Tris Pump Instruction Manual





Part #69-1613-297 of Assembly #60-1613-293 Copyright © 2001, 2004 All rights reserved, Teledyne Isco, Inc. Revision E, April 19, 2005

Foreword

This instruction manual is designed to help you gain a thorough understanding of the operation of the equipment. Teledyne Isco recommends that you read this manual completely before placing the equipment in service.

Although Teledyne Isco designs reliability into all equipment, there is always the possibility of a malfunction. This manual may help in diagnosing and repairing the malfunction.

If the problem persists, call or email the Teledyne Isco Customer Service Department for assistance. Contact information is provided below. Simple difficulties can often be diagnosed over the phone. If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by the Customer Service Department, including the use of the **Return Authorization Number** specified. **Be sure to include a note describing the malfunction.** This will aid in the prompt repair and return of the equipment.

Teledyne Isco welcomes suggestions that would improve the information presented in this manual or enhance the operation of the equipment itself.

Teledyne Isco is continually improving its products and reserves the right to change product specifications, replacement parts, schematics, and instructions without notice.

Contact Information

Phone:	(800) 228-4373	(USA, Canada, Mexico)
	$(402) \ 464 \text{-} 0231$	(Outside North America)
Repair Service:	(800) 775-2965	(Analytical and Process Monitoring Instruments)
	(800) 228-4373	(Samplers and Flow Meters)
Fax:	$(402)\ 465\text{-}3022$	
Email address:	info@isco.com	
Website:	www.isco.com	
Return equipment to: 4700 Superior Street, Lincoln, NE 68504-1398		
Other correspondence: P.O. Box 82531, Lincoln, NE 68501-2531		

Frequently ordered replacement parts for the Teledyne Isco Tris Pump

These replacement parts are often ordered by Tris owners. All parts are pictured and identified by number and description in the replacement parts appendix of this manual. The part number prefix for catalog items is 68-, but the manual part number prefix is 60-. If you come across a number which is identical except for the prefix, it is the same part.

Description	Part Number
Cassette assembly (each)	60-1614-072
Silicone tubing, ¹ /8" ID, 20 ft length (3 meters)	681617017
Silicone tubing, ¹ /16" ID, 20 ft length (3 meters)	681617018
Viton tubing, ¹ /8" ID, 10 ft length (1.5 meters)	681617025
Connectors for tubing (package of 10 with nuts and ferrules)	681617022

Trademarks

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- ® Halar is a trademark of Allied Chemical
- ® Tygon is a trademark of Norton Company

General Warnings

Before installing, operating, or maintaining this equipment, it is imperative that all hazards and preventive measures are fully understood. While specific hazards may vary according to location and application, take heed in the following general warnings:

Liquids associated with this instrument may be classified as carcinogenic, biohazard, flammable, or radioactive. Should these liquids be used, it is highly recommended that this application be accomplished in an isolated environment designed for these types of materials in accordance with federal, state, and local regulatory laws, and in compliance with your company's chemical/hygiene plan in the event of a spill.

Eviter de répandre des liquides dangereux. Les liquides qui sont analysés dans cet instrument peuvent être cancérigènes, hasards biologiques, inflammables, ou radioactifs. Si vous devez utiliser tels liquides, il est très recommandé que vous le faites à l'intérieur d'un environnement isolé conçu pour tels liquides. Cet environnement isolé devrait être construit selon les règlements fédéraux, provinciaux, et locaux, aussi que le plan de votre compagnie qui concerne l'évènement d'un accident avec les matières hasardeuses.

Avoid hazardous practices! If you use this instrument in any way not specified in this manual, the protection provided by the instrument may be impaired.

Éviter les usages périlleux! Si vous utilisez cet instrument d'une manière autre que celles qui sont specifiées dans ce manuel, la protection fournie de l'instrument peut être affaiblie; cela augmentera votre risque de blessure.

If this system uses flammable organic solvents, Teledyne Isco recommends that you place this system in a well-ventilated environment, designed for these types of materials. This environment should be constructed in accordance with federal, state, and local regulations. It should also comply with your organization's plan concerning chemical and hygiene mishaps. In all cases use good laboratory practices and standard safety procedures.

Ce système peut utiliser des dissolvants organiques inflammables. Pour réduire le péril qui peut être causé par l'accumulation des vapeurs explosives, Teledyne Isco recommande que vous installez ce système dans un environnement bien-aéré qui est conçu pour les matières hasardeuses. Cet environnement devrait être construit selon les règlements fédéraux, provinciaux, et locaux. Aussi, il devrait se conformer au plan de votre organisation qui concerne les mésaventures de l'hygiène ou de chimique. En tout cas, utilisez toujours de pratiques bonnes de la laboratoire et des procédures standardes de la sûreté.

Hazard Severity Levels

This manual applies *Hazard Severity Levels* to the safety alerts, These three levels are described in the sample alerts below.

Cautions identify a potential hazard, which if not avoided, may result in minor or moderate injury. This category can also warn you of unsafe practices, or conditions that may cause property damage.

Warnings identify a potentially hazardous condition, which if not avoided, could result in death or serious injury.

DANGER – limited to the most extreme situations to identify an imminent hazard, which if not avoided, will result in death or serious injury. Hazard Symbols

The equipment and this manual use symbols used to warn of hazards. The symbols are explained below.

	Hazard Symbols
Warnings and Cautions	
Â	The exclamation point within the triangle is a warning sign alerting you of important instructions in the instrument's technical reference manual.
<u>A</u>	The lightning flash and arrowhead within the triangle is a warning sign alert- ing you of "dangerous voltage" inside the product.
	This symbol warns you that your fingers or hands will sustain serious injury if you place them between the moving parts of the mechanism near this symbol.
Symboles de sécurité	
	Ce symbole signale l'existence d'instructions importantes relatives au pro- duit dans ce manuel.
<u>A</u>	Ce symbole signale la présence d'un danger d'électocution.
	Ce symbole vous avertit que les mains ou les doigts seront blessès sérieusement si vous les mettez entre les éléments en mouvement du mécanisme près de ce symbole.
Warnungen und Vorsichtshinweis	e
	Das Ausrufezeichen in Dreieck ist ein Warnzeichen, das Sie darauf aufmerksam macht, daß wichtige Anleitungen zu diesem Handbuch gehören.
<u>A</u>	Der gepfeilte Blitz im Dreieck ist ein Warnzeichen, das Sei vor "gefährlichen Spannungen" im Inneren des Produkts warnt.
Advertencias y Precauciones	
	Esta señal le advierte sobre la importancia de las instrucciones del manual que acompañan a este producto.
<u>Á</u>	Esta señal alerta sobre la presencia de alto voltaje en el interior del producto.

Tris Pump Safety

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Section 1 Introduction

1.1 Introduction	The Tris peristaltic pump is a general purpose pump for liquid
	chromatography and other laboratory applications. The pump
	operates on 14 Vac supplied from a wall-mounted transformer
	and delivers accurately calibrated (true velocity servo) flows up
	to 500 ml/hour and 30 psi (207 kPa) from each of its three chan-
	nels. The pump will automatically control a fraction collector to
	keep a constant fraction volume regardless of pump speed. It can
	also be remotely controlled to start, stop, and change directions.

1.2 Controls	The controls and connectors are detailed in Figure 1-1 and Table
	1-2.

Tabl	e 1-1 Technical specifications
POWER MAINS REQUIREMENTS: (Use only Teledyne Isco-made power packs)	100 ± 10 Vac, 15 VA maximum (Part No. 60-1614-092) 117 ± 12 Vac, 15 VA maximum (Part No. 60-1614-091) 234 ± 23 Vac, 15 VA maximum (Part No. 60-3874-053)
MAINS FREQUENCY	50 Hz or 60 Hz NOTE: 117 Vac/50 Hz is not available.
LINE VOLTAGE NOISE TOLERANCE	1.7 x nominal rms line voltage, 10 μsec pulses, any phase angle, random or repetitive
DIMENSIONS	4.5 in wide x 6.5 in high x 7.38 in long (1.76 cm x 2.54 cm x 2.63 cm)
WEIGHT	6 lbs 10 ozs (3.0 kg)
FLOW RATE LINEARITY	\pm 2% full-scale from 10% to 100% on either speed range
	(Not including variation in peristaltic action of tubing)
FLOW RATE ACCURACY	Channel-to-channel difference: $\pm 5\%$ Short term variation: zero to 8 hours: $\pm 3\%$ per channel Long term variation: zero to 100 hours: $\pm 5\%$ per channel <i>Limitation due to variation in peristaltic action of tubing</i>
OUTPUT PRESSURE	0 to 30 psi (207 kPa)
TUBING LIFE	Greater than 600 hours at X10 100% speed and 5 psi with $^{1}\!/\!8"$ or $^{1}\!/\!16"$ ID silicone tubing
AMBIENT OPERATING RANGE	0° to 40 °C, 100% relative humidity maximum if left connected to mains
EXTERNAL SPEED CONTROL	0 V to 10 Vdc input. 10 Vdc equals 100% X10 range of front panel controls.
POLLUTION DEGREE	2
INSTALLATION CATEGORY	П
MAXIMUM ALTITUDE	2,000 meters

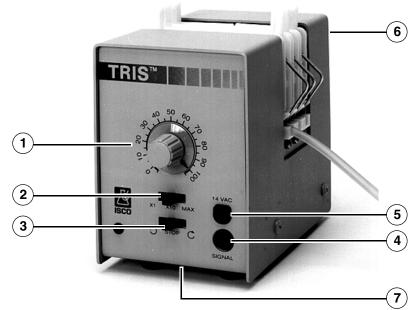


Figure 1-1 Tris controls and connectors

Table 1-2 Controls and Connectors			
Item No. on Fig. 1-1	Control or Connector	Description	Purpose
1	% CONTROL	Potentiometer	Determines speed of pump over 0–100% of X1 or X10 range.
2	X1/X10/MAX speed range	3-position slide switch	Provides X1 or X10 speed ranges (up to 50 and 500 ml/hr respectively with ¹ /8" ID tubing) and momentary MAX (700 ml/hr with ¹ /8" ID tubing) speed.
3	STOP C	3-position slide switch	Determines pump direction and turns pump off (when in STOP position).
4	SIGNAL	8-pin DIN connector	Pin 7 - 0 to + 10 Vdc in equals 100 ° X10 range.
			Pin 5 - Output signals for volumetric collection with fraction collector.
			Pin 2 - Recorder chart drive control.
			Pin 3 - Inputs for start/stop. Pin 4 - Reverse direction.
			Pin 1 - Common.
			For more information, refer to section 4.2.
5	POWER	3-pin jack	14 Vac power input to the pump from the 100, 117, or 234 Vac mains wall plug transformer.
6	unlabeled	grounding terminal	Allows earth grounding of the Tris cabinet.
7	EXT. / INT.	2-position slide switch (located on case bottom)	Selects external or internal speed control.

