



1701 South Sutro Terrace
Carson City, NV 89704
775.883.2500 Fax 775.883.6388
www.universalanalyzers.com

MODEL 510S PORTABLE GAS SAMPLE CHILLER INSTRUCTION MANUAL



See us on the WEB at <http://www.universalanalyzers.com>
e-mail address: sales@universalanalyzers.com
MAN510 Rev C



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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.



1701 SOUTH SUTRO TERRACE
CARSON CITY, NV 89706-0364
TELEPHONE (800) 993-9309
(775) 883-2500
FAX: 775-883-6388

UNIVERSAL ANALYZERS MODEL 510S SAMPLE COOLER

SPECIFICATIONS

SAMPLE FLOW RATE:	0 to 2 L/M (at STP)
MAXIMUM INLET TEMPERATURE:	500° F. (260° C.)
MAXIMUM INLET GAS DEW POINT:	180° F. (82° C.)
MAXIMUM INLET WATER CONCENTRATION:	50%*
MINIMUM AMBIENT TEMPERATURE:	32° F. (0° C.)
MAXIMUM AMBIENT TEMPERATURE:	105° F. (41° C.)*
MAXIMUM COOLING POWER:	50 BTU'S/Hr. (47 kJ/Hr.)
OUTLET SAMPLE DEW POINT:	41° F. (5° C.), adjustable
MAXIMUM INPUT POWER:	150 WATTS
VOLTAGE:	90 - 125 VAC, 50/60 Hz or 180 - 250 VAC, 50/60 Hz
ELECTRICAL CLASSIFICATION:	NEMA 1
DIMENSIONS:	9" x 10" x 6", HWD
WEIGHT:	11 LB's., (5 KG)

*at reduced flow rates. See capacity chart.

See us on the WEB at <http://www.universalanalyzers.com>
e-mail address: sales@universalanalyzers.com
510 Text Rev -

MODEL 510S SAMPLE COOLER OPERATING INSTRUCTIONS

APPLICATION

The Model 510S was designed as a self contained transportable sample conditioning system to dehydrate a gas sample prior to being analyzed by a combustion monitor or transportable infrared analyzer. It can be left in place, powered continuously to protect an analyzer which is on stream, continuously analyzing a gas sample.

DESCRIPTION

The Model 510S sample cooler is a thermoelectric chiller containing a DC power supply, a temperature controller, a 316SS heat exchanger, and a condensate pump all encased within a stainless steel enclosure. The enclosure has a convenient handle to make it easily transportable. A power cord is provided to connect the chiller to line power.

The heat exchanger is milled out of a solid block of 316SS with tubing fittings welded onto the block. The sample path is in the shape of a "V" with the inlet and outlet at the top of the block and the condensate drain at the bottom of the "V". Two thermoelectric elements are sandwiched between the heat exchanger and the heat sink which discharges the heat produced by the thermoelectric elements

Two thermoelectric elements are wired in series and supplied with 24 VDC to cool the sample heat exchanger. A controller is provided to interrupt the current through the thermoelectric elements when the temperature drops below the temperature set point. The temperature is factory set at 5^o C. This temperature can be adjusted using a potentiometer on the control circuit board. The temperature sensor is an AD592 semiconductor device.

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 24 VDC muffin fan blowing directly into the heat sink. The heat sink is fabricated from solid block 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.

A small peristaltic pump flowing at a continuous rate of 5 ml per minute is used to remove the condensate from the heat exchanger.

PERFORMANCE:

