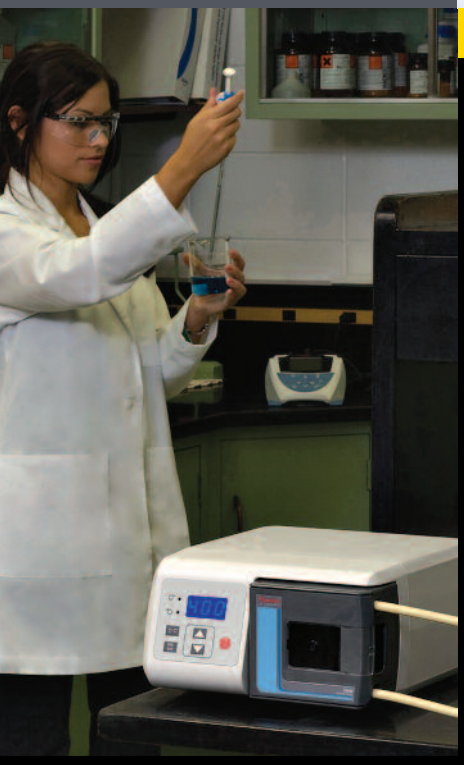
Thermo Scientific
Fluid Handling



Thermo Scientific FH Series
Peristaltic Pump Systems

Thermo SCIENTIFIC

The Thermo Scientific advantage

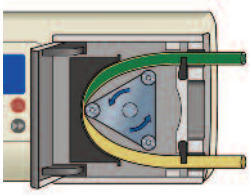
We are a leading manufacturer of peristaltic pump technology and a world-class innovator in fluid handling and flow control. We provide accurate, dependable tubing and hose pump solutions throughout the world. Our five decades of experience has culminated in the development of the FH Series pump systems. These highly durable, accurate pumps have proven ideal for a wide variety of fluid handling applications—from laboratory and research to plant and production floor.

The Thermo Scientific FH family of digital peristaltic pump systems offers superior performance with the precision and ease-of-use that's long been the hallmark of the Thermo Scientific fluid handling product range. Designed to handle a wide range of fluids, from the highest purity to extremely caustic solutions, FH Series pumps are used in a broad range of critical applications—from agriculture to chemical processing; and from beverage dispensing to semiconductor polishing.

Peristaltic Pump Advantages

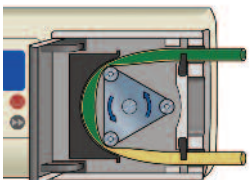
- Contamination free pumping—fluid contacts only the tubing or hose material
- High volumetric efficiency allows operation in metering or dosing applications where high accuracy is required
- Elimination of check valves prevents parts replacement and downtime
- Programmable, easy-to-use, low maintenance units
- Capable of running dry and pumping fluids with high quantities of entrained air, such as black liquor soap, sodium hypochlorite, or hydrogen peroxide
- Smooth inner tubing surfaces are easy to clean and prevent particle entrapment
- Tubing materials are available and approved to global pharmaceutical, sanitary and food standards (USP, EP, FDA and NSF)
- Elimination of priming requirements provides suction lift and self-priming capabilities up to 8 m WC (26 ft H20)
- Handles fluids ranging from glycerin to molasses, latex to cell suspensions, and from slurries to corrosive fluids

Principle of Operation



1

A pump head consists of only two parts: the rotor and the housing. The tubing is placed in the tubing bed—between the rotor and housing—where it is occluded (squeezed).



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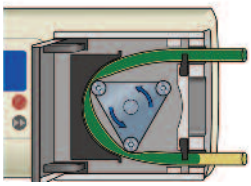
The rollers on the rotor move across the tubing, pushing the fluid. Tubing behind the rollers recovers its shape, creating a vacuum and drawing in fluid behind it.



3

A "pillow" of fluid is formed between the rollers. This is specific to the ID of the tubing and the geometry of the rotor. Flow rate is determined by multiplying speed by the size of the pillow. This pillow stays fairly constant except with extremely viscous fluids.

The FH Series Benefits

The Thermo Scientific FH series of pumps provides a wide selection of models to meet many applications of fluid handling from lab to process. Some of these benefits include:

- A unique rapid load pump head that allows fast tube loading and minimizes downtime
- Safety interlock powers down unit when changing tubing
- Robust design assures years of reliable service
- Integrated pump and drive systems are provided fully assembled reducing set-up time
- Compact housings conserve valuable space whether in the lab or process floor
- Intuitive controls and a simple menu available in seven languages (on FH100D and FH100M models)
- Integration with plant control systems allows automation of the fluid handling process
- Complies with stringent safety standards of UL, ETL, CE, C1 and with RoHS and WEEE directives

Markets/Applications

Ideal for a wide variety of life science and industrial applications:

- Sample prep
- General, media and reagent dispensing
- Filling
- Buffer recirculation
- Chromatography
- Fermenter recirculation
- Stem cell research
- Bio-reactor feed and chemistry control
- Cell Culture
- Cell Harvesting
- Spectroscopy
- Lab analyzers
- Reagent metering applications
- Chemical feed
- Filtration
- Tangential-flow or cross flow filtration
- Biopharmaceuticals
- Agrochemicals
- Oil analysis
- Sampling
- Pilot to process scale-up

Quality design in a compact package

Thermo Scientific FH10, FH15, and FH30 pumps offer enhanced and versatile performance in an ultra-compact, low-maintenance design. These highly innovative peristaltic pumps are ideal for meeting a wide range of fluid handling needs and provide long-term, reliable service.

These units are provided as complete pumping systems, consisting of a pump, motor, and control in a stackable steel housing. With standard flow ranges from 0.002 mL/min to 105 mL/min and pressures to 2.5 bars, these instrument quality peristaltic pumps provide an ideal, cost-effective alternative to syringe pumps. A robust, fixed occlusion design allows for reliable, accurate pumping and dispensing with a wide variety of tubing materials and varying differential pressure applications.