Section 2 Initial Checkout



DO NOT OPERATE THE ROLLERS WITHOUT THE CASSETTES INSTALLED. SERIOUS INJURY TO YOUR FINGERS WILL RESULT IF YOU PLACE THEM INSIDE THE MECHANISM WHILE IT IS ROTATING WITHOUT THE CASSETTES IN PLACE.



RISQUE DE BLESSURE DES DOIGTS. NE PAS METTRE LES MAINS DEDANS LA POMPE QUAND ELLE FONCTIONNE ET LES MÉCANISMES QUI TIENNENT LE TUYAUTERIE NE SONT PAS MONTÉS. LES ROULEAUX DANS LA POMPE BLESSERONT LES DOIGTS SÉRIEUSEMENT.

2.1 Initial Checkout

- 1. With the speed range set to X10 setting and the direction switch set clockwise, vary the speed between 0 and 100%. The pump rotor should turn clockwise and increase its speed from zero to about 7 rpm as the setting is changed from -2 to 100%.
- 2. Change the speed range to X1 and the direction switch to the counterclockwise position. The pump should turn counterclockwise at 1/10 of the former speed and decrease in speed down to zero when the speed dial is moved from the 100% setting down to -2%.
- 3. With the pump set at X10 and 100% speed, push the speed range switch to the **MAX** position. At this position, the pump should run slightly faster. When the slide switch is released, the pump should return to the slower speed.

This completes the initial checkout, if the results of this initial checkout are unsatisfactory in any way, contact the Teledyne Isco Service Department, 1-800-775-2965.

Section 3 Operation



DO NOT OPERATE THE ROLLERS WITHOUT THE CASSETTES INSTALLED. SERIOUS INJURY TO YOUR FINGERS WILL RESULT IF YOU PLACE THEM INSIDE THE MECHANISM WHILE IT IS ROTATING WITHOUT THE CASSETTES IN PLACE.



RISQUE DE BLESSURE DES DOIGTS. NE PAS METTRE LES MAINS DEDANS LA POMPE QUAND ELLE FONCTIONNE ET LES MÉCANISMES QUI TIENNENT LE TUYAUTERIE NE SONT PAS MONTÉS. LES ROULEAUX DANS LA POMPE BLESSERONT LES DOIGTS SÉRIEUSEMENT.

3.1 Operation

To operate the Tris, turn the pump on by selecting a pumping direction and choose either the X1 or X10 speed range. The 0-100% dial acts as a zero to one speed multiplier within each range. For priming or purging the fluid lines, the momentary MAX speed can be used.

Mote

For precise calibration, actual flow rates should be measured using volumetric glassware. The flow rates listed in Table 3-1 are approximate.

🗹 Note

In order to maximize pump life, it is recommended that the Tris pump be run clockwise when operated in one direction for long periods of time.

Table 3-1 Approximate Flow Rates				
Tubing Used	Displacement Per Rotor Revolution	100% at 1X Range	100% of 10X Range	"MAX" (Momentary)
¹ /16" ID SILICONE TUBING (60-1617-018)	0.00 ml/mu	d 5 million		040
¹ /16" ID VITON TUBING (60-1617-028)	0.36 ml/rev.	15 ml/hr	150 ml/hr	210 ml/hr
¹ /8" ID SILICONE TUBING (60-1617-017)		50 14		700 //
¹ /8" ID VITON TUBING (60-1617-025)	1.19 ml/rev.	50 ml/hr	500 ml/hr	700 ml/hr

Mote

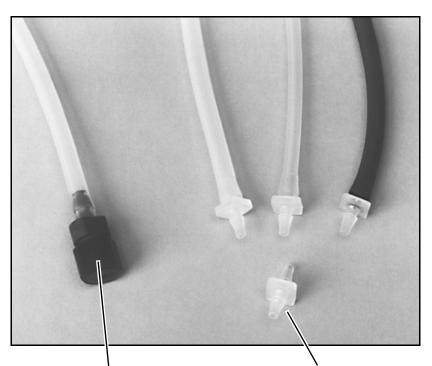
For applications requiring maximum flow rate accuracy or reproducibility, the Tris pump should be run for one hour with the tubing in place. This ensures that the tubing is completely seated and stretched within the cassette.

3.2 Installation of Tubing

The Tris pump uses silicone or Viton® tubing which needs to be cut to the appropriate length and installed into the pump with the proper tubing connectors attached. Supplied with the pump in the accessory package (60-1619-004) are two types of tubing connectors. The translucent polypropylene unions (209-0162-12) are used to connect $^{1}/_{16}$ " ID or $^{1}/_{8}$ " ID silicone and Viton tubing lengths together. The red Halar® lead connectors (60-1613-012) connect $^{1}/_{16}$ " ID and $^{1}/_{8}$ " ID silicone and Viton pump tubing to $^{1}/_{16}$ " OD and $^{1}/_{8}$ " OD tubing of all types including Teflon®, Tygon®, polyethylene, glass and stainless steel. These fittings have $^{1}/_{8}$ " barbs for use with $^{1}/_{16}$ " ID and $^{1}/_{8}$ " ID silicone and $^{1}/_{8}$ " ID Viton tubing. Refer to Figure 3-1 and 3-2.

¹/8 INCH I.D. SILICONE TUBING WILL BURST WHEN PRESSURIZED OVER 40 PSI. TELEDYNE ISCO INC. DOES NOT RECOMMEND USING ¹/8 INCH I.D. SILICONE TUBING FOR PUMPING FLAMMABLE OR OTHERWISE HAZARDOUS FLUIDS.

TUYAUTERIE DE SILICONE DE 3 mm DIAMÈTRE INTÉRIEUR ÉCLATERA QUAND ELLE EST PRESSURISÉE PLUS DE 276 KPA. TELEDYNE ISCO NE RECOMMANDE PAS QUE VOUS UTILISEZ LA TUYAUTERIE DE CE TYPE POUR POMPER LES LIQUIDES QUI SONT INFLAMMABLES OU AUTREMENT HASARDEUX.



Red Halar lead connector (60-6013-112) connects 1/16" and 1/8" ID silicone and viton pump tubing to any 1/8" or 1/16" OD tubing. (See Figure 3-3) Polypropylene union (209-0162-12) Connects 1/16 and 1/8 ID silicone and Viton pump tubing to other flexible tubing from 1/16" to 1/8" ID.

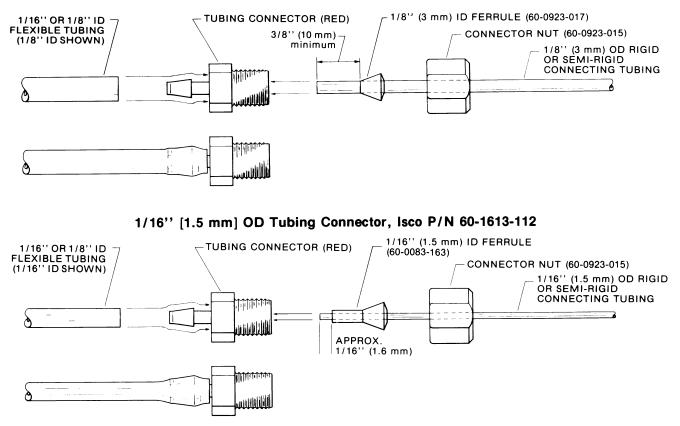
Figure 3-1 Tubing Connectors

🗹 Note

For proper operation, the pump must be used with the recommended tubing and with either the unions or lead connectors in place as described in this section. These fittings prevent the tubing from being pushed through the pump.

To Install the Tubing

- 1. Cut the tubing to be used to a length of 7.0 inches (178 mm) for $\frac{1}{8}$ " ID silicone and ID Viton. For the $\frac{1}{16}$ " ID Viton and silicone tubing, cut a 6.7 inch (170 mm) length.
- 2. Install either the unions or the red lead connectors provided with the pump at both ends of the tubing.
- 3. Stretch the tubing across the rollers and insert the attached connectors into the slots on both sides of the pump (Figure 3-3 and 3-7).



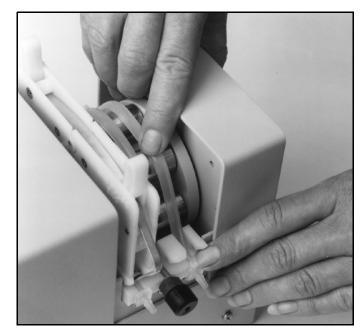
1/8" [3 mm] OD Tubing Connector, Isco P/N 60-1613-112

Installation Procedure

- 1. Slide the connector nut over the connecting tubing. Follow it with an appropriately sized ferrule (refer to the Ferrule Application Information sheet at the back of this manual). Both should slide up clear of the end of the tube (the 1/8'' ID ferrule must clear by at least 1/4'' and the 1/16'' ID ferrule by about 1/16''.
- 2. Insert the tubing into the connector until it bottoms. While holding it bottomed, slide the nut (and ferrule) down and tighten the nut in place.