MAXIMUM FLOW RATE: 3 LPM

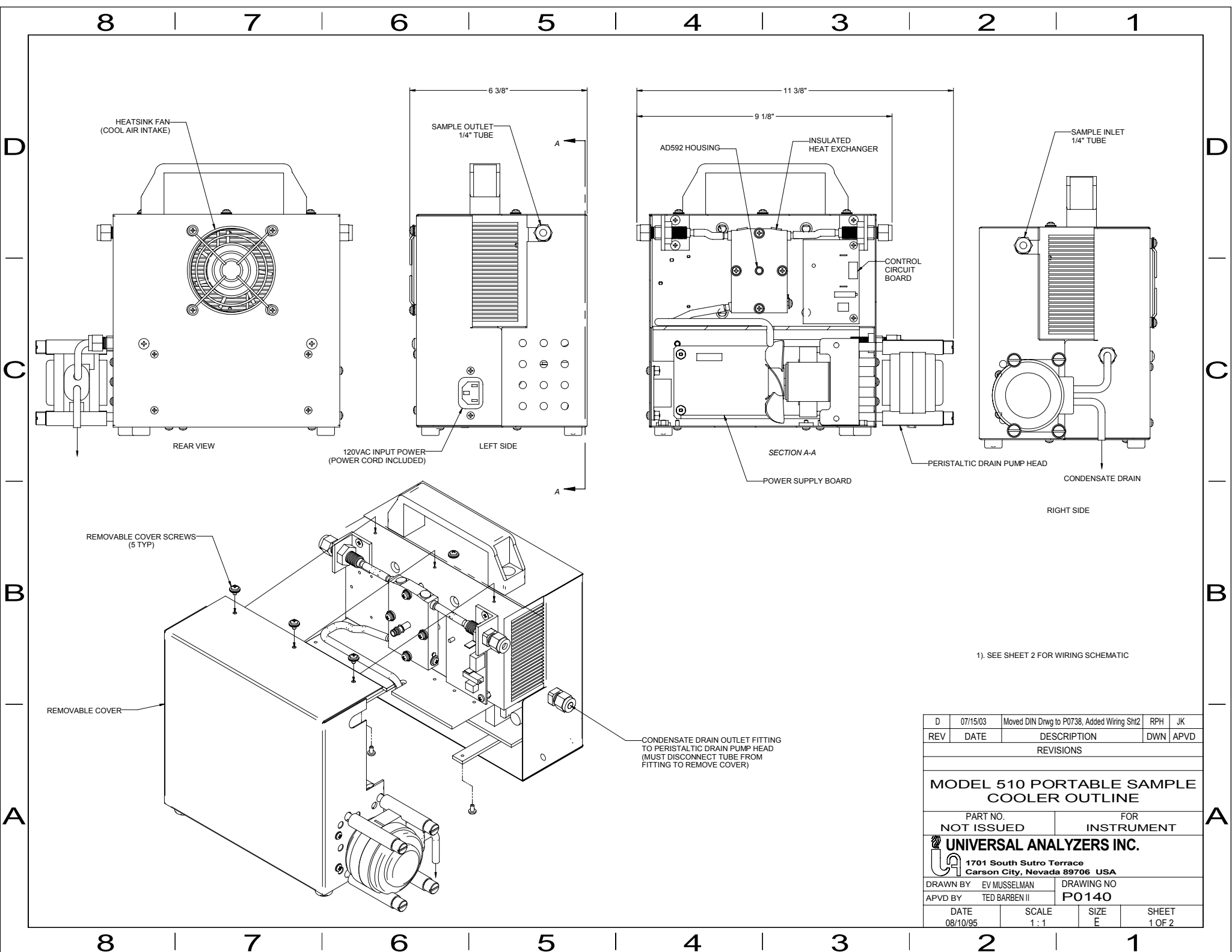
<u>AMBIENT TEMPERATURE</u>	<u>WATER VAPOR CONCENTRATION IN GAS SAMPLE (BY VOLUME)</u>			
	<u>15%</u>	<u>30%</u>	<u>50%</u>	
77° F. (25° C.)	2 LPM	1 LPM	0.5 LPM	(EXIT DEW POINT: 7° C.)
90° F. (32° C.)	2 LPM	1 LPM	0.5 LPM	(EXIT DEW POINT: 9° C.)
105° F. (41° C.)	2 LPM	1 LPM	0.5 LPM	(EXIT DEW POINT: 18° C.)

TROUBLE SHOOTING

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:

