KrosFlo® RESEARCH I PERISTALTIC PUMP

KrosFlo® Research I Peristaltic Pump

Product Information and Operating Instructions

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ISO 9001:2008 CERTIFIED

Spectrum's KrosFlo® Research I Peristaltic Pump meets strict quality control standards and is warranted against defects in material and workmanship for a period of two (2) years from date of shipment.

The information contained herein is believed to be accurate and is offered in good faith for the convenience of the user. PRODUCTS ARE FURNISHED UPON THE CONDITION THAT THE USER ASSUMES ALL RISKS AND LIABILITIES AND THAT NEITHER THE SELLER NOR MANUFACTURER SHALL BE LIABLE FOR ANY LOSS OR DAMAGE, DIRECT OR CONSEQUENTIAL, ARISING FROM THE USE OF THESE PRODUCTS.

REV CONTROL:

REV	DCO	Description	By	Check	Approved	Date

SAFETY PRECAUTIONS

DANGER: Remove power from the pump before any cleaning operation is started.

WARNING: Remove power from the pump before attempting any maintenance.

WARNINGS: Tubing breakage may result in fluid being sprayed from pump. Use appropriate measures to protect operator and equipment.

Turn Pump System off before removing or installing tubing. Fingers or loose clothing could get caught in drive mechanism.

CAUTIONS: When changing flow direction, allow the pump to come to a complete stop before starting again. Failure to do so could cause permanent damage to the motor.

Replace the fuse only with one of the same type and rating. The fuse rating and type are stated on the rear panel.

CAUTION: To avoid electrical shock, the power cord protective grounding conductor must be connected to ground. Not for operation in wet locations as defined by EN61010-1.

If the product is not used in a manner specified in the instructions, the protection provided by the equipment may be impaired.

This product is not designed for, nor intended for use in patient connected applications; including, but not limited to, medical and dental use, and accordingly has not been submitted for FDA approval.

Explanation of Symbols

CAUTION: Risk of Danger. Consult Operator's manual for nature of hazard and corrective actions.

CAUTION: Risk of crushing. Keep fingers away from rotor while pump is in operation. Stop pump before loading or unloading tubing.

CAUTION: Hot Surface. Do not touch.

CAUTION: Risk of electric shock. Consult Operator's manual for nature of hazard and corrective actions.

WARNING: Product Use Limitation

This product is not designed for, nor intended for use in hazardous duty areas as defined by ATEX or the NEC (National Electrical Code); including, but not limited to use with flammable liquids.

SAFETY

1. Read instructions before operating the unit.
2. Observe safety precautions at all times, especially when pumping dangerous liquids.
3. If the pump runs unusually noisy or if bunching of the tubing in the pump can be observed, make sure the tubing is clamped down tightly and/or replace it with a new piece of tubing.
4. This pump must be well-grounded at all times.
5. This pump is equipped with a current-limiting circuit that will shut the motor down if any of the following conditions exist:
   a. Tubing that is too hard is loaded in the pump.
   b. Incorrect tubing size or wall thickness is loaded in the pump.
   c. Tubing is improperly loaded into the Pump Head.
6. The unit is fused and grounded to protect the operator in the event of short circuits that could be caused by liquid entering the case.

CAUTION: Replace the fuse only with one of the same type and rating. The fuse rating and type are stated on the rear panel.

7. This pump should not be used in outdoor or hazardous locations.

Table of Contents

1. Introduction

1.1 General Description

The Pump Drives control the speed of the Pump Heads to provide flow rates from 0.06 to 2300 mL/min.

The 600 rpm KR1 can mount up to two (2) pump heads.

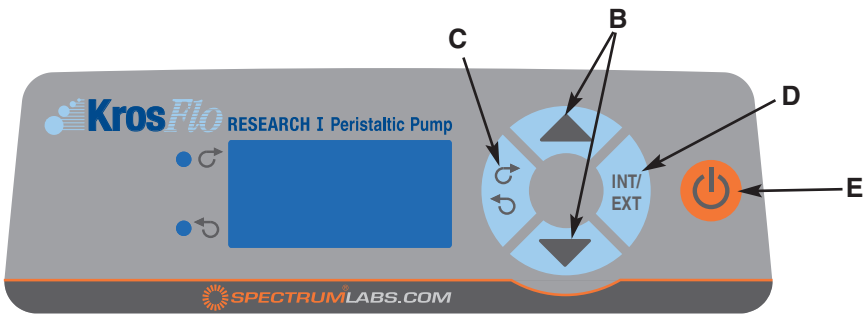
The 100 rpm KR1 can mount up to four (4) pump heads.