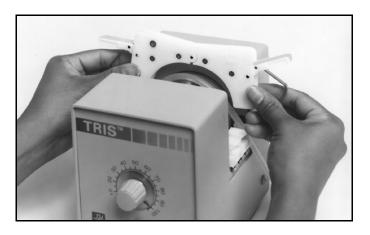
CAUTION: Do not overtighten; this can collapse thin wall tubing.

Figure 3-2 Tubing connector



Push the tubing into the slots in the cassette clip so that the attached plastic union or connector is flush with the side of the clip.

Figure 3-3 Installation of tubing, Step 1



Place the cassette down over the tubing.

Figure 3-4 Installation of tubing, Step 2

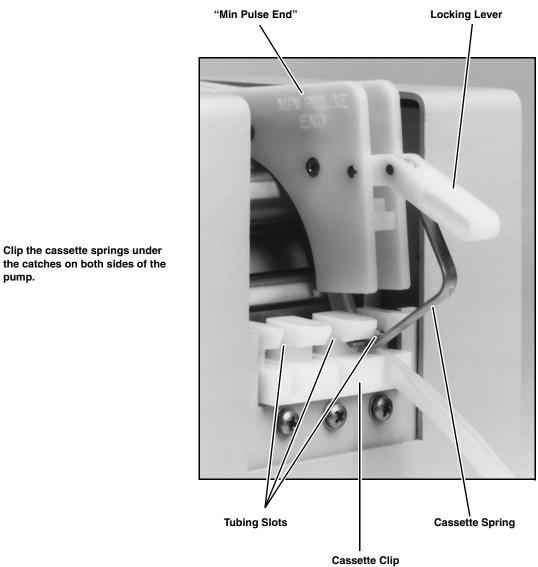
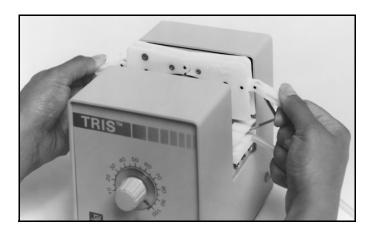


Figure 3-5 Installation of tubing, Step 3

pump.



Move the locking levers to the vertical position for operation.

Figure 3-6 Installation of tubing, Step 4

3.3 Installation of Cassettes	All four types of tubing recommended for use with the Tris pump use the same self-adjusting tubing cassettes (patent pending) which are installed as shown in Figures 3-3 through 3-6. The cas- sette springs are hooked under the catches on both sides of the pump and the locking levers are moved to the vertical position for operation. The Tris cassette locking levers have one operating position (vertical) and should not be moved to other positions in an attempt to modify the performance of the pump.
3.4 Removal of Cassettes	To remove the cassettes:
	1. Move the locking levers to the horizontal position as shown in Figure 3-5.
	2. Press down on the locking levers, and at the same time, pull the cassette springs out and down to release them from their positions in the cassette clips.
3.5 Suggestions for Best Performance	For applications that require optimum flow accuracy or repeat- ability, follow these suggestions:
	1. Once the tubing is in place, start the pump and allow it to run at 100%, X10 speed in the proper flow direction for 15 minutes. If more than one channel is used, run the pump for one hour. This process allows the tubing to stretch slightly and stabilize at the operation tension.
	2. Each cassette has the wording MIN PULSE END on one end (see Figure 3-5). The Tris has less pulsation when that end of the cassette is used as the flow outlet when the pump is delivering, or as the inlet when the pump is used to draw liquid in.
	3. For maximum flow rate repeatability, use the same pump channel, same cassette, same tubing, and same scale set- ting. Removing and replacing the same tubing in the cas- sette may affect reproducibility.
	4. Always set the 1% speed dial from directly in front of the pump to prevent variation caused by parallax due to setting the pump speed while viewing from an angle.
3.6 Flow Rates	Approximate flow rate maxima for each of the four recommended tubing types are shown in Table 3-1.
3.7 Tubing Selection	Table 3-2 lists representative liquids and the recommended tub- ing for each liquid. The recommendations are meant to serve as a general indication as to which tubing types are compatible with the liquid in question. If it is essential that the tubing not affect the sample in any way (<i>e.g.</i> , by leaching tubing components into the solution), further testing should be done. Under mutually satisfactory conditions, silicone tubing has better accuracy and about four times the life of Viton tubing.

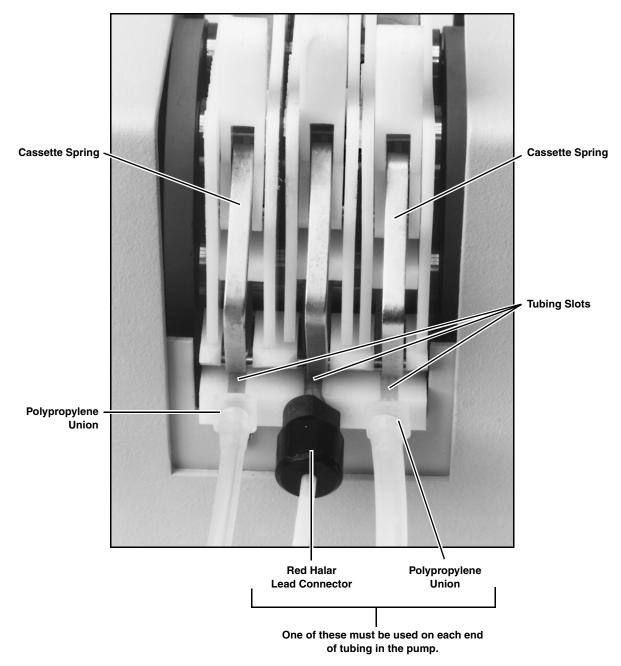


Figure 3-7 Tubing and connectors in place

Table 3-2	Chemical com	patibilities of silic	one and Viton tubing
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S - Satisfactory T - Testing required U - Unsatisfactory Blank - no compatibility data currently available

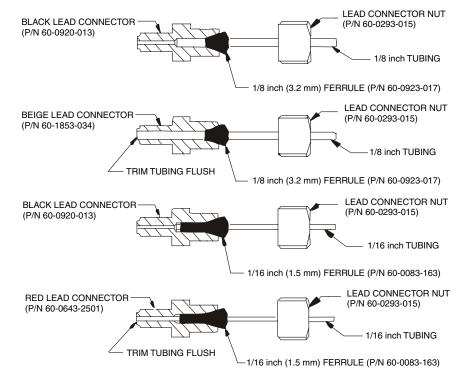
Substance	Tub	-	currently available Substance	Tub	ing
Substance			Substance		•
	Silicone	Viton		Silicone	Viton
Acetic acid (less than 5%)	S	S	Hydrochloric acid (dil)	U	S
Acetic acid (more than 5%)	S	Т	Hydrochloric acid (med conc)	U	S
Acetonitrile	Т		Hydrochloric acid (conc)	U	S
Acetone	S	U	Ketones	U	U
Acids, organic, between acetic and stearic acid	т	Т	Methyl chloride	Т	S
Alcohols (methyl, ethyl, propyl only)	S	S	Nitric acid (dil)	Т	S
Aliphatic hydrocarbons	Т	U	Nitric acid (med conc)	U	S
Ammonium hydroxide	S	S	Nitric acid (conc)	U	Т
Ammonium phosphate	S	S	Oils, animal	Т	S
Aromatic hydrocarbons	Т	S	Oils, mineral	Т	S
Benzaldehyde	U	U	Oils, vegetable	S	S
Benzene	U	S	Perchloric acid	U	S
Benzoic acid	Т	S	Phosphoric acid (ortho)	Т	S
Butanol and higher alcohols	Т	S	Pyridine	U	U
Carbon tetrachloride	U	S	Sodium bicarbonate	S	S
Chloracetic acid	U		Sodium chloride	S	S
Chloroform	U	S	Sodium hydroxide (dil)	Т	S
Chromic acid	U	S	Sodium hydroxide (med conc)	Т	S
Cyclohexane	U	S	Sodium hydroxide (conc)	Т	Т
Dimethyl formamide	Т	U	Stearic and higher order organic acids	Т	S
Ethers	U	Т	Sulfuric acid (dil)	U	S
Ethyl acetate	Т	U	Sulfuric acid (med conc)	U	S
Ethyl bromide	S		Sulfuric acid (conc)	U	S
Ethyl chloride	U	S	Toluene	U	S
Ethylene glycol	S	S	Trichloracetic acid	U	
Fatty acids	Т	S	Trichloroethylene	U	S
Formic acid	Т	U	Trisodium phosphate	S	
Glucose	S	S	Urea	S	S
Glycerol	S	S	Xylene	U	S

FERRULE APPLICATION INFORMATION

Two types of very low density polyethylene ferrules are provided for use with this instrument. Characteristic properties and application of these ferrules are as follows:

	1/16 inch (1.5 mm) with ferrule P/N 60-0083-163
OD OF TUBING TO BE USED	1/8 inch (3.2 mm) with ferrule P/N 60-0923-017
INSTALLATION PROCEDURE Finger tightening of connector nut	
COMPATIBLE SOLVENTS	Polyethylene ferrules may be used with acids, bases, and all organic solvents, but are subject to long-term damage due to swell when exposed to halogenated hydrocarbons over extended time. In most cases, such a damaged ferrule is still useable until the lead connector nut is loosened, unless the pressure of swelling collapses thin-walled connecting tubing.

FERRULES PICTURED AS INSTALLED



FERRULE INSTALLATION PROCEDURE

Slide lead connector nut over tubing. Slide ferrule over tubing. For black lead connector with either 1/16 or 1/8 OD tubing, insert tubing until it bottoms out on the lead connector. For red lead connector with 1/8 tubing, also insert tubing until it bottoms out. For red lead connector with 1/8 OD tubing, insert tubing through entire connector until it protrudes 1/8" beyond end of lead connector. Slide ferrule into lead connector and secure with lead connector nut. Trim excess tubing flush with end of lead connector. CAUTION: Do not overtighten lead connector nut! Overtightening can lead to collapsing thin-walled tubing.