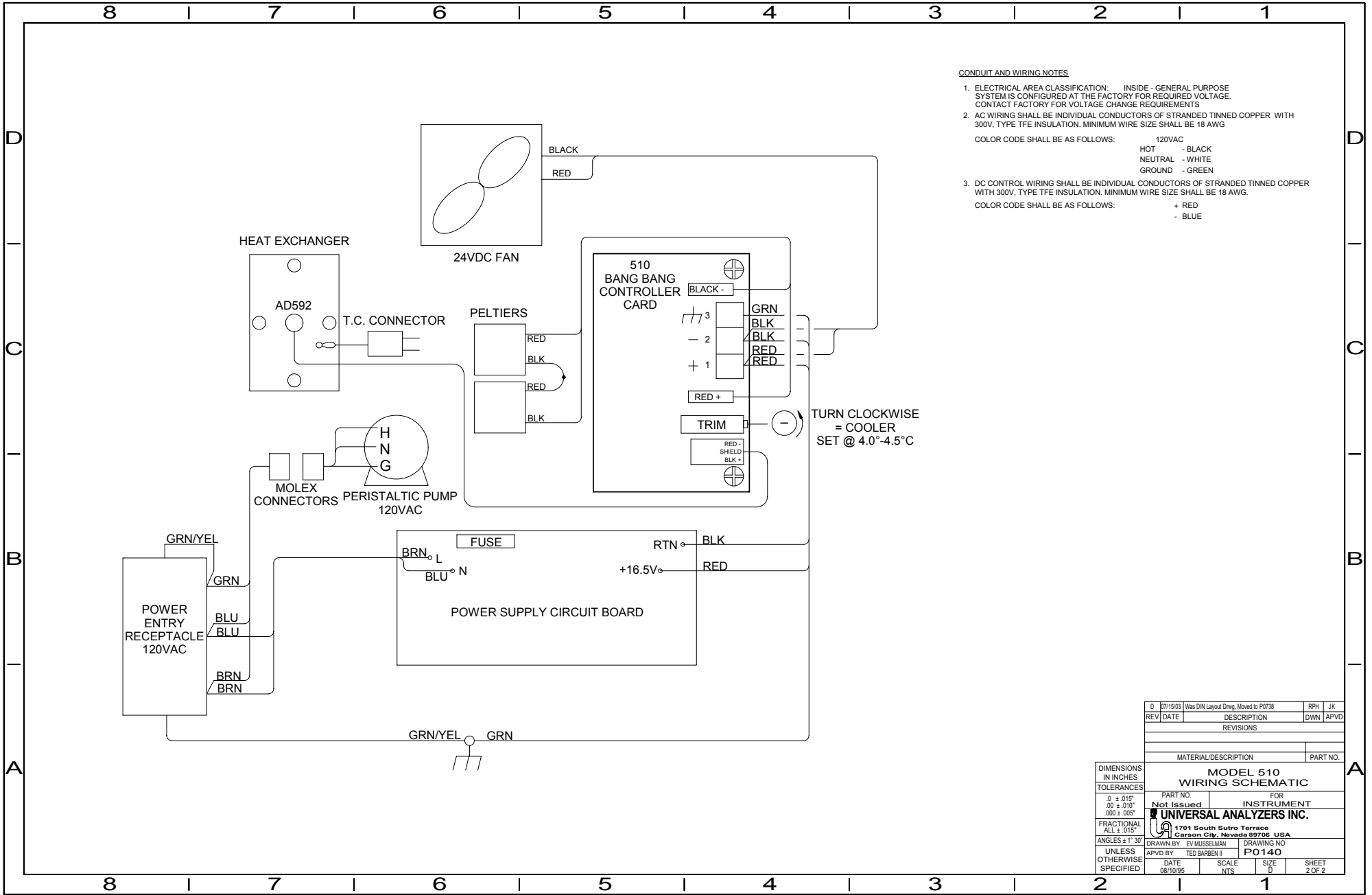
1. Overloading of the cooling capacity of the chiller due to too much water vapor in the sample or due to too great a sample flow rate.
2. The condensate pump may be faulty. The heat exchanger may be full of condensate. This could be due to the need to change the peristaltic pump tubing. The tubing has a 3 to 6 month life.
3. An air leak may be in the condensate removal system allowing air to enter and blow the condensate back into the heat exchanger.
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 near a heat source.
5. The sample cooler could have failed.

If additional information is required, telephone assistance can be obtained from the factory by calling (800) 993-9309 or (775) 883-2500 or FAX request to (775) 883-6388.



