

# Harvard Apparatus Pumps

legendary  
performance for  
every application



Superior Quality • Legendary Reliability  
Expert Technical Support • Highest Accuracy & Precision  
Over 100 years of Fluidics Experience

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**HA** Harvard  
Apparatus  
a division of Harvard Bioscience, Inc.

## Pump 33 DDS (Dual Drive System)

### The NEW Harvard Apparatus Pump 33 DDS (Dual Drive System)

is a leap forward in syringe pump capability. The Pump 33 DDS has two independent pumping channels controlled by an intuitive touch screen interface.

This multi-purpose syringe pump employs advanced syringe mechanisms that include a tight gripping, extremely secure syringe clamp that accommodates syringe sizes 0.5  $\mu$ l to 60 ml. The Pump 33 DDS offers enhanced flow performance with high accuracy and smooth flow from 1.02  $\mu$ l/min to 106 ml/min.



Please see page 32-33 for complete details.

## Peristaltic Pump Series of Peristaltic Pumps

- First Peristaltic Pump with a Touch Screen Controller
- Simple to Use
- Accurate Delivery  $\pm 1.0\%$
- Unmatched Versatility:
  - Pump Controller
  - Interchangeable Motor Pump Heads
- Widest Flow Rate Range in a Peristaltic Pump
  - P-70 - 0.001 to 70 ml/min, – P-230 - 0.001 to 230 ml/min
  - P-1500 - 0.01 to 1,500 ml/min



Please see page 62-65 for complete details.

Harvard Apparatus is known globally for creating the most advanced syringe pumps in the market. We are now excited to offer the **Harvard Peristaltic Pump**. This new Peristaltic Pump Series is built with the legendary quality and reliability that is synonymous with Harvard Apparatus.

## PHD ULTRA™ Series of Syringe Pumps

The PHD ULTRA™ Series is the solution for your most demanding fluidics applications. We are proud to announce the newest member of the family, the **NEW PHD ULTRA™ CP**. This pump delivers fluid at constant pressure. The PHD™ ULTRA pumps have unmatched flow accuracy and precision. The new LCD color touch screen and intuitive icon interface provide unparalleled ease of use so you can easily program simple to complex methods without a PC.



Please see pages 16 to 25 for the entire PHD ULTRA™ family of pumps.

## Pump 11 Elite/Pico Plus Elite Series of Syringe Pumps

The **Pump 11 Elite Series** expands its capabilities to satisfy your experimental requirements. These compact syringe pumps carry on the tradition as the premier workhorse infusion pump. They offer outstanding flow performance and unparalleled ease of use with a high resolution color touch screen and intuitive icon interface. The Pump 11 Elite Series allows you to create simple to complex methods without a PC. Now with glucose clamp capability.



Please see page 11-15 for complete details.



# Harvard Apparatus Pumps

**H**arvard Apparatus offers a broad selection of syringe, peristaltic and continuous flow pumps to suit almost every application. Syringe pump models have been expanded to include new innovative pumps with the widest range of flow rates and forces of any manufacturer. Recent additions are the PHD ULTRA™ CP, capable of delivering flow at constant pressure, and the PHD ULTRA™ XF with force capability in excess of 1,000 lb., ideal for high flow rates and viscous solutions.

With more than 100 years of success and a proven track record of designing and manufacturing high quality reliable syringe and peristaltic pumps, only Harvard Apparatus has the scientific depth and fluidics knowledge to recommend the right pump and accessories for your application. Our superior technical experts are available to assist you from start to finish.

Harvard Apparatus invented the lead screw based syringe pump in the 1950's and introduced the first microprocessor pump, in the 1980's. Our syringe pumps are so accurate, even at low flow rates, that they have become the standard for mass spectrometry calibration, animal infusion and anywhere accurate volumes must be delivered.

Our PHD ULTRA™ and Pump 11 Elite Series have set a new standard in syringe pumps. They are easy to use with an intuitive interface controlled via touchscreen. The PHD ULTRA™ and Pump 11 Elite are suitable for a wide range of applications including mass spec calibration, drug and nutritional studies, macro to micro reactors, LP chromatography, electrospraying, aerosols and microfluidics to microfluidics. Running a syringe pump has never been easier.

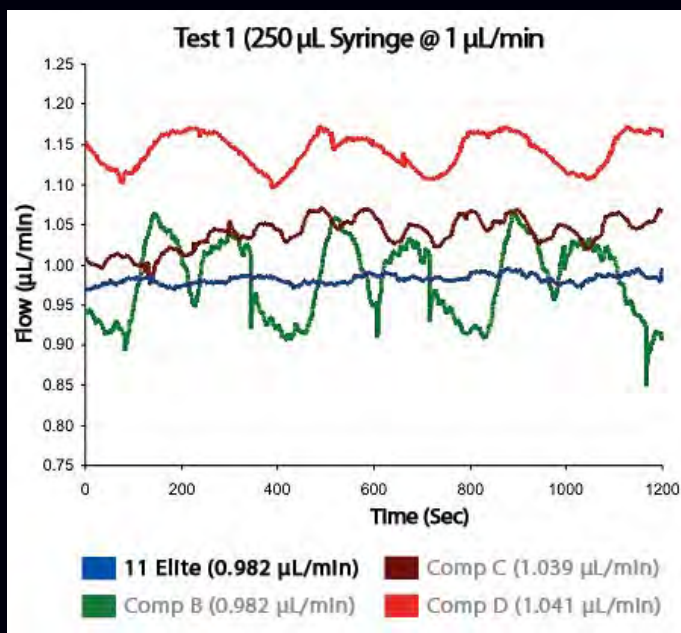
The Pump 11 Pico Plus Elite is best suited for low flow rate studies and small volume injections. It is ideal for applications including: microdialysis, animal drug and nutritional studies, cellular injection, and more.

The **NEW** Pump 33 DDS provides two independently controlled syringe pump channels in one syringe pump. When combined with a valve box, the Pump 33 DDS can also provide the continuous flow of a peristaltic pump with the smooth flow of a syringe pump.

## Results you can count on!

Since 2011, there have been more than 2,000 scientific publications referencing the use of Harvard Apparatus pumps in areas including: infusion, microfluidics, perfusion, electrospraying, and more. You can count on our expert technical support to provide product recommendations and application support to advance your studies.

If you don't find what you need, please contact us! Our technical support and engineering teams can assist in creating special pumps or custom pumping systems to meet your requirements.



## Performance

All pumps are not created equal. The graph above shows the flow profiles of the Pump 11 Elite versus three similar competitive pumps run under the same conditions. When volume accuracy and flow stability are important to your experiments, only Harvard Apparatus delivers.

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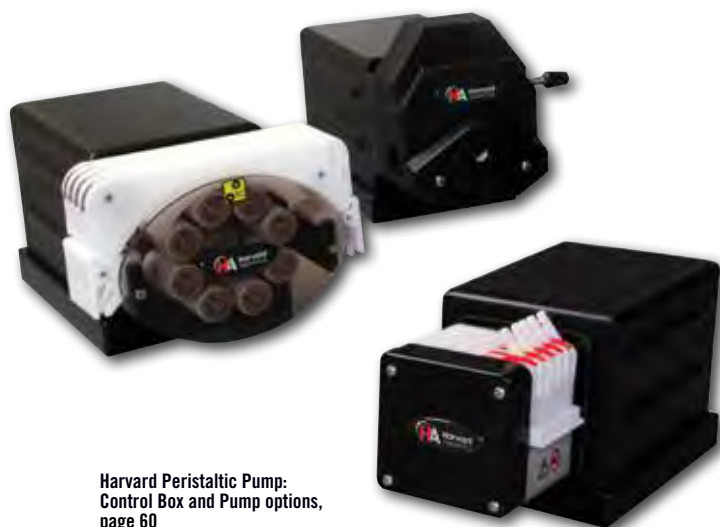


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# Syringe Pumps

## Choosing the Right Pump for Your Application & Budget

### SYRINGE PUMP QUESTIONS

- What is your application?
- How many syringes will be used simultaneously?
- What size syringe will be used?
- What flow rate(s) will be used? See pump reference pages 109-111
- What is the total volume to be delivered?
- Does the pump need to withdraw (fill the syringe) as well as infuse (dispense)?

Syringe Pump Selection Guide								
MODEL	INFUSION ONLY			INFUSION/VOL				
	PUMP 11 ELITE	PHD 22/2000	PHD ULTRA™	NANOCOOL™	PUMP 11 ELITE	PUMP 11 PICO PLUS ELITE	PUMP 11 ELITE NANO-MITE	
SEE PAGE	11	32	19	29	11 & 15	14 & 15	15 & 16	
STANDARD PUMP	PC6 70-4500 PC6 70-4501	PC6 70-2000	PC6 70-3005	–	–	–	–	
PROGRAMMABLE PUMP	–	–	–	PC6 88-1050	PC6 70-4504 PC6 70-4505	PC6 70-4506 PC6 70-4511	PC6 70-4507	
NUMBER OF SYRINGES	1 or 2	2 to 10*	2 to 10*	1	1 or 2	2	1	
MINIMUM SYRINGE SIZE	0.5 µl	0.5 µl	0.5 µl	50 µl	0.5 µl	0.5 µl	0.5 µl	
MAXIMUM SYRINGE SIZE	50/60 ml (single) 10 ml (dual)	140 ml	140 ml	500 µl	50/60 ml (single) 10 ml (dual)	50/60 ml (single) 10 ml (dual)	1 ml	
MINIMUM FLOW RATE	1.26 pl/min	0.0001 µl/hr	1.50 pl/min	3.66 pl/min	1.26 pl/min	0.54 pl/min	3.66 pl/min	
MAXIMUM FLOW RATE	88.40 ml/min (single) 26.02 ml/min (dual)	220.82 ml/min	216.0 ml/min	1.91 ml/min	88.40 ml/min (single) 26.02 ml/min (dual)	39.77 ml/min (single) 11.70 ml/min (dual)	3.82 ml/min	
AVERAGE LINEAR FORCE	16 kg (35 lb) (adjustable)	23 kg (50 lb) or 30 kg (66 lb)	34 kg (75 lb) (adjustable)	–	16 kg (35 lb) (adjustable)	16 kg (35 lb) (adjustable)	5 kg (11 lb) (adjustable)	
COMPUTER CONTROL	USB	RS-232	USB + RS-232	USB + RS-232	USB	USB	USB	
I/O + TTL CONNECTION	No	Yes	Yes	Yes	Yes	Yes	Yes	
DIMENSIONS (H x W x D)	22.6 x 17.78 x 15 cm (9 x 7 x 6 in)	15.9 x 22.8 x 27.9 cm (6.3 x 9 x 11 in)	10.16 x 30.5 x 21.6 cm (4 x 12 x 8.5 in)	30.5 x 21.6 x 10.6 cm (12 x 8.5 x 4.3 in)	22.6 x 17.78 x 15 cm (9 x 7 x 6 in)	22.6 x 17.78 x 15 cm (9 x 7 x 6 in)	22.6 x 17.78 x 9.32 cm (9 x 7 x 3.67 in)	
PUMP HEAD DIMENSIONS (H x W x D)	–	–	–	20.3 x 5.1 x 5.1 cm (8 x 2 x 2 in)	–	–	6.35 x 5.08 x 19.05 cm (2.5 x 2.0 x 7.5 in)	
WEIGHT	2.1 kg (4.61 lb)	4.5 kg (10 lb)	4.5 kg (10 lb)	4.5 kg (10 lb)	2.1 kg (4.6 lb)	2.1 kg (4.61 lb)	1.96 kg (4.32 lb)	

Please contact Technical Support for assistance.

\* Depends upon the Syringe Rack

4 x 140 Syringe Rack Holds four 60 ml or 140 ml plastic syringes only  
 6 x 10 Syringe Rack Holds six 30 to 60 ml syringes or ten 0.5 µl to 20 ml syringes  
 Microliter Syringe Rack Holds four 0.5 µl to 10 ml syringes

\*\* Some larger syringes may be compatible with the Pump 33 DDS. Please contact Technical Support for assistance.

\*\*\* Push/Pull pump can hold syringes up to 140 ml if full stroke is not required. Larger syringes will not fully infuse or withdraw. Max of 50 ml syringe if full stroke is required.



# Syringe Pumps

## Choosing the Right Pump for Your Application & Budget

### SYRINGE PUMP QUESTIONS (CONTINUED)

- What is the viscosity of the liquid you are pumping? See pump reference page 108
- What are the pressure requirements of your experiment? See pump reference pages 109-111
- Does the pump need to continuously infuse over a 24 hour period of time?
- Does the pump need to be programmable?
- Does the pump need to be controlled with a computer?
- Does the pump need to have TTL capabilities (ex. external control of valves, use of footswitch, etc)?

WITHDRAWAL						PUSH/PULL	
	PHD ULTRA™ NANO-MITE	PHD ULTRA™ & PHD ULTRA™ CP	PHD ULTRA™ HPSI & PHD ULTRA™ XF	PHD ULTRA™ 4400	PUMP 33 DDS	PHD ULTRA™ PUSH/PULL	PHD 22/2000
	28	17 & 19	26	27	30	24	32
		PC6 70-3006 PC6 88-3015	–	–	PCS 70-3333	PC6 70-3008	PC6 70-2020 PC6 70-2120 PC6 71-2020 PC6 71-2120
	PC6 70-3601	PC6 70-3007	PC6 70-3111 PC6 70-3314	PC6 70-3010 PC6 70-3310	–	PC6 70-3009	PC6 70-2019 PC6 70-2119 PC6 71-2019 PC6 71-2119
	1	2 to 10*	4	1	2	4 (2 on each side of pusher block)	4 (2 on each side of pusher block)
	0.5 µl	0.5 µl	20 ml	0.5 ml	0.5 µl	0.5 µl	0.5 µl
	1 ml	140 ml	200 ml	140 ml	60 ml**	140 ml***	140 ml***
	3.66 pl/min	1.50 pl/min	50.79 nl/min	3.06 pl/min	1.02 pl/min	1.50 pl/min	0.0001 µl/hr
	3.82 ml/min	216.0 ml/min	144.3 ml/min	216.0 ml/min	106 ml/min	216.0 ml/min	220.82 ml/min
	5 kg (11 lb) (adjustable)	34 kg (75 lb) (adjustable)	197 kg (433 lb) (adjustable)	91 kg (200 lb) (adjustable)	31.75 kg (70 lb per syringe) (adjustable)	34 kg (75 lb) (adjustable)	22.7 kg (50 lb) or 29.9 kg (66 lb)
	USB	USB + RS-232	USB + RS-232	USB + RS-232	USB + RS-232	USB + RS-232	RS-232
	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	30.5 x 21.6 x 11.1 cm (12.0 x 8.5 x 4.38 in)	10.16 x 30.5 x 21.6 cm (4 x 12 x 8.5 in)	30.48 x 21.59 x 10.8 cm (12 x 8.5 x 4.25 in)	30.5 x 21.6 x 10.8 cm (12 x 8.5 x 4.25 in)	28 x 39 x 21 cm (12 x 15 x 8 in)	10.16 x 30.5 x 21.6 cm (4 x 12 x 8.5 in)	15.9 x 22.8 x 27.9 cm (6.3 x 9 x 11 in)
	6.35 x 5.08 x 19.05 (2.5 x 2.0 x 7.5 in)	–	40.64 x 30.5 x 19.7 cm (16 x 12 x 7.75 in)	–	–	–	–
	–	4.5 kg (10 lb)	13.7 kg (30.2 lb)	6.4 kg (14 lb)	9.09 kg (21 lb)	4.5 kg (10 lb)	4.5 kg (10 lb)



Our technical support specialists are eager to assist you with product selection & questions, call today!