- 1. Red lead connectors have 0.063" (1.5 mm) fluid passages Black lead connectors have 0.036" (0.9 mm) fluid passages Beige lead connectors have a 0.128" (3.0 mm) fluid passages
- 2. Tubing OD tolerance is \pm 0.2 mm.

Figure 3-8 Ferrule Application Information

3.8 Connection to Teledyne Isco Fraction Collectors and Recorders

Seven cables are available for connecting the Tris pump to Teledyne Isco fraction collectors and recorders. These are listed in Table 3-3 and shown in Figures 3-9 to 3-15.

Table 3-3 Connect cables for Teledyne Isco fractioncollectors and recorders

		oracio
Cable	Connects to	Function
68-1010-119	Non-Teledyne Isco controllers	See Table 3-5.
68-1020-158	Cygnet (2170) fraction collectors	Stops pump at end of run.
68-1020-159	Cygnet, Retriever II, Retriever IV and Foxy	Volumetric collection and pump stop between tubes and at end of run.
68-1020-204	Foxy 200	Pump count and pump stop.
68-1020-161	Retriever II, Retriever III, Retriever IV, Foxy, 1850, 1200/1220,2111, Foxy 200	Pump stops at end of run.
68-1020-162	Retriever III, 1850, 1200/1220, 2111	Volumetric collection and pump stop at end of run.
68-120-163*	UA-6, V4, 1840 Absorbance Detectors and Model 615 Recorder	Stops recorder chart drive when pump stops.
*NOTE: This cable can be used in combination with cables 68-1020-159, -161, or -162 to provide the functions of both cables. Refer to Figure 3-13 and 3-14.		

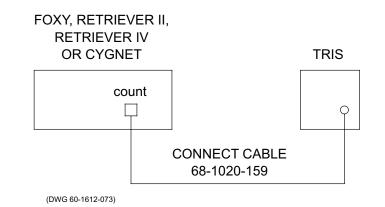


Figure 3-9 Connection of Foxy, Retriever II, Retriever IV and Cygnet to Tris for volumetric collection, pump stop between tubes and at the end of the run

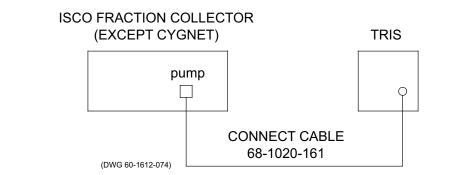


Figure 3-10 Connection of all Teledyne Isco Fraction Collectors (except Cygnet) to Tris for pump stop at the end of the run

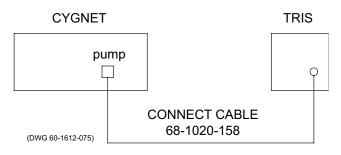


Figure 3-11 Connection of Cygnet and Tris for pump stop at the end of the run

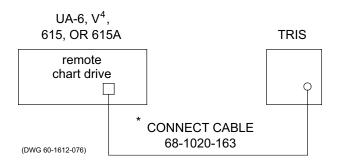


Figure 3-12 Connection of recorders chart drive in UA-6, V4, 1840 or Model 615 for Charts stop when Tris shuts off

🗹 Note

Cable 68-1020-163 is a Y-cable which includes a 5-pin DIN male connector to allow the attachment of cables 68-1020-159, -161, -162 for complete interfacing of pump, recorder and fraction collector. Figures 3-13 and 3-14 show the connections.

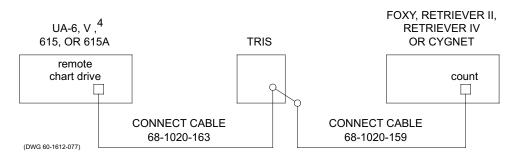


Figure 3-13 Connection for chart stop, volumetric collection and pump shut off

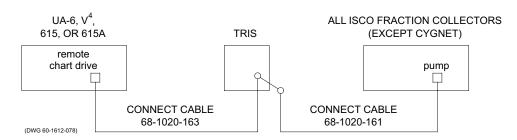


Figure 3-14 Connection for chart stop and pump shut off

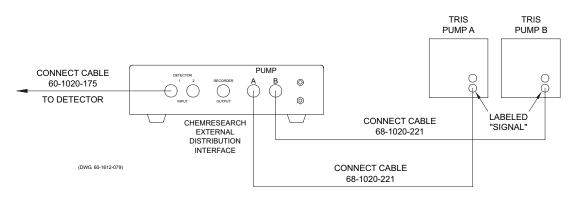


Figure 3-15 Connection for voltage control speed of dual pumps gradient

3.8.1 Connection to a Teledyne Isco UA-6 Teledyne Isco UA-6 Teledyne Isco UA-6 Teledyne Isco UA-6 The chart recorder of the UA-6 can be set to produce charts based on cm/ml (length of chart per unit of volume pumped) instead of the traditional cm/hr (length of chart per unit of time). For volume-based charts, plug the square four-pin connector on the cable (P/N 60-1020-163 or 60-1020-228) into the socket labeled "REMOTE CHART DRIVE" on the back of the UA-6.

The chart length per unit volume (cm/ml) is shown in Table 3-4 for each "chart speed" setting on the UA-6, the tubing size in the Tris pump, and the line frequency (60 Hz in USA, 50 Hz in Europe, etc.).

Table 3-4 Chart Length per Unit of Fluid Volume Pumped (cm/ml) for Single Channel of Pump Approximate cm per ml				
Chart Speed	60 Hz line	frequency	50 Hz line frequency	
cm/hr	¹ /16" tubing	¹ /8" tubing	¹ /16" tubing	¹ /8" tubing
300	1.7	0.5	2.0	0.6
150	0.83	0.25	1.0	0.3
60	0.33	0.1	0.4	0.12
30	0.17	0.05	0.2	0.06
15	0.083	0.025	0.1	0.03
6	0.033	0.03	0.04	0.012
3	0.017	0.005	0.02	0.006
1.5	0.0083	0.0025	0.01	0.003
0.6	0.0033	0.001	0.004	0.0012
0.3	0.0017	0.0005	0.002	0.0006

Changing a jumper inside the Tris pump from the default setting (P104 pin 4-8) to P104 pin 3-7 will double the cm/ml. Refer to section 5 of this manual for more information.

The actual chart speed (cm/hr) when generating charts can be calculated from the following equation:

[Tris speed] \times [Tris range] \times [UA-6 chart speed range] \times 0.049804687 = chart speed [UA-6 line frequency]

Example 1:

 $[100\%] \times [10] \times [300 \text{ cm/hr}] \times 0.049804687$ = 249.02343 cm/hr [60 Hz]

Example 2:

 $[25\%] \times [1] \times [15 \text{ cm/hr}] \times 0.049804687$ = 0.3735153 cm/hr [50 Hz]

3.9 Volumetric Fraction Collection	This transmits at 267 pulses (open collector transistor output) per 10 revolutions of its rotor assembly. These pulses can be counted by Teledyne Isco fraction collectors to allow collection of fractions based upon fractions of pump revolutions. Volumetric interfacing to Teledyne Isco fraction collectors is illustrated in Figures 3-9 and 3-10. Set the count switches to the desired volume to be pumped to each fraction collector tube (22 counts is approximately 1 ml with $1/8$ " ID tubing; 78 counts with $1/16$ " ID tubing). Allow the pump to operate at the selected speed for approximately 30 minutes to wear in the tubing. Connect the pump to the fraction collector to the desired accuracy. This step is necessary, since the ID of standard silicone tubing can vary as much as 10%.
	Example: Fraction of 5 ml are required and the pump is found to dispense 1.21 ml per rotor revolution, or 5 ml in 4.56 revolutions. At 267 pulses per 10 rotor assembly revolutions, Tris will send out 110 pulses for each 5 ml pumped (22 pulses/ml with ¹ / ₈ " tubing). By programming the fraction collector to collect 110 units in the volume mode, 5 ml fractions will be collected.
	For volumetric collection by non-Teledyne Isco fraction collectors, pulses are available as open-collector signal (20 mA or 30 volts maximum) from pins 5 with pin 1 as common.
3.10 Other Connections to Teledyne Isco and Non-Teledyne Isco Fraction Collectors	The Tris pump has two inputs which can be interfaced to either Teledyne Isco or non-Teledyne Isco equipment. A sustained con- tact closure or logic level low between pins 3 and 1 will stop the Tris. A contact closure between pins 4 and 1 will reverse the pumping direction.
	For connection to Teledyne Isco fraction collectors, except Cygnet, Tris can be shut off at the end of a run by cable 68-1020-161. For Cygnet, Tris can be shut off at the end of a run by cable 68-1020-158.
3.11 Connection to Cheminterface for Computer Control	The Tris connects to the Teledyne Isco ChemInterface to allow computer control via an RS-232-C serial port. Cable 68-1020-145 connects Tris to the "Pump 1" socket on Cheminterface. Controls available from the computer are start/stop and reverse direction. See the ChemInterface manual for further details.
3.12 Dual Pump Gradient	The Tris pump can now run by external voltage control. Set S103 (via access hole in case bottom) to EXT. Range and speed controls are now inoperable. Speed, direction and start/stop are now left to the External Controller. Tris will now operate with a 0 to +10.0 VDC input pumping at a rate of 0 to 100% X10 range. Set STOP switch on TRIS to CW. This enables the use of the ChemResearch Data Management/System Controller or other LC software to perform dual pump gradients. Refer to Figure 3-15 for connection to external control device.

3.13 Gradient Formation with Peristaltic Pumps

Peristaltic pumps can be used to form gradients for eluting columns, density gradient centrifugation, or other applications. By using two or more pump channels and different sized tubing, a variety of gradients can be formed.

3.13.1 Non-linear Gradient

Slightly Convex Gradient

This simple gradient set-up uses only two pump channels as shown in Figure 3-16. One channel carries the final solution (B) to the mixing vessel which is filled with initial solution. The second channel pumps the formed gradient out of the mixing vessel. If two tubing lengths of identical inside diameter are used, the gradient is slightly convex as shown in Figure 3-16.