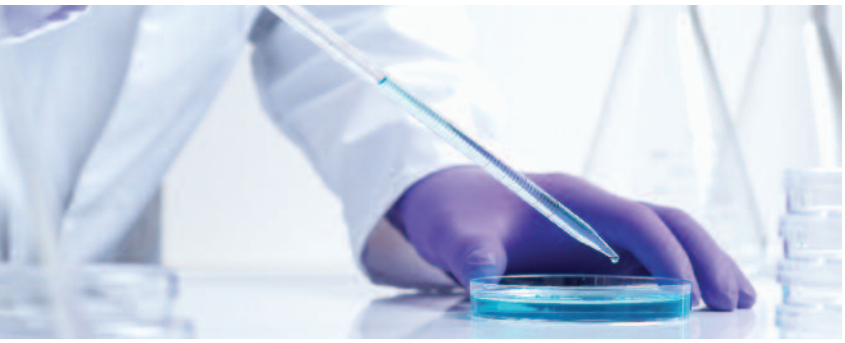
FH10, FH15 and FH30 Pumps
Product Benefits and Features

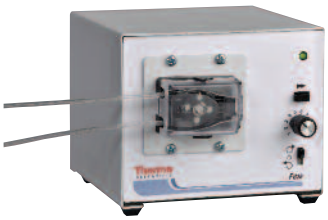
Easy to maintain
- Simple, fast tubing changes
- Fixed occlusion eliminates adjustment after tubing changes and assures operation against pressure up to 30 PSIG

Easy to use
- Contamination free pumping—fluid contacts only the tubing material
- Controls are mounted on front panel with a separate single-turn speed control
- Flow direction switch with center "OFF" position
- Green LED power "ON" indicator
- "Prime" button runs pump at maximum speed to rapidly prime or flush tubing
- Reversible pump direction permits purging of tubing prior to use

Diverse performance range
- Flow rates less than 2 µl/min to 105 ml/min
- Pressure up to 2.5 bar (30 PSIG)
- Accurate and repeatable flow delivery
- Filtration, up to 60 PSIG
- Address a wide range of critical applications with tubing materials that are approved to USP class VI, FDA and NSF standards
- Accommodates all sizes and formulations of microbore flow rated tubing

Ergonomic design
- Space efficient—low profile, stackable design
- Remote capability—actuate unit with a foot switch or contact closure





FH10

FH15

FH30

Specifications and Ordering Information

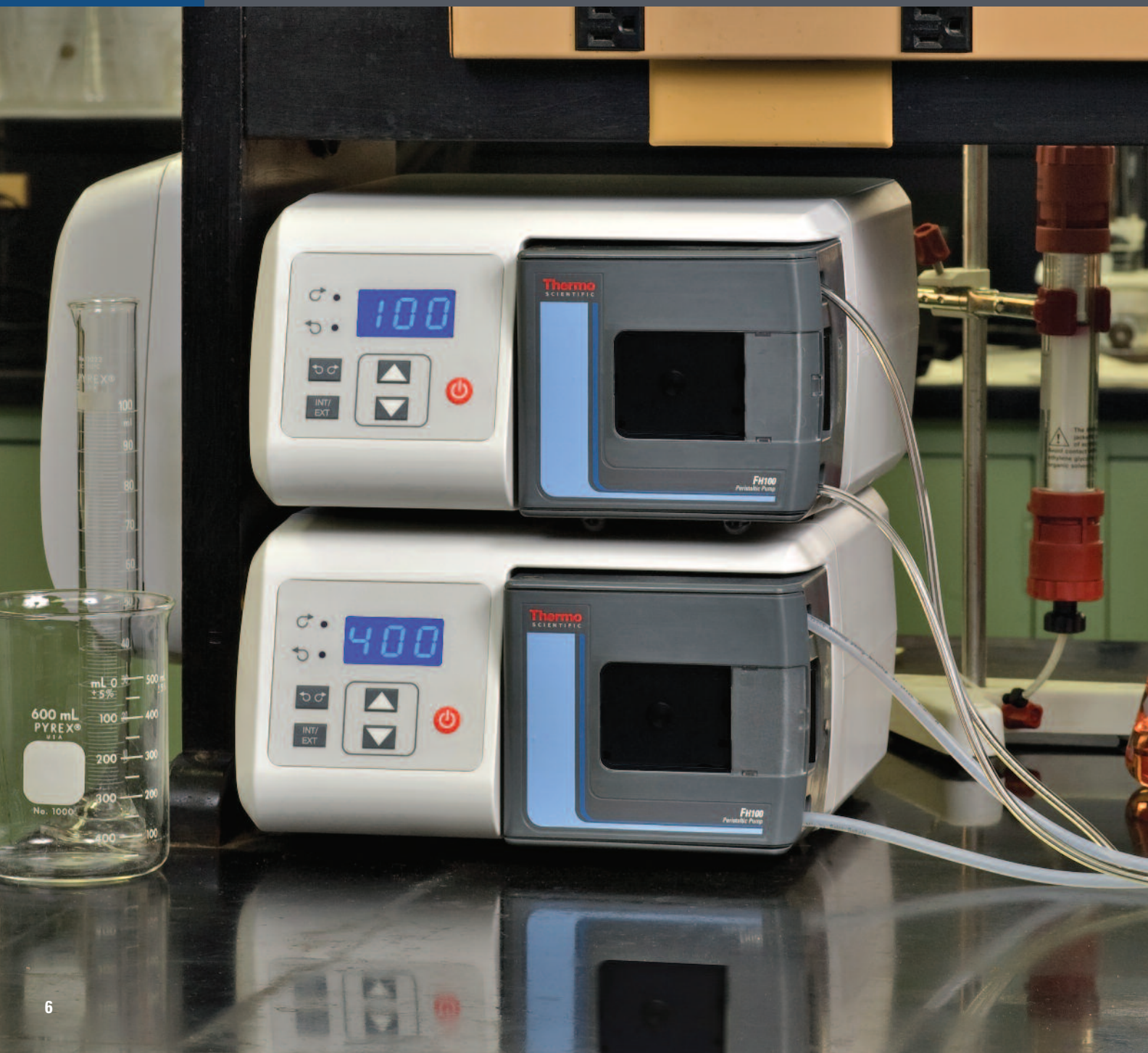
	FH10		FH15		FH30
Catalog number	**72-310-010**	**72-310-080**	**72-310-300**	**72-315-100**	**72-330-100**
PERFORMANCE					
Number of channels	1	1	1	1	2
Flow Capacity (mL/min)	0.002 to 1.65	0.017 to 11	0.07 to 50	0.8 to 105	0.8 to 14
RPM	1.2 to 10	13 to 80	50 to 300	20 to 100	20 to 100
ELECTRICAL					
Voltage (50/60 Hz)	90-130 or 160-260V AC (auto selected)				
Motor type	PMDC				
Control type	PWM (Pulse Width Modulated)				
PHYSICAL SPECIFICATIONS					
Operating temperature	0 to 40°C (32 to 104°F)				
Storage temperature	–25 to 65°C (–13 to 149°F)				
Housing materials	Powder-coated steel				
IP rating	IP22				
Agency approvals	UL, cUL, CE, ROHS Power Supply				
Controller dimensions (L x W x H)	7.0 x 5.25 x 4.5 (17.8 x 13.4 x 11.4 cm)				
Shipping weight	3.3 lbs. (1.5 kg)				

See page 13 for flow performance and tubing selection

Precision metering, worry free performance

Thermo Scientific FH100 and FH100X peristaltic pumps are ideal general purpose tubing pumps for high-repeatability, precision metering, and worry free performance in a variety of life science, industrial and process applications. The broad flow range capability of these units make them ideal for laboratory to pilot process scale-up requirements.