**1-800-272-2775 & 508-893-8999**

# Syringe Pumps

## Choosing the Right Pump for Your Application & Budget

Find your application and go to the pages indicated for more information!

Syringe Pump Application Guide							
	STANDARD SYRINGE PUMPS						
	PUMP 11 ELITE	PUMP 11 PICO PLUS ELITE	PUMP 11 ELITE NANOMITE	NANOCOOL™	PHD 22/2000	PUMP 33 DDS	PHD ULTRA™
SEE PAGE	11	14	16	29	32	30	19
ACCURATE DELIVERY OF COATINGS		X			X		X
ANIMAL FEEDING	X				X		X
BULK FLUID TRANSFER						X	X
CELL CULTURES	X					X	X
CELLULAR INJECTION		X	X		X		X
CONSTANT PRESSURE INFUSIONS							
CONTINUOUS INFUSIONS						X	
DOPING	X				X		X
DRUG DELIVERY (SAME INFUSION RATES)	X				X	X	X
DRUG DELIVERY (DIFFERENT INFUSION RATES)	X				X	X	
DRUG DELIVERY (TIME RELEASED)	X						X
DRUG DEVELOPMENT	X				X	X	X
ELECTROSPINNING	X				X	X	X
FLUID BLENDING	X				X (RS-232)*		X
FLUID BLENDING (2 INDEPENDENT CHANNELS)						X	
FLUID SAMPLING	X	X	X		X		X
GRADIENTS	X				X (RS-232)*		X
HIGH PRESSURE INJECTION							
HIGHLY CORROSIVE FLUIDS							
HPLC	X	X				X	X
INJECTING INTO HIGH PRESSURE REACTION VESSELS		X					
INJECTION PRESSURE CALCULATIONS	X				X		X
INSTRUMENT INJECTIONS	X				X		X
LOW PRESSURE CHROMATOGRAPHY	X					X	X
MASS SPECTROMETRY	X	X			X	X	X
MEDICAL COATING DELIVERY						X	X
MICRODIALYSIS	X	X					X
MICROFLUIDICS	X	X			X		X
MRI STUDIES							
MULTIPLE SIMULTANEOUS FEEDING STATIONS	X				X (RS-232)*	X	X
NANOFLUIDICS		X			X		X
NUTRITIONAL STUDIES	X				X		X
OEM MODULES							
OOCYTE APPLICATIONS		X	X				X
PATCH CLAMPING							X
REMOTE PUMPING OF HAZARDOUS MATERIAL			X		X		X
STEM CELL INJECTIONS				X			
STEREOTAXIC INJECTIONS			X				
TITRATIONS	X					X	X
VISCOUS SOLUTIONS		X					X

\*Note: Can be done using RS-232 Computer Control



# Syringe Pumps

## Choosing the Right Pump for Your Application & Budget

						OEM SYRINGE PUMP MODULES		
PHD ULTRA™ PUSH/ PULL	MRI PHD 22/2000	PHD ULTRA™ HPSI	PHD ULTRA™ 4400	PHD ULTRA™ CP	PHD ULTRA™ XF	MICROLITER	MILLILITER	HIGH PRESSURE
24	34	26	27	17	26	38	38	39-40
X				X	X			X
				X	X			
X				X	X			
X				X	X			
				X	X	X	X	
				X				
X						X	X	
				X	X			
				X	X			
		X (RS-232)*						
			X	X	X			
				X				
				X	X			X
			X	X		X	X	
						X	X	
				X		X	X	
		X	X	X	X			X
		X	X	X	X			X
X		X	X	X	X			X
				X				
				X		X	X	X
				X				
				X				X
				X				
	X							
				X			X	
				X		X		
				X				
				X		X	X	X
				X				
		X	X	X	X	X	X	X
				X	X	X	X	
		X	X	X	X			X

# Syringe Pumps

## Application Selection Guide

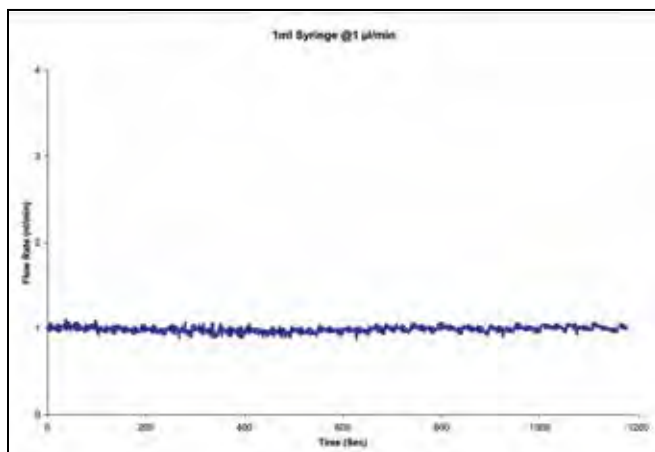
**W**ith more than 60 years of experience in the development, manufacture, and support of the highest quality syringe pumps, and 100 years in fluidics, Harvard Apparatus has a wealth of experience to share in recommending the right solution for your application. Following is only a partial guide of some application suggestions. Contact our Technical Support group for their input or with questions for the best pump to meet your need.

If you do not see what you feel is the best solution for your application, give us a call as we often develop or modify standard products for particular applications at little or no extra cost.

### Neuroscience

Applications in this area include: microdialysis and site specific microinjection into various brain regions.

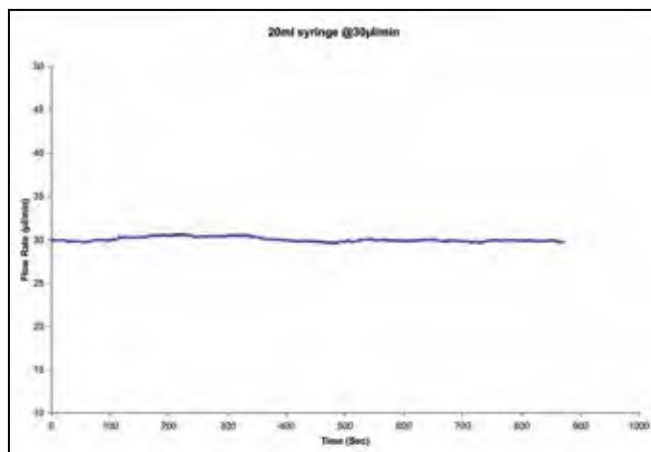
- **For stereotactically guided, single channel microinjection**, see the Pump 11 Elite Nanomite on page 16, or the PHD ULTRA™ Nanomite on page 28.
- **For single or dual probe microdialysis**, see the Pump 11 Elite on page 11 or Pico Plus Elite on page 14.
- **For applications using a liquid switch, or for running multiple experiments simultaneously**, see the PHD ULTRA™ on page 19.



### Infusion and Drug Delivery

Delivering accurate volumes and flows is critical to maintaining dosing regimens, interpretation of pharmacokinetics and other data.

- **For single or dual channel infusions**, see the Pump 11 Elite on page 11, or PHD ULTRA™ on page 19.
- **If MRI or MRI Compatible PET studies are being conducted**, see the PHD 22/2000 on page 34.
- **To run multiple studies from a single pump**, see the PHD ULTRA™ on page 19.



#### Neuroscience References

Differences in performance between Sprague-Dawley and Fischer 344 rats in positive reinforcement tasks, **PHARMACOLOGY BIOCHEMISTRY AND BEHAVIOR**, Volume 89, Issue 1, March 2008, Pages 17-22  
J Appl Physiol 106: 1793-1799, 2009.

Processing cardiovascular information in the vPAG during electroacupuncture in rats: roles of endocannabinoids and GABA, **PHARMACOLOGY BIOCHEMISTRY AND BEHAVIOR**, J Appl Physiol 106: 1793-1799, 2009. First published March 26, 2009; doi:10.1152/japplphysiol.00142.2009 8750-7587/09

DCPIB, a specific inhibitor of volume regulated anion channels (VRACs), reduces infarct size in MCAo and the release of glutamate in the ischemic cortical penumbra, **EXPERIMENTAL NEUROLOGY**, Volume 210, Issue 2, April 2008, Pages 514-520

#### Infusion and Drug Delivery References

Prosthetic systems for therapeutic optical activation and silencing of genetically-targeted neurons, **PROC SOC PHOTO OPT INSTRUM ENG.**, 2008; 6854: 68540H. doi: 10.1117/12.768798.

Intravenously administered phosphodiesterase 4 inhibitors dilate retinal blood vessels in rats, **EUROPEAN JOURNAL OF PHARMACOLOGY**, Volume 602, Issue 1, 5 January 2009, Pages 112-116

Electroencephalogram spindle activity during dexmedetomidine sedation and physiological sleep, **ACTA ANAESTHESIOLOGICA SCANDINAVICA**, Volume 52, Issue 2, pages 289-294, February 2008

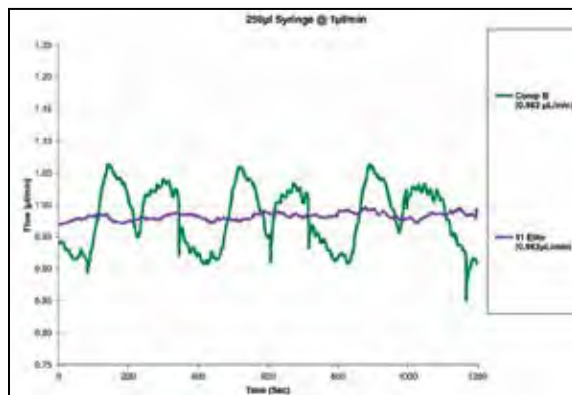


## Application Selection Guide

### Cell Biology

Cellular studies typically involve the injection of very small volumes under controlled conditions. Several models offer a foot pedal accessory to start/stop flow on command.

- **For cellular microinjections of plasmids, viruses, and the like**, see either the Pump 11 Pico Plus Elite on page 14, PHD ULTRA™ Nanomite on page 28 or the Pump 11 Elite Nanomite on page 16.



#### Cell Biology References

Microfluidic electroporation for selective release of intracellular molecules at the single-cell level, **ELECTROPHORESIS**, Volume 29, Issue 14, pages 2939–2944, No. 14 July 2008

L-selectin-mediated lymphocyte-cancer cell interactions under low fluid shear conditions, **THE JOURNAL OF BIOLOGICAL CHEMISTRY**, 283, 15816–15824

Shear assay measurements of cell adhesion on biomaterials surfaces, **MATERIALS SCIENCE AND ENGINEERING: C**, Volume 29, Issue 4, 5 May 2009, Pages 1293–1301

### Chemical & Industrial/Electrospinning

Where chemical synthesis, pressurized systems, and other applications demand high performance Harvard Apparatus has the right solution.

- **For high pressure applications**, consider the PHD ULTRA™ XF and PHD ULTRA™ HPSI with stainless steel syringes on page 26 or the PHD ULTRA™ 4400 on page 27.

Harvard Apparatus pumps are used in creating Nano and Micro scale polymer fibers in a high voltage field. The stability of flow and flexibility of use, in the PHD ULTRA™ series pumps, makes it easy to alter the variables relating to successful electrospinning. Our pumps include a grounded power supply and can be supplied with a grounding strap, which will shunt any high voltage arcs to ground.



#### Chemical and Industrial/Electrospinning References

Microfluidic electroporation for selective release of intracellular molecules at the single-cell level, **ANAL. CHEM.**, 2008, 80 (9), pp 3112–3122

Optical and electrical properties of indium tin oxide nanofibers prepared by electrospinning, **NANOTECHNOLOGY**, 2008 19 145603

Manufacture of small calibre quadruple lamina vascular bypass grafts using a novel automated extrusion-phase-inversion method and nanocomposite polymer, **JOURNAL OF BIOMECHANICS**, Vol. 42, issue 6, Pages 722–730 (16 April 2009)

### Mass Spectrometry Calibration and Electrospray Ionization

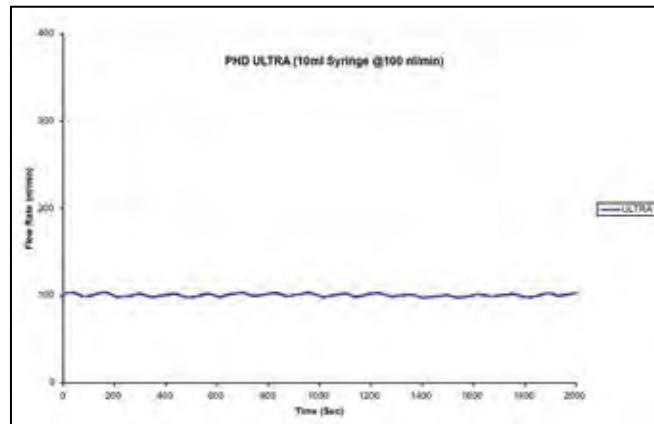
#### Calibration and Electrospray Ionization

Where precise volume delivery and pulse free flow are required for optimum instrument calibration or solvent elimination, the Pump 11 series has long been the industry standard for manufacturers in OEM configurations and end users. See the Pump 11 Elite on page 11, and Pump 11 Pico Plus Elite systems on page 14.

Additionally, use of the gradient capabilities of the Pump 11 Elite or PHD ULTRA™ Series allows for automated multi-point calibration when performing GLP studies.

#### MALDI-TOF Matrix Addition

Using the Nanomite with its detachable delivery and electronics allows for easy placement of the syringe over the target to facilitate the dispensing of the appropriate matrix. See the PHD ULTRA™ Nanomite on page 28 or the Pump 11 Elite Nanomite on page 16.



#### Mass Spectrometry Calibration References

Which Electrospray-Based Ionization Method Best Reflects Protein-Ligand Interactions Found in Solution? A Comparison of ESI, nanoESI, and ESSI for the Determination of Dissociation Constants with Mass Spectrometry, **JOURNAL OF THE AMERICAN SOCIETY FOR MASS SPECTROMETRY**, Volume 19, Issue 3, March 2008, Pages 332–343

Gas-phase IR spectra of intact  $\alpha$ -helical coiled coil protein complexes, *International Journal of Mass Spectrometry*, **INTERNATIONAL JOURNAL OF MASS SPECTROMETRY**, Volume 283, Issues 1–3, 1 June 2009, Pages 161–168

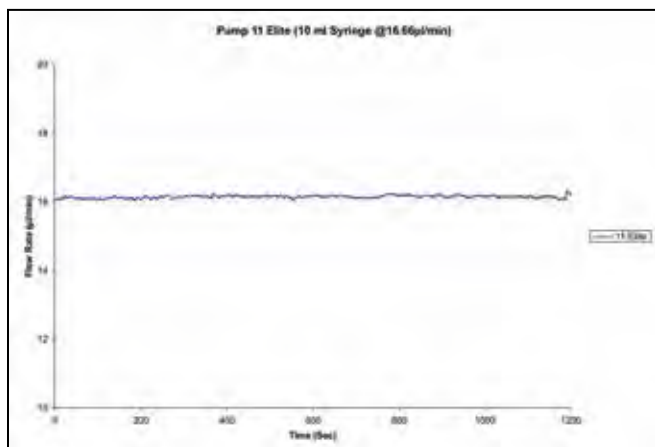
Fragmentation patterns of newly isolated cassane butenolide diterpenes and differentiation of stereoisomer by tandem mass spectrometry, **JOURNAL OF MASS SPECTROMETRY**, Volume 43, Issue 10, pages 1413–1420, October 2008

# Syringe Pumps

## Application Selection Guide

### Microfluidics

The PHD ULTRA™ series and Pump 11 Elite series pumps have the performance and flow stability required in micro and nanofluidics. These pumps can be used to mix flow streams and/or create multiple parallel flow streams. Another option is the NanoLeader pressure pump that can push and/or pull fluids using positive or negative air pressure, creating the smoothest flow possible.



