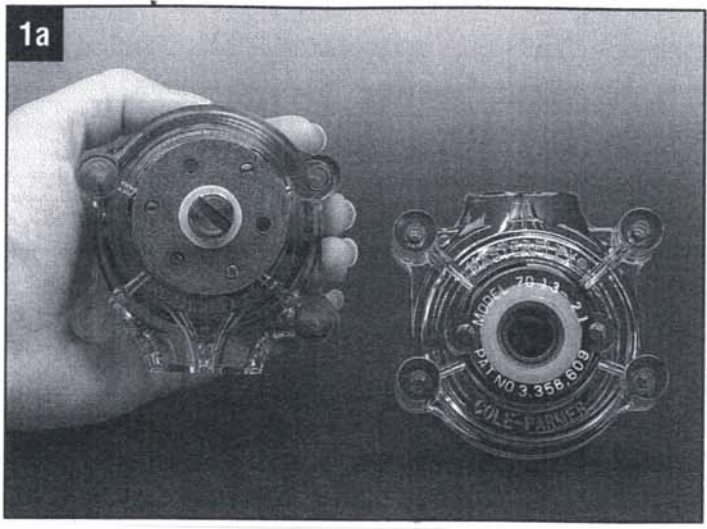
Flat bladed Screwdriver required for mounting.

Tubing loading key required for mounting.

**Note:** Order special mounting hardware for multi-channel pumping, see "3. Replacement Parts and Accessories".

- a) Load the pump heads with tubing.
- b) Install the four correct length mounting screws into the drive.
- c) Slide the first pump head onto the mounting screws.
- d) Place key in slot on rotor shaft. Twist to align tang on rotor shaft with slot in motor drive shaft. Shift the pump housing around until it drops over the alignment pins (if present).
- e) Repeat for each additional pump head, aligning pump head tang with slot on previously mounted pump head.
- f) Slide the four flat washers onto screws and secure with the four wing nuts. Tighten with fingers only.
- g) A support bracket is supplied with 3- and 4-channel mounting hardware for additional support. Mount over bottom two screws. Insert one of three different adjustment screws depending upon drive height.

Trademarks bearing the ® symbol in this publication are registered in the U.S. and in other countries.





### 3. Replacement Parts and Accessories

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

Pump Head number	PC Order number	Pump Head number	PPS Order number
07013-00, -20	<b>07013-81</b>	—	—
07013-10, -21	<b>07013-91</b>	07013-50, -52	<b>07013-92</b>
07014-00, -20	<b>07014-81</b>	—	—
07014-10, -21	<b>07014-91</b>	07014-50, -52	<b>07014-92</b>
07015-00, -20	<b>07015-81</b>	—	—
07015-10, -21	<b>07015-91</b>	07015-50, -52	<b>07015-92</b>
07016-00, -20	<b>07016-81</b>	—	—
07016-10, -21	<b>07016-91</b>	07016-50, -52	<b>07016-92</b>
07017-00, -20	<b>07017-81</b>	—	—
07017-10, -21	<b>07017-91</b>	07017-50, -52	<b>07017-92</b>
07018-00, -20	<b>07018-81</b>	—	—
07018-10, -21	<b>07018-91</b>	07018-50, -52	<b>07018-92</b>
07024-00, -20	<b>07024-81</b>	—	—
07024-10, -21	<b>07024-91</b>	07024-50, -52	<b>07024-92</b>
07035-02, -20	<b>07035-81</b>	—	—
07035-12, -21	<b>07035-91</b>	—	—

#### B. Rotor assemblies

Pump Head number	Pump Head suffix	Order number
07013, 07014, 07016, 07017, 07018	-00	<b>07013-75</b>
	-10, -50	<b>07013-76</b>
	-20	<b>07013-80</b>
	-21, -52	<b>07013-95</b>
07015, 07024, 07035	-00, -02	<b>07015-75</b>
	-10, -50, -12	<b>07015-76</b>
	-20	<b>07015-80</b>
	-21, -52	<b>07015-90</b>

C. 07021-04 Thrust washers. Pack of 10.

D. 07013-90 Tubing loading key.

E. Mounting hardware for standard pump heads.

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

Number of heads to be mounted	Cold-rolled steel order number	Stainless steel order number
1	<b>07013-02</b>	<b>07013-04</b>
2	<b>07013-03</b>	<b>07013-05</b>
3	<b>07013-06</b>	<b>07013-08</b>
4	<b>07013-07</b>	<b>07013-09</b>