1.2 Application Solutions

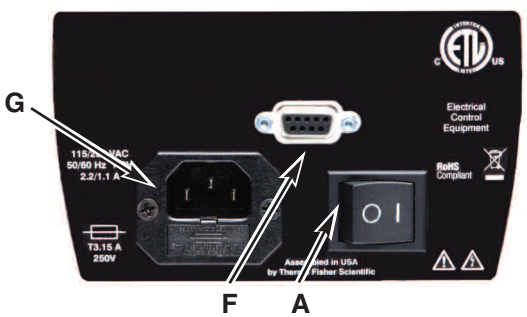
Advantages of Peristaltic Pumps:

- Handle abrasive slurries and corrosive fluids with minimal wear. Ideal for titanium dioxide or diatomaceous earth filter aid applications.
- Low maintenance; seal less and valveless design
- Valve less design prevents clogging.
- Inner surfaces are smooth and easy to clean.
- Contamination free; fluid contacts only the tubing or tube material.
- Suction lift and priming up to 8.8 m water column at sea level.
- Low shearing for handling the most shear sensitive of fluids such as latex or fire fighting foam.
- Capable of running dry and pumping fluids with high quantities of entrained air, such as black liquor soap.
- High volumetric efficiency allows operation in metering or dosing applications where high accuracy is required.
- Handles extremely viscous fluids.
- Availability of tubing and tube materials that are suitable for food and pharmaceutical use.

1.3 Controls, Indicators and Connector



Front Panel



Rear Panel

Controls, Indicators and Connectors

A. POWER (ON/OFF) SWITCH: Turns the unit ON or OFF.

B. SPEED KEYS: Sets the speed of the pump. The higher the number, the faster the speed of the pump. When the speed key is depressed the smallest speed units change first followed by an increasing rate of change.

C. FLOW DIRECTION KEY: Sets the direction of pump rotation Clockwise/Counterclockwise. An LED annunciator indicates the active direction. The motor is brought to a controlled stop before reversing direction.

D. INTERNAL/EXTERNAL KEY: Changes the drive operation mode. Internal (Local) operation from the front panel keypad is designated by INT, external (Remote) operation is designated by EXT. In INT mode, START/STOP, FLOW DIRECTION, and SPEED keys on the front panel determine operating state. Depression and release of keys enables toggling between the two operating states.

E. START/STOP KEY: Press once to start the pump and again to stop the pump. If the pump is in EXT mode then pressing this won't start the pump but if the pump is already running pressing this will still stop it.

F. EXTERNAL/REMOTE CONNECTOR: Utilized to connect wiring for remote control operation with a DB9 connector.

G. IEC Power Entry Module/Line Cord: Utilized to connect line cord to drive.

2. Installation and Setup

2.1 Before Starting Drive

- The drive should be placed on a flat horizontal surface. Up to a maximum of two (2) Pump Heads can be added for 600 rpm drives or four (4) Pump Heads for 100 rpm drives.
- The ambient air temperature should not exceed 104° F (40° C) and adequate air flow should be provided.
- The drives are provided with a grounded plug. If used in a GFCI protected circuit, nuisance tripping may occur.
- Tubing should be clean and arranged so that it is not kinked

WARNING:  Turn drive off before removing or installing tubing. Fingers or loose clothing could get caught in drive mechanism.

- Use a tube size of appropriate diameter for the flow rate and viscosity required.
- For Pump Head (Part # ACR2-H3S-01N) information, see Pump Head datasheets within this CD.
- Before cleaning or conducting maintenance on unit remove power from the drive.

DANGER:  High voltages exist and are accessible. Use extreme caution when servicing internal components.

2.2 Mounting the Pump Head

Mount Pump Head (Part # ACR2-H3S-01N) and load tubing (See Pump Head information within this CD). Check to make sure that rollers are clean and free of defects.

2.3 Optional Stand Assembly

Assemble stand to bottom of pump drive. See stand assembly instructions included within this CD.