### Microfluidics References

*Spiropyran modified micro-fluidic chip channels as photonically controlled self-indicating system for metal ion accumulation and release,* **SENSORS AND ACTUATORS B: CHEMICAL**, Volume 140, Issue 1, 18 June 2009, Pages 295-303

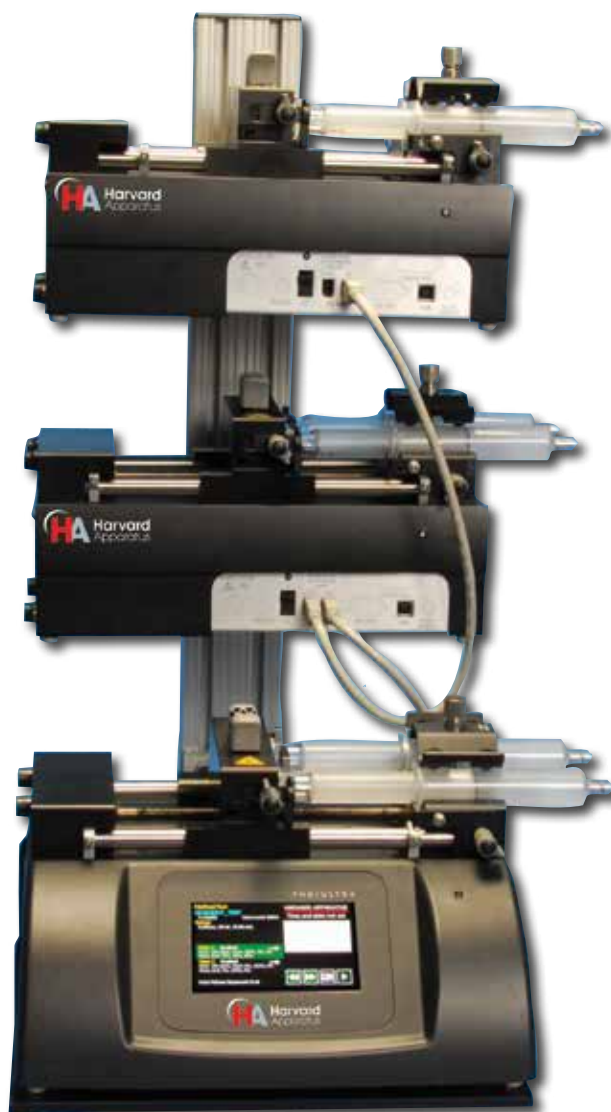
*Microfluidic high-throughput encapsulation and hydrodynamic self-sorting of single cells,* **PNAS**, March 4, 2008 vol. 105 no. 9 3191-3196

*In vitro analysis of a hepatic device with intrinsic microvascular-based channels,* **BIOMEDICAL MICRODEVICES** Volume 10, Number 6, 795-805

*Plasmonic Nanoholes in a Multichannel Microarray Format for Parallel Kinetic Assays and Differential Sensing,* **ANAL. CHEM.**, 2009, 81 (8), pp 2854-2859

### Nano/Micro Liquid Chromatography

The advanced programming capabilities of the PHD ULTRA™ and the Pump 11 Elite Syringe Pumps allow for the easy generation of binary or ternary gradients at flow rates ranging from 100 nl/min to 1.0 ml/min at pressures up to 7,500 PSI. Depending on the number of syringes used, up to one liter of mobile phase may be delivered from each pump used.





# Syringe Pumps

## Pump 11 Elite



### KEY FEATURES

- Easy-to-use touchscreen and icon interface
- Outstanding flow performance
- Easily run simple to complex methods without a PC
- Alphanumeric keypad for easy Method naming and recall
- Adjustable linear force up to 35 lb
- Upgrade new versions of software remotely
- Legendary reliability – 2 year warranty

### APPLICATIONS

- Microfluidics
- Drug/Nutritional Delivery
- Microdialysis
- Emulsification
- Bioreactors
- Electrospinning
- Mass Spectrometry

The Pump 11 Elite Series of syringe pumps expands its capabilities to satisfy your experimental requirements. These compact syringe pumps carry on the tradition as the premier workhorse infusion pump, offering unparalleled ease of use with a high resolution color touchscreen with intuitive icon interface. The Pump 11 Elite Series allows you to create, save and run simple to complex methods without a PC.

### Superior Performance

These syringe pumps have a new mechanism that includes a tight gripping, very secure syringe clamp for syringes ranging from 0.5 µl to 60 ml (single syringe) and 0.5 µl to 10 ml (dual syringe). The Pump 11 Elite Series offers enhanced flow performance with high accuracy and smooth flow from 1.26 pl/min to 88.40 ml/min (26.02 ml/min for dual syringe rack).

The Pump 11 Elite Series is available in Infusion Only or Infusion/Withdrawal Programmable Models with single or dual syringe racks. All Pump 11 Elite syringe pumps have a footswitch input and USB serial port for computer control. The Infusion/Withdrawal Programmable models also have RS-485 (or optional RJ-11) ports for daisy chaining pumps and Digital I/O for external control via an independent computer or device (see page 13 for more information on connectivity).

Since 1901 Harvard Apparatus has been supporting bioresearch fluidics requirements with a key milestone being the introduction of the first commercial syringe pump for bioresearch in 1956. Since 1956, over 70,000 satisfied syringe pump users around the world have made Harvard Apparatus syringe pumps the worlds #1 choice.

The Pump 11 Elite Series is a family of accurate, low flow syringe pumps designed for use in applications including: mass spec calibration, drug and nutritional studies, reactor dosing, electrospinning and more.

### Easy-to-Use Interface

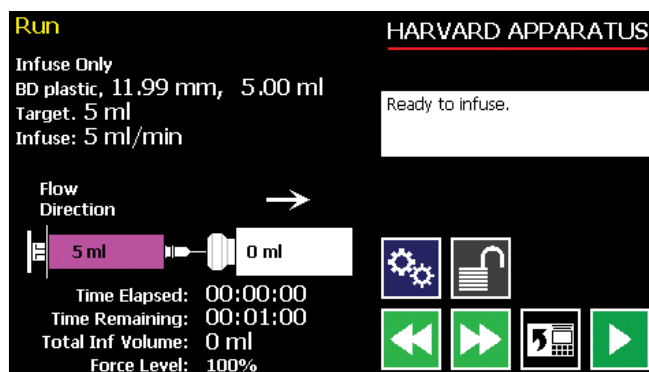
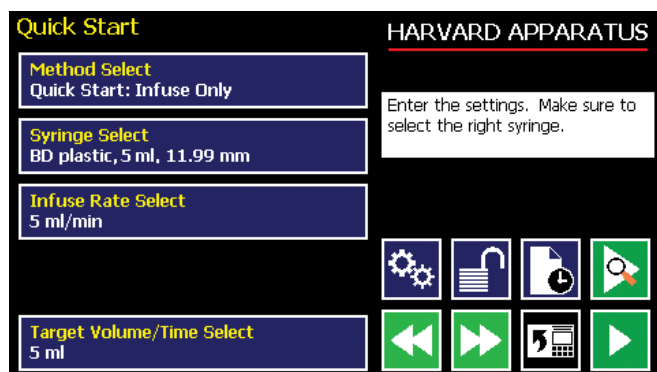
The Pump 11 Elite Syringe Pumps are very easy to use with an LCD color touchscreen and icon interface. The Message Area of the touchscreen is used to display helpful instructions for the currently displayed screen. It is also used to display error or warning messages to indicate problem conditions in a Method or error conditions during pump operation. The Run Screen shows all of the pump parameters on one screen for easy review.

The software is organized into three main navigational branches, the quick start Methods, user-defined Methods, and system settings. You can control operations directly through the touchscreen or remotely from an independent computer or device via the external I/O interface.



# Syringe Pumps

## Pump 11 Elite



### Pump Models

The Pump 11 Elite Syringe Pumps are available in two configurations designed for different operating environments and varying degrees of operational flexibility.

1. **Infusion Only (single and dual syringe models):** This model supports infusion operations at user-defined flow rates and with selectable target volume or time values to control the total infusion volume. The Infusion Only models do not include programmable, user-defined Methods.
2. **Infusion/Withdrawal Programmable (single and dual syringe models):** This model supports infuse only, withdraw only, infuse/withdraw and withdraw/infuse operations at user-defined flow rates and with selectable target volume or time. This model also allows users to create and store up to two user-defined Methods of 50 steps each on the pump.

### Accessories

A full range of accessories are compatible with the Pump 11 Elite including syringe heaters, in-line heaters and coolers, nanofluidic circuits, connectors, tubing, syringes and more.

### Program Description

To operate the Pump 11 Elite, the user defines all the required parameters for infusing or withdrawing liquids through a Method. This may be a Quick Start Method, Pre-Programmed or User-Defined Method. The basic operation is a simple 3-step procedure:

1. **Select a method**
2. **Enter operating parameters**
3. **Preview or Run your method**

Quick Start Methods are simple infusions, withdrawals or a combination (depending upon the model). Custom user-defined Methods can be created when more advanced programming is required. The setup for a custom Method is easy using the standard profiles found on all Infusion/Withdrawal Programmable Elite Models. The list of available profiles is:

Constant Rate	Gradient (binary)
Ramp	Autofill

By programming custom (user-defined) Methods into the pump, multi-user errors are reduced. Easily transfer Methods to other pumps and/or download Methods from a PC. Forget having to duplicate Method-development efforts for each new pump added to your system.

### Alarms

There are several alarms available on the Model 11 Elite Syringe Pumps:

- End of Run
- Near End of Run
- Power Up
- Stall

### Advanced Documentation Features

- Download experimental parameter information to PC
- Alphanumeric keypad for method naming

### Adjustable Force

The maximum linear force of the Pump 11 Elite is 16 kg (35 lb). Depending upon the syringes you are working with and your overall experimental setup you may want to adjust the amount of force applied to the pusher block. You can select a percentage of the total force from 20% to 100%. Refer to the user's manual for suggested force level settings.

## CONTROL MULTIPLE PUMPS VIA DAISY CHAIN WITH RS-485

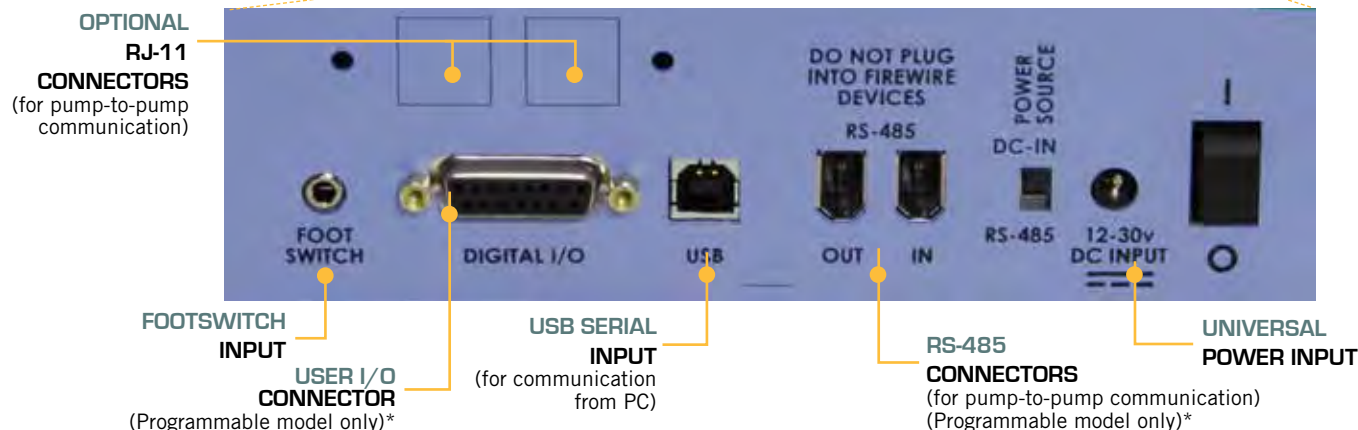


# Syringe Pumps

## Pump 11 Elite

### Advanced Connectivity

The infusion only Pump 11 Elite Syringe Pumps come standard with a Footswitch input and USB connector. The infusion/withdrawal programmable Pump 11 Elite Syringe Pumps include a Footswitch input, USB, RS-485 and I/O connectors. There is also an option for RJ-11 connectors on the programmable pumps. This option has to be ordered at the time the pump is ordered.