1). SEE SHEET 2 FOR WIRING SCHEMATIC

D	07/15/03	Moved DIN Dwg to P0738, Added Wiring Sht2	RPH	JK
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
MODEL 510 PORTABLE SAMPLE COOLER OUTLINE				
PART NO.		FOR INSTRUMENT		
NOT ISSUED				
UNIVERSAL ANALYZERS INC.				
1701 South Sutro Terrace Carson City, Nevada 89706 USA				
DRAWN BY	EV MUSSELMAN	DRAWING NO		
APVD BY	TED BARBEN II	P0140		
DATE	08/10/95	SCALE	1:1	SHEET
			E	1 OF 2



CONDUIT AND WIRING NOTES

- ELECTRICAL AREA CLASSIFICATION: INSIDE - GENERAL PURPOSE SYSTEM IS CONFIGURED AT THE FACTORY FOR REQUIRED VOLTAGE. CONTACT FACTORY FOR VOLTAGE CHANGE REQUIREMENTS
- AC WIRING SHALL BE INDIVIDUAL CONDUCTORS OF STRANDED TINNED COPPER WITH 300V, TYPE TFE INSULATION. MINIMUM WIRE SIZE SHALL BE 18 AWG
 COLOR CODE SHALL BE AS FOLLOWS:
 120VAC
 HOT - BLACK
 NEUTRAL - WHITE
 GROUND - GREEN
- DC CONTROL WIRING SHALL BE INDIVIDUAL CONDUCTORS OF STRANDED TINNED COPPER WITH 300V, TYPE TFE INSULATION. MINIMUM WIRE SIZE SHALL BE 18 AWG.
 COLOR CODE SHALL BE AS FOLLOWS:
 + RED
 - BLUE

D	07/15/03	Was DIN Layout Dwg. Moved to P0738	RPH	JK
REV	DATE	DESCRIPTION	DWN	APVD
REVISIONS				
MATERIAL/DESCRIPTION				
PART NO.				

DIMENSIONS IN INCHES				
TOLERANCES				
0 ± .015"	PART NO.			
.00 ± .010"	FOR INSTRUMENT			
.000 ± .005"	Not Issued			
FRACTIONAL ALL ± .015"	UNIVERSAL ANALYZERS INC.			
ANGLES ± 1° 30'	1701 South Sutro Terrace Carson City, Nevada 89706 USA			
UNLESS OTHERWISE SPECIFIED	APVD BY	DATE	SCALE	SHEET
	TED BARBER II	08/10/95	NTS	2 OF 2
			SIZE D	
			P0140	



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SPARE PARTS FOR MODEL 510 TRANSPORTABLE SAMPLE COOLER

<u>Part Number</u>	<u>Description</u>	<u>Price each</u>
9216-0017	2' length of 1/4" O. D. Viton sample tubing, #16	\$ 14.50
3016-0003	Thermoelectric elements	\$ 192.00
9515-0034	Insulation kit	\$ 63.00
5200-0062	316SS Heat Exchanger	\$ 108.00
4800-0013	24 VDC Cooling Fan	\$ 74.00
1150-0017	Temperature Transducer Assembly	\$ 75.00
3600-0018	Control Circuit Board	\$ 130.00
5400-0006	24 VDC Power Supply	\$ 210.00
4958-0028	Peristaltic Condensate Pump Motor, 115 VAC	\$ 210.00
4958-0031	Peristaltic Condensate Pump Motor, 230 VAC	\$ 210.00
4958-0055	Peristaltic Condensate Pump Head, #16	\$ 130.00

MASTERFLEX®

L/S®

for all models of MASTERFLEX
L/S Standard Pump Heads

MASTERFLEX Laboratoire
Tête de pompe Standard
Bedienungsanleitung für alle
MASTERFLEX
L/S Standard-Pumpenköpfe

Para todos los modelos MASTERFLEX
L/S Cabezales Standard

Serie MASTERFLEX
L/S Teste Pompanti Standard
標準ポンプヘッド



Cole-Parmer Instrument Co.

1-800-MASTERFLEX (627-8373) (U.S. and Canada only)
11 (847) 549-7600 (outside U.S.)
(847) 549-7600 (Local)
www.masterflex.com

Barnant Company

1-800-637-3739 (U.S. and Canada only)
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(847) 381-7050 (Local)
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A-1299-0108
Edition 13



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625 East Bunker Court
Vernon Hills, Illinois U.S.A. 60061-1844
1-800-MASTERFLEX (627-8373) (U.S. and Canada only)
11 (847) 549-7600 (outside U.S.)
(847) 549-7600 (Local)
FAX (847) 247-2929 (U.S. and Canada only)
11 (847) 549-1700 (Fax outside U.S.)
www.masterflex.com
e-mail: techinfo@coleparmer.com



Barnant Company

28W092 Commercial Ave.
Barrington, Illinois U.S.A. 60010-2392
1-800-637-3739 (U.S. and Canada only)
11 (847) 381-7050 (outside U.S.)
(847) 381-7050 (Local)
11 (847) 381-7053 (Fax outside U.S.)
(847) 381-7053 (Local Fax)
www.barnant.com
e-mail: barnant@barnant.com



These products are covered by the following U.S. and corresponding foreign patent: 3,358,609.