2.4 Turning On the System

a. Plug the power cord into the IEC Connector, located on the rear of the drive. Plug the opposite end of the power cord into an electrical outlet.

b. Turn on the power switch located on the rear of the pump.

c. After the flash screen appears, the home screen will appear on the LCD screen.

CAUTION:  To avoid electrical shock, the power cord protective grounding conductor must be connected to ground. Not for operation in wet locations as defined by EN 61010-1.

WARNINGS:  Tubing breakage may result in fluid being sprayed from pump. Use appropriate measures to protect operator and equipment.

Turn drive off before removing or installing tubing. Fingers or loose clothing may get caught in drive mechanism.

3. Operation

3.1 Inserting Tubing

WARNINGS:  Tubing breakage may result in fluid being sprayed from pump. Use appropriate measures to protect operator and equipment.

CAUTION:  To avoid electrical shock, the power cord protective grounding conductor must be connected to ground. Not for operation in wet locations as defined by EN 61010-1.

If the product is not used in a manner specified in the instructions, the protection provided by the equipment may be impaired.

1. To load tubing, open the pump head by moving the actuator lever counterclockwise (left, if pump head is mounted facing down).

2. Insert a loop of tubing into one open tubing retainer, between the occlusion bed and the rollers and into the other tubing retainer. Position the tubing so that it is firmly centered against the rollers.

3. While holding the tubing ends, move the actuator lever back to the far clockwise (right) position. The pump head will automatically grip the tubing. Tubing sizes L/S® 13, L/S® 14, L/S® 16, L/S® 25, L/S® 17 and L/S® 18 (thin wall) will automatically be stretched by the pump. Approximately 5 pounds of force must be applied to the actuator lever to fully close the pump head and place the lever in its locked position (far right position) or to fully open the pump head (far left position).

NOTE: It is not necessary to have an end of the tubing free to load or unload tubing from the pump head. A length of tubing, attached to other devices, may be loaded into the pump head, without disconnecting the tubing from adjacent devices.

3.2 Removal of Tubing

1. Before unloading tubing from the pump head, first turn off the drive.
2. Open the pump head by moving the actuator lever counterclockwise (left), as described above. This will automatically open the tubing retainers, as well as lift the occlusion bed away from the tubing.
3. Pull the tubing away from the pump head.

NOTE: When pump is not being used, store with actuator lever half way between far left and far right positions.

3.3 Tubing Inspection and Replacement

Tubing should be inspected periodically for tears, cracks, cut marks, abrasions, inability to hold pressure, bubbles in the flow stream and reduction or loss of flow.

Tubing life may be extended by periodically moving the worn tubing inside the occlusion bed of the pump to the outside of the occlusion bed to the suction side of the pump. This will avoid excessive tubing wear at any specific point.

Always move the worn tubing to the suction side of the pump.

3.4 Pump Controls

CAUTION: When changing flow direction, allow the pump to come to a complete stop before starting again. Failure to do so could cause permanent damage to the motor.

1. Make sure the speed is set to the minimum setting.
2. Turn the power switch ON. Increase the speed to start the pump action. The higher the rpm, the faster the speed of the pump.
3. The KR1 Pump Drives are self-priming. To begin pumping, select a flow direction with the flow direction button, insert the intake and output tubing into a reservoir, and turn the unit ON. Prime the tubing for at least 5 minutes. If accurate flow control is important,allow the pump to prime for approximately 20 minutes for more stable flow conditions.
4. When finished press the stop/start key to turn pump off.

3.5 Keypad Lockout

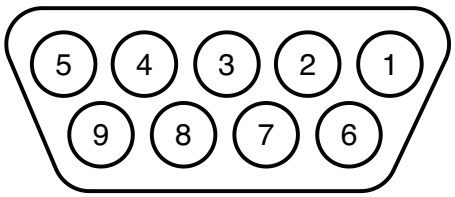
Enable/Disable

Press and hold the INT/EXT key. After five (5) seconds, display will change to all dashes. Release INT/EXT key and press UP ARROW key five (5) times.

3.6 External Operation

Models are equipped with inputs that can be controlled by external signals connected at the rear panel 9-pin “D” shell connector. The External inputs permit control of the pump by remote equipment or accessories. Figure below shows the signal locations of the connector.