### Pump 11 Elite Specifications

<b>TYPE</b>	Microprocessor single or dual syringe, infusion only or infusion/withdrawal programmable
<b>ACCURACY</b>	±0.5%
<b>SYRINGE:</b>	
Type	Plastic or glass
Size (single syringe)	0.5 µl to 50/60 ml
Size (dual syringe)	0.5 µl to 10 ml
<b>FLOW RATE:</b>	
Single Syringe	1.26 µl/min to 88.4 ml/min
Dual Syringe	1.26 µl/min to 26.02 ml/min
<b>DISPLAY</b>	4.3" WQVGA TFT color display with touchscreen
<b>CONNECTORS:</b>	
RS-485	IEEE-1394, 6 position*
USB	Type B
I/O & TTL	15-pin D-Sub Connector*
Footswitch	mini phono jack
<b>AVERAGE LINEAR FORCE</b>	16 kg (35 lb) @ 100% Force Selection
<b>STEP RESOLUTION</b>	0.069 µm/µstep
<b>INPUT POWER</b>	12-30 VDC
<b>INPUT POWER CONNECTION</b>	2.5 mm ID x 5.5 mm OD male plug
<b>POWER SUPPLY</b>	100 to 240 VAC, 50/60 Hz, 18 Watts Universal Power Supply, Use Only a Harvard Apparatus Approved Power Supply and Line Cord
<b>DIMENSIONS, H x W x D</b>	22.6 x 17.78 x 15 cm (9 x 7 x 6 in)
<b>WEIGHT</b>	2.1 kg (4.6 lb)
<b>REGULATORY CERTIFICATIONS</b>	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

<b>FOOTSWITCH INPUT</b>	Start and stop a pump
<b>USB SERIAL INPUT</b>	Control your pump with a computer
<b>RS-485 CONNECTORS</b>	Connect multiple pumps together (daisy chain up to 99 pumps) Connect satellite pumps to the Master pump for binary gradient system (% composition)
<b>RJ-11 CONNECTORS (OPTION)</b>	Connect multiple pumps together (daisy chain)
<b>USER I/O CONNECTOR</b>	
Direction Control Input	Set pump to infuse or withdraw
Trigger Input	Connect an external device to start and stop a pump or Method
Trigger 1 Output	Signal another device to start and stop a pump or Method
Run indicator	Connect an external LED or monitoring device to a pump

Order #	Product
<b>PC6 70-4500</b>	Pump 11 Elite Infusion Only Single Syringe
<b>PC6 70-4501</b>	Pump 11 Elite Infusion Only Dual Syringe
<b>PC6 70-4504</b>	Pump 11 Elite Infusion/Withdrawal Programmable Single Syringe
<b>PC6 70-4505</b>	Pump 11 Elite Infusion/Withdrawal Programmable Dual Syringe
<b>Accessories</b>	
<b>PC6 70-4000</b>	RS-485 Cable for Pump-to-Pump Communication, 0.5 m (1.6 ft)
<b>PC6 70-4001</b>	RS-485 Cable for Pump-to-Pump Communication, 2 m (6.6 ft)
<b>PC6 70-4020</b>	RS-485 Extension Cable, 9.1 m (30 ft)
<b>PC6 70-4002</b>	USB Cable for PC-to-Pump Communication, 2 m (6.6 ft)
<b>PC6 70-4003</b>	USB Cable for PC-to-Pump Communication, 5 m (16.4 ft)
<b>PC6 70-4006</b>	Adapter, D-sub 15 to Term, Blk
<b>PC6 72-8340</b>	Adapter, USB to Serial
<b>PC6 70-2215</b>	Footswitch (with Phono Plug)
<b>PC6 55-7760</b>	Cable Assy, Daisy Chain, Legacy RS-232 RJ-11, 0.6 m (2 ft)
<b>PC6 72-2478</b>	Cable Assy, Daisy Chain, Legacy RS-232 RJ-11, 2.1 m (7 ft)
<b>PC6 55-8000</b>	Adapter for 25 ml, Hamilton GasTight™ Syringes
<b>PC6 70-3030</b>	RS-232 RJ-11 Connectors Option



# Syringe Pumps

## Pump 11 Pico Plus Elite



PC6 70-4506 Pump 11 Pico Plus Elite Infusion/Withdrawal Programmable Dual Syringe



PC6 70-4511 Pump 11 Pico Plus Elite Infusion/Withdrawal Programmable Single Syringe



### KEY FEATURES

- Easy-to-use touchscreen and icon interface
- Outstanding flow performance
- Easily run simple to complex methods without a PC
- Alphanumeric keypad for easy Method naming and recall
- Adjustable linear force up to 35 lb
- Upgrade new versions of software remotely
- Legendary reliability – 2 year warranty

### APPLICATIONS

- Microfluidics
- Drug/Nutritional Delivery
- Microdialysis
- HPLC
- Cellular Injections
- Mass Spectrometry

The Pump 11 Pico Plus Elite is the lowest flow, highest accuracy syringe pump. It offers enhanced flow performance with high accuracy and smooth flow from 0.54 pl/min to 39.77 ml/min (single syringe version) or 0.54 pl/min to 11.70 ml/min (dual syringe version). This precision syringe pump offers unparalleled ease of use with a high resolution color touchscreen with intuitive icon interface. The Pump 11 Pico Plus Elite allows you to create, save and run simple to complex methods without a PC.

The Pump 11 Pico Plus Elite is a dual syringe Infusion/Withdrawal Programmable Model. It has a footswitch input, USB serial port for computer control, RS-485 ports for daisy chaining pumps and Digital I/O for external control via an independent computer or device (see page 13 for more information on connectivity). There is also an option of daisy chaining pumps through the RS-232 (RJ-11) ports. For more information on the Pump 11 Pico Plus Elite including features and programming see the Pump 11 Elite on page 11.

### Pump 11 Pico Plus Elite Specifications

<b>TYPE</b>	Microprocessor single and dual syringe, infusion/withdrawal programmable
<b>ACCURACY</b>	±0.35%
<b>SYRINGE:</b>	
Type	Plastic or glass
Size (Single Syringe)	0.5 µl to 50/60 ml
Size (Dual Syringe)	0.5 µl to 10 ml
<b>FLOW RATE:</b>	
Minimum	(Single/Dual) 0.54 pl/min
Maximum	(Single) 39.7 ml/min (Dual) 11.7 ml/min
<b>DISPLAY</b>	4.3" WQVGA TFT color display with touchscreen
<b>CONNECTORS:</b>	
RS-485	IEEE-1394, 6 position
USB	Type B
I/O & TTL	15-pin D-Sub Connector
Footswitch	Mini phono jack
<b>AVERAGE LINEAR FORCE</b>	16 kg (35 lb) @ 100% Force Selection
<b>STEP RESOLUTION</b>	0.031 µm/µstep
<b>INPUT POWER</b>	12 to 30 VDC
<b>INPUT POWER CONNECTION</b>	2.5 mm ID x 5.5 mm OD male plug
<b>POWER SUPPLY</b>	100 to 240 VAC, 50/60 Hz, 18 Watts Universal Power Supply, Use Only a Harvard Apparatus Approved Power Supply and Line Cord
<b>DIMENSIONS, H x W x D</b>	22.6 x 17.78 x 15 cm (9 x 7 x 6 in)
<b>WEIGHT</b>	2.1 kg (4.6 lb)
<b>REGULATORY CERTIFICATIONS</b>	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

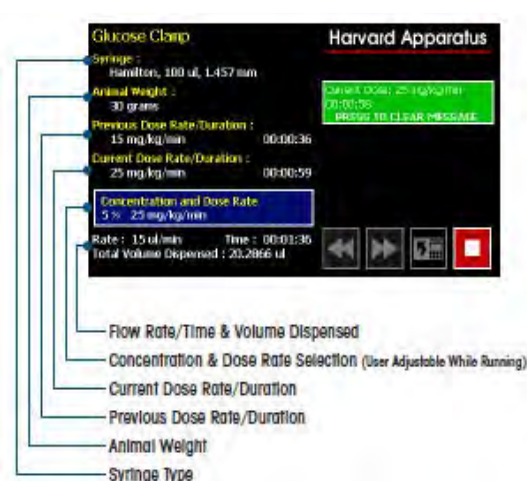
Order #	Product
PC6 70-4511	Pump 11 Pico Plus Elite Infusion/Withdrawal Programmable Single Syringe
PC6 70-4506	Pump 11 Pico Plus Elite Infusion/Withdrawal Programmable Dual Syringe

## Syringe Pumps

### Pump 11 Elite Glucose Clamp Syringe Pump



Glucose Clamp Infusion System



#### KEY FEATURES

- Intuitive touchscreen with glucose clamping capabilities
- Program animal weight, concentration and dose rate without a PC
- Ability to change dose rate while running
- Previous dose rate display

#### APPLICATIONS

- Euglycemic or hyperglycemic studies
- Drug Infusion

The renowned Harvard Apparatus syringe pump technology enhanced for academic euglycemic or hyperglycemic glucose clamp studies

The Pump 11 Elite Glucose Clamp Infusion System is a time saving syringe pump enhancement that offers quick and simple set-up using our innovative touchscreen display. The built-in software capabilities reduce the potential for error in your research by providing the most accurate fluid delivery available.

#### Syringe Pump Ordering Information

Order #	Product
PC6 70-4504GC	Pump 11 Elite Infusion/Withdrawal Programmable Single Syringe Pump with Glucose Clamp Method
PC6 70-4505GC	Pump 11 Elite Infusion/Withdrawal Programmable Dual Syringe Pump with Glucose Clamp Method
PC6 70-4506GC	Pump 11 Pico Plus Elite Infusion/Withdrawal Programmable Dual Syringe Pump with Glucose Clamp Method
PC6 70-4507GC	Pump 11 Elite Nanomite Infusion/Withdrawal Programmable Single Syringe Pump with Glucose Clamp Method
PC6 70-4511GC	Pump 11 Pico Plus Elite Infusion/Withdrawal Programmable Single Syringe Pump with Glucose Clamp Method

#### Typical System for Rat Glucose Clamp Ordering Information

Order #	Product
Various	Pump 11 Elite Syringe Pump with Glucose Clamp Method (see syringe pump chart)
PC6 61-0003	22 ga Dual Channel Swivel
PC6 72-4455	2-Channel VAHD Tether Assembly, 12 in, Sterile
PC6 72-4454	2-Channel Rat VAH Harness Injector, Sterile
PC6 75-0403	Catheter for Rat Jugular Vein, PU 3Fr, 3.0 cm
PC6 75-0404	Catheter for Rat Carotid Artery, PU 1.9-3 Fr, 16.5 cm
PC6 75-0220	PinPorts, 22 ga, with Injectors, Sterile
PC6 75-0214	Counter-Balanced Lever Arm, 6 in, with Holder for 4-Way Connector
PC6 75-0212	4-Way X Connector, 22 ga, Sterile

#### Typical System for Mouse Glucose Clamp Ordering Information

Order #	Product
Various	Pump 11 Elite Syringe Pump with Glucose Clamp Method (see syringe pump chart)
PC6 75-0277	Low Torque Dual Channel Swivel, 22 ga OD, 25 ga ID
PC6 75-0289	2-Channel Mouse VAH Tether Assembly, 7 in, Sterile
PC6 75-0290	2-Channel Mouse VAH Harness, Injector, Sterile
PC6 75-0401	Catheter for Mouse Jugular Vein, PU 2 Fr, 10.0 cm
PC6 75-0402	Catheter for Mouse Carotid Artery, 1-3 Fr, 8 cm
PC6 75-0215	Counter-Balanced Lever Arm, 3.5 in, with Holder for 4-Way Connector
PC6 75-0213	4-Way X Connector, 25 ga, Sterile

# Syringe Pumps

## Pump 11 Elite Nanomite



### KEY FEATURES

- Easy-to-use LCD color touchscreen with GUI interface
- Light weight makes it ideal for hand-held or stereotaxic injection
- Easily program simple to complex Methods without a PC
- Create and store up to 2 Methods

### APPLICATIONS

- Cellular Injections
- Drug Delivery
- Microinjections
- Hand-Held Automated Delivery
- Stereotaxic Injections
- Regenerative Medicine

The Pump 11 Elite Nanomite is a single syringe infusion/withdrawal programmable syringe pump. This pump allows you to create, save and run simple to complex Methods without a PC. The flow rate range is 3.66  $\mu\text{l}/\text{min}$  to 3.82  $\text{ml}/\text{min}$  with 11 lb of adjustable force across the entire flow rate range.

The Pump 11 Elite Nanomite has a footswitch input, USB serial port for computer control, RS-485 ports for daisy chaining pumps and Digital I/O for external control via an independent computer or device. There is also an option for daisy chaining pumps through the RS-232 (RJ-11) ports. This option must be ordered at the time the pump is ordered. See page 13 for more information on connectivity.

This pump consists of a control unit, an injection unit, a 6 foot cable to connect the two units and a footswitch. For more information on the Pump 11 Elite Nanomite including features and programming, see the Pump 11 Elite on page 11.

For filling small volume syringes & needles, see the HA Priming Kit on page 86.

### Pump 11 Elite Nanomite Specifications

TYPE	Microprocessor single syringe, infusion/withdrawal programmable
ACCURACY	$\pm 0.5\%$
SYRINGES (MIN./MAX.)	0.5 $\mu\text{l}$ / 1 ml
FLOW RATE:	
Minimum	3.66 $\mu\text{l}/\text{min}$
Maximum	3.82 $\text{ml}/\text{min}$
DISPLAY	4.3" WQVGA TFT color display with touchscreen
CONNECTORS:	
RS-485	IEEE-1394, 6 position
USB	Type B
I/O & TTL	15-pin D-Sub Connector
Footswitch	mini phono jack
AVERAGE LINEAR FORCE	5 kg (11 lb) @ 100% force selection
STEP RESOLUTION	0.198 $\mu\text{m}/\mu\text{step}$
INPUT POWER	12-30 VDC
INPUT POWER CONNECTION	2.5 mm ID x 5.5 mm OD male plug
POWER SUPPLY	100 to 240 VAC, 50/60 Hz, 18 Watts Universal Power Supply, Use Only a Harvard Apparatus Approved Power Supply and Line Cord
DIMENSIONS, H x W x D:	
Control Box	22.6 x 17.78 x 9.32 cm (9 x 7 x 3.67 in)
Mechanism	6.35 x 5.08 x 19.05 cm (2.5 x 2.0 x 7.5 in)
WEIGHT	1.96 kg (4.32 lb)
REGULATORY CERTIFICATIONS	CE, ETL (UL, CSA), WEEE, EU ROHS & CB Scheme

Order #	Product
PC6 70-4507	Pump 11 Elite Nanomite Infusion/Withdrawal Programmable Single Syringe

## Syringe Pumps

# PHD ULTRA™ CP Constant Pressure Syringe Pump



PC6 88-3015 PHD ULTRA™ CP  
Infusion/Withdrawal  
Programmable



Our user-friendly touchscreen interface allows for simple control of either constant pressure or constant flow-based applications.

### KEY FEATURES

- Enables continuous pressure-controlled infusion
- Use in constant flow or constant pressure mode
- Enhances safety for sensitive infusion targets and physiological experimentation
- Compatible with a wide range of pressure transducers
- Automatically adjusts flow rate to maintain constant pressure
- PC Datalog Application with real-time parameter plotting
- Legendary Reliability -2 year warranty

### APPLICATIONS

- Short-term organ perfusion studies that require the maintenance of physiologic conditions
- Introduction of chemical reactants in a controlled manner
- Ocular injections and perfusions
- Small animal whole-body perfusions
- Constant pressure microfluidic mixing
- Administration of genetic material into organs without viral vectors

## Constant Pressure Syringe Pump Technology Breakthrough

The PHD ULTRA™ CP Syringe Pump is the first of its kind to allow operation under constant pressure or constant flow. Historically, the only means available to dispense at constant pressure has involved the use of various amplifiers and other accessories/software. The PHD ULTRA™ CP Syringe Pump, when combined with virtually any commercially available pressure transducer/amplifier combination with 0-10 V DC analog output, results in a constant pressure dispensing system. This system can deliver fluids with an applied force up to 1,000 lb (depending upon the pump).

### Superior Functionality

Using Harvard Apparatus syringe pump technology and software controlled pressure monitoring, the PHD ULTRA™ CP Syringe Pump is able to maintain a user-defined system pressure  $\pm 2\%$  once the steady state pressure value has been achieved.

A user-adjustable sensitivity setting allows for the customization of the system response time necessary to attain the set pressure. The PHD ULTRA™ CP Syringe Pump allows the user to set pressures in the units of their choice including mmHg, kPa, and psi.

### Pressure & Flow Rate Data

Data can be monitored via RS-232 from the PHD ULTRA™ CP Syringe Pump to a PC. In practice, the 0-10 V analog output of a pressure transducer amplifier is connected to the analog input on the rear panel of the pump. The amplifier or signal conditioner can be provided by the customer, or accomplished with various transducers and amplifiers available from Harvard Apparatus, see pages 42 to 45. The pressure range may be scaled to fit the available transducer voltage output for systems that output less than 10 V. While in constant pressure mode, in addition to the set and actual pressure, the pump displays the flow rate. This data may be output for further analysis with a variety of data acquisition packages.

### Accuracy & Reproducibility

In addition to constant pressure mode, the PHD ULTRA™ CP Syringe Pump may also be used in flow mode with its world renowned accuracy and reproducibility.