Mote

Unless the volume of solvent B is arbitrarily large, this gradient will not reach 100% of the final (B) solution.

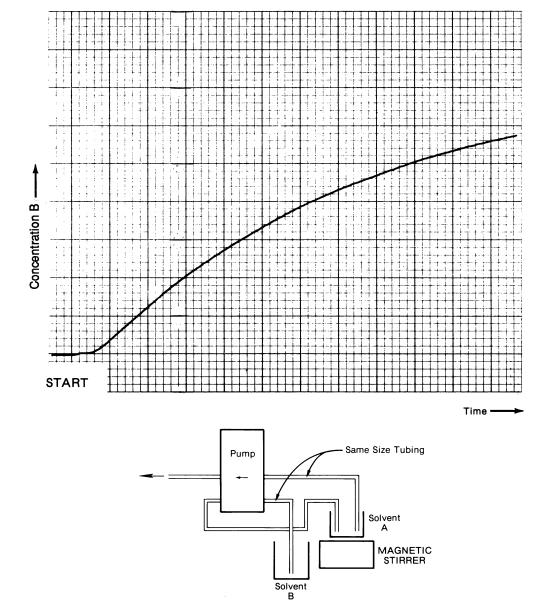


Figure 3-16 Slightly convex gradient

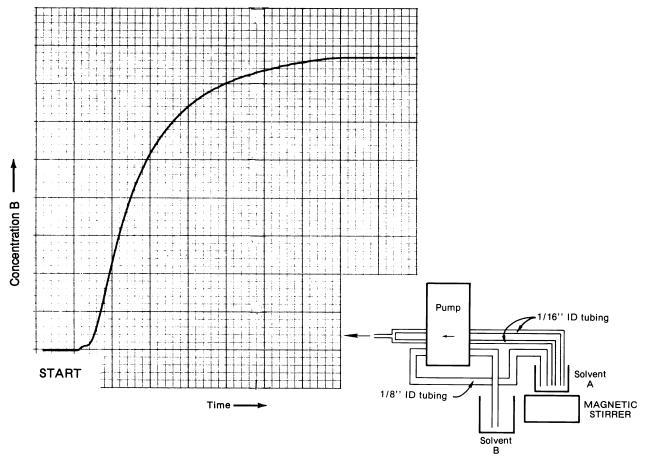


Figure 3-17 Sharply convex gradient

Sharply Convex Gradient By using three pump channels, the convex gradient shown in Figure 3-17 is formed. One channel of 1/8" ID tubing is used to carry the final solution (B) to the mixing vessel and two channels of ¹/16" ID tubing pump the gradient out. Theoretically, this gradient will not reach 100% of B. (The two ¹/16" tubing lengths are connected together downstream of the pump as shown in Figure 3-17). By using two channels, a slightly concave gradient can be Slightly Concave Gradient formed. The final solution is transferred to the mixing vessel via ¹/16" ID tubing and the mixed gradient is pumped out with ¹/8" ID tubing (Figure 3-18). Two channels are used to pump the gradient solution out of the Sharply Concave Gradient mixing vessel. One of these channels uses a ¹/16" ID tubing and the other uses ¹/8" ID tubing. The third channel uses ¹/16" ID tubing to pump component B into the mixing vessel (Figure 3-19).

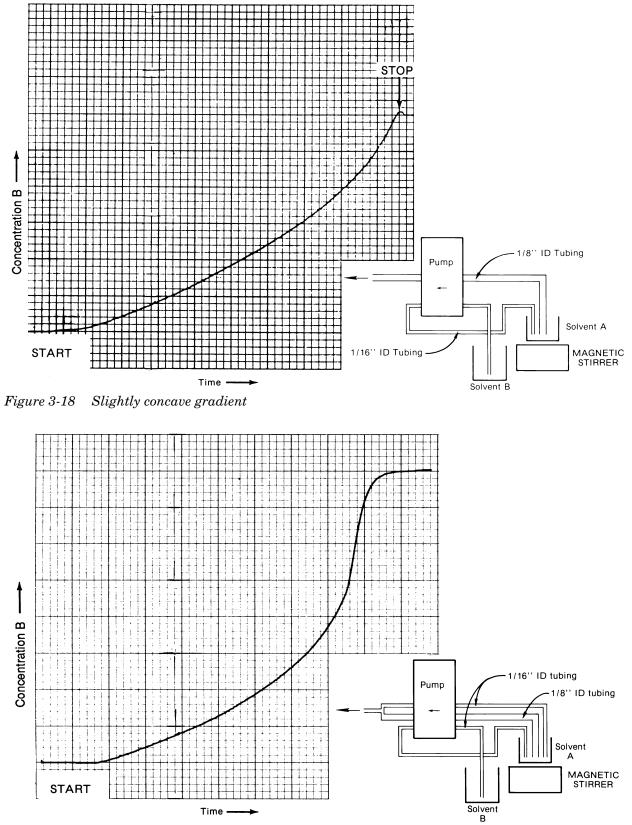


Figure 3-19 Sharply concave gradient

Linear Gradient By using three pump channels with the same size tubing, a linear gradient is formed (Figure 3-20). One channel is used to transfer final solution (100% B) to the mixing vessel and two channels are used to pump the gradient out. (These two channels are combined downstream of the pump as shown in Figure 3-20.) To ensure maximum linearity, the three tubing lengths should be identical in age and material as well as inside diameter.

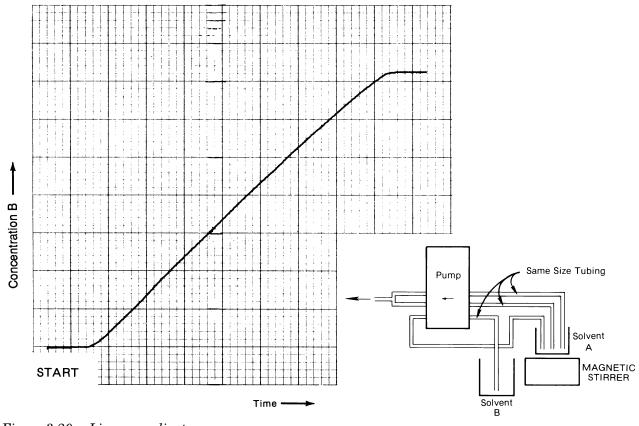


Figure 3-20 Linear gradient

3.14 Optional Mounting Clamps

The Tris may be mounted on a mast $(^{1}/_{2}"$ to $^{3}/_{4}"$ diameter) or lab shelf with an optional clamp available as part number 68-1617-024, on earlier models, and 68-1617-027, on later models.

The clamp is attached to the pump on earlier models by threading the screw (provided with the clamp) through the back of the clamp, through the #10 lockwasher (provided with the clamp) and into the threaded receptacle in the back panel of the pump. The clamp is then secured to the mast or shelf by tightening the thumbscrew provided. On later models, the clamp is attached to the pump by placing the lockwasher on the screws, and threading the screws through the back of the clamp and into the threaded receptacle in the back panel of the pump. With this clamp, Tris is mounted in the operating position shown in Figure 3-21.

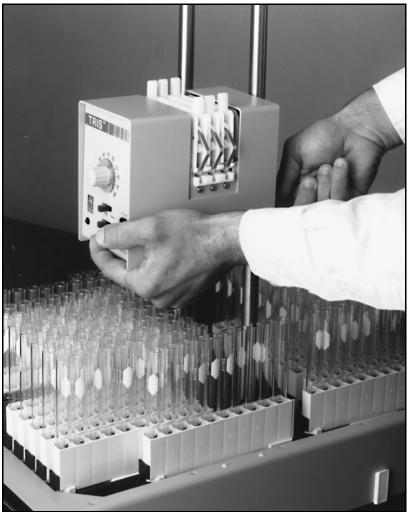


Figure 3-21 Tris mounted on fraction collector

3.15 External Manual Speed Control Switch S103 to EXT. S103 can be actuated through an access hole in the case bottom. External speed control can be accomplished in three ways:

- 1. Computer control as discussed in section 3.12.
- 2. Use of a 0 to +10 Vdc power supply connected from pin 7 J103 to pin 1 J103 (common). +10 Vdc input equals 100% on the X10 range of the front panel controls. Cable 60-1010-119 is recommended for method 2 and 3. See Table 3-5 for connection of cable 60-1010-119.

1	Table 3-5 Connect Cable 60-1010-119, Tris to Non-Teledyne Isco Controllers				
Pin	Conductor Color	Function	Direction of Signal	Description	
1	Yellow	Common			
2	Red	Teledyne Isco Chart recorder drive signal	Output	Open collector providing 50 Hz at X10 and 100% speed. Changeable to 100 Hz.	
3	Green	Pump Stop	Input	Contact closure or open collector referenced to common.	
4	Black	Pump Reverse	Input	Contact closure or open collector referenced to common.	
5	Brown	Fraction Collector Pulses	Output	Open collector providing 267 pulses per 10 revolutions of the pump rotor assembly. Changeable to 534 pulses.	
6	Orange	Manual External Speed Control	Voltage output	For use with external manual speed control. See section 3.15.	
7	Blue	External Speed Control	Input	0 to +10 Vdc input for external speed control. S103 must be in EXT position.	
8	White	Manual external speed control	Voltage output	For use with external manual speed control. See section 3.15.	

Tris Pump

Section 4 Theory of Operation

4.1 Mechanical Description

The Tris is driven by a dc gear motor. A 17.5:1 external gear reduction, utilizing acetal and brass spur gears, increases the overall gear ratio to 341:1.

The spur gear driven rollers coupled to an internal tooth ring gear form an epicyclic gear train or planetary drive. The internal tooth gear forms a stationary "ring gear", the roller mounted spur gears set as revolving "planets", the spool flanges act as the "planet carriers" and the spool shaft acts as the planet carrier shaft.

The difference in diameters between the rollers and roller mounted spur gears was carefully selected to decrease the stress applied to the tubing. This diametral difference causes a small amount of "back spin" on the roller which increases the tubing life substantially.