DB-9 Connector



Pin No.	Function
1	Speed Control Voltage Input (0-lOV) (+)
2	Speed Control Current Input (4-20 mA) (+)
3	Speed Control Reference (-)
4	CW/CCW Input
5	CW/CCW and START/STOP Reference
6	Tachometer Reference (-)
7	START/STOP Input
8	Tachometer Output (+)
9	Chassis (Earth) Ground

Section 4. Maintenance

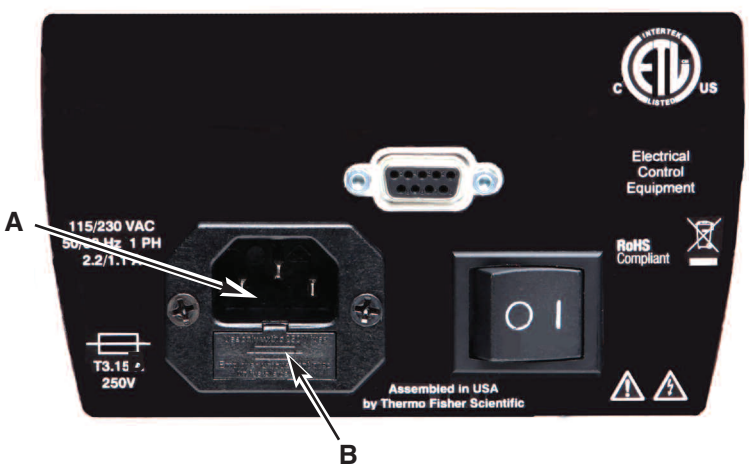
4.1 Cleaning

WARNING: Remove power from the pump before any cleaning operation is started.

Keep the drive enclosure clean with mild detergents. Do not immerse or use excessive fluid when cleaning.

4.2 Fuse Replacement

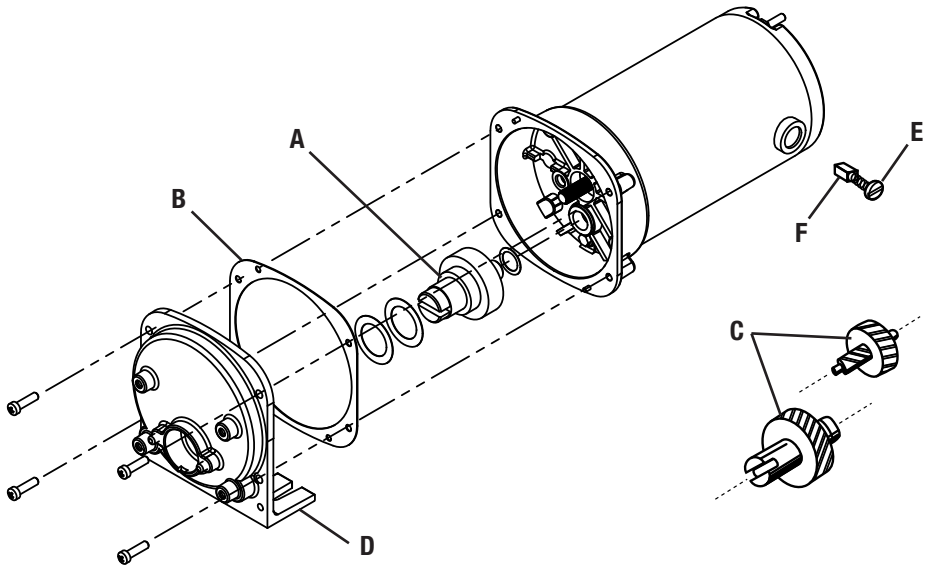
1. Place the power switch in the off position.
2. Disconnect the AC power input line cord from the receptacle.
3. Use a small flat screwdriver to slide open the fuse drawer. Check the fuse and replace if defective.