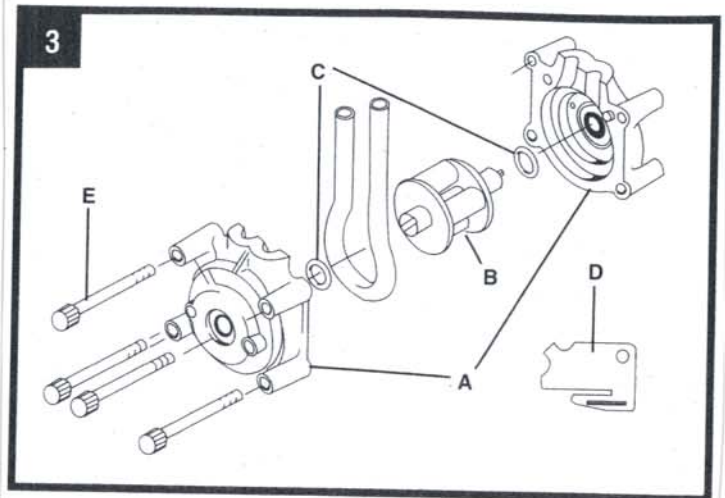
### 4. Specifications

	Thin wall*	Thick wall*
Maximum continuous discharge pressure—psi (bar):	20 (1.4)	25 (1.7)
Maximum intermittent discharge pressure—psi (bar):	35 (2.4)	40 (2.7)
Maximum vacuum:	660 (510 <sup>†</sup> ) mm Hg; 26 (20 <sup>†</sup> ) in Hg	
Maximum suction lift:	8.8 (6.7 <sup>†</sup> ) m H <sub>2</sub> O; 29 (22 <sup>†</sup> ) ft H <sub>2</sub> O	
Number of rollers:	3	
Occlusion:	Standard fixed	
Maximum pump speed (rpm):	600	
Nominal torque load:	6.5 kg-cm (90 oz-in)	
Housing materials:	Polycarbonate (PC) all models, or Polyphenylene sulfide (PPS) all models except 07035	
Roller/rotor materials:	Cold-rolled steel (CRS) or Stainless steel (SS)	
Operating temperature <sup>‡</sup> :	0 to 40°C (32 to 104°F)	

\* Thin wall: tubing 13, 14, 16, 17, 18. Thick-wall: tubing 15, 24, 35.

† With tubing 17 & 18.

‡ Use in this temperature range for continuous duty operation with no decrease in performance or product life. Pump heads will work outside this range with some possible reductions in performance or product life.



### 5. Warranty and Return of Items

#### Warranty

Use only MASTERFLEX precision tubing with MASTERFLEX pumps to ensure optimum performance. Use of other tubing may void applicable warranties.

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

The warranty period for this product is noted on the Warranty Card.

#### Product Return

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

#### Technical Assistance

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



## Masterflex® Tubing Formulation Descriptions

### Silicone Tubing

While our silicone tubing formulations share many characteristics, listed are some basic differences.

### Platinum-Cured Silicone Tubing

- Slightly greater clarity
- Smooth surface; low protein binding levels
- Ideal for pharmaceutical and biotechnology use
- Fewer potential leachables

### Peroxide-Cured Silicone Tubing

- Greater physical compression capability
- Potential outgassing of peroxide products
- Economical
- Longer tubing life

### BioPharm Silicone Tubing

- Platinum-cured; ultra-smooth inner surface minimizes particle entrapment
- Fewer extractables
- Lab, biotech, and pharmaceutical applications

### BioPharm Plus Silicone Tubing

- Platinum-cured
- Lower spallation than regular silicone
- Enhanced pressure capabilities
- Longest tubing life
- Ultra-smooth inner surface and fewer extractables
- Documented biocompatibility for sensitive applications

### C-FLEX® Tubing

- Long tubing life
- Ultra-smooth inner surface; fewer extractables

### To Sterilize Silicone Tubing

- **High-speed instrument (flash) autoclave**
  - Place tubing on non-linting cloth or sterilizing paper in a clean, open tray for 10 minutes at 132°C (270°F) at 2 kg/cm<sup>2</sup> (30 psi).
- **Standard gravity autoclave**
  - Wrap tubing in non-linting cloth or sterilizing paper and place in a clean, open tray for 30 minutes at 121°C (250°F) at 1 kg/cm<sup>2</sup> (15 psi).
- **Pre-vacuum high-temperature autoclave**
  - Wrap tubing in non-linting cloth or sterilizing paper and place in a clean, open tray for normal cycle of 30-35 minutes at 121°C (250°F).
- **Gamma radiation**
  - 2.5 Mrad.