The individual rollers on the rotor are supported at each end by fluorocarbon lined, steel jacketed bearings. The rollers themselves are precision machined Type 303 stainless steel. The rotor assembly is supported on both ends by double shielded stainless steel ball bearings in which a Type 303 stainless steel axle is utilized.

The self-calibrating cassettes are designed in such a way as to eliminate any need for adjustments. The side of the cassette on which MIN PULSE END is located, produces a very uniform (non-pulsing) flow at low pressure and can be used for either the intake or exhaust side of the pump. The cassette material is an acetal copolymer. It was selected for its strength, lubricity, and chemical resistance. This plastic is resistant to weak or strong alkalies, and most weak acids. Strong acids are not recommended unless extra precaution is taken to prevent tubing rupture and subsequent exposure of the cassettes to the liquid.

The leaf springs on the cassette are heat treated high carbon steel, which are cadmium plated after the forming and heat treatment. A polypropylene drip shield is located directly below the rotor assembly, and if a tube should rupture, the effluent flows down the drip shield and out through holes provided in the bottom of the pump case.

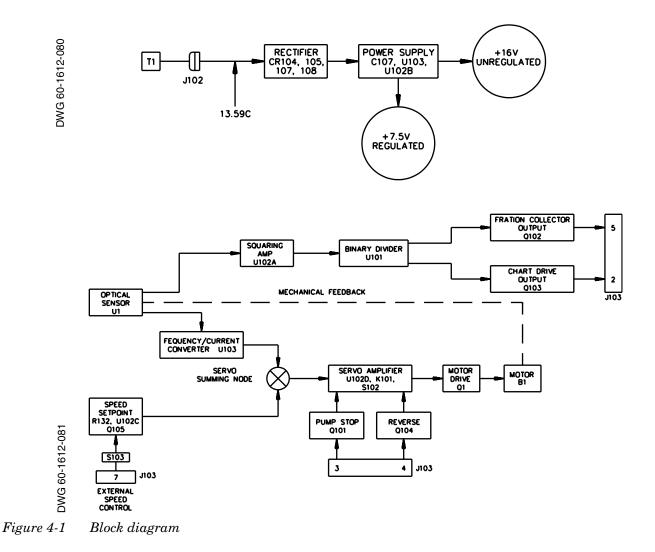
Table 4-1 Signal Plug (J103) Pin Functions			
Pin #	Function	Direction of Signal	Description
1	Common		
2	Teledyne Isco chart recorder drive signal	Output	Open collector providing 50 Hz at X10 and 100% speed. Changeable to 100 Hz.
3	Pump stop	Input	Contact closure or open col- lector referenced to common.
4	Pump reverse	Input	Contact closure or open col- lector referenced to common.
5	Fraction collector pulses	Output	Open collector providing 267 pulses per 10 revolutions of the pump rotor assembly. Changeable to 534 pulses.
6	Manual external speed control	Voltage output	For use with external manual speed control. See section 3.15.
7	External speed control	Input	0 to + 10 Vdc input for exter- nal speed control S103 must be in EXT position.
8	Manual external speed control	Voltage output	For use with external manual speed control. See section 3.15.

4.2 Electrical Description

Refer to the block diagram (Figure 4-1) and the schematic drawings. To view the schematic drawings for the Tris pump that aren't included in this section, first find the serial number for your unit. Then go to our Web site at www.isco.com. Select Training and Support and then Product Support. Click on Liquid Chromatography Products and then select Schematics in the left margin. After you enter your serial number, you will be able to view the schematics online. If you need any assistance, or don't see the correct schematic for your specific unit, contact our service department.

The power supply consists of a wall mounted transformer, a full-wave bridge rectifier, a 7.5 volt regulator (part of U103), and a voltage follower (U102C). The outputs supplied are a filtered +16 V and a regulated + 7.5 V. Anticondensation heaters R130 and R131 are provided for cold room operation.

A precision tachometer feedback signal providing motor speed information is supplied by optical sensor U1. A plastic disk, mounted on the armature shaft of the motor, interrupts the optical sensor at a rate proportional to the speed. The signal from the sensor is applied to the comparator input of the precision frequency-to-current converter (U103). The signal from the frequency-to-current converter consists of precise dc current pulses, which are proportional to the input frequency and motor speed.



The speed set point current is derived by a voltage selected from potentiometer R132 to the set point voltage-to-current converter (U102B and Q105). This reference current is compared at the servo summary node to the current from the frequency-to current converter. The difference is applied to an operational amplifier (U102D) which provides the motor drive signal to the base of the power transistor (Q1) mounted on the case. The operational amplifier and power transistor provide the motor drive current necessary to maintain a constant tachometer signal frequency. If the tachometer signal doesn't correspond to the desired speed, the servo amplifier shifts to a higher or lower voltage to adjust the motor power so it turns at the desired speed.

Shorting terminals 3 to 1 on the SIGNAL plug (J103) turns on Q101 (allowing the current through R112 to pin 13 of U102D), which stops the motor. The motor starts again soon after the terminals are opened.

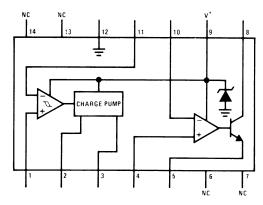
Shorting terminal 4 to 1 on the SIGNAL plug (J103) turns on Q104 (energizes the relay, K101), which changes motor direction. The motor will reverse direction again when the terminals are opened. The squaring circuit output (U102A) is applied to the input of binary divider (U101). Here the pulse rate is divided down for a volumetric fraction collector output pulse signal and a chart drive signal at the SIGNAL plug (J103).

Fraction collector pulses from the binary divider (U101) provides 267 or 534 pulses per 10 rotor assembly revolutions, depending on the setting of the jumper of P104-1 or 2. This output is applied to the fraction collector transistor (Q102). Q102 provides an open collector circuit to pin 5 on the SIGNAL plug J103.

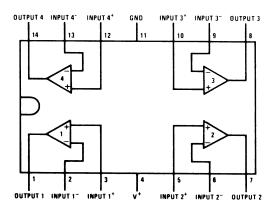
The other output pulses from the binary divider (U101) will provide approximately a 50 Hz or 100 Hz output, depending on the setting of the jumper of P104-3 or 4. This output is applied to the chart drive transistor (Q103). Q103 provides an open collector circuit to control the speed of a chart recorder connected to pin 2 on the SIGNAL plug J103.

External speed control can be accomplished by placing S103 in the EXT position. This disables the front panel speed control and allows an external voltage source to control the pumping speed. The MAX position of the front panel range switch is still active during external speed control. A 0 to +10 Vdc voltage applied to pin 7 J103 and pin 1 J103 (common) will operate the pump over its entire range. +10 Vdc input is equivalent to the front panel control set at 100% X10 range. The external voltage entering through pin 7 J103 is attenuated by R144 and R145 to produce the proper bias for U102B. As discussed earlier in this section, U102B converts this voltage to a current signal which is summed by the current servo circuitry.

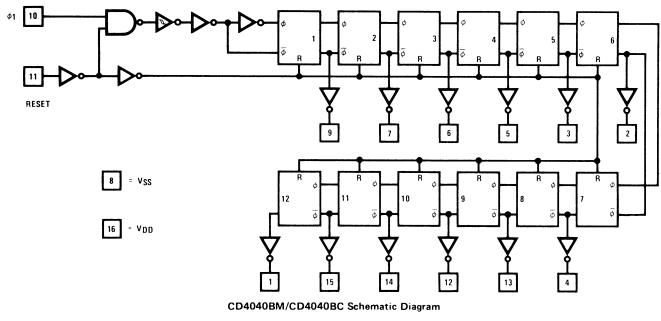
4.3 Integrated Circuits The diagrams and tables in Figure 4-2 are adapted from manufacturer's data and provide information on the integrated circuits used in this unit. They are intended to help you when servicing a unit in the field when reference data may not be readily available.



LM2917 Frequency to Voltage Converter



LM324 Low Power Quad Operational Amplifiers



CD4040BC 12-Stage Ripple Carry Binary Counters

Figure 4-2 Integrated Circuits

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Tris Pump

Section 5 Maintenance, Repair, and Troubleshooting

5.1 Introduction

This section is provided to help you solve instrumentation problems. Included are procedures for maintaining or replacing parts that may wear out.



DO NOT OPERATE THE ROLLERS WITHOUT THE CASSETTES INSTALLED. SERIOUS INJURY TO YOUR FINGERS WILL RESULT IF YOU PLACE THEM INSIDE THE MECHANISM WHILE IT IS ROTATING WITHOUT THE CASSETTES IN PLACE.



RISQUE DE BLESSURE DES DOIGTS. NE PAS METTRE LES MAINS DANS LA POMPE QUAND ELLE FONCTIONNE ET LES MÉCANISMES QUI TIENNENT LE TUYAUTERIE NE SONT PAS MONTÉS. LES ROULEAUX DANS LA POMPE BLESSERONT LES DOIGTS SÉRIEUSEMENT.

5.2 Case Top Removal	The following steps are provided to help you remove the case top. To remove the case top:		
	1. Remove the tubing cassettes and tubing from the pump.		
	2. Remove the two screws located on each side of the pump, and loosen the screw in the case back.		
	3. Gently spread the bottom of the case while lifting the case straight up so the case will clear the cassette hold-ing catches.		
5.3 Lubrication	Occasionally the pump may develop some gear noise. To correct the noise, remove the case top as described above and lubricate the drive and idler gears with fluorosilicone oil.		
5.4 Motor-pump Assembly and	The motor-pump assembly may be removed as a unit. To remove the motor pump assembly:		
Removal	1. Remove the case top as described in section 5.2.		
	2. Remove the four screws located on the case bottom which secure the motor pump assembly.		

3. Disconnect the multi-pin plug (P101) attached to the circuit board.

Three power modules can be used with this unit. All have an output of 14 Vac. Use the one which most nearly matches the available line voltage. The voltage requirement of each power module is molded on the prong-side of the case.