Fuse Replacement

Item	Description
A	IEC Power Entry Module / Line Cord
B	3.15A (5×20 mm) Fuse – Do Not Substitute

4.3 Motor Gear and Brush Replacement



Item	Description
A	6-600 & 3-300 rpm gear assembly
B	Gasket
C	1-100 rpm gear set
D	Gear Case cover assembly
E	Brush Cap
F	Motor Brush

5. Troubleshooting

Symptom	Remedy
Unit will not turn on	If the unit is plugged into a GFCI protected circuit verify that the circuit has not been tripped or reset the circuit. Verify that the unit is plugged into a functioning outlet. Verify that the power cord is firmly attached to the unit. Verify that the fuse for the incoming voltage is not blown (located in the slot next to the power cord).
	Check the tubing. Tubing should be snug, but not tight, against the rollers. Verify that the mode EXT/INT is set correctly.
Error XX is displayed on the screen	Err's 3 & 10, check pump for obstructions, all other Errs return unit for repair.
Unit will turn on but display would dim and pump will not spin	Verify that the incoming voltage meets the required minimum of 90Vrms.
Unit vibrates excessively when pump is running	Check that the tubing was loaded properly.

6. Specifications

Output:

Speed:

ACR1-U10-01N / ACR1-U1S-01N	1 - 100 rpm
ACR1-U20-01N / ACR1-U2S-01N / SYR1-U20-01N	6 - 600 rpm

Torque, Maximum:

600 rpm models	180 oz-in (13 kg•cm), 540 oz-in Starting
100 rpm models	360 oz-in (26 kg•cm), 1080 oz-in Starting

Input:

Operating Voltage/Frequency:	90-260Vrms, 50/60 Hz, 2.2A @ 115Vrms, 1.1A @ 230 Vrms

External Inputs:

START/STOP, CW/CCW, Remote/Local Speed Control	Contact closure
Voltage input	0–10V DC @ 10 kohm,
Accuracy:	±0.5% Full Scale
Current input	4–20 mA @ 250 ohm,
Accuracy:	±0.5% Full Scale

Environment:

Operating Temperature:	32 to 104°F (0 to 40°C)
Storage Temperature:	-13 to 149°F (-25 to 65°C)
Humidity:	10% to 90% non-condensing
Altitude:	Less than 6562 ft (2000 m)
Pollution Degree:	Pollution degree 2 (indoor use–lab, office)

Construction:

Dimensions - not including stand (L × W × H):	10.5 in × 8 in × 8 in (267 × 203 × 203 mm)
Weight:	6.9 kgs (15.2lbs)
Color:	Light Grey, Orange (5% Black)
Material:	Aluminum, ABS plastic and vinyl
Enclosure Rating:	IP33 per IEC-60529

Compliance:

UL 61010-1 CAN/CSA-C22.2 No. 61010:	This product has been tested to the requirements of CAN/CSA-C22.2 No. 61010-1, second edition, including Amendment 1, or a later version of the same standard incorporating the same level of testing requirements.
For CE Mark:	EN61010-1: (EU Low Voltage Directive) and EN61326: (EU EMC Directive)

6.1 Precision Tubing Specifications

Tubing size	L/S 13	L/S 14	L/S 16	L/S 25	L/S 17	L/S 18
Inside diameter* in. (mm)	0.03 (0.8)	0.06 (1.6)	0.12 (3.1)	0.19 (4.8)	0.25 (6.4)	0.31 (7.9)
Hose barb size* in. (mm)	1/16 (1.6)	1/16 (1.6)	1/8 (3.2)	3/16 (4.8)	1/4 (6.4)	3/8 (9.5)
Flow range with 6 to 600 rpm drive mL/min	0.36 to 36	1.3 to 130	4.8 to 480	10 to 1000	17 to 1700	23 to 2300
Maximum pressure, continuous**	25 psig (1.7 bar)			20 psig (1.4 bar)	15 psig (1.0 bar)	10 psig (0.7 bar)
Maximum pressure, intermittent**	40 psig (2.7 bar)			35 psig (2.4 bar)	20 psig (1.4 bar)	15 psig (1.0 bar)
Maximum vacuum**	26" Hg (660 mm Hg)				20" Hg (510 mm Hg)	
Suction lift	29 ft H_2O (8.8 m H_2O)				22 ft H_2O (6.7 m H_2O)	
Reorder No. / Part No.	ACTU-P13-25N	ACTU-P14-25N	ACTU-P16-25N	ACTU-P25-25N	ACTU-P17-25N	ACTU-P18-25N

* Nominal size.
** Actual performance varies depending on tubing formulation.