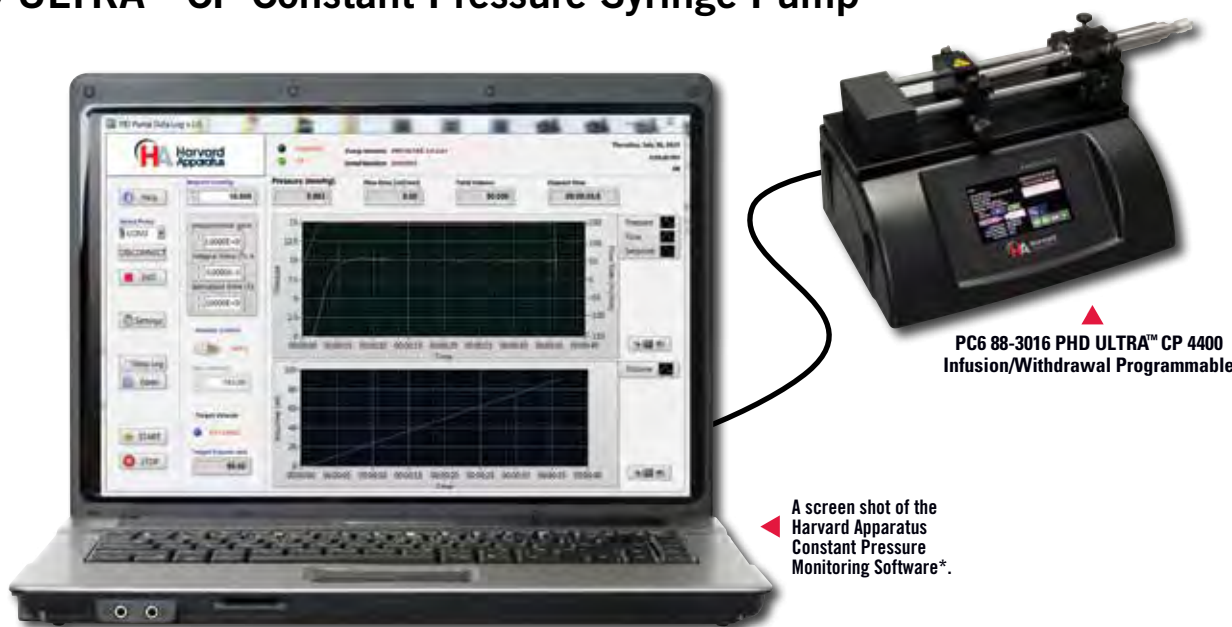
All PHD ULTRA™ CP Syringe Pumps are infusion/withdrawal programmable models. When used in flow mode, these offer programmable features such as method storage and flow programming functions to allow the user to create simple to complex methods (see page 19). The PHD ULTRA™ CP Syringe Pump is available in a variety of configurations to suit the desired pressure or flow rate ranges.



## Syringe Pumps

### PHD ULTRA™ CP Constant Pressure Syringe Pump

SYRINGE PUMPS PHD ULTRA™ Constant Pressure Syringe Pump



PC6 88-3016 PHD ULTRA™ CP 4400  
Infusion/Withdrawal Programmable

A screen shot of the  
Harvard Apparatus  
Constant Pressure  
Monitoring Software\*.

Specifications	PHD ULTRA™ CP	PHD ULTRA™ CP 4400
<b>TYPE</b>	Microprocessor, multiple syringe, infusion/withdrawal, programmable	Microprocessor, multiple syringe, infusion/withdrawal, programmable
<b>FLOW ACCURACY</b>	±0.25%	±0.35%
<b>PRESSURE ACCURACY</b>	< ±2%	< ±2%
<b>SYRINGE SIZE, MIX/MAX</b>	0.5 µl to 140 ml	0.5 µl to 140 ml
<b># SYRINGES</b>	2-10	1
<b>FLOW RATE:</b>		
<b>MINIMUM</b>	1.50 pl/min	3.06 pl/min
<b>MAXIMUM</b>	216.0 ml/min	216.0 ml/min
<b>CONNECTORS:</b>		
<b>USB (PC-to-Pump)</b>	Type B	Type B
<b>RS-232 (PC-to-Pump)</b>	9-pin D-Sub	9-pin D-Sub
<b>RS-485* (Pump-to-Pump)</b>	IEEE-1394, 6 pos	IEEE-1394, 6 pos
<b>I/O &amp; TTL</b>	15-pin D-Sub	15-pin D-Sub
<b>AVERAGE LINEAR FORCE</b>	34 kg (75 lb) at 100%	91 kg (200 lb) at 100%
<b>MAXIMUM PRESSURE (with 100 ml Syringe)</b>	50 psi	135 psi
<b>DIMENSIONS CONTROL BOX</b>	30.5 x 21.6 x 17.8 cm (12 x 8.5 x 7 in)	30.5 x 21.6 x 10.6 cm (12 x 8.5 x 4.3 in)
<b>WEIGHT</b>	4.5 kg (10 lb)	5.4 kg (12 lb)
<b>VOLTAGE RANGE</b>	100 to 240 VAC; 50/60 Hz	100 to 240 VAC; 50/60 Hz
<b>Order #</b>	<b>PC6 88-3015</b>	<b>PC6 88-3016</b>

#### KEY FEATURES

- Enables continuous pressure-controlled infusion
- Use in constant flow or constant pressure mode
- Enhances safety for sensitive infusion targets and physiological experimentation
- Compatible with a wide range of pressure transducers
- Automatically adjusts flow rate to maintain constant pressure
- Alpha/numeric keyboard without a PC
- Icon operation
- New color LCD touchscreen
- Up-front control knobs for ease of operation
- Vertical or horizontal orientation
- Adjustable linear force to 75 lb across the entire flow range
- PC Application Included (For datalogging and PC control if required)
- CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme Approved
- 2 year warranty

#### APPLICATIONS

- Short-term organ perfusion studies that require the maintenance of physiologic conditions.
- Introduction of chemical reactants in a controlled manner.
- Ocular injections and perfusions.
- Small animal whole-body perfusions.
- Constant pressure microfluidic mixing.
- Administration of genetic material into organs without viral vectors.

\*Note: PC laptop not included.

## Syringe Pumps

### PHD ULTRA™ Advanced Syringe Pumps



CE

#### KEY FEATURES

- Superior drive mechanism for unmatched smooth flow, accuracy and precision
- For operation at  $\mu\text{L}/\text{min}$  to  $\text{mL}/\text{min}$  flow rates
- Easily program simple to complex methods without a PC
- Alphanumeric keypad for easy Method naming and recall
- Real and relative time clocks
- Intuitive touchscreen and icon interface
- Vertical or horizontal orientation
- Adjustable linear force to 75 lb
- Multi-syringe racks for multi-channel operation or large capacity reservoir
- Legendary reliability – 2 year warranty

#### APPLICATIONS

- Microfluidics
- Drug/Nutritional Delivery
- Electrospraying
- Reaction Chamber Addition
- Mass Spec Calibration
- Feeding Cells
- Low Pressure Chromatography
- Continuous Flow
- Flow Programming
- Gradients
- % Composition Step Changes
- Large Flow Deliveries
- I/O Interactive Experiments



#### PHD ULTRA™

The PHD ULTRA™ is the solution for your most demanding fluidics applications. This pump represents the latest technology in syringe pumps and was developed utilizing the feedback of the world's largest population of syringe pump users.

The PHD ULTRA™ will change the way you think about syringe pumps. There are three major reasons the PHD ULTRA™ is the new standard for syringe pumps:

- 1. Superior mechanical drive mechanism and syringe holding mechanics to achieve the highest performance of any syringe pump.**
- 2. EZ PRO Software and user interface allow easy programming of Methods from simple to complex, all without the use of a PC.**
  - *Preprogrammed Methods for simple to complex operations that allow you to be up and running with the touch of a button.*
  - *LCD, high resolution color touchscreen for powerful functionality, yet very easy to use.*
- 3. Levels of Versatility**
  - a. Configurations: Standard, push-pull, remote, high pressure, multi-racks.
  - b. Connectivity: For USB or RS-232 computer control; RS-485 or optional RJ-11 for daisy chain (control multiple pumps).
  - c. Orientation: Horizontal or vertical orientation to optimize bench space or to minimize tubing.

Since 1901 Harvard Apparatus has been supporting bioresearch fluidics requirements beginning with the introduction of the first commercial syringe pump for bioresearch in 1956. Since 1956, over 70,000 satisfied syringe pump users around the world have made Harvard Apparatus syringe pumps the world's #1 choice.

The PHD ULTRA™ Syringe Pump series is a family of high-accuracy, easy to use, rugged pumps designed for versatile applications including mass spectrometry calibration, drug and nutritional studies, microdialysis, dispensing, chromatography, LC/HPLC and more.

## Syringe Pumps

# PHD ULTRA™ Advanced Syringe Pumps



### Highest Accuracy and Precision

The PHD ULTRA™ syringe pump family has a superior fluidics drive mechanism which assures ease of use and high performance, for the smoothest, most accurate flow rates of any syringe pump. Flow rates of 1.50 µl/min to 216.0 ml/min are accurate within 0.25% and reproducible within 0.05%. A microprocessor-controlled, small step angle stepper motor drives a lead screw and pusher block. Advanced micro-stepping techniques are employed to further reduce the step angle to eliminate flow pulsation.

### Maximum Experimental Versatility

This pump can be oriented vertically or horizontally for optimum experimental connectivity. This pump comes standard to hold 2 syringes, but can be purchased with 3 other syringe racks: 6/10 syringe rack, 4 x 140 ml syringe rack and 4 x microliter syringe rack. Syringe racks can be ordered separately. Multi-syringe racks provide multi-channel operation or serve as a large capacity reservoir.

### Syringe Racks

- The standard 2-syringe rack holds 2 syringes from 0.5 µl to 140 ml
- The 4 x 140 multi-rack holds four 60 ml or 140 ml plastic syringes only
- 6/10 multi-rack will hold up to 10 syringes from 0.5 µl to 20 ml and up to 6 syringes from 30 ml to 60 ml
- The microliter syringe rack independently holds 4 syringes, from 0.5 µl to 10 ml, enabling syringes of different sizes to run simultaneously.

### Easy-to-Use Interface

The PHD ULTRA™ Syringe Pumps are very easy to use with an LCD color touchscreen and icon interface. The Message Area of the touchscreen is used to display helpful instructions for the currently displayed screen. It is also used to display error or warning messages to indicate problem conditions in a Method or error conditions during pump operation. The Run Screen shows all of the pump parameters on one screen for easy review.

### Pump Models

The PHD ULTRA™ Pumps are available in three configurations designed for different operating environments and varying degrees of operational flexibility.

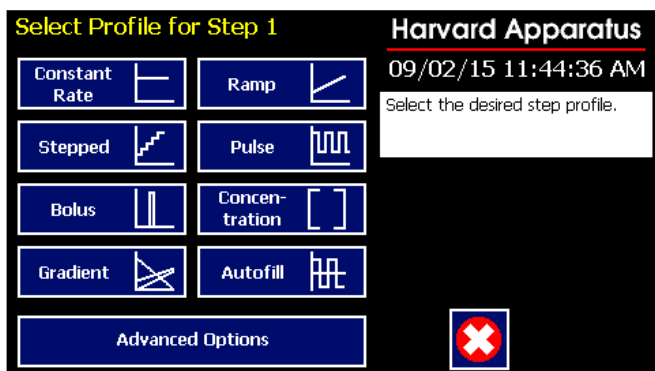
**Infusion Only:** This model supports infusion operations at user-defined flow rates and with selectable target volume or time values to control the total infusion volume. The Infusion Only models do not include programmable, user-defined Methods.

**Infusion/Withdrawal:** This model supports infuse only, withdraw only, infuse/withdraw and withdraw/infuse operations at user-defined flow rates and with selectable target volume or time. Users can create and store one Method up to 800 steps.

**Infusion/Withdrawal Programmable:** This model supports infuse only, withdraw only, infuse/withdraw and withdraw/infuse operations. Users can create and store multiple Methods of up to 800 steps on the pump.



## PHD ULTRA™ Advanced Syringe Pumps



### Program Description

To operate the PHD ULTRA™, the user defines all the required parameters for infusing and/or withdrawing liquids through a Method. This may be a Quick Start, Pre-Programmed or User-Defined Method. The basic operation is a simple 3-step procedure:

1. **Select a Method**
2. **Enter operating parameters**
3. **Preview or Run your Method**

Quick Start Methods are for simple infusions, withdrawals or a combination (depending on the pump model). Custom user-defined Methods can be created when a more advanced Method is required. The setup for a custom Method is easy using the standard profiles found on all Infusion/Withdrawal and Infusion/Withdrawal Programmable PHD ULTRAS. The list of available profiles are:

Constant Rate	Bolus	Pulse
Ramp	Concentration	Autofill
Stepped	Gradient	

By programming and saving custom Methods in the pump, multi-user errors are reduced. Easily transfer complex methods to other pumps and/or download methods from a PC. Forget having to duplicate method-development efforts for each new pump added to your system.

In addition to the advanced pumping profiles listed above, the PHD ULTRA™ contains a variety of advanced options allowing the user to repeat steps, link methods, control valves, external triggers etc.

### Advanced Programming Features

**Flow Programming:** Change the flow with time, volume or a triggered event as many times as you like.

**Bolus:** Inject a large volume of drug (or drugs) at once. The bolus injection can be made in time or volume.

**Concentration Delivery:** Calibrate flow in concentration units of mg/kg easily so flow is calibrated to concentration of drug and animal weight.

**Gradients:** EZ PRO software allows you to easily program gradients, continuous or stepped.

**% Ratio:** Up to three solvents.

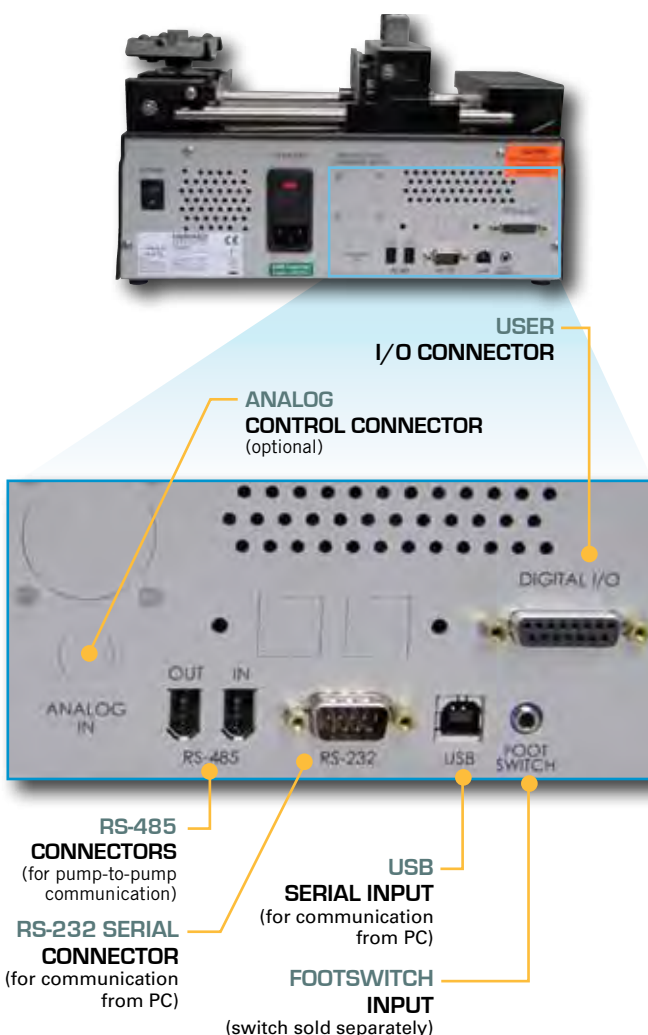
**I/O:** Dedicated and user defined I/O.