Formulation	Silicone (platinum-cured)	Silicone (peroxide-cured)	BioPharm Silicone (platinum-cured)	BioPharm Plus Silicone (platinum-cured)	C-FLEX® (50 A)
Series number	96410	96400	96420	96440	06424
Tubing photo					
Advantages	Excellent biocompatibility. No leachable additives, DOP, or plasticizers; phthalate and latex-free; odorless and nontoxic, fungus-resistant. No taste imparted to transported fluids. Extremely good over a wide temperature range. Weather, ozone, corona, and radiation resistant. Minimal tendency to take a set. See information above on the differences between silicone formulations.	Excellent biocompatibility. No additives, plasticizers or DOP; odorless and nontoxic, fungus-resistant. No taste imparted to transported fluids. Extremely good at low temps. Weather, ozone, corona, and radiation resistant. Minimal tendency to take a set. See information above on the differences between silicone formulations.	Shorter life. Ultra-smooth inner surface. Minimizes particle entrapment. Lower absorption; excellent biocompatibility; no leachable additive, DOP, or plasticizers. Odorless and nontoxic, fungus-resistant. No taste imparted to transported fluids. Weather, ozone, corona, and radiation resistant. Platinum-cured.	Platinum-cured silicone tubing with long life and ultra-smooth inner surface. Minimizes particle entrapment; lower absorption. Excellent biocompatibility. No leachable additives, DOP, or plasticizers; odorless, nontoxic. Fungus-resistant. No taste imparted to transported fluids. Weather, ozone, corona, and radiation resistant.	Physical properties similar to silicone with chemical compatibility of Tygon®. Inexpensive. Excellent biocompatibility. Smooth bore. Nontoxic, no leachable plasticizers. Lower gas permeability than silicone. Use with many acids and alkalis.
Limitations	Do not use with concentrated acids and bases, organic solvents, or oils.	Do not use with concentrated solvents, oils, acids. Relatively high gas permeability. See additional notes above.	Do not use with concentrated solvents, oils, or acids. Relatively high gas permeability.	Do not use with concentrated solvents, oils, or acids. Relatively high gas permeability.	Not recommended for use with oils. Moderate pumping life.
Application suitability:	Acids Alkalies Organic solvents Pressure Vacuum Viscous fluids Sterile fluids	Poor Poor Not recommended Fair Good Fair Excellent	Poor Poor Not recommended Fair Good Fair Excellent	Poor Poor Not recommended Fair Good Fair Excellent	Good Good Not recommended Fair Good Fair Excellent
Physical characteristics and composition	Thermal set rubber. Siloxane polymers and amorphous silica. Excellent compression strength. Soft material; flexible. Translucent, clear to light amber	Thermal set rubber. Siloxane polymers and amorphous silica. Excellent compression strength. Soft material. Translucent, clear to light amber.	Thermal set rubber. Siloxane polymers and amorphous silica. Excellent compression strength. Soft material. Translucent, clear to light amber.	Thermal set rubber. Siloxane polymers and amorphous silica. Excellent compression strength. Soft material. Translucent, clear to light amber.	Thermoplastic elastomer. Styrene-ethylene-butylene modified block copolymer with silicone oil. Excellent tensile and tear strength. Soft material. Opaque, white.
Temperature range	-50 to 230°C (-58 to 446°F)	-50 to 230°C (-58 to 446°F)	-60 to 232°C (-75 to 450°F)	-60 to 232°C (-75 to 450°F)	-73 to 135°C (-100 to 275°F)
Meets classifications	USP Class V Extractables; exceeds Class VI Implant; EP, FDA 21 CFR 177.2600; Exceeds 3A Sanitary Standards; Produced to Bulk Pharm. cGMPs (FDA 21 CFR 210 and 211).	USP Class VI FDA 21 CFR 177.2600	USP Class VI, EP FDA 21 CFR 175.300 Exceeds 3A sanitary standards	USP Class VI, EP, and FDA 21 CFR Part 177.2600 criteria Exceeds 3A sanitary standards	USP Class VI FDA 21 CFR 177.2600
Gas permeability $\frac{\text{cc} \times \text{mm}}{\text{cm}^2 \times \text{sec.} \times \text{cm Hg}} \times 10^{-10}$	CO <sub>2</sub> : 20,132 H <sub>2</sub> : 6579 O <sub>2</sub> : 7961 N <sub>2</sub> : 2763	CO <sub>2</sub> : 20,132 H <sub>2</sub> : 6579 O <sub>2</sub> : 7961 N <sub>2</sub> : 2763	CO <sub>2</sub> : 25,147 H <sub>2</sub> : — O <sub>2</sub> : 4715 N <sub>2</sub> : 2284	CO <sub>2</sub> : 25,147 H <sub>2</sub> : — O <sub>2</sub> : 4715 N <sub>2</sub> : 2284	CO <sub>2</sub> : — H <sub>2</sub> : — O <sub>2</sub> : 150 N <sub>2</sub> : —
Cleaning/sterilization	Clean with hot water/soap solution; use a non-oily soap such as Ivory®. Do not use synthetic detergent or oil-based soap as they may be absorbed by the tubing and may leach into fluid. Rinse well with distilled water. ETO sterilization is not recommended—sufficient data is not available regarding complete outgassing of residual ETO and other ETO products.	Clean with isopropyl alcohol or hot water/soap solution. Use non-oily soap such as Ivory®. Do not use synthetic detergent or oil-based soap as they may be absorbed by the tubing and may leach out into the fluid. Rinse thoroughly with distilled water. May use ethylene oxide (ETO) sterilization. Autoclavable.	To autoclave: coil loosely in non-linting cloth or paper; autoclave at 121°C (250°F), 1 bar (15 psi) for 30 minutes. Sterilize by ethylene oxide (ETO), autoclave, or gamma irradiation up to 2.5 Mrad.	To autoclave: coil loosely in non-linting cloth or paper; autoclave at 121°C (250°F), 1 bar (15 psi) for 30 minutes. Sterilize by ethylene oxide (ETO), autoclave, or gamma irradiation up to 2.5 Mrad	Sterilize by ethylene oxide (ETO) gamma radiation, or autoclave