Ces produits sont couverts par le brevet américain suivant et les brevets étrangers correspondants : 3,358,609.

Diese Produkte sind durch das folgenden US- und entsprechende ausländische Patent geschützt: 3,358,609.

Estos productos están cubiertos por la siguiente patente de EE.UU., y patente extranjera correspondiente: 3,358,609

Questi prodotti sono protetti dal seguente brevetto statunitense e dal corrispondente brevetto straniero: 3,358,609.

これらの製品は、以下の米国及び当該国における以下の特許により保護されています。第 3,358,609 号

1. Single Pump Head Loading

WARNING: PRODUCT USE LIMITATION

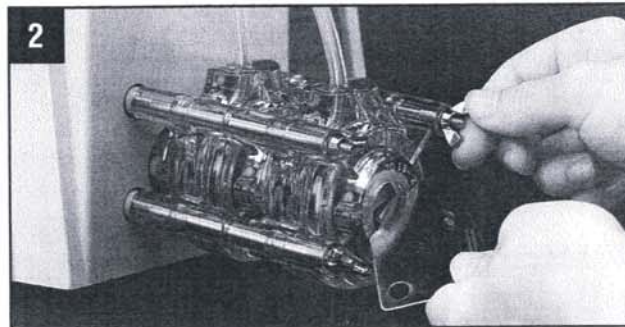
These products are not designed for, nor intended for use in patient connected applications; including, but not limited to, medical and dental use, and accordingly have not been submitted for FDA approval.