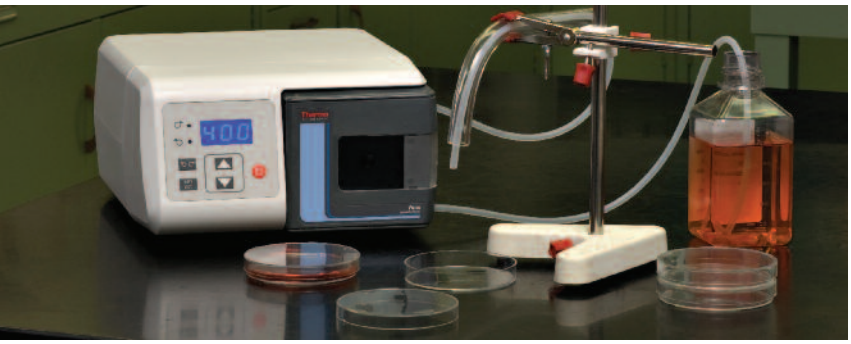
With the FH100 and FH100X units, our highly regarded peristaltic pump technology is combined with innovative digital control to provide robust performance at an economical value. These units offer a reliable alternative to lab piston metering pumps, gear pumps and small circulating pumps used in life science laboratory applications. These stackable, variable speed pumps are self priming, able to operate dry, and contain no valves or seals eliminating replacement needs. Fluid contacts only the tubing, providing for contamination-free pumping in high-purity applications.



FH100 and FH100X Pumps
Product Benefits and Features

Easy to maintain
- New loading pump head enables rapid tubing changes
- Robust motor and drive system provides low-maintenance long-term operation
- Contamination free pumping—the fluid contacts only the tubing material

Easy to use
- Intuitive control keypad
- Stop and start from the front panel
- Easily increase/decrease flow through the membrane key-pad
- Universal voltage and frequency capability allows operation world-wide—IEC320 socket provided
- Reversible pump direction permits purging of tubing prior to use
- Quick start guide included for fast easy set-up



Diverse performance range
- Utilizes various tubing sizes to provide a broad flow range
- Ability to pump against pressure up to 60 PSIG providing longer filtration cycles

Ergonomic design
- Space efficient—low-profile, stackable design
- Safety interlocks powers unit down when changing tubing
- Remote control capability—ideal for automated process applications
- Accurate, reliable control of flow and dosing-digital display of RPM for accurate control

FH 100

FH 100X

Specifications & Ordering Information

	FH100 (thin wall)	FH100X (thick wall)
Catalog number	**72-320-000**	**72-320-100**
PERFORMANCE		
Flow Capacity (mL/min)	0.5 to 3,000	14 to 4,000
RPM	4 to 400	
Reversible	Yes	
External Control - Input	4-20 mA; 0–10V; Remote/Local; Dir (CW/CCW); Start/Stop	
Pump Open Lockout or door Sensor	Yes	
ELECTRICAL		
Voltage (AC) 60/50 (Hz)	90 to 130V AC or 200 to 260V AC; Single phase, auto-selected	
Current	1.6 A @ 115V; 1.9A @ 230V	
Motor Type	PMDC	
Motor Size	1/10 (75w)	
Phase Control	Phased Controlled	
Display (rpm)	Seven-segment, 3-digit, Blue LED, 1 RPM resolution	
Speed regulation (accuracy)	± 0.25%	
PHYSICAL SPECIFICATIONS		
Housing and pump head construction	Housing: ABS; Pump head: GF Nylon, Delrin®, Stainless steel, Cold-rolled steel, Buna N, Polycarbonate	
IP rating	IP31	
Agency approvals	ETL, cETL, CE, RoHS	
Storage temperature	–25 to 65°C (–13 to 149°F)	
Operating temperature	0C to 40C	
Dimensions (L x W X H)	31.7 x 27.9 x 15.2 (cm) 12.5 x 11 x 6 (in)	
Shipping Weight	7 (kgs) 15 lbs	

See page 14 and15 for flow performance and tubing selection.

Pump, dispense and fill—all with one unit

Thermo Scientific FH100D and FH100DX peristaltic pumps are specifically designed for critical metering and dispensing applications—you can pump, dispense and fill—all with one unit.

FH100D and FH100DX peristaltic pumps are simple to set-up as dosing pumps, or dispensing systems by volume, time, or copy mode with a timed interval. The pump is also reversible, allowing for purging of transfer lines or emptying containers. The innovative FH100D and FH100DX systems provide a number of important advantages for users, including single-channel variable flow from 0.5 mL/min to 3000 mL/min at a variable speed range of 4-400 rpm. The unit's powerful motor provides better than 0.25% percent speed control accuracy and repeatability as well as remote control operation.

FH100D and FH100DX Dispenser Pumps
Product Benefits and Features

Easy to maintain

- New rapid loading pump head allows tubing change in less than 30 seconds
- Robust motor and drive system provides low-maintenance long-term operation
- Contamination free pumping—the fluid contacts only the tubing material

Easy to use

- Programmable in seven languages—provides easy set-up in almost any global location
- Universal voltage and frequency capability allows operation world-wide—IEC320 socket provided
- Reversible pump direction permits purging of tubing prior to use
- Quick start guide included for fast, easy set-up

Diverse performance range

- Control capabilities include programmable dispensing by volume, time, or copy modes with a programmable delay between cycles for convenient, automated dispensing
- Each pump utilizes various tubing sizes providing a broad flow range
- Able to pump against pressure up to 60 PSIG providing longer filtration cycles

Ergonomic design

- Optimizes system accuracy by calibrating the pump system in process—the calibration is stored in memory—one calibration value per tubing size
- Safety interlock powers down unit when changing tubing
- Broad range of remote control options—ideal for automated process applications
- Space efficient—low-profile, stackable design
- Accurate, reliable control of flow and dosing—digital display of RPM for accurate control