(Continued on next page)



## Masterflex® Tubing Formulation Descriptions (Continued)

### Tygon® Tubing

Our Tygon® tubing comes in four separate formulations that share common characteristics but differ in tubing life and other specifications. See descriptions below for details about each formulation.

### Tygon® LFL Tubing

- Longest tubing life
- Broad chemical compatibility
- Low gas permeability
- USP Class VI and FDA

### Tygon® Food Tubing

- Meets various food and sanitary regulations
- Unaffected by all commercial sanitizers
- Non-wetting properties enable flush-cleaning and complete drainage
- Smooth inner surface

### Tygon® Lab Tubing





- Ideal for general transfer applications
- Economical
- Nontoxic, nonaging, and nonoxidizing

### Tygon® Fuel & Lubricant Tubing

- Ideal for transporting hydrocarbons, gasoline, kerosene, heating oils, cutting compounds, and glycol-based coolants
- Not for use with concentrated strong acids or alkalis

### Sterilization Notes

- **Standard gravity autoclave:**
  - Coil loosely in non-linting cloth or sterilizing paper and place in a clean, open tray for 30 minutes at 121°C (250°F) at 1 kg/cm<sup>2</sup> (15 psi); air dry at max 66°C (150°F) for 2 to 2½ hours until clear.
- **Ethylene oxide (ETO):**
  - Coil loosely in non-linting cloth or sterilizing paper. Follow the sterilization equipment manufacturers directions as to gas type, concentration, times, and temperatures; maintain humidity within the prescribed limits, generally between 30 to 65%.
- **Radiation:**
  - Cap ends of tubing if required. Radiation should be product specific and according to GMP.