6.2 High-Performance Precision Tubing Specifications

(requires optional pump head available separately, ACR2-H4S-01N)

Tubing size	L/S 15	L/S 24	L/S 35	L/S 36
Inside diameter* in. (mm)	0.19 (4.8)	0.25 (6.4)	0.31 (7.9)	0.38 (9.7)
Hose barb size* in. (mm)	3/16 (4.8)	1/4 (6.4)	3/8 (9.5)	3/8 (9.5)
Flow range with 6 to 600 rpm drive	10 to 1000	17 to 1700	23 to 2300	29 to 2900
in mL/min. Values in ( ) obtained with High-Performance pump head	(11 to 1100)	(18 to 1800)	(26 to 2600)	(34 to 3400)
Maximum pressure, continuous**	25 psig (1.7 bar)		20 psig (1.4 bar)	15 psig (1.0 bar)
Maximum pressure, intermittent**	40 psig (2.7 bar)		35 psig (2.4 bar)	20 psig (1.4 bar)
Maximum vacuum**	26" Hg (660 mm Hg)			24" Hg (610 mm Hg)
Suction lift	29 ft H_2O (8.8 m H_2O)			27 ft H_2O (8.3 m H_2O)

* Nominal size.

**Actual performance varies depending on tubing formulation.

7. Ordering Information

KrosFlo® Research I Tangential Flow Filtration System

Part Number	Description
SYR1-U20-01N	
600 RPM Drive	The general purpose pump drive controls the speed of the pump head to provide flow rates between 0.06 to 2300 mL/min.
Pump Head ACR2-H3S-01N	Easy-Load 3 Pump Head for thin walled tubing. For use with #13,14,16,17 and 18 tubing sizes.
Stand Kit ACR1-STND-01N	Includes the bar, post, and hardware for assembly. The stand kit may be used to support modules and/or bottles.
Fitting Kit ACR1-UFP-01N	The KR1 fitting kit includes two module holding trilobites, one bottle holding trilobite, cable ties, cable tie installation tool, adjustable flow control valves, pinch clamps and a fitting assortment with the components necessary to assemble basic flowpaths.
Bottles	Two 3 port conical bottom bottles are included. A 50 mL and a 15 mL.
Tubing	A 25' tubing pack of #14 Pharmapure.
CD	Included are the drive manual, the pump head manual, the stand assembly instructions, and additional information.
ACR1-U2S-01N	
600 RPM Drive	The general purpose pump drive controls the speed of the pump head to provide flow rates between 0.06 to 2300 mL/min.
Pump Head ACR2-H3S-01N	Easy-Load 3 Pump Head for thin walled tubing. For use with #13,14,16,17 and 18 tubing sizes.
Stand Kit ACR1-UFP-01N	Includes the bar, post, and hardware for assembly. The stand kit may be used to support modules and/or bottles.
CD	Included are the drive manual, the pump head manual, the stand assembly instructions, and additional information.
ACR1-U1S-01N	
100 RPM Drive	The general purpose pump drive controls the speed of the pump head to provide flow rates between 0.06 to 480 mL/min.
Pump Head ACR2-H3S-01N	Easy-Load 3 Pump Head for thin walled tubing. For use with #13,14,16,17 and 18 tubing sizes.
Stand Kit ACR1-STND-01N	Includes the bar, post, and hardware for assembly. The stand kit may be used to support modules and/or bottles.
CD	Included are the drive manual, the pump head manual, the stand assembly instructions, and additional information.

KrosFlo® Research I Tangential Flow Filtration System (continued)

Part Number	Description
ACR1-U10-01N	
100 RPM Drive	The general purpose pump drive controls the speed of the pump head to provide flow rates between 0.06 to 480 mL/min.
Pump Head ACR2-H3S-01N	Easy-Load 3 Pump Head for thin walled tubing. For use with #13,14,16,17 and 18 tubing sizes.
CD	Included are the drive manual, the pump head manual, the stand assembly instructions, and additional information.
ACR1-U20-01N	
600 RPM Drive	The general purpose pump drive controls the speed of the pump head to provide flow rates between 0.06 to 2300 mL/min.
Pump Head ACR2-H3S-01N	Easy-Load 3 Pump Head for thin walled tubing. For use with #13,14,16,17 and 18 tubing sizes.
CD	Included are the drive manual, the pump head manual the stand assembly instructions, and additional information.