**Pulsed Flow:** So you can program the pulse easily.

### Advanced Connectivity

All PHD ULTRA™ Syringe Pumps come standard with a footswitch, USB, RS-232, RS-485 and I/O connectors. There is also an option for RJ-11 connectors and analog control. These options have to be ordered at the time the pump is ordered.

<b>FOOTSWITCH INPUT</b>	Start and stop a pump
<b>USB AND RS-232 SERIAL INPUTS</b>	Control your pump with a computer
<b>RS-485 CONNECTORS</b>	Connect multiple pumps together (up to 99) Connect remote mechanism Connect satellite pumps to the Master pump for binary or ternary gradient system (% composition)
<b>RJ-11 CONNECTORS (OPTION)</b>	Connect multiple pumps together (daisy chain)
<b>USER I/O CONNECTOR</b>	
<b>Direction Control input</b>	Set pump to infuse or withdraw
<b>Trigger Input</b>	Connect an external device to start or stop a pump or Method
<b>Footswitch Input</b>	Start and stop a pump
<b>Trigger 1 Output</b>	Signal another device to start and stop a pump or Method
<b>Trigger 2 Output</b>	Signal another device to start and stop a pump or Method
<b>Sync Output</b>	Synchronize other devices
<b>Valve Output</b>	External valve control
<b>Run Indicator</b>	Connect an external LED or monitoring device to a pump
<b>ANALOG CONTROL (OPTIONAL)</b>	Analog control of the motor speed (0 to 10 V). This option must be ordered at the same time the pump is ordered.





## Syringe Pumps

### PHD ULTRA™ Advanced Syringe Pumps

#### Alarms

There are several alarms available on the PHD ULTRA™ Syringe Pumps.

**End of Run, Near End of Run, Power Up, Stall, Calibration Reminder**

You may choose to activate one, activate them all or mute them all.

#### Advanced GLP Documentation Features

- Download experimental parameters to PC
- Alpha/Numeric capability

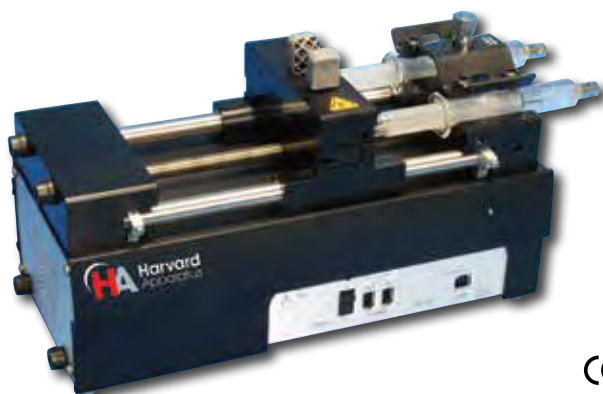
#### Upgrade

We offer pumps that can be upgraded. If you buy an infusion/withdrawal pump and later decide you want programmability you can upgrade it. You pay a lot less than buying a whole new pump.

#### Accessories

A full range of accessories are compatible with the PHD ULTRA™ including syringe heaters, in-line heaters and coolers, microfluidic circuits, connectors, tubing, syringes and more.

### PHD ULTRA™ Satellite Pumps



CE

#### PHD ULTRA™ Satellite Pumps

The PHD ULTRA™ Satellite Pumps are infusion/withdrawal pumps. They are available in three configurations: standard, push/pull and high force. The Satellite Pumps are combined with stand alone PHD ULTRA™ Pumps to create a Gradient System. Satellite Pumps can only be powered from a stand alone PHD ULTRA™ via RS-485. They cannot be controlled with a PC. Satellite Pumps include a footswitch input, USB and RS-485 connectors.

### PHD ULTRA™ Syringe Pump Modules

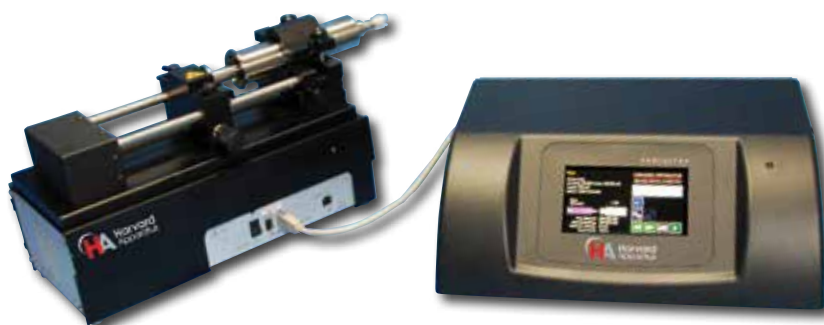


CE

#### PHD ULTRA™ Syringe Pump Modules

The PHD ULTRA™ Syringe Pump Modules are infusion/withdrawal pumps. They are available in three configurations: standard, push/pull and high force. These modules include a footswitch input, USB, RS-232, RS-485 and I/O connectors. They can be controlled via PC. You can also start and stop a pump using the 15-pin user I/O connector. See Advanced Connectivity on page 21 for more information. See page 34 for more information on Syringe Pump Modules.

### PHD ULTRA™ Remote Pumps



CE

#### PHD ULTRA™ Remote Pumps

The PHD ULTRA™ Remote Pumps consist of a control unit and syringe pumping mechanism all connected via a 30 foot RS-485 (IEEE-1394) cable. Every version of the PHD ULTRA™ is available in a remote model. Use the remote pump in hazardous environments where the researcher is safer when distanced from the material being pumped or for applications where it is necessary to have your pump inside an incubator.

## PHD ULTRA™ Advanced Syringe Pumps

PHD ULTRA™ Specifications	
<b>TYPE</b>	Microprocessor multiple syringe, infusion only, infusion/withdrawal or infusion/withdrawal programmable
<b>ACCURACY</b>	±0.25%
<b>SYRINGES:</b>	
<b>Type</b>	Plastic, glass or stainless steel
<b>Size Minimum</b>	0.5 µl
<b>Size Maximum</b>	140 ml
<b>FLOW RATE:</b>	
<b>Minimum</b>	1.50 µl/min
<b>Maximum</b>	216.0 ml/min
<b>DISPLAY</b>	4.3" WQVGA TFT color display with touchscreen
<b>CONNECTORS:</b>	
<b>RS-232</b>	9-pin D-Sub Connector
<b>RS-485</b>	6-position IEEE-1394
<b>USB</b>	Type B
<b>I/O &amp; TTL</b>	15-pin D-Sub Connector
<b>Footswitch</b>	Phono jack
<b>LINEAR FORCE</b>	34 kg (75 lb) @ 100% force selection
<b>STEP RESOLUTION</b>	0.082 µm/µstep
<b>VOLTAGE RANGE</b>	Universal input 100 to 240 VAC, 50/60 Hz
<b>DIMENSIONS, H x W x D</b>	17.8 x 30.48 x 21.59 cm (7 x 12 x 8.5 in)
<b>WEIGHT</b>	4.5 kg (10 lb)
<b>REGULATORY CERTIFICATIONS</b>	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

Product	Order #	Order #	Order #	Order #
<b>PHD ULTRA™ Standard</b>	<b>Stand Alone</b>	<b>Remote</b>	<b>Satellite*</b>	<b>Syringe Pump Module</b>
PHD ULTRA™ Infusion Only	PC6 70-3005	PC6 70-3305	–	–
PHD ULTRA™ Infusion/Withdrawal	PC6 70-3006	PC6 70-3306	PC6 70-3406	PC6 70-3506
PHD ULTRA™ Infusion/Withdrawal Programmable	PC6 70-3007	PC6 70-3307	–	–
<b>PHD ULTRA™ Push/Pull</b>	<b>Stand Alone</b>	<b>Remote</b>	<b>Satellite*</b>	<b>Syringe Pump Module</b>
PHD ULTRA™ Push/Pull Infusion/Withdrawal	PC6 70-3008	PC6 70-3308	PC6 70-3408	PC6 70-3508
PHD ULTRA™ Push/Pull Infusion/Withdrawal Programmable	PC6 70-3009	PC6 70-3309	–	–
<b>PHD ULTRA™ High Pressure</b>	<b>Stand Alone</b>	<b>Remote</b>	<b>Satellite*</b>	<b>Syringe Pump Module</b>
PHD ULTRA™ 4400 Pump I/W Programmable	PC6 70-3010	PC6 70-3310	PC6 70-3410	PC6 70-3510
PHD ULTRA™ HPSI Remote Pump I/W Programmable	–	PC6 70-3311	–	–
PHD ULTRA™ HPSI Remote Pump I/W Programmable with 10 x 140 Rack	–	PC6 70-3312	–	–
PHD ULTRA™ XF Remote I/W Programmable	–	PC6 70-3314	–	PC6 70-3514

\*Note: Gradient Systems are available, see page 25 for details.

Order #	Product
<b>PHD ULTRA™ Options and Kits</b>	
PC6 70-3030	RS-232 RJ-11 Connectors Option (daisy chain)
PC6 70-3033	Analog Control Input Option (0-10 V) <sup>2</sup>
PC6 70-3034	Internal Fan Option <sup>3</sup>
PC6 70-3023	Anti-Siphon Kit for PHD ULTRA™
<b>PHD ULTRA™ Syringe Rack Kits Ordered without a Pump</b>	
PC6 70-3024	6/10 Multi-Syringe Rack for PHD ULTRA™, independently holds 10 syringes
PC6 70-3021	4 x 140 Multi-Syringe Rack for PHD ULTRA™
PC6 70-3022	Microliter Rack for PHD ULTRA™, independently holds 4 syringes
<b>PHD ULTRA™ Syringe Rack Kits Ordered with a Pump</b>	
PC6 70-3024A	6/10 Multi-Syringe Rack for PHD ULTRA™, independently holds 10 syringes
PC6 70-3021A	4 x 140 Multi-Syringe Rack for PHD ULTRA™
PC6 70-3022A	Microliter Rack for PHD ULTRA™, independently holds 4 syringes
<b>PHD ULTRA™ Upgrades</b>	
PC6 70-4010	Upgrade Infusion Only to I/W <sup>1</sup>
PC6 70-4011	Upgrade Infusion Only to Programmable <sup>1</sup>
PC6 70-4012	Upgrade I/W to Programmable <sup>1</sup>

<sup>1</sup> Note: Requires Return to Factory

<sup>2</sup> Note: Only for Programmable Models. Not available on Satellite Boxes.

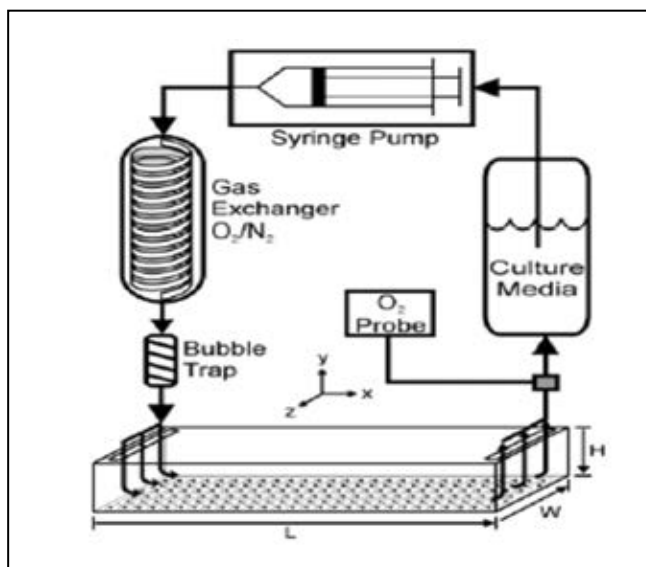
<sup>3</sup> Note: Fan option is required if external operating ambient is expected to be >35°C

Accessories	
PC6 70-4000	RS-485 Cable for Pump-to-Pump Communication, 0.5 m (1.6 ft)
PC6 70-4001	RS-485 Cable for Pump-to-Pump Communication, 2 m (6.6 ft)
PC6 70-4020	RS-485 Extension Cable, 9.1 m (30 ft)
PC6 70-4021	RS-485 Extension Cable, 1 m (3.2 ft)
PC6 70-4002	USB Cable for PC-to-Pump Communication, 2 m (6.6 ft)
PC6 70-4003	USB Cable for PC-to-Pump Communication, 5 m (16.4 ft)
PC6 70-4004	RS-232 Cable for PC-to-Pump Communication, 9-pin D-sub, 2 m (6.6 ft)
PC6 70-4005	Adapter, PHD Digital I/O
PC6 70-4006	Adapter, D-sub 15 to Term. Blk
PC6 72-8340	Adapter, USB to Serial
PC6 70-2215	Footswitch (with Phono Plug)
PC6 55-7010	Auto Fill Valve Box, Low Pressure, 25 psi
PC6 55-0121	Auto Fill Valve Box, Medium Pressure, 100 psi
PC6 55-7008	Auto Fill Valve Box, High Pressure, 200 psi
PC6 55-7760	Cable Assy, Daisy-chain, Legacy RS-232 RJ-11, 0.6 m (2 ft)
PC6 72-2478	Cable Assy, Daisy-chain, Legacy RS-232 RJ-11, 2.1 m (7 ft)
PC6 55-8000	Plunger Adapter for 25 ml, 50 ml, 100 ml Hamilton GasTight™ Syringes

## Syringe Pumps

### PHD ULTRA™ Push/Pull Syringe Pump

SYRINGE PUMPS PHD ULTRA™ Push/Pull Syringe Pump



Pressure-driven flow was continuous using a programmable push-pull syringe pump (Harvard Apparatus, Holliston, MA). Media was equilibrated with 10% or 21%  $O_2$  in a gas exchanger made with gas-permeable silastic tubing<sup>1</sup>.

#### KEY FEATURES

- **Compensating Flows:** The control of continuous infusion and simultaneous withdrawal of liquids while monitoring fluid levels
- **Perfusion Across Tissue Beds:** Directional control of flows across tissue beds using switching valves
- **Continuous Flow with High Accuracy and Smooth Flow:** Pump Any Volume Large or Small with Smooth, Non Pulsating Flow
- **Continuous Accurate Flow for High Pressure Systems:** Unlike peristaltic pumps, syringe pumps can pump against high pressures
- **Easily Sterilized Flow Path:** By replacing syringe and tubing with a sterilized set, this pump can maintain its sterility

#### PHD ULTRA™ Push/Pull References

High-density cell seeding of myocyte cells for cardiac tissue engineering, Radisic et. al., 2008, Biotechnology and Bioengineering, Volume 82, Issue 4

Fabrication of 3D hepatic tissues by additive photopatterning of cellular hydrogels, Tsang et. al., 2007, FASEB, Volume 21

<sup>1</sup>Formation of Steady-State Oxygen Gradients In Vitro, Application to Liver Zonation Allen et. al., 2003, Biotechnology and Bioengineering, Volume 82, No 3

The PHD ULTRA™ Push-Pull syringe pump provides virtually pulse free, high accuracy and high precision flow. Complex programs can be written using on-board EZ Pro software to reduce shear stress during cell deposition and adhesion during tissue and organ development. Conversely, the same complex programs can be used to create particular shear forces on developing cells.