- 1. Remove the case top as described in section 5.2.
- 2. Refer to the circuit board in the Replacement Parts List during the following steps.
- 3. Tris is shipped from the manufacturer with 267 pulses per 10 revolutions of the rotor assembly. The position of the jumper should be on P104, pin 1.
- 4. To change from a 267 pulse to a 534 pulse per 10 revolutions of the rotor assembly, pull off the jumper from P104, pin 1. Push on the jumper to P104, pin 2.
- 1. Remove the case top as described in section 5.2.
- 2. Refer to the circuit board in the Replacement Parts List during the following step.
- 3. Tris is shipped from Teledyne Isco with an output signal frequency of 50 Hz at the maximum speed of 7 rpm. This is 427 pulses per revolution of the rotor assembly. If the chart speed switch is set at 30 cm/hr (60 Hz recorder version), then the chart recorder paper will advance at 250 cm/hr at the pump's maximum speed. The position of the jumper (Item 46) should be on P104, pin 4.
- 4. Reinstall the case top.

The following adjustments should be made whenever electrical components are replaced in the Tris pump:

DO NOT OPERATE THE ROLLERS WITHOUT THE CASSETTES INSTALLED. SERIOUS INJURY TO YOUR FINGERS WILL RESULT IF YOU PLACE THEM INSIDE THE MECHANISM WHILE IT IS ROTATING WITHOUT THE CASSETTES IN PLACE.

RISQUE DE BLESSURE DES DOIGTS. NE PAS METTRE LES MAINS DANS LA POMPE QUAND ELLE FONCTIONNE ET LES MÉCANISMES QUI TIENNENT LA TUYAUTERIE NE SONT PAS MONTÉS. LES ROULEAUX DANS LA POMPE BLESSERONT LES DOIGTS SÉRIEUSEMENT.

1. Remove the case top as described in section 5.2.

5.7 Converting to a Different Chart Recorder Signal Out

5.5 Operation from

5.6 Converting to a

Collectors)

Different Voltages

Different Pulse Count

Output (for Fraction

5.8 Adjustments

- 2. Adjust R106, R107, and R125 to mid-range and R104 and R105 fully clockwise.
- 3. Set the X1/X10/MAX switch to X10, the direction switch to clockwise, and the % control to 0.
- 4. Adjust R125 until the motor just stops.
- 5. Adjust R105 counterclockwise until the motor starts and then clockwise until the motor stops.
- 6. Set the X1/X10/MAX switch to the X1 and the % control to 0.
- 7. Adjust R104 counterclockwise until the motor starts and then clockwise until the motor just stops.
- 8. Connect a frequency counter probe to TP102 (a less accurate method is to connect a voltmeter to P101, pin 3 (+) and circuit common TP109).
- 9. Set the % control to 100.
- 10. Adjust R106 to a frequency reading of $6375 \text{ Hz} \pm 50 \text{ Hz}$. (If using the less accurate method described in step 8, you should get a voltage reading of +5.9 Volts on the motor.)
- 11. Change the X1/X10/MAX switch to X1.
- 12. Adjust R107 to a frequency reading of $638 \text{ Hz} \pm 5 \text{ Hz}$. (If using the less accurate method described in step 8, you should get a voltage reading of +1.2 Volts on the motor.)
- 13. Disconnect the power module and reinstall the case top.

5.9 Technical Troubleshooting

It is a good idea to begin troubleshooting by verifying the 14 voltage ac transformer output and the +16 volt dc and +7.5 volt dc outputs of the power supply. These three values (within their acceptable limits) can be verified at the following test points. The dc voltage reading with respect to ground (TP109) are:

- 14 Vac ± 1.4 Vac, at pins 1 and 2 of J102
- +16 Vdc ± 3 Vdc, at positive lead of C107
- +7.5 Vdc ± 0.5 Vdc, TP104

Table 5-1 Symptom/Remedy Chart For Technical Troubleshooting

NOTE: This chart provides basic information. Refer to the electrical description in section 4.2 of this manual for a thorough discussion of the electronic circuitry.

Symptom	Possible Cause	Remedy
1. Motor runs at high speed.	a. U1, U103, Q105, U102D, Q1	a. Isolate and replace
2. Motor does not run.	a. U102C, U102D, U102B, Q105, Q101, Q1.	a. Isolate and replace
3. Motor does not change direction.	a. Q104, K101.	a. Isolate and replace.
4. No pump and/or chart pulse output.	a. U102A, CR102, U101. b. Pump pulses only:Q103 c. Chart pulses only: Q102	a. Isolate and replace. b. Replace c. Replace

5.10 Service Department	If you have a problem with the instrument or need parts infor- mation, contact the Service Department. If you write, please include all pertinent information that may be helpful in solving your problem. Address you letter to:
	Teledyne Isco, Inc. Service Department P.O. Box 82531 Lincoln, NE 68501-2531
	We suggest you call the Service Department first, however, before deciding to return the unit for factory repair. Often a prob- lem can be solved in the field with a little extra help. Our toll-free number is: (800) 775-2965.
5.11 How to Ship Returns	Be sure all parts and hardware are back in place before packing. Attach the gold shipping bracket which protects the capillary compartment. This shipping bracket must be in place when the unit is shipped, otherwise the warranty will be voided. Wrap the unit in heavy paper or put it in a plastic bag. If the original car- ton is not available, put the unit in a strong cardboard box at least six inches longer in all three dimensions than the unit. Fill the box equally around the unit with resilient packing material (shredded paper, bubble pack, expanded foam chunks, etc.). Seal it with strapping tape or gummed cloth tape and ship it to the address given previously. The warranty at the end of the manual describes the conditions under which Teledyne Isco will pay sur- face shipping costs.
	It is very important that the shipment be well packaged and fully insured. Damage claims must be settled between you and the carrier. This can delay repair and return of the unit to you.
5.12 Purchasing Parts	Only the parts listed in the Replacement Parts List of this man- ual are stocked for immediate delivery by Teledyne Isco. Virtu- ally all other parts are also available, but there may be some delay in shipping them because they are not normally stocked.
	The figures in the Replacement Parts List at the end of the man- ual illustrate the immediate delivery items. Each part is given an item number which is shown in the callout "balloons" in the illus- tration and in the item number column list. When ordering replacement parts, please supply the following information: 1. series number of the unit
	2. item number
	3. part number
	5. part number
5.13 Cleaning the Instrument	Do not totally immerse the instrument in a bath for cleaning. The instrument is not hermetically sealed and delicate compo- nents would get wet, resulting in possible damage to them. The cassettes may be removed, however, and placed in a bath of mild detergent in water.
	The outer enclosure may be washed with water and a mild deter- gent, or for spills of an organic nature, use a sponge dipped in iso- propyl alcohol mostly squeezed out.

Tris Pump

Appendix A Replacement Parts

A.1 Replacement Parts

Replacement parts are called out in the following illustrations. Refer to the call-out in the adjacent table to determine the part number for the item.

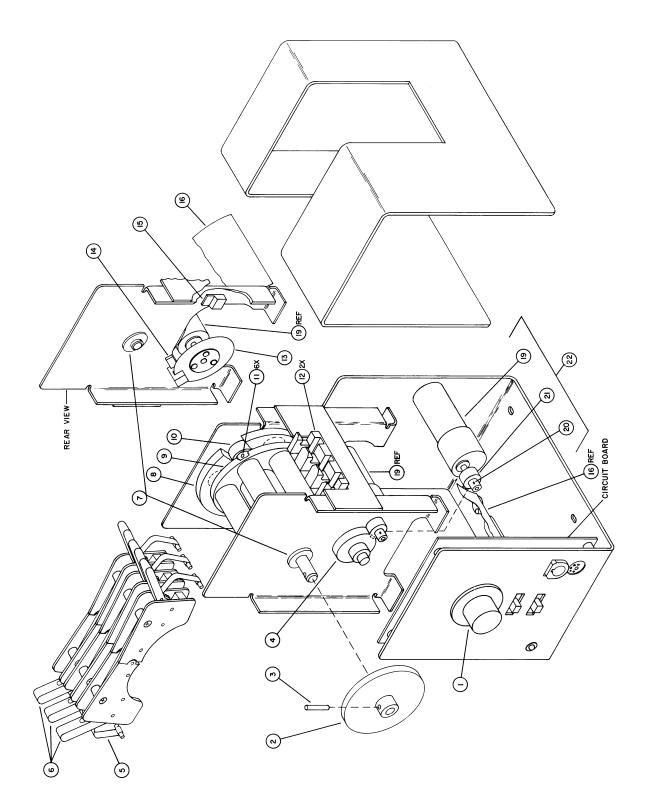
Replacement parts can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco, Inc.