FH 100D

FH 100DX

Specifications & Ordering Information

	FH100D (thin wall)	FH100DX (thick wall)
Catalog number	**72-320-200**	**72-320-250**
PERFORMANCE		
Flow Capacity (mL/min)	0.5 to 3000	14 to 4000
RPM	4 to 400	
Reversible	Yes	
Pump open door sensor	Yes	
ELECTRICAL		
External control – input	0 to 20 mA, 4 to 20 mA, or 0 to 10V; Scalable	
	START/STOP, DIR. (CW/CC), PRIME via contact closure	
	Remote / Local Indication	
External control – output	4 to 20 mA, or 0 to 10V	
Motor running logic	N.O. or N.C. (1A @ 24V)	
Tachometer output	5V, TTL pulse	
Voltage (50/60 Hz)	115/230V AC (auto selected)	
Motor type	1/10 HP, (75 w) PMDC	
Control type	Phase-Controlled	
Speed resolution (repeatability)	±0.1 rpm @ 4 to 400 RPM	
Speed regulation	±0.25% (full scale)	
PHYSICAL SPECIFICATIONS		
Operating temperature	0 to 40°C (32 to 104°F)	
Storage temperature	–25 to 65°C (–13 to 149°F)	
Housing materials	Housing: ABS; Pump head: GF Nylon, Delrin®, Stainless steel, Cold-rolled steel, Buna N, Polycarbonate	
IP rating	IP31	
Agency approvals	ETL, cETL, CE, ROHS	
Controller dimensions (L × W × H)	31.7 x 27.9 x 15.2 (cm) 12.5 x 11 x 6 (in)	
Shipping weight	7 (kgs) 15 lbs	

See page 14 and15 for flow performance and tubing selection.

Accurate multichannel pumping

Thermo Scientific FH100M Series peristaltic pumps provide multichannel pumping with the accuracy of flow control and broad flow range to efficiently service most pumping applications, including bioassays, electrophoresis, chromatography, and pH control.

With flow ranges from 1.2 microliters per minute to 760 mL/min and three modes of operation: flow, timed flow and programmable cycle dispensing—FH100M Series multichannel pumps can save considerable time and resources while greatly improving process efficiency.

Featuring remote control of speed, pumping direction, and start/stop/purge, FH100M pumps are available with a wide range of interchangeable multichannel pump heads, drives, and tubing and can deliver up to 12 channels simultaneously. A configured FH100M pump system consists of a pump head, drive, and a full set of cassettes.

FH100M Multichannel Pumps
Product Benefits and Features

Easy to maintain

- Cassette design provides fast tubing changes, and eliminates hardware in other multi-channel designs
- Rugged motor and controls ensure long-term reliable operation
- Contamination free pumping—the fluid contacts only the tubing material

Easy to use

- Programmable in seven languages—provides easy set-up in almost any global location
- Universal voltage and frequency capability allows operation world-wide—IEC320 socket provided
- Quick start guide included for fast, easy set-up

Diverse performance range

- Three modes of operation—Flow, Timed Flow and Programmable Cycle Dispensing
- Lower pulsation flow and higher accuracy at low volumes and low flow rates
- High repeatability on all channels
- Cassettes provide defined and repeatable occlusion conditions
- Available in 4, 8, or 12 channel models (2, 4, and 6 channels when using the large cassettes)
- Capable of accurate, metered, parallel flows with difficult or multiphase fluids

Ergonomic design

- Digital display of pump speed or percent of maximum speed or number of dispense cycles
- Adjustable occlusion setting provides flow and pressure performance, and optimizes tubing life
- Valveless replacement alternative to diaphragm and piston pumps

FH 100M

Specifications & Ordering Information

	All FH100M Series Pumps					
Catalog Number	**72-320-046**	**72-320-048**	**72-320-083**	**72-320-084**	**72-320-126**	**72-320-128**
Model Description	FH100M 4/6	FH100M 4/8	FH100M 8/3	FH100M 8/4	FH100M 12/6	FH100M 12/8
Max Number of Channels	4	4	8	8	12	12
Number of Rollers	6	8	3	4	6	8
Cartridges Included:						
Small	–	4	–	8	–	12
Large	2	–	4	–	6	–
PERFORMANCE						
Flow Capacity (mL/min)	0.21 to 360	0.013 to 67.0	0.22 to 760	0.02 to 100	0.002 to 14.0	0.033 to 128.0
RPM	2 to 530				0.8 to 80	
Reversible	Yes					
ELECTRICAL						
External control – input	0 to 20 mA, 4 to 20 mA, or 0 to 10V; Scalable					
	START/STOP, DIR. (CW/CC), PRIME via contact closure					
	Remote / Local Indication					
External control – output	4 to 20 mA, or 0 to 10 V					
Motor running logic	N.O. or N.C. (1A @ 24V)					
Tachometer output	5V, TTL pulse					
Voltage (50/60 Hz)	115/230V AC (auto selected)					
Motor type	1/10 HP, (75 w) PMDC					
Control type	Phase-Controlled					
Speed resolution (repeatability)	±0.1 rpm @ 4 to 400 RPM					
Speed regulation	±0.25% (full scale)					
PHYSICAL SPECIFICATIONS						
Operating temperature	0 to 40°C (32 to 104°F)					
Storage temperature	–25 to 65°C (–13 to 149°F)					
Housing materials	Housing: ABS; Pump head: Polysulfone, Stainless steel, Anodized aluminum, Rulon, Buna-N; Cartridge: Polycarbonate, GF Nylon, Anodized aluminum knob.					
IP rating	IP31					
Agency approvals	ETL, cETL, CE, ROHS					
Controller dimensions (L × W × H)	31.7 x 27.9 x 15.2 (cm) 12.5 x 11 x 6 (in)					
Shipping weight	7 (kgs) 15 lbs					