Formulation	Tygon® LFL	Tygon® food (B-44-4X)	Tygon® lab (R-3603)	Tygon® fuel & lubricant (F-4040-A)
Series number	06429	06419	06409	06401
Photo				
Advantages	Longest life of all Tygon® peristaltic tubing (1000 hrs) Nonaging, nonoxidizing Clear for easy flow monitoring Broad chemical resistance Low gas permeability Smooth bore Good for viscous fluids High dielectric constant	Designed especially for handling food products: bore is extremely smooth (better than most stainless steels), nontoxic, will not affect taste or odor, and clear for CIP and flow verification. Excellent non wetting properties permit flush cleaning and complete drainage. High dielectric constant	Inexpensive tubing for general laboratory applications Non aging, non oxidizing Clear for easy flow monitoring Handles virtually all inorganic chemicals. Low gas permeability Smooth bore Good for viscous fluids High dielectric constant	Specially formulated to transport hydrocarbons, petroleum products and distillates. Suitable for gasoline, kerosene, heating oils, cutting fluids, and glycol-based coolants Minimum extractability Low gas permeability High dielectric constant
Limitations	Potential leaching of plasticizer	Limited pumping life	Limited pumping life Potential leaching of plasticizer	Don't use with strong acids and alkalis. Potential leaching
Application suitability:				
Acids	Good	Good	Good	Good
Alkalies	Good	Good	Good	Good
Organic solvents	Not recommended	Not recommended	Not recommended	Not recommended
Pressure	Good	Good	Good	Good
Vacuum	Good	Good	Good	Good
Viscous fluids	Excellent	Excellent	Excellent	Excellent
Sterile fluids	Good	Good	Poor	Poor
Physical characteristics and composition	Thermoplastic PVC-based material with plasticizer Firm (stiff) material Transparent, clear	Thermoplastic PVC-based material with plasticizer Firm (stiff) material Transparent, clear	Thermoplastic PVC-based material with plasticizer Firm (stiff) material Transparent, clear	Thermoplastic PVC-based material with plasticizer Firm (stiff) material Transparent, yellow
Temperature range	-50 to 74°C (-58 to 165°F)	-44 to 74°C (-47 to 165°F)	-50 to 74°C (-58 to 165°F)	-37 to 74°C (-35 to 165°F)
Meets classifications	USP Class VI FDA 21 CFR 175.300	FDA 21 CFR 175.300 NSF-listed (Standard 51) All 3A Sanitary Plastics Products Various USDA standards	FDA 21 CFR 175.300	None
Gas permeability $\frac{\text{cc} \times \text{mm}}{\text{cm}^2 \times \text{sec} \times \text{cm Hg}} \times 10^{-10}$	CO <sub>2</sub> : 563 H <sub>2</sub> : — O <sub>2</sub> : 124 N <sub>2</sub> : 67	CO <sub>2</sub> : 270 H <sub>2</sub> : 97 O <sub>2</sub> : 60 N <sub>2</sub> : 30	CO <sub>2</sub> : 360 H <sub>2</sub> : 97 O <sub>2</sub> : 80 N <sub>2</sub> : 40	CO <sub>2</sub> : 100 H <sub>2</sub> : 97 O <sub>2</sub> : 22 N <sub>2</sub> : 12
Cleaning/sterilization	Sterilize with ethylene oxide (ETO) or autoclave. To autoclave: Coil loosely in non linting cloth or paper; autoclave at 121°C (250°F), 1 kg/cm <sup>2</sup> (15 psi) for 30 mins. (tubing will appear milky); air dry at max 66°C (150°F) for 2 to 2½ hours until clear.	Unaffected by all commercially available sanitizers (when using recommended procedures) Sterilize with ethylene oxide (ETO) or autoclave. To autoclave: Coil loosely in non linting cloth or paper; autoclave at 121°C (250°F), 1 kg/cm <sup>2</sup> (15 psi) for 30 minutes (tubing will appear milky); air dry at max 66°C (150°F) for 2 to 2½ hours until clear.	Sterilize with ethylene oxide (ETO) or autoclave. To autoclave: Coil loosely in non linting cloth or paper, autoclave at 121°C (250°F), 1 kg/cm <sup>2</sup> (15 psi) for 30 minutes (tubing will appear milky); air dry at max 66°C (150°F) for 2 to 2½ hours until clear.	Sterilization is not recommended.





### PharMed® Tubing

- Over 10,000 hours of tubing life
- Resists ozone and UV radiation
- Non-cytotoxic and non-hemolytic
- Ideal for tissue and cell culture work
- Heat sealable and bondable

### Norprene® Tubing

- Up to 10,000 hours of tubing life
- Best choice for pressure/vacuum applications
- Resists heat, ozone, acids, and alkalis
- Heat sealable and bondable
- Nonaging, nonoxidizing

### Norprene® Food Tubing

- Ideal for high-temperature food and beverage applications
- Similar characteristics as Norprene® tubing
- Meets FDA and NSF standards

### Viton® Tubing

- Excellent chemical resistance
- Resists corrosives, solvents, and oils at elevated temperatures.
- Low gas permeability
- FDA formulation available

### WHERE TO ORDER TUBING

- C/L® tubing ..... 1305
- L/S® tubing ..... 1323-1327
- I/P® tubing ..... 1358-1359
- B/T® tubing ..... 1383



**Continuous pressures up to 100 psi!**  
**L/S® High-Pressure Pump System**

See page 1339 for details and to order our L/S® high-pressure tubing.