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

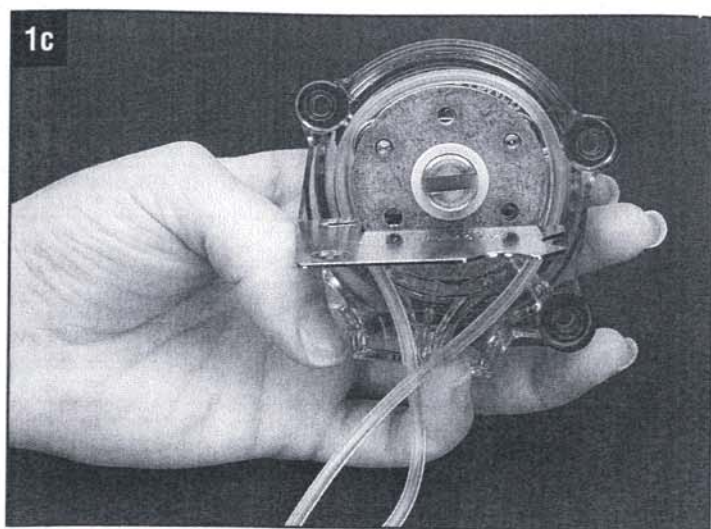
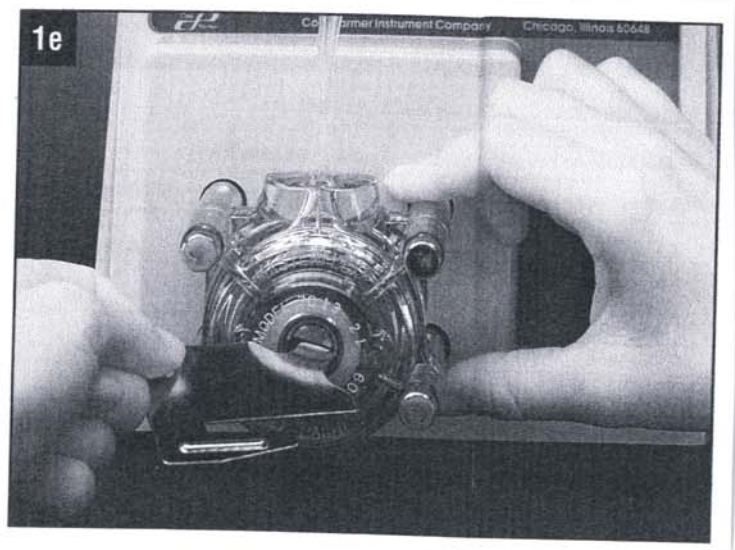
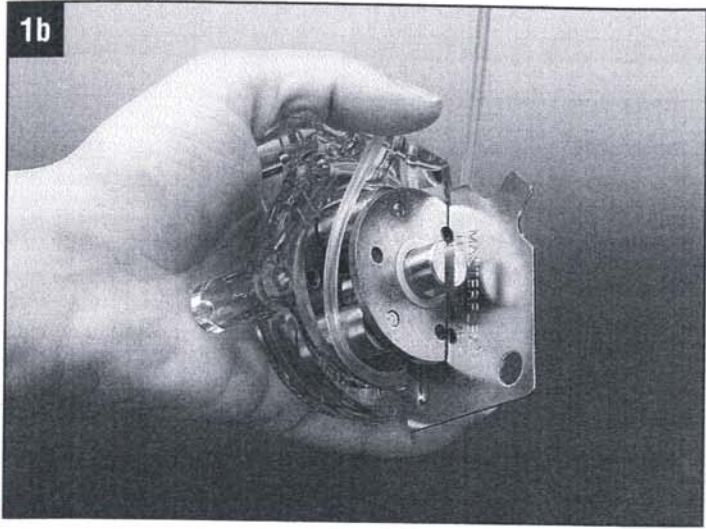
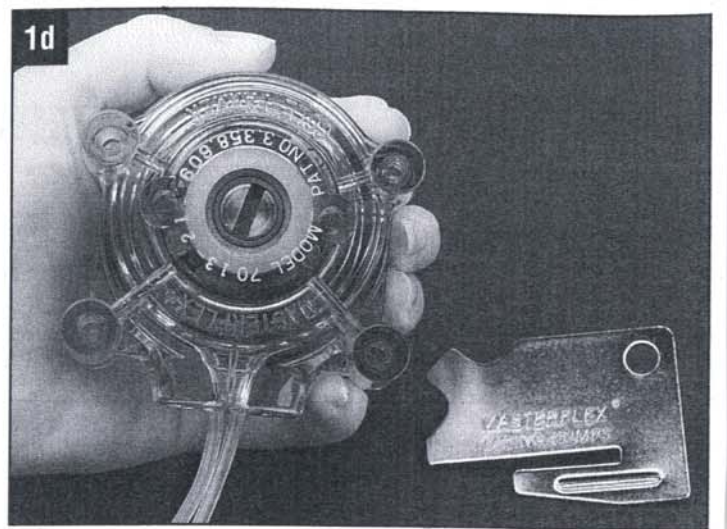
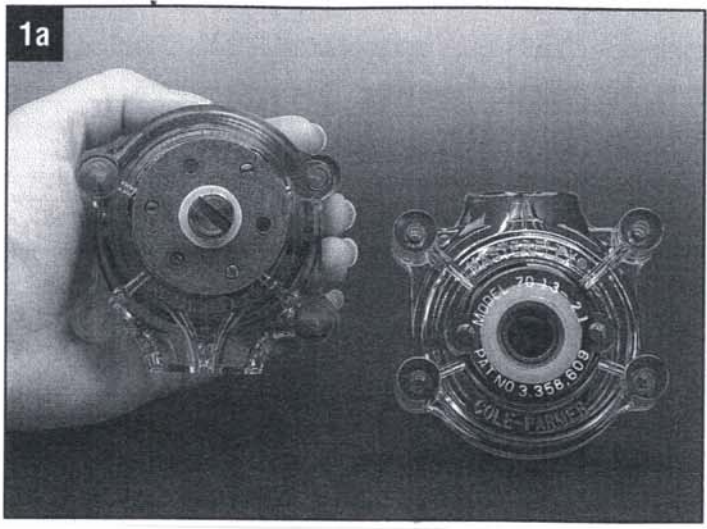
Flat bladed Screwdriver required for mounting.