8. Optional Accessories

Bottles

Part Number	Description
ACBT-015-C1N	15 mL, 3 ports, 1/32” ID x 3/32” OD
ACBT-050-C1N	50 mL, 3 ports, 1/16” ID x 1/8” OD C-Flex
ACBT-250-C1N	250 mL, 3 ports, 1/8”ID x ¼” OD C-Flex
ACBT-500-C1N	500 mL
ACBT-1TC-01N	1 Liter, 4 ports, TC and HB
ACBT-1HB-01N	1 Liter, 4 Ports, HB
ACBT-2TC-01N	2 Liter, 4 ports, TC and HB
ACBT-2HB-01N	2 Liter, 4 ports, HB
ACBT-4TC-01N	4 Liter, 4 ports, TC

Tubing Packs

Extended Life Silicone Tubing

- Provides longer life than other platinum and peroxide cured silicone formulations.
- Exceeds USP Class VI and 3A sanitary standards; meets FDA 21 CFR part 177.2600 and 177.2710

Sizes available:

Part Number	Description
ACTU-E13-25N	Extended Life Silicone Tubing Size 13, 0.03" (0.8mm) ID, 1/16" Hose Barb
ACTU-E14-25N	Extended Life Silicone Tubing Size 14, 0.06" (1.6mm) ID, 1/16" Hose Barb
ACTU-E16-25N	Extended Life Silicone Tubing Size 16, 0.12" (3.1mm) ID, 1/8" Hose Barb
ACTU-E17-25N	Extended Life Silicone Tubing Size 17, 0.25" (6.4mm) ID, 1/4" Hose Barb
ACTU-E18-25N	Extended Life Silicone Tubing Size 18, 0.31" (7.9mm) ID, 3/8" Hose Barb

PharmaPure Tubing

- Nontoxic and nonhemolytic with excellent biocompatibility
- Long pump life
- Low extractables and low gas permeability
- Meets FDA and USP Class VI criteria

Sizes available:

Part Number	Description
ACTU-P13-25N	Pharmapure® Tubing, L/S 13, (1/32" ID), 25 ft/pkg
ACTU-P14-25N	Pharmapure® Tubing, L/S 14, (1/16" ID), 25 ft/pkg
ACTU-P16-25N	Pharmapure® Tubing, L/S 16, (1/8" ID), 25 ft/pkg
ACTU-P25-25N	Pharmapure® Tubing, L/S 25, (3/16" ID), 25 ft/pkg
ACTU-P17-25N	Pharmapure® Tubing, L/S 17, (1/4" ID), 25 ft/pkg
ACTU-P18-25N	Pharmapure® Tubing, L/S 18, (3/8" ID), 25 ft/pkg

NOTE: Contact Spectrum for assistance selecting the appropriate HF Module, Flow-path, Reservoir Bottles and Customized Sterile Flowpaths (MBT's) for your application.

Replacement Parts

Part Number	Description
ACR2-MPL-01N	Pump head mounting plate
ACR1-STND-01N	Stand Kit
ACR1-UFP-01N	Fitting Kit
ACR2-H3S-01N	Standard Pump Head, for use with thin walled tubing,
ACR2-H4S-01N	High Performance Pump Head, for use with thick walled tubing

Larger Pump Systems

Part Number	Description
SYR2-U20-01N	KrosFlo® Research IIi (KRIIi), similar flow rates as the KR1, includes integrated pressure monitoring, compatible with automatic backpressure valves and permeate scales,
SYM3-111-01N	KrosFlo® MiniKros® Plus (KMP), For use in processing volumes from 10 -1000 liters. Includes integrated pressure monitoring (110V)
SYM3-112-01N	KrosFlo® MiniKros® Plus (KMP), For use in processing volumes from 10 -1000 liters. Includes integrated pressure monitoring (220V)

KrosFlo® MBT Sets designed for Process Filtration Systems

Spectrum has expanded the concept of disposability by incorporating irradiated KrosFlo® hollow fiber filter modules into sterile KrosFlo® EZ-Bag Manifolds to provide a totally disposable process filtration flow-path. Quickly and easily installed on a KrosFlo System for R&D or Process Development, the new single-use flow-path provides a revolutionary approach: pre-packaged, disposable and complete! Customized to your specific application, the Module Flow-paths are available in two different bag configurations and your choice of KrosFlo brand hollow fiber modules.

Contact a sales representative for details.

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