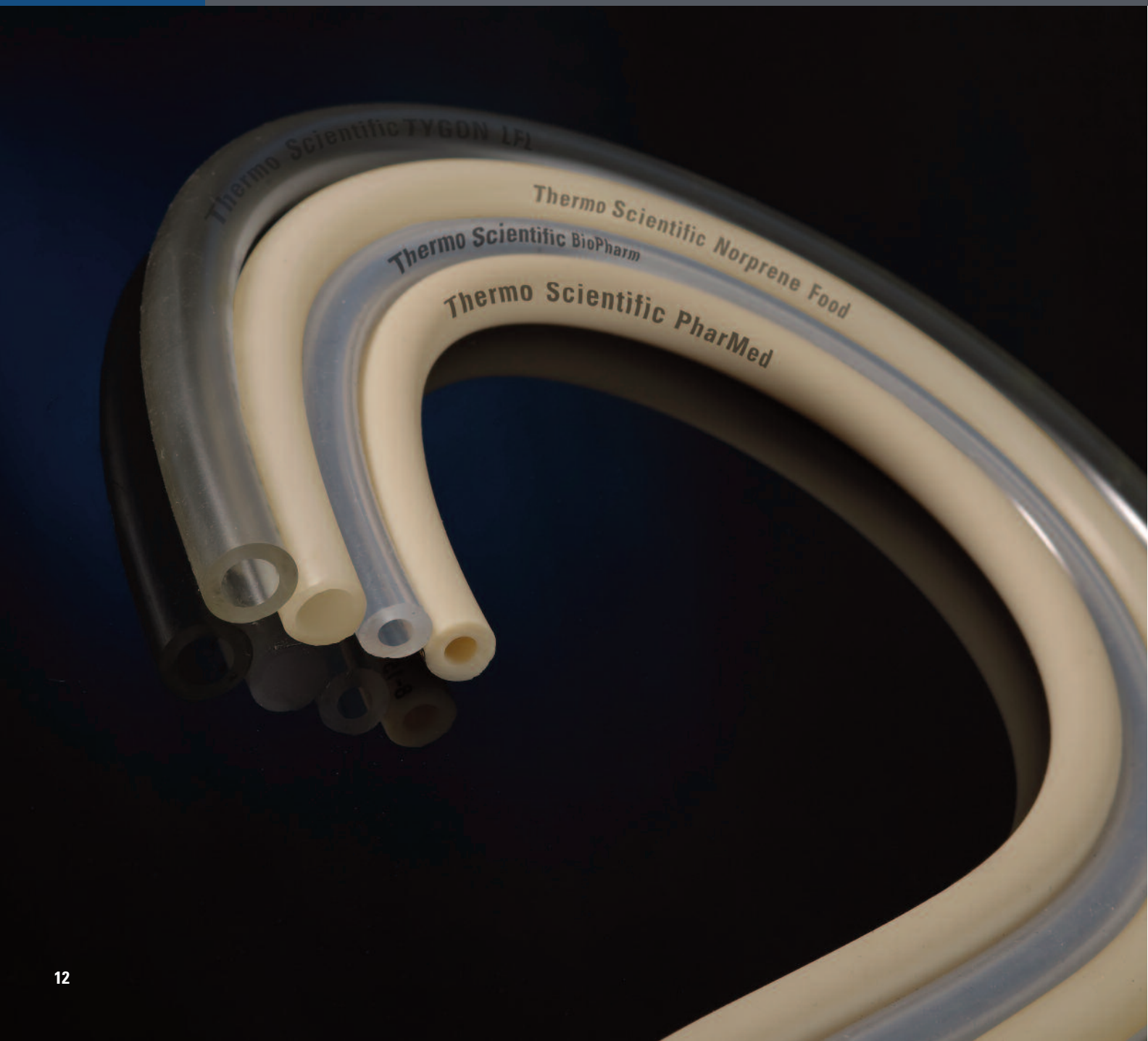
See page 16 for flow performance and tubing selection.

Tubing formulations to meet virtually any application

Thermo Scientific high precision peristaltic pump tubing is manufactured to exacting specifications to optimize accuracy, repeatability, and to provide enhanced tubing life. This tubing has been tested and quality assured to operate in Thermo Scientific peristaltic pumps.

We offer three grades of tubing to meet your specific requirements: General purpose; Precision tubing links, and HRT (High-Resilient Tube) elements. Each grade is offered in four different formulations allowing the broadest range of chemical compatibility and purity.

Precision tubing links optimize accuracy, life and pressure performance and they are easy to load. The HRT (High-Resilience Tube) elements can operate at the highest pressures (60 PSIG), provide the highest purity (eliminating spallation), and the longest life performance.



FH10, FH15 and FH30 Peristaltic Pump Tubing

Pump tubing formulation	Silicone (platinum)	Tygon® R-3603	Tygon® LFL	Bio-Pharm® (silicone)	PharMed® BPT	FDA Viton®
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.	Inexpensive tubing for general laboratory applications. Clear for easy flow monitoring Handles virtually all inorganic chemicals. Nonaging, nonoxidizing. Low gas permeability. Good for viscous fluids. High dielectric constant.	Longest life of all Tygon peristaltic tubing (up to 1000 hrs). Clear for easy flow monitoring. Broad chemical resistance. Nonaging, nonoxidizing. Low gas permeability. Smooth bore. Good for viscous fluids. High dielectric constant.	Ultra-smooth inner surface minimizes particle entrapment. Lower absorption; excellent biocompatibility; no leachable additive, DOP, or plasticizers. Very low extractables. Odorless and nontoxic, fungus-resistant. No taste imparted to transported fluids. Weather, ozone, corona, and radiation resistant.	Great for tissue and cell work—nontoxic and nonhemolytic. 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. Low gas permeability. High-pressure (100 psi) version available.	Similar to Viton (06412) but with FDA compliance. Perfect for food and lab applications where FDA compliance is required. Excellent chemical resistance. Resistant to corrosives, solvents, and oils at elevated temperatures. Low gas permeability.
Limitations	Do not use with concentrated acids and bases, organic solvents, or oils. Relatively high gas permeability.	Limited pumping life. Potential leaching of plasticizer	Potential leaching of plasticizer.	Do not use with concentrated solvents, oils, acids. Relatively high gas permeability.	Potential leaching of USP mineral oil or blend material.	Limited pumping life.
Application suitability:						
Acids	Not recommended	Good	Good	Not recommended	Good	Excellent
Alkalies	Not recommended	Good	Good	Not recommended	Good	Excellent
Organic solvents	Not recommended	Not recommended	Not recommended	Not recommended	Not recommended	Variable—test before using
Pressure	Fair	Good	Good	Excellent	Good	Good
Vacuum	Good	Good	Good	Good	Good	Good
Viscous fluids	Fair	Excellent	Excellent	Good	Excellent	Good
Sterile fluids	Excellent	Poor	Good	Excellent	Excellent	Fair
Physical characteristics and composition	Thermal set rubber. Siloxane polymers and amorphous silica. Excellent compression strength. Soft material; flexible. Translucent, clear to light amber.	Thermoplastic. PVC-based material with plasticizer. Firm (stiff) material. Transparent, clear.	Thermoplastic. PVC-based material with plasticizer. Firm (stiff) material. Transparent, clear.	Thermal set rubber. Siloxane polymers and amorphous silica. Excellent compression strength. Soft material; flexible. Translucent, clear to light amber.	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.
Temperature Range	–50 to 230°C (–58 to 446°F)	–50 to 74°C (–58 to 165°F)	–50 to 74°C (–58 to 165°F)	–60 to 232°C (–76 to 450°F)	–51 to 132°C (–60 to 270°F)	–32 to 205°C (–25 to 400°F)
Meets classifications	USP Class V Extractables; exceeds Class VI Implant; FDA 21 CFR 177.2600; Exceeds 3A Sanitary cGMPs (FDA 21 CFR 210 and 211). European Pharmacopoeia (EP)	FDA 21 CFR 175.300	USP Class VI FDA 21 CFR 175.300	USP Class VI FDA 21 CFR 177.2600 Exceeds 3A sanitary standards European Pharmacopoeia (EP)	USP Class VI FDA 21 CFR 177.2600 European Pharmacopoeia (EP)	FDA 21 CFR 177.2600
Gas permeability $\frac{cc \times mm}{(cm^2 \times sec \times cm\ Hg) \times 10^{-10}}$	CO_2: 20,132 H_2: 6579 O_2: 7961 N_2: 2763	CO_2: 360 H_2: 97 O_2: 80 N_2: 40	CO_2: 563 H_2: — O_2: 124 N_2: 67	CO_2: 25,147 H_2: — O_2: 4715 N_2: 2284	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
Cleaning and sterilization	Clean with hot water/soap solution; use a non-oily soap such as Ivory®, not synthetic detergent or oil-based soap as they may be absorbed by the tubing and into the fluid. Rinse well with distilled water. Ethylene oxide (ETO) sterilization is not recommended—sufficient data is not available about complete out-gassing of residual ETO and other ETO products.	Sterilize with ETO or autoclave. To autoclave: Coil tubing loosely in nonlinting cloth or paper, autoclave at 121°C (250°F), 1 kg/cm2 (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 ETO or autoclave. To autoclave: Coil tubing loosely in nonlinting cloth or paper, autoclave at 121°C (250°F), 1 kg/cm2 (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 by ETO, autoclave, or gamma radiation up to 2.5 Mrad. To autoclave: coil loosely in nonlinting cloth or paper; autoclave at 121°C (250°F), 1 bar (15 psi) for 30 minutes.	Sterilize by ETO, autoclave, or gamma radiation up to 2.5 Mrad. Repeated autoclaving will not affect overall life.	Sterilize by using a circulating hot air oven at 249°C (480°F) for 16 hours.