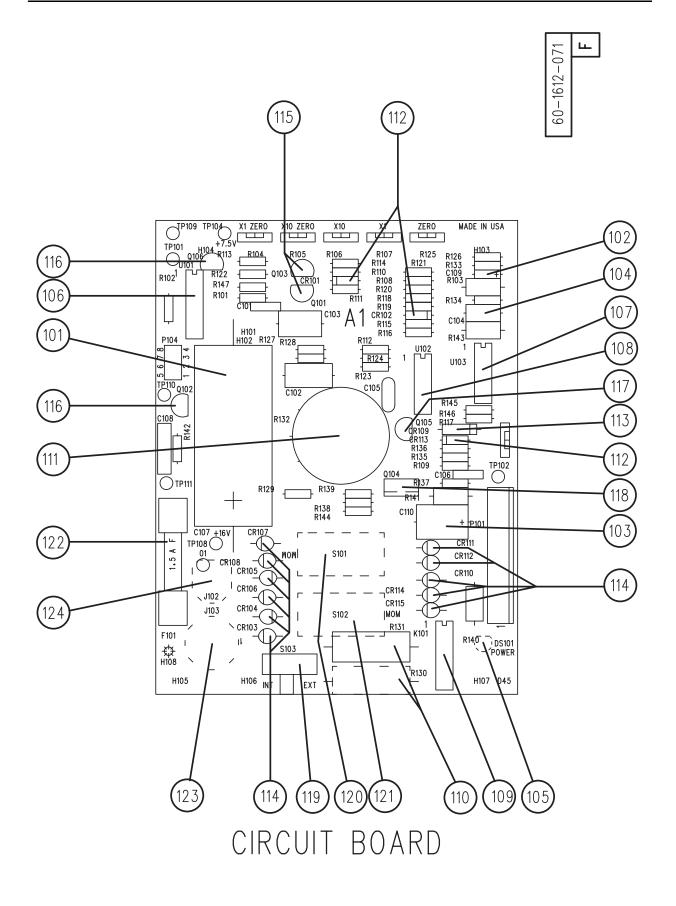
Customer Service Department P.O. Box 82531 Lincoln, NE 68501 USA

Phone: (800) 228-4373 (402) 464-0231 FAX:(402) 465-3022

E-mail:info@isco.com



REPLACEMENT PARTS LISTDWG. NO.: 60-1612-065Isco, Inc.SHEET: 2 OF 2REV.: B DATE: 95349				
TEM NO.	PART NUMBER DESCRIPTION			
1	60-1618-022	KNOB ASSY		
2	60-1615-038	SPUR GEAR		
3	236-4006-12	SPRING PIN		
4	60-1614-116	COMBINATION GEAR & BEARING ASSY		
5	69–1613–150	SIDE SPRING		
6	60-1614-072	CASSETTE ASSY (INCLUDES ITEM 5)		
7	201-1222-00	SPOOL BEARING		
8	60-1615-011	1615–011 INTERNAL GEAR		
9	60-1614-115	ROLLER SPOOL ASSY		
10	60-1615-012	D12 SPUR GEAR		
11	236-4106-08	ROLL PIN		
12	60-1613-147	CASSETTE CATCH		
13	60-1614-111	TACHOMETER DISK ASSY		
14	319-0003-84	IC OPB840W11		
15	402-0262-92	XSTR 2N6292		
16	60–1613–287	DRIP SHIELD		
17	REMOVED			
18	REMOVED			
19	69-2133-572	MOTOR		
20	236-4104-06	ROLL PIN		
21	60-1613-274	0-1613-274 MOTOR DRIVE GEAR		
22	60-1614-112 MOTOR & GEAR ASSY (INCLUDES ITEMS 19, 20 & 21)			
23	60-1617-017	1/8" ID SILASTIC TUBING 20' LONG (NOT SHOWN)		
24	60-1617-025	1/8" ID VITON TUBING 10' LONG (NOT SHOWN)		
25	60-1617-018	1/16" ID SILASTIC TUBING 20' LONG (NOT SHOWN)		
26	60-1613-112	TUBING CONNECTOR (NOT SHOWN)		
27	60-0923-015 CONNECTOR (NOT SHOWN)			
28	60-0083-163	FERRULE (NOT SHOWN)		
29	60-0923-017	FERRULE (NOT SHOWN)		
30	60-1614-119	117V TRANSFORMER ASSY (NOT SHOWN)		
30	60-1614-121	234V TRANSFORMER ASSY (NOT SHOWN)		
30	60-1614-120	100V TRANSFORMER ASSY (NOT SHOWN)		
31	60-1617-028	.065" ID VITON TUBING 5' LONG (NOT SHOWN)		
32	209-0162-12	BARBED UNION (NOT SHOWN)		
		prices and quotations on parts, contact Isco Service Department, (800) 228—4250 subject to change without notice.		



T NUMBER 5429-00 5005-00 7560-00 0320-00 0004-00 -1105-00 -1600-11	CIRCUIT BOAR REFERENCE DESIGNATION C107 C109 C110 C104 DS101	DESCRIPTION CAP 2900uF 30VDC CAP 1.0uF 20VDC CAP 6.8uF 35VDC CAP 2000pF 160VDC
5005-00 7560-00 0320-00 0004-00 -1105-00	C109 C110 C104	CAP 1.0uF 20VDC CAP 6.8uF 35VDC
7560-00 0320-00 0004-00 -1105-00	C110 C104	CAP 6.8uF 35VDC
0320-00 0004-00 -1105-00	C104	
0004-00 -1105-00		CAP 2000pF 160VDC
-1105-00	DS101	
		LED MV5753 RED
-1600–11	U101	IC 4040B
	U103	IC LM2917N
-0020-00	U102	IC LM324
-3012-00	К101	RLY DPDT 12V
-4015-40	R130 R131	RES 150 5W 10%
615-041	R132	POT MOD 5K 2W 10%
-0914-00	CR101 CR102 CR113	DIO 1N914
-1127-00	CR109	DIO 1N273
0150-00	CR103 CR104 CR105 CR106 CR107	DIO 1N5060
	CR108 CR110 CR111 CR112 CR114 CR115	
-0237-00	Q101 Q103	XSTR 2N3702
-0237-01	Q102 Q106	XSTR 2N3704
-0237-02	Q105	XSTR 2N3707
-0261-00	Q104	XSTR 2N6107
3303-00	S103	SW SLIDE DPDT
3904-03	S101	SW SLIDE DPTT
3904-11	S102	SW SLIDE DPTT
0322-56	F101	FUSE 1.5A FB
9018-08	J103	SKT 8 PIN DIN
1001-01	J102	SKT 3 PIN
10		U1-U1 J1U2

NOTICE

Disregard the following "CE Declaration of Conformity" if your instrument does not have a CE label on its rear panel.

DECLARATION OF CONFORMITY



Application of Council Directive: 89/336/EEC – The EMC Directive 73/23/EEC – The Low Voltage Dir Manufacturer's Name: Teledyne Isco, Inc. Manufacturer's Address: 4700 Superior, Lincoln, Nebraska

Equipment Type/Environment: Trade Name/Model No: Year of Issue: Standards to which Conformity is Declared: 73/23/EEC – The EMC Directive
73/23/EEC – The Low Voltage Directive
Teledyne Isco, Inc.
4700 Superior, Lincoln, Nebraska 68504 USA
Mailing Address: P.O. Box 82531, Lincoln, NE 68501
Laboratory Equipment for Light Industrial/Commercial Environments
Tris Pump/Tris
2000
EN 61326-1998 EMC Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use
EN 61010-1 Safety Requirements for Electrical Equipment for Measurement,

Control, and Laboratory Use

Standard	Description	Severity Applied	Performance Criteria
EN61000-4-2	Electrostatic Discharge	Level 2 - 4kV contact discharge Level 3 - 8kV air discharge	B B
EN61000-4-3	Radiated RF Immunity	80 MHz to 1000MHz 80% AM at 1kHz Level 1 - 1 V/m	A
EN61000-4-4	Electrical Fast Transient	Level 2 - 1kV on ac lines	В
EN61000-4-5	Surge on AC Lines	1kV common mode, 500V differential mode	В
EN61000-4-6	Conducted RF	150 kHz to 80 MHz, 1V rms, 80% modulated	В
EN61000-4-11	Voltage Dips/Short Interruptions	0.5 cycle, each polarity/100%	В
CISPR11/ EN 55011	RF Emissions	Group 1, Class A Industrial, Scientific, and Medical Equipment	
EN61000-3-2, 3-3	Harmonic Flicker	Group 1, Class A	

We, the undersigned, hereby declare that the design of the equipment specified above conforms to the above Directive(s) and Standards as of June 20, 2000.

Velliand

William Foster USA Representative



TELEDYNE ISCO A Teledyne Technologies Company

William Foster Director of Engineering Teledyne Isco, Inc. 4700 Superior Street Lincoln, Nebraska 68504

Phone: (402) 464-0231 Fax: (402) 464-4543

> 60-1612-092 Rev D

Teledyne Isco One Year Limited Factory Service Warranty *

Teledyne Isco warrants covered products against failure due to faulty parts or workmanship for a period of one year (365 days) from their shipping date, or from the date of installation by an authorized Teledyne Isco Service Engineer, as may be appropriate.

During the warranty period, repairs, replacements, and labor shall be provided at no charge. Teledyne Isco's liability is strictly limited to repair and/or replacement, at Teledyne Isco's sole discretion.

Failure of expendable items (e.g., charts, ribbon, tubing, lamps, glassware, seals and filters), or from normal wear, accident, misuse, corrosion, or lack of proper maintenance, is not covered. Teledyne Isco assumes no liability for any consequential damages. Teledyne Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose.

This warranty applies only to products sold under the Teledyne Isco trademark and is made in lieu of any other warranty, written or expressed.

No items may be returned for warranty service without a return authorization number issued from Teledyne Isco.

This warranty does not apply to the following products: Process Analyzers, SFX 3560 SFE Extractor, 6100 VOC Sampler.

The warrantor is Teledyne Isco, Inc. 4700 Superior, Lincoln, NE 68504, U.S.A.

* This warranty applies to the USA and countries where Teledyne Isco Inc. does not have an authorized dealer. Customers in countries outside the USA, where Teledyne Isco has an authorized dealer, should contact their Teledyne Isco dealer for warranty service.

In the event of instrument problems, always contact the Teledyne Isco Service Department, as problems can often be diagnosed and corrected without requiring an on-site visit. In the U.S.A., contact Teledyne Isco Service at the numbers listed below. International customers should contact their local Teledyne Isco agent or Teledyne Isco International Customer Service.

Return Authorization

A return authorization number must be issued prior to shipping. Following authorization, Teledyne Isco will pay for surface transportation (excluding packing/crating) both ways for 30 days from the beginning of the warranty period. After 30 days, expense for warranty shipments will be the responsibility of the customer.

Shipping Address:	Teledyne Isco, Inc Attention Repair Service 4700 Superior Street Lincoln NE 68504 USA		
Mailing address:	Teledyne Isco, Inc. PO Box 82531 Lincoln NE 68501 USA		
Phone:	Repair service: (800)775-2965 (lab instruments) (800)228-4373 (samplers & flow meters)		
	Sales & General Information (800)228-4373 (USA & Canada)		
Fax:	(402) 465-3001		
Email:	service@isco.com Web site: www.isco.com		