### Need FDA Viton® Tubing?

For chemical resistance & FDA approval, we offer FDA Viton® tubing.

See details below.



Formulation	PharMed® (65)	Norprene® (A 60 G)	Norprene® food (A 60 F)	Viton®	FDA Viton®
Series number	06485	06404	06402	06412	96412
Photo					
Advantages	Great for tissue and cell work—nontoxic and non-hemolytic. Long service life minimizes risk of fluid exposure; reduces tubing costs and pump downtime. Opaque to UV and visible light to protect light-sensitive fluids. Heat sealable, bondable, and formable. Extremely low gas permeability.	Best choice for vacuum/pressure applications. Offers longest life with good flow consistency. Heat and ambient ozone resistant. Good resistance to acids/alkalis. Black color hides dirt and dust. Heat sealable, nonaging, and nonoxidizing. High dielectric constant.	Similar to Norprene® (06404) but with FDA approval. Excellent for food/dairy applications. Longest life, good flow consistency. Heat and ozone resistant. Good resistance to acids/alkalis. Heat sealable, nonaging, and nonoxidizing. High dielectric constant.	Our most chemical resistant tubing. Resistant to corrosives, solvents, and oils at elevated temperatures. Low gas permeability.	Perfect for food and lab applications where FDA compliance is required. Good chemical resistance. Resistant to corrosives. High temperature properties.
Limitations	Potential leaching of USP mineral oil or blend material	Potential leaching of USP mineral oil or blend material	Potential leaching of USP mineral oil or blend material	Limited pumping life	Limited pumping life
Application suitability:					
Acids	Good	Good	Good	Excellent	Excellent
Alkalies	Good	Good	Good	Excellent	Excellent
Organic solvents	Not recommended	Not recommended	Not recommended	Variable—test before using	Variable—test before using
Pressure	Good	Excellent	Excellent	Good	Good
Vacuum	Excellent	Excellent	Excellent	Good	Good
Viscous fluids	Good	Excellent	Excellent	Good	Good
Sterile fluids	Excellent	Not recommended	Good	Fair	Fair
Physical characteristics and composition	Thermoplastic elastomer. Polypropylene-based material with USP mineral oil. Excellent tensile strength. Firm (stiff) material. Opaque, beige.	Thermoplastic elastomer. Polypropylene-based material with USP mineral oil. Excellent tensile strength. Firm (stiff) material. Opaque, black.	Thermoplastic elastomer. Polypropylene-based material with USP mineral oil. Excellent tensile strength. Firm (stiff) material. Opaque, beige.	Thermal set rubber. Viton B (67% fluorine). Firm (stiff) material. Opaque, black.	Thermal set rubber. Viton B (67% fluorine). Firm (stiff) material. Opaque, black.
Temperature range	-59 to 135°C (-60 to 270°F)	-59 to 135°C (-60 to 270°F)	-59 to 135°C (-60 to 270°F)	-32 to 205°C (-25 to 400°F)	-32 to 205°C (-25 to 400°F)
Meets classifications	USP Class VI. FDA 21 CFR 177.2600. NSF-listed (Standard 51)	None	FDA 21 CFR 177.2600. NSF-listed (Standard 51)	None	FDA 21 CFR 177.2600
Gas permeability <small>cc x mm (cm<sup>2</sup> x sec. x cm Hg) x 10<sup>-10</sup></small>	CO <sub>2</sub> : 1200 H <sub>2</sub> : — O <sub>2</sub> : 200 N <sub>2</sub> : 80	CO <sub>2</sub> : 1200 H <sub>2</sub> : — O <sub>2</sub> : 200 N <sub>2</sub> : 80	CO <sub>2</sub> : 1200 H <sub>2</sub> : — O <sub>2</sub> : 200 N <sub>2</sub> : 80	CO <sub>2</sub> : 76 to 79 H <sub>2</sub> : — O <sub>2</sub> : 13 to 15 N <sub>2</sub> : 4.3	CO <sub>2</sub> : 76 to 79 H <sub>2</sub> : — O <sub>2</sub> : 13 to 15 N <sub>2</sub> : 4.3
Cleaning/sterilization	Sterilize with ethylene oxide (ETO), autoclave or gamma irradiation up to 2.5 Mrad. Repeated autoclaving will not affect overall life.	Sterilize by autoclave only.	Sterilize by autoclave. Repeated autoclaving will not affect overall life.	Sterilization is not recommended.	Sterilize with circulating hot air oven at 249°C (480°F) for 16 hours.