FH10, FH15 and FH30 Flowrate by Tubing Size (mL/min)

Pump Model	Catalog Number	RPM	Microbore pump tubing size (ID)							
			0.19 mm	0.25 mm	0.51 mm	0.89 mm	1.14 mm	1.42 mm	2.06 mm	2.79 mm
FH10	72-310-010	1.7 to 10	0.002 to 0.013	0.004 to 0.022	0.015 to 0.087	0.041 to 0.25	0.064 to 0.39	0.09 to 0.57	0.18 to 1.05	0.25 to 1.65
	72-310-080	13.to 80	0.017 to 0.10	0.03 to 0.18	0.12 to 0.70	0.33 to 2.0	0.52 to 3.1	0.75 to 4.5	1.4 to 8.5	1.8 to 11.0
	72-310-300	50 to 300	0.06 to 0.38	0.11 to 0.67	0.43 to 2.6	1.2 to 7.4	1.9 to 11.5	2.8 to 17.0	5.3 to 32	7.2 to 43
			Size 13 Tubing		Size 14 Tubing		Size 16 Tubing		Size 25 Tubing	
FH15	72-315-100	20 to 100	0.8 to 4.0		2.8 to 14		11 to 54		21 to 105	
FH30	72-330-100	20 to 100	0.8 to 4.0		2.8 to 14		Not recommended			

FH10 Tubing

Size ID (mm)	Silicone Platinum	Tygon R-3603	Tygon LFL	PharMed BPT	FDA Viton
0.19	X	95609-10	X	X	X
0.25	X	95609-12	X	95809-12	X
0.51	95590-18	95609-18	96429-18	95809-18	X
0.89	95590-26	95609-26	96429-26	95809-26	97632-26
1.14	95590-30	95609-30	96429-30	95809-30	97632-30
1.42	95590-34	95609-34	96429-34	95809-34	97632-34
2.06	95590-42	95609-42	96429-42	95809-42	97632-42
2.79	95590-48	95609-48	96429-48	95809-48	97632-48
Qty/Pk	50 FT (15.2 m)	50 FT (15.2 m)	100 FT (30.4 m)	100 FT (30.4 m)	50 FT (15.2 m)

FH15 and FH30 Tubing Links

Tubing Size	Silicone Platinum	Tygon R-3603	BioPharm Plus Silicone	PharMed BPT
13	6421-13	6416-13	96116-13	96114-13
14	6421-14	6416-14	96116-14	96114-14
16	6421-16	6416-16	96116-16	96114-16
25	6421-25	6416-25	96116-25	96114-25
Qty/Pk	8	8	8	8

FH15 and FH30 Connection Tubing

Use with Tubing Size	Silicone Platinum	Tygon R-3603	BioPharm Plus Silicone	PharMed BPT
13	X	X	X	72-303-013
14	72-300-014	72-310-014	72-300-014	72-303-014
16	72-300-016	72-310-016	72-300-016	72-303-016
25	72-300-025	72-310-025	72-300-025	72-303-025
Qty/Pk	25 ft (7.6 m)	50 ft (15.2M)	25 ft (7.6 m)	25 ft (7.6 m)

FH100 and FH100X Peristaltic Pump Tubing and Links
FH100D and FH100DX Dispenser Pump Tubing and Links