The PHD ULTRA™ Push Pull combines the high accuracy of our ULTRA line of pumps. Harvard Apparatus also has a wide array of temperature control products to provide complete environmental control. Our 2 year warranty and robust construction allow these pumps to work continuously for extended periods of time with unsurpassed reliability.

Order #	Product
PC6 70-3009	PHD ULTRA™ Push-Pull Programmable Syringe Pump
PC6 61-0270	Continuous Flow Tubing Segment

\*Note: For full product offering please see page 23.

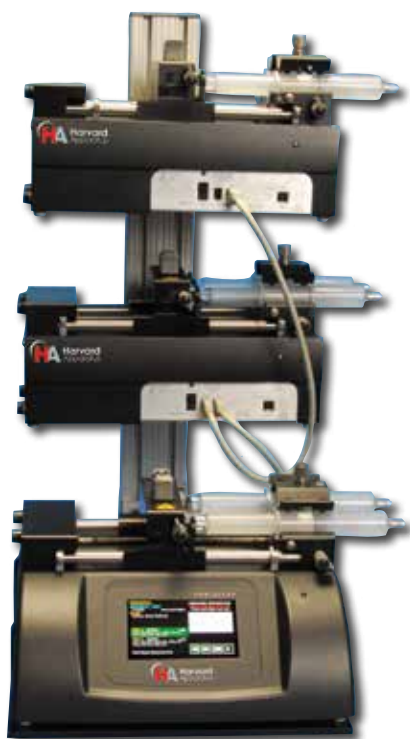
Watch a video demonstration of a PHD ULTRA™ Push-Pull Programmable Syringe Pump. To view press release, use your smart phone to scan the QR code or to view in a web browser go to <http://tinyurl.com/44to6pv>



# Syringe Pumps

## Mixture/Dose Delivery System

PC6 70-4102  
PHD ULTRA™  
Gradient System  
with Stand



### KEY FEATURES

- Easily run binary or ternary gradients without a PC
- Combine multiple flow streams into one common output
- No stopping experiment to fill syringes with different mixtures

### APPLICATIONS

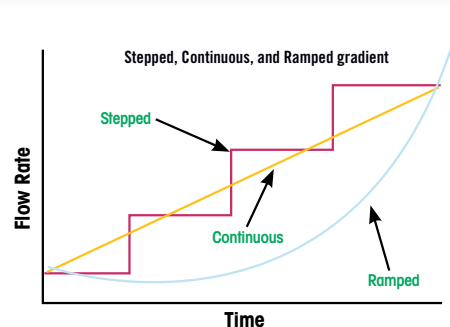
- Serial Dilutions of reaction dosing solutions
- Serial Dilutions for drug infusion experiments
- Serial Dilutions for nutritional infusion experiments
- Serial Dilutions for mixing polymers in electrospinning
- Chromatography
- FIA systems

The PHD ULTRA™ Gradient Systems allows you to quickly and easily run binary or ternary mixtures automatically without a PC. The Method is totally programmed from a master controller pump, for easy set-up. The intuitive program interface makes simple to complex mixing easy. The Gradient Profile is used to combine multiple flow streams from different pumps into a common output stream. The flow can be smooth and continuous or stepped. No stopping the experiment, mixing different % volume mixtures and placing new syringes into the pumps. Push one button and it all happens automatically.

Binary and ternary gradient systems are available with or without a stand. Individual Satellite units are also available for purchase separately.

For more information on the PHD ULTRA™ Syringe Pumps see page 18-22. For more information on the PHD ULTRA™ Satellite units see page 22.

*Note: PHD ULTRA™ 4400 Gradient Systems available, contact Harvard Apparatus for details.*



**Step 1, Gradient** **HARVARD APPARATUS**  
10/27/09 11:57:15 AM

**Set Combined Flow Rate**  
221 ml/min

**Address** **Set** **0 %** **25 %**

**Address** **01** **25 %** **33 %**

**Address** **02** **75 %** **42 %**

**Set Time & # Steps**  
30 second(s) 5 steps

Enter your total time and number of steps and then press the Enter button (green check mark) to accept or press the Cancel button (red X) to cancel and return to the previous screen.

### Mix/Dose Delivery System Specifications

<b>TYPE</b>	Microprocessor multiple syringe, infusion/withdrawal programmable
<b>ACCURACY</b>	±0.25%
<b>SYRINGES:</b>	
<b>Type</b>	Plastic, glass or stainless steel
<b>Size Minimum</b>	0.5 µl
<b>Size Maximum</b>	140 ml
<b>FLOW RATE:</b>	
<b>Minimum</b>	1.50 µl/min
<b>Maximum</b>	216.0 ml/min
<b>DISPLAY</b>	4.3" WQVGA TFT Color Display with Touchpad
<b>CONNECTORS:</b>	
<b>RS-232</b>	9-pin D-Sub Connector
<b>RS-485</b>	6-position IEEE-1394
<b>USB</b>	Type B
<b>I/O &amp; TTL</b>	15-pin D-Sub Connector
<b>Footswitch</b>	Phono jack
<b>LINEAR FORCE</b>	34 kg (75 lb) @ 100% force selection
<b>STEP RESOLUTION</b>	0.082 µm/µstep
<b>VOLTAGE RANGE</b>	Universal input 100 to 240 VAC, 50/60 Hz
<b>DIMENSIONS, H x W x D</b>	10.16 x 30.48 x 21.59 cm (4 x 12 x 8.5 in)
<b>WEIGHT</b>	4.5 kg (10 lb)
<b>CERTIFICATIONS</b>	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

Order #	Product
<b>PC6 70-4101</b>	PHD ULTRA™ Infusion/withdrawal programmable Gradient System 1 Master/1 Satellite with Stand
<b>PC6 70-4102</b>	PHD ULTRA™ Infusion/withdrawal programmable Gradient System 1 Master/2 Satellites with Stand
<b>PC6 70-4106</b>	PHD ULTRA™ Infusion/withdrawal programmable Gradient System 1 Master/1 Satellite without Stand
<b>PC6 70-4107</b>	PHD ULTRA™ Infusion/withdrawal programmable Gradient System 1 Master/2 Satellites without Stand



## Syringe Pumps

### PHD ULTRA™ XF and PHD ULTRA™ HPSI



#### KEY FEATURES: PHD ULTRA™ XF

- Pump up to 800 ml with four 200 ml syringes
- Ultra high pressure – delivers over 400 lb of pumping force (HPSI Model)
- Ultra high pressure – delivers 1000 lb of pumping force (XF Model)
- Intuitive touchscreen with icon interface
- Easily program simple to complex Methods without a PC

#### APPLICATIONS

- High Pressure Injections
- Drug Delivery
- Pumping Highly Corrosive Fluids
- Injecting into High Pressure Reaction Vessels
- Remote pumping of Hazardous Material

The PHD ULTRA™ HPSI and PHD ULTRA™ XF pumps are infusion/withdrawal programmable syringe pumps that hold four stainless steel syringes ranging from 20 ml to 200 ml. These high pressure pumps deliver over 400 lb and 1000 lb of pumping force respectively. The PHD ULTRA™ HPSI and PHD ULTRA™ XF syringe pumps are ideal for high pressure applications or for pumping large volumes.

The PHD ULTRA™ HPSI Syringe Pump consists of a control unit, a syringe pumping mechanism and a 5 foot (1.5 m) cable to connect the two units. Although stainless steel syringes are recommended, this pump includes mounting brackets for plastic syringes.

The PHD ULTRA™ XF Syringe Pump consists of a control unit, a syringe pumping mechanism and a 30 foot (9.1 m) cable to connect the two units.

#### PHD ULTRA™ XF and HPSI Remote Specifications

<b>TYPE</b>	Microprocessor multiple syringe, infusion/withdrawal or infusion/withdrawal programmable
<b>ACCURACY</b>	±0.50%
<b>SYRINGES:</b>	
<b>PHD ULTRA™ XF</b>	20 ml to 200 ml (stainless steel only)
<b>PHD ULTRA™ HPSI</b>	PC6 70-3311: 20 ml to 200 ml (stainless steel) PC6 70-3312: 60 ml or 140 ml (plastic syringes only)
<b>FLOW RATE:</b>	
<b>Minimum</b>	50.79 nl/min (using 20 ml syringe)
<b>Maximum</b>	144.3 ml/min (using 200 ml syringe)
<b>DISPLAY</b>	4.3" WQVGA TFT color display with touchscreen
<b>CONNECTORS:</b>	
<b>RS-232</b>	9-pin D-Sub Connector
<b>RS-485</b>	6-position IEEE-1394
<b>USB</b>	Type B
<b>I/O &amp; TTL</b>	15-pin D-Sub connector
<b>Footswitch</b>	Phono jack
<b>AVERAGE LINEAR FORCE:</b>	
<b>PHD ULTRA™ XF</b>	454 kg (1000 lb) @ 100% force selection
<b>PHD ULTRA™ HPSI</b>	196 kg (433 lb) @ 100% force selection
<b>STEP RESOLUTION</b>	0.082 µm/step
<b>VOLTAGE RANGE</b>	Universal input 100 to 240 VAC, 50/60 Hz
<b>DIMENSIONS, H x W x D</b>	10.16 x 30.48 x 21.59 cm (4 x 12 x 8.5 in)
<b>DIMENSIONS (CONTROL BOX)</b>	30.48 x 21.59 x 10.8 cm (12 x 8.5 x 4.25 in)
<b>DIMENSIONS (REMOTE BOX)</b>	40.64 x 30.48 x 19.69 cm (16 x 12 x 7.75 in)
<b>WEIGHT</b>	13.7 kg (30.2 lb)
<b>REGULATORY CERTIFICATIONS</b>	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

Order #	Product
<b>PC6 70-3311</b>	PHD ULTRA™ HPSI Remote Infusion/Withdrawal Programmable Syringe Pump
<b>PC6 70-3312</b>	PHD ULTRA™ HPSI Remote Infusion/Withdrawal Programmable Syringe Pump with 10 x 140 Rack
<b>PC6 70-3314*</b>	PHD ULTRA™ XF Remote Infusion/Withdrawal Programmable Syringe Pump
<b>PC6 70-3030</b>	PHD ULTRA™ RS-232 and RJ-11 Connectors Option
<b>PC6 70-3033</b>	PHD ULTRA™ Analog Control Input Option (0-10 VDC)

\*Note: XF Pump also available as a Syringe Pump Module (PC6 70-3514).  
Standard mounting is for stainless steel syringes. Inquire for mounting other types of syringes.  
\*High Force and Push-Pull Gradient Systems are available.

# Syringe Pumps

## PHD ULTRA™ 4400



PHD ULTRA™ 4400  
Stand-Alone

### KEY FEATURES

- Delivers >200 lb (91 kg) linear pumping force across a wide flow rate range
- Accurate and smooth flow
- Ideally suited for stainless steel syringes
- Easy-to-use touchscreen and icon interface
- Program simple to complex Methods without a PC
- Legendary reliability – 2 year warranty

### APPLICATIONS

- High Pressure Injections
- Drug Delivery
- Pumping Highly Corrosive Fluids
- Injecting into High Pressure Reaction Vessels
- Remote pumping of Hazardous Material

The PHD ULTRA™ 4400 is a single syringe infusion/withdrawal programmable syringe pump. This pump allows you to create, save and run simple to complex Methods without a PC or just enter a flow rate and run. The flow rate range is 3.06 pl/min to 216.0 ml/min with 200 lb of adjustable force across the entire flow rate range. For more information on the PHD ULTRA™ 4400 including features and programming see page 26.

The PHD ULTRA™ 4400 pump is ideal for high pressure applications. This pump is available in two configurations: stand-alone and remote. The remote model consists of a control unit, a syringe pumping mechanism and a 5 foot cable to connect the two units.

The PHD ULTRA™ 4400 has a footswitch input, RS-232 and USB serial ports for computer control, RS-485 ports for daisy chaining pumps and Digital I/O for external control via an independent computer or device. There is also an option for daisy chaining pumps through the RS-232 (RJ-11) ports. This option must be ordered at the time the pump is ordered.

*Note: PHD ULTRA™ 4400 Gradient Systems available, contact Harvard Apparatus for details.*

Specifications	PHD ULTRA™ 4400 Stand-Alone	PHD ULTRA™ 4400 Remote
TYPE	Microprocessor single syringe infusion/withdrawal programmable	Microprocessor single syringe infusion/withdrawal programmable
ACCURACY	±0.35%	±0.35%
SYRINGES		
Type	Glass, Plastic or Stainless Steel	
Size Minimum	0.5 µl	0.5 µl
Size Maximum	140 ml	140 ml
FLOW RATE:		
Minimum	3.06 pl/min	3.06 pl/min
Maximum	216.0 ml/min	216.0 ml/min
DISPLAY	4.3" WQVGA TFT color display with touchscreen	
CONNECTORS:		
RS-232	9-pin D-Sub Connector	9-pin D-Sub Connector
RS-485	IEEE-1394, 6 pos	IEEE-1394, 6 pos
USB	Type B	Type B
I/O & TTL	15-pin D-Sub Connector	15-pin D-Sub Connector
Footswitch	Phono jack	Phono jack
AVERAGE LINEAR FORCE	91 kg (200 lb) @ 100% Force Selection	91 kg (200 lb) @ 100% Force Selection
STEP RESOLUTION	0.164 µm/µstep	0.164 µm/µstep
VOLTAGE RANGE	Universal input 100 to 240 VAC, 50/60 Hz, 50 W, 0.5 A fuse	Universal input 100 to 240 VAC, 50/60 Hz, 75 W, 0.5 A fuse
DIMENSIONS, H x W x D:		
Control Box	30.48 x 21.59 x 18.4 cm (12 x 8.5 x 7.25 in)	30.48 x 21.59 x 10.8 cm (12 x 8.5 x 4.25 in)
Remote Box	N/A	27.9 x 13.5 x 18.4 cm (11.0 x 5.3 x 7.25 in)
WEIGHT	5.5 kg (12.1 lb)	6.4 kg (14.1 lb)
REGULATORY CERTIFICATIONS	CE, ETL (UL, CSA), WEEE, EU RoHS and CB Scheme	
Order #	PC6 70-3010	PC6 70-3310