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	07013-81	—	—
07013-10, -21	07013-91	07013-50, -52	07013-92
07014-00, -20	07014-81	—	—
07014-10, -21	07014-91	07014-50, -52	07014-92
07015-00, -20	07015-81	—	—
07015-10, -21	07015-91	07015-50, -52	07015-92
07016-00, -20	07016-81	—	—
07016-10, -21	07016-91	07016-50, -52	07016-92
07017-00, -20	07017-81	—	—
07017-10, -21	07017-91	07017-50, -52	07017-92
07018-00, -20	07018-81	—	—
07018-10, -21	07018-91	07018-50, -52	07018-92
07024-00, -20	07024-81	—	—
07024-10, -21	07024-91	07024-50, -52	07024-92
07035-02, -20	07035-81	—	—
07035-12, -21	07035-91	—	—

B. Rotor assemblies

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

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	07013-02	07013-04
2	07013-03	07013-05
3	07013-06	07013-08
4	07013-07	07013-09

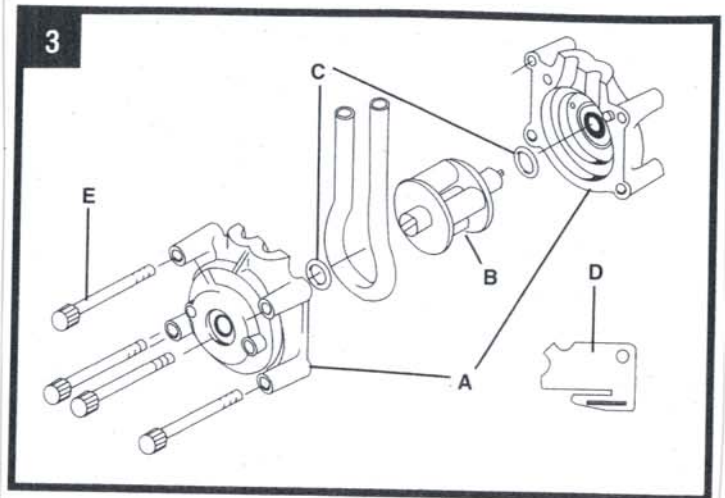
4. Specifications

	Thin wall*	Thick wall*
Maximum continuous discharge pressure—psi (bar):	20 (1.4)	25 (1.7)
Maximum intermittent discharge pressure—psi (bar):	35 (2.4)	40 (2.7)
Maximum vacuum:	660 (510 [†]) mm Hg; 26 (20 [†]) in Hg	
Maximum suction lift:	8.8 (6.7 [†]) m H ₂ O; 29 (22 [†]) ft H ₂ 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 [‡] :	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/cm² (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/cm² (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: Poor Alkalies: Poor Organic solvents: Not recommended Pressure: Fair Vacuum: Good Viscous fluids: Fair Sterile fluids: Excellent	Acids: Poor Alkalies: Poor Organic solvents: Not recommended Pressure: Fair Vacuum: Good Viscous fluids: Fair Sterile fluids: Excellent	Acids: Poor Alkalies: Poor Organic solvents: Not recommended Pressure: Fair Vacuum: Good Viscous fluids: Fair Sterile fluids: Excellent	Acids: Poor Alkalies: Poor Organic solvents: Not recommended Pressure: Fair Vacuum: Good Viscous fluids: Fair Sterile fluids: Excellent	Acids: Good Alkalies: Good Organic solvents: Not recommended Pressure: Fair Vacuum: Good Viscous fluids: Fair Sterile fluids: 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 ₂ : 20,132 H ₂ : 6579 O ₂ : 7961 N ₂ : 2763	CO ₂ : 20,132 H ₂ : 6579 O ₂ : 7961 N ₂ : 2763	CO ₂ : 25,147 H ₂ : — O ₂ : 4715 N ₂ : 2284	CO ₂ : 25,147 H ₂ : — O ₂ : 4715 N ₂ : 2284	CO ₂ : — H ₂ : — O ₂ : 150 N ₂ : —
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/cm² (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 ₂ : 563 H ₂ : — O ₂ : 124 N ₂ : 67	CO ₂ : 270 H ₂ : 97 O ₂ : 60 N ₂ : 30	CO ₂ : 360 H ₂ : 97 O ₂ : 80 N ₂ : 40	CO ₂ : 100 H ₂ : 97 O ₂ : 22 N ₂ : 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 ² (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 ² (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 ² (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 (cm² x sec. x cm Hg) x 10⁻¹⁰</small>	CO ₂ : 1200 H ₂ : — O ₂ : 200 N ₂ : 80	CO ₂ : 1200 H ₂ : — O ₂ : 200 N ₂ : 80	CO ₂ : 1200 H ₂ : — O ₂ : 200 N ₂ : 80	CO ₂ : 76 to 79 H ₂ : — O ₂ : 13 to 15 N ₂ : 4.3	CO ₂ : 76 to 79 H ₂ : — O ₂ : 13 to 15 N ₂ : 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.