Pump tubing formulation	BioPharm® Silicone Tubing (platinum-cured	PharMed® BPT	Norprene® Food (A 60 F)	Tygon® Lab (R-3603)
Series number	**72-300-XXX**	**72-303-XXX**	**72-305-XXX**	**72-310-XXX**
Advantages	Ultra-smooth inner surface minimizes particle entrapment. Lower absorption; excellent biocompatibility; no leachable additive, DOP, or plasticizers. Very low extractables. Odorless and nontoxic, fungus-resistant. No taste imparted to transported fluids. Weather, ozone, corona, and radiation resistant.	Great for tissue and cell work—nontoxic and nonhemolytic. 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. Low gas permeability. High-pressure (100 psi) version available.	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/alkalies. Heat sealable, nonaging, and nonoxidizing. High dielectric constant.	Inexpensive tubing for general laboratory applications. Clear for easy flow monitoring Handles virtually all inorganic chemicals. Nonaging, nonoxidizing. Low gas permeability. Good for viscous fluids. High dielectric constant.
Limitations	Do not use with concentrated solvents, oils, acids. Relatively high gas permeability.	Potential leaching of USP mineral oil or blend material.	Potential leaching of USP mineral oil or blend material	Limited pumping life. Potential leaching of plasticizer
Application suitability:				
Acids	Not recommended	Good	Good	Good
Alkalies	Not recommended	Good	Good	Good
Organic solvents	Not recommended	Not recommended	Not recommended	Not recommended
Pressure	Excellent	Good	Excellent	Good
Vacuum	Good	Good	Excellent	Good
Viscous fluids	Good	Excellent	Excellent	Excellent
Sterile fluids	Excellent	Excellent	Good	Poor
Physical characteristics and composition	Thermal set rubber. Siloxane polymers and amorphous silica. Excellent compression strength. Soft material; flexible. Translucent, clear to light amber.	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, beige.	Thermoplastic. PVC-based material with plasticizer. Firm (stiff) material. Transparent, clear.
Temperature Range	–60 to 232°C (–76 to 450°F)	–51 to 132°C (–60 to 270°F)	–59 to 135°C (–60 to 270°F)	–50 to 74°C (–58 to 165°F)
Meets classifications	USP Class VI FDA 21 CFR 177.2600 Exceeds 3A sanitary standards European Pharmacopoeia (EP)	USP Class VI FDA 21 CFR 177.2600 NSF-listed (Standard 51). European Pharmacopoeia (EP)	FDA 21 CFR 177.2600 NSF-listed (Standard 51)	FDA 21 CFR 175.300
Gas permeability $\frac{\text{cc x mm}}{\text{(cm2 x sec x cm Hg) x 10–10}}$	CO_2: 25,147 H_2: — O_2: 4715 N_2: 2284	CO_2: 1200 H_2: — O_2: 200 N_2: 80	CO_2: 1200 H_2: — O_2: 200 N_2: 80	CO_2: 360 H_2: 97 O_2: 80 N_2: 40
Cleaning/sterilization	Sterilize by ETO, autoclave, or gamma radiation up to 2.5 Mrad. To autoclave: coil loosely in nonlinting cloth or paper; autoclave at 121°C (250°F), 1 bar (15 psi) for 30 minutes.	Sterilize by ETO, autoclave, or gamma radiation up to 2.5 Mrad. Repeated autoclaving will not affect overall life.	Sterilize by autoclave. Repeated autoclaving will not affect overall life.	Sterilize with ETO or autoclave. To autoclave: Coil tubing loosely in non linting cloth or paper, autoclave at 121°C (250°F), 1 kg/cm2 (15 psi) for 30 minutes (tubing will appear milky); air dry at max 66°C (150°F) for 2 to 2½ hours until clear.

		FH100 and FH100D Flow Rates						FH100X and FH100DX Flow Rates			
Flow rate by Tubing Size	Tubing Size	13	14	16	25	17	18	15	24	35	36
	mL/min	0.50 – 40	2.0 – 150	6.5 – 550	16 – 1200	24 – 2000	368 – 3000	14 to 1200	24 to 2000	36 to 3000	48 to 4000
	Tubing I.D.	1/32	1/16	1/8	3/16	1/4	5/16	3/16	1/4	5/16	3/8
		0.08 mm	1.6 mm	3.2 mm	4.8 mm	6.4 mm	8.0 mm	4.8 mm	6.4 mm	8.0 mm	9.5 mm

		1.6 mm Wall - Use in FH100 and FH100D						2.4 mm wall- Use in FH100X and FH100DX			
General Purpose	Formulation	0.08 mm	1.6 mm	3.2 mm	4.8 mm	6.4 mm	8.0 mm	4.8 mm	6.4 mm	8.0 mm	9.5 mm
	BioPharm Silicone	X	72-300-014	72-300-016	72-300-025	72-300-017	72-300-018	72-300-015	72-300-024	72-300-035	72-300-036
	PharMed BPT	72-303-013	72-303-014	72-303-016	72-303-025	72-303-017	72-303-018	X	X	X	X
	Norprene Food	X	72-305-014	72-305-016	72-305-025	72-305-017	72-305-018	X	X	X	X
	Tygon	X	72-310-014	72-310-016	72-310-025	72-310-017	72-310-018	X	72-310-024	72-310-035	72-310-036

		1.6 mm Wall - Use in FH100 and FH100D						2.4 mm wall- Use in FH100X and FH100DX			
	Formulation	Size 13	Size 14	Size 16	Size 25	Size 17	Size 18	Size 15	Size 24	Size 35	Size36
Precision	BioPharm Silicone	X	75-300-014	75-300-016	75-300-025	75-300-017	75-300-018	X	X	X	X
Precision Tubing Links	Norprene Food	75-305-130	75-305-140	75-305-160	75-305-250	75-305-170	75-305-180	75-305-155	75-305-245	75-305-355	75-305-365
	BioPharm Silicone	75-300-130	75-300-140	75-300-160	75-300-252	75-300-170	75-300-180	75-300-155	75-300-245	75-300-355	75-300-365
	Pharmed BPT	75-303-130	75-303-140	75-303-160	75-303-250	75-303-170	75-303-180	75-301-155	75-301-245	75-301-355	75-303-365
	Tygon	75-310-130	75-310-140	75-310-160	75-310-250	75-310-170	75-310-180	75-310-155	75-310-245	75-310-355	75-310-365

FH100 and FH100X HRT PeristalticPump Elements
FH100D and FH100DX Dispenser Pump Elements

Pump tubing formulation	INDUSTRIAL GRADE		
	GORE® Style 500	GORE® Style 100SC	GORE® Style 400
Series number	**96210-XX**	**96200-XX**	**6439-XX**
Advantages	Similar to Style 500 tubing but with enhanced chemical resistance. Resistant to many organic and inorganic fluids. Long life at pressure up to 60 psi (4 bar). Spallation-free. Excellent biocompatibility. Low gas permeability.	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 and ozone resistant. Spallation-free. Minimal tendency to take a set.	Excellent chemical resistance. Resistant to corrosives, solvents, and oils at elevated temperatures. Low gas permeability.
Limitations	Sold as tube elements only; no continuous lengths available	Sold as tube elements only; no continuous lengths available	Sold as tube elements only; no continuous lengths available
Application suitability:			
Acids	Excellent	Not recommended	Excellent
Alkalies	Good	Not recommended	Excellent
Organic solvents	Excellent	Not recommended	Variable—test before using
Pressure	Excellent	Excellent	Good
Vacuum	Good	Good	Excellent
Viscous fluids	Good	Good	Excellent
Sterile fluids	Excellent	Excellent	Excellent
Physical characteristics and composition	ePTFE (expanded PTFE) and per-fluoroelastomer (FFKM). Excellent tensile strength. Firm (stiff) material. Opaque, off-white.	Platinum-cured silicone and ex-panded PTFE Excellent tensile strength. Firm (stiff) material. Opaque, white.	Viton® fluoroelastomer (FKM) and expanded PTFE Firm (stiff) material. Opaque, beige.
Temperature Range	–80 to 200°C (–112 to 392°F)	–44 to 200°C (–47 to 3920°F)	(0°C to 200°C (32°F to 392°F)
Meets classifications	RoHS and ADF compliant	RoHS and ADF compliant	RoHS and ADF compliant
Gas permeability $\frac{cc \times mm}{(cm2 \times sec \times cm\ Hg) \times 10^{-10}}$	CO_2: 76 to 79 H_2: — O_2: — N_2: 4.3	CO_2: 20,132 H_2: 6579 O_2: 7961 N_2: 2763	CO_2: 76 to 79 H_2: — O_2: 13 to 15 N_2: 4.3
Cleaning/sterilization	Sterilize by ETO, autoclave or SIP (steam in place). Repeated autoclaving will not affect overall life.	Sterilize by ETO, autoclave or SIP (steam in place). Repeated autoclaving will not affect overall life.	Sterilize by ETO, autoclave or SIP (steam in place). Repeated autoclaving will not affect overall life.