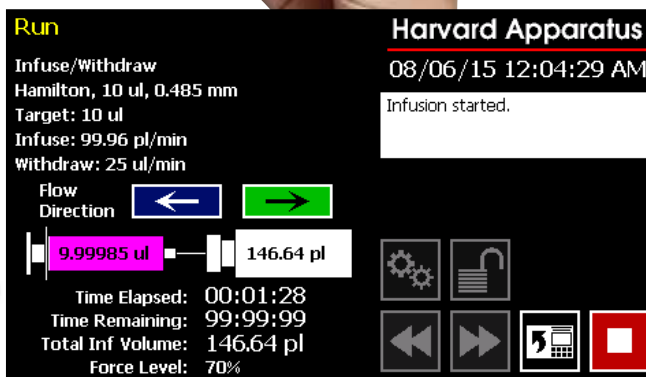
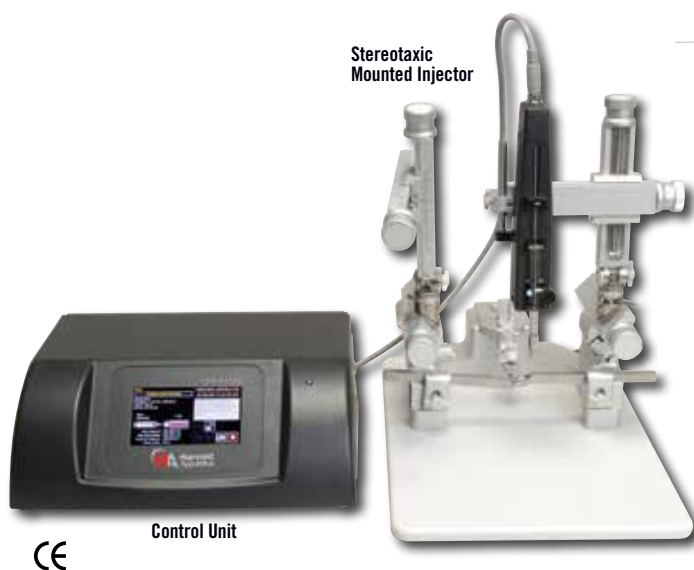
### Accessories

<b>PC6 70-4000</b>	RS-485 Cable for Pump-to-Pump Communication, 0.5 m (1.6 ft)
<b>PC6 70-4021</b>	RS-485 Cable for Pump-to-Pump Communication, 1 m (3.3 ft)
<b>PC6 70-4001</b>	RS-485 Cable for Pump-to-Pump Communication, 2 m (6.6 ft)
<b>PC6 70-4002</b>	USB Cable for PC-to-Pump Communication, 2 m (6.6 ft)
<b>PC6 70-4003</b>	USB Cable for PC-to-Pump Communication, 5 m (16.4 ft)
<b>PC6 70-4004</b>	RS-232 Cable for PC-to-Pump Communication, 9-pin D-sub, 2 m (6.6 ft)
<b>PC6 70-4020</b>	RS-485 Cable (IEEE-1394) Remote Extension Cable, 9.1 m (30 ft)
<b>PC6 70-4005</b>	Adapter, PHD Digital I/O
<b>PC6 72-4006</b>	Adapter, D-sub 15 to Term, Blk
<b>PC6 70-3315</b>	Footswitch (with Phono Plug)
<b>PC6 55-7760</b>	Cable Assy, Daisy-chain, Legacy RS-232 RJ-11, 0.6 m (2 ft)
<b>PC6 72-2478</b>	Cable Assy, Daisy-chain, Legacy RS-232 RJ-11, 2.1 m (7 ft)

# Syringe Pumps

## PHD ULTRA™ Nanomite

SYRINGE PUMPS PHD ULTRA™ Nanomite



### KEY FEATURES

- Light weight makes it ideal for hand-held or stereotaxic injection
- Easy-to-use LCD color touchscreen with GUI interface
- Create and store >50 programs for
- High performance in a small package
- 1000 times better than manual syringes

### APPLICATIONS

- Cellular Injections
- Drug Delivery
- Microinjections
- Hand-Held Automated Delivery
- Stereotaxic Injections
- Regenerative Medicine

The PHD ULTRA™ Nanomite is a single syringe infusion/withdrawal programmable syringe pump. This pump allows you to create, save and run simple to complex Methods without a PC. The flow rate range is 3.66 pl/min to 3.82 ml/min with 11 lb of adjustable force across the entire flow rate range.

The PHD ULTRA™ Nanomite has a footswitch input, RS-232 and USB serial ports for computer control, RS-485 ports for daisy chaining pumps and Digital I/O for external control via an independent computer or device. There is also an option for daisy chaining pumps through the RS-232 (RJ-11) ports. This option must be ordered at the time the pump is ordered. See page 19 for more information on connectivity.

This pump consists of a control unit, an injection unit, a 6 foot cable to connect the two units and a footswitch.

For more information on the PHD ULTRA™ Nanomite including features and programming see the PHD ULTRA™ on page 19.

### PHD ULTRA™ Nanomite Specifications

<b>TYPE</b>	Microprocessor single syringe Infusion/Withdrawal Programmable
<b>ACCURACY</b>	±0.5%
<b>SYRINGES:</b>	
Type	Glass or plastic
Size Minimum	0.5 µl
Size Maximum	1 ml
<b>FLOW RATE:</b>	
Minimum	3.66 pl/min
Maximum	3.82 ml/min
<b>DISPLAY</b>	4.3" WQVGA TFT color display with touchscreen
<b>CONNECTORS:</b>	
RS-232	9-pin D-Sub Connector
RS-485	IEEE-1394, 6 position
USB	Type B
I/O & TTL	15-pin D-Sub Connector
Footswitch	Mini phono jack
<b>AVERAGE LINEAR FORCE</b>	5 kg (11 lb) @ 100% force selection
<b>STEP RESOLUTION</b>	0.198 µm/µstep
<b>VOLTAGE RANGE</b>	100 to 240 VAC, 50/60 Hz, 75 W, 0.5 A fuse
<b>DIMENSIONS H x W x D:</b>	
Control Box	30.5 x 21.6 x 11.1 cm (12.0 x 8.5 x 4.38 in)
Injector Unit	6.35 x 5.08 x 19.05 cm (2.5 x 2.0 x 7.5 in)
<b>WEIGHT:</b>	
Control Box	2.06 kg (4.55 lb)
Injector Unit	0.458 kg (1.01 lb)
<b>REGULATORY CERTIFICATIONS</b>	CE, ETL (UL, CSA), WEEE, EU RoHS and CB Scheme

Order #	Product
PC6 70-3601	PHD ULTRA™ Nanomite Infusion/Withdrawal Programmable Single Syringe

# Syringe Pumps

## NanoCool™ Injector



### KEY FEATURES

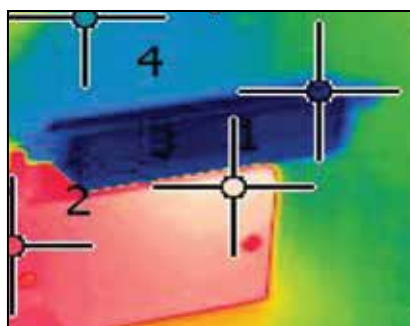
- 18°C for optimal cell viability on any delivery syringe and Eppendorf
- 20% Increase in Survivability, 76% Lower O<sub>2</sub> Consumption Rate at 18°C vs. 37°C
- Flow ramping to reduce injection site blowback
- Programmed methods for automatic recall of entire cell delivery system. Up to 100 methods stored for recall
- 2 year warranty
- High accuracy delivery between 3.66 pL/min to 1.91 mL/min
- Preprogrammed bolus injection mode, just specify injection size and time of dispense
- Footswitch activation keeps hands free

### NanoCool™ Cell Delivery System

When injecting stem cells viability of cells can be a major issue. The injection system and sample vortex holder are held at 18°C. The cell delivery is totally integrated in its operation through the NanoCool's microprocessor system: power, temperature injection volumes and flow ramping are all controlled by the NanoCool's program. Keeping the cells at 18°C instead of 37°C reduces O<sub>2</sub> consumption of cells by an average of 76%. The chart to the right shows the different organ utilization curves.

### Temperature Effect on O<sub>2</sub> Consumption by Organ Cell Type

Organ	Temperature	Oxygen Consumption	Change in O <sub>2</sub> Consumption	% Change
Kidney	37 to 18	3.7 to 0.9	2.8	75.7
Liver	37 to 18	3.0 to 0.6	2.4	80
Heart	37 to 18	2.4 to 0.7	1.7	70.8
Brain	37 to 18	1.9 to 0.4	1.5	78.9
Muscle	37 to 18	0.8 to 0.2	0.6	75
Skin	37 to 18	0.4 to 0.1	0.3	75



IR Temperature Image  
NanoCool at 18°C

### NanoCool™ Injector Specifications

ACCURACY	±0.5%
SYRINGES (MIN./MAX.)	50 µL / 500 µL
FLOW RATE:	
Minimum	3.66 pL/min
Maximum	1.91 mL/min
INJECTOR HEAD/ACTUATOR, L x H x W	20.3 x 5.1 x 5.1 cm (8 x 2 x 2 in)

### Order # Product

PC6 88-1050 NanoCool™ Injector



# Syringe Pumps

## PUMP 33 DDS



Pump 33 DDS

### KEY FEATURES

- Two independently controlled syringe pumps in one instrument
- High Accuracy  $\pm 0.25\%$
- Accommodates syringe sizes 0.5  $\mu$ l to 60 ml
- Smooth flow down to 1.02  $\mu$ l/min (syringe dependent)

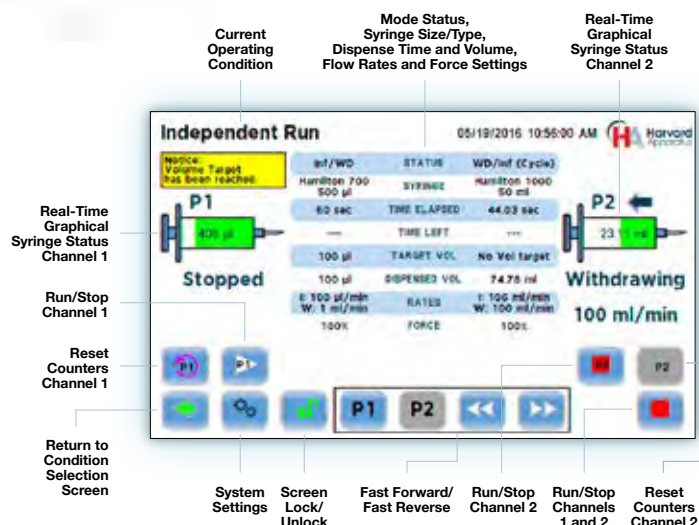
The Harvard Apparatus Pump 33 DDS (Dual Drive System) is a leap forward in syringe pump capability. The Pump 33 DDS has two independent pumping channels controlled by an intuitive touchscreen interface.

### Graphical User Interface

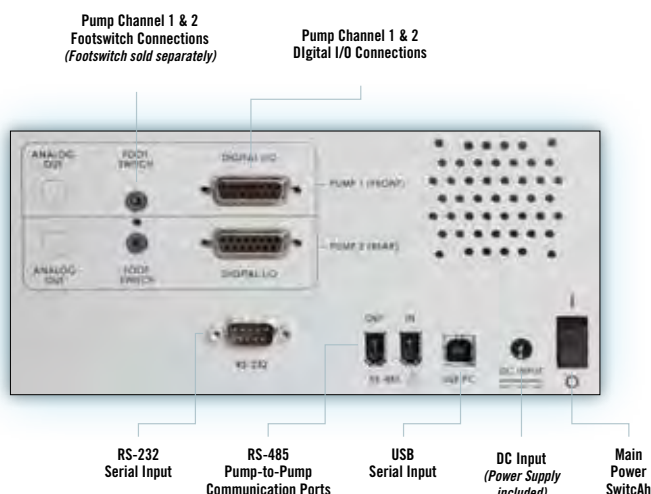
The intuitive Pump 33 DDS graphical user interface controlled with a large 7" LCD color touchscreen display allows quick and easy setup. The display run screen presents the user with all key dispensing parameters in real time. Syringe tables containing all major syringe manufacturers allow simple selection of any compatible syringe size. Audible Alarms, Adjustable Force and Screen Lock are all features that are available with a touch of the screen.

### Advanced Connectivity

The Pump 33 DDS comes standard with USB and RS-232 for PC communication and RS-485 for pump-to-pump communication. An entire suite of ASCII commands is available to control the pump remotely with a PC. The pump contains a footswitch input and digital input/output for each independent pumping channel.



Pump 33 DDS Syringe Selection Screen



Harvard Apparatus syringe pumps are for research purposes only. Not for use on humans.

# Syringe Pumps

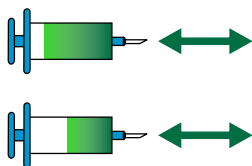
## PUMP 33 DDS

### Operating Conditions

Three operating conditions are available to accommodate a wide range of setups and experimental protocols.

#### Independent Condition

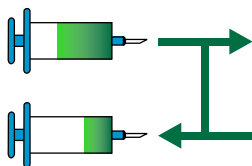
Independent Condition allows the Pump 33 DDS to operate as two separate syringe pumps named P1 & P2. Each syringe will operate independently with different syringe types, size, force, target (volume or time, mode dependent).



	Mode	Syringe	Rate	Target Volume/Time
P1	Infuse, Withdraw, Infuse/Withdraw, Withdraw/Infuse	Any size/type 0.5 µl -60 ml	Any within syringe capability	Any (Mode Dependent)
P2	Infuse, Withdraw, Infuse/Withdraw, Withdraw/Infuse	Any size/type 0.5 µl -60 ml	Any within syringe capability	Same as P1

#### Reciprocating Condition

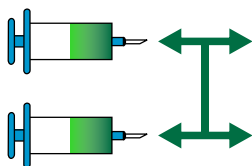
In reciprocating condition, both syringe channels move in opposite directions at the same rate using the same syringe size and type. When combined with a valve box, the reciprocating condition can provide the continuous fluidic delivery of a peristaltic pump with the accurate, low flow rates provided by a syringe pump.



	Mode	Syringe	Rate	Target Volume/Time
P1	Infuse/Withdraw, Withdraw/Infuse	Any size/type 0.5 µl -60 ml	Any within syringe capability	Any
P2	Opposite of P1	Same as P1	Same as P1	Same as P1

#### Twin Condition

Twin Condition allows both syringes to operate in the same mode using the exact same syringe type, syringe size, force, target (volume or time) and flow rate settings. The pump also allows the user to combine both flows for higher speed and volume infusion applications.



	Mode	Syringe	Rate	Target Volume/Time
P1	Infuse, Withdraw, Infuse/Withdraw, Withdraw/Infuse	Any size/type 0.5 µl -60 ml	Any within syringe capability	Any (Mode Dependent)
P2	Same as P1	Same as P1	Same as P1	Same as P1

Specifications	
Type	Microprocessor dual independent infuse/withdraw/continuous syringe pump
Accuracy	±0.25%
Syringe:	
Type	Glass, plastic and stainless steel
Size Minimum	0.5 µl (0.103 mm minimum inner diameter)
Size Maximum	60 ml (32.573 mm maximum inner diameter)*
Flow Rate:	
Minimum	1.02 pl/min (0.5 µl syringe, 0.103 mm inner diameter)
Maximum	106 ml/min (60 ml syringe, 32.573 mm diameter)
Display	7" color display with touchscreen
Connectors:	
USB	Type B
RS-232	9-pin D-sub connector
RS-485	IEEE-1394, 6 pos for pump-pump communication
TTL Input/Output	Two 15-pin D-sub connectors, one for each pump mechanism

Footswitch	Two phonojack inputs, one for each pump mechanism
Average Linear Force	70 lb (31.75 kg) at 100% force setting up to a flow rate of 90 ml/min using up to a 60 ml syringe with a 32.573 mm inner diameter
	50 lb (22.6 kg) at 100% force setting for flow rates 90 ml/min to 106 ml/min using the same size syringe
Power Supply	Input 100 