		FH100 and FH100D Flow Rates						FH100X and FH100DX Flow Rates			
Flow rate by Tubing Size	Tubing Size	13	14	16	25	17	18	15	24	35	36
	mL/min	0.50 – 40	2.0 – 150	6.5 – 550	14 – 1200	24 – 2000	36 – 3000	14 to 1200	24 to 2000	36 to 3000	48 to 4000
	Tubing I.D.	1/32	1/16	1/8	3/16	1/4	5/16	3/16	1/4	5/16	3/8
		0.08 mm	1.6 mm	3.2 mm	4.8 mm	6.4 mm	8.0 mm	4.8 mm	6.4 mm	8.0 mm	9.5 mm

		1.6 mm Wall - Use in FH100 and FH100D						2.4 mm wall- Use in FH100X and FH100DX			
High Resilience	Formulation	Size 13	Size 14	Size 16	Size 25	Size 17	Size 18	Size 15	Size 24	Size 35	Size36
	Style 100 SC	X	96200-14	96200-16	96200-25	96200-17	96200-18	96200-15	96200-24	96200-35	96200-36
	Style 500 FKM	X	96210-14	96210-16	96210-25	96210-17	96210-18	96210-15	96210-24	96210-35	96210-36
	Style 400 FKM	X	X	6439-16	X	6439-17	X	6439-15	6439-24	6439-35	6439-36

FH100M Peristaltic Pump Tubing and Links

Pump tubing Formulation	PharMed® BPT Santoprene	Silicone Platinum Cured	Tygon® R-3603 PVC	Viton® Fluoroelastomer
Series number	**72-47X-XXX**	**72-46X-XXX**	**72-45X-XXX**	**72-48X-XXX**
Advantages	Thermoplastic elastomer. Polypropylene-based material with USP mineral oil. Excellent tensile strength. Firm stiff material. Opaque, beige.	Thermal set rubber Siloxanes polymers and amorphous silica. Excellent compression strength. Soft material Translucent, clear to light amber.	Thermoplastic PVC based material with plasticizer. Firm stiff material. Transparent, clear	Thermal set rubber. Viton B (67% Fluorine) Firm stiff material Opaque, black
Temperature Range	(-59 to 135C (-75 to 275F)	(-51 to 232C (-60 to 460F)	-50 to 74C (-58 to 165F)	-32 to 205C (-25 to 400F)
Meets classifications	USP Class VI FDA 21 CFR 177.2600 NSF Listed (Standard 51)	USP Class VI FDA 21 CFR 177.2600 NSF-listed (Standard 51).	FDA 21 CFR 175.300	None

Flow Rates in ml/min with Microbore Tubing (Use with Small Cartridges)

Model Number	Number of Rollers	Microbore 2-stop tubing links					
		0.19 mm id	0.25 mm id	0.89 mm id	1.42 mm id	2.06 mm id	2.79 mm id
FH100 4/8	8	0.013 to 0.60	0.018 to 0.91	0.18 to 9.1	0.04 to 20.0	0.88 to 44.0	1.38 to 67.0
FH100 8/4	4	0.02 to 0.04	0.03 to 1.0	0.26 to 13.0	0.53 to 26.0	1.14 to 57.0	2.06 to 100.0
FH100 12/8	8	0.002 to 0.11	0.004 to 0.20	0.03 to 1.9	0.07 to 4.3	0.14 to 8.6	0.25 to 14.0

Flow Rates in ml/min with Precision Tubing Links (Use with Large Cartridges)

Model Number	Number of Rollers	FH100M precision tubing links				
		-013	-014	-016	-025	-017
FH100 4/6	6	0.21 to 10.0	0.60 to 30.0	2.2 to 110.0	4.0 to 200.0	5.6 to 280.0
FH100 8/3	3	0.22 to 11.0	0.84 to 42.0	3.2 to 160.0	6.8 to 340.0	10.6 to 530.0
FH100 12/6	6	0.033 to 1.9	0.012 to 6.6	0.35 to 20.0	0.70 to 40.0	0.98 to 56.0

Microbore Tubing Links and Transfer Tubing Ordering Information

Tubing ID (mm) Links	PVC 12/pk	Silicone 6/pk	Santoprene 12/pk	Viton 12/pk
0.19	72-450-019	–	–	–
0.25	72-450-025	–	72-470-025	–
0.89	72-450-089	72-460-089	72-470-089	72-480-089
1.42	72-450-142	72-460-142	72-470-142	72-480-142
2.06	72-450-206	72-460-206	72-470-206	72-480-206
2.79	72-450-279	72-460-279	72-470-279	72-480-279
Tubing	**100 ft**	**50 ft**	**100 ft**	**50 ft**
0.19	72-451-019	–	–	–
0.25	72-451-025	72-461-025	72-471-025	–
0.89	72-451-089	72-461-089	72-471-089	72-481-089
1.42	72-451-142	72-461-142	72-471-142	72-481-142
2.06	72-451-206	72-461-206	72-471-206	72-481-206
2.79	72-451-279	72-451-279	72-471-279	72-481-279

Precision Pump Tubing Links and General Purpose Transfer Tubing Ordering Information

Tubing Size Links	Inside Dia.	Hose Barb	Tygon 12/pk	Silicone 6/pk	PharMed BPT 12/pk
13	.08	1/16	72-580-135	72-570-135	72-573-135
14	1.6	1/16	72-580-145	72-570-145	72-573-145
16	3.2	1/8	72-580-165	72-570-165	72-573-165
25	4.8	3/16	72-580-255	72-570-255	72-573-255
17	6.4	1/4	72-580-175	72-570-175	72-573-175
Tubing			**50 ft/pk**	**25 ft/pk**	**25 ft/pk**
13	.08	1/16	–	–	72-303-013
14	1.6	1/16	72-310-014	72-300-014	72-303-014
15	3.2	1/8	72-310-016	72-300-016	72-303-016
16	4.8	3/16	72-310-025	72-300-025	72-303-025
17	6.4	1/4	72-310-017	72-300-017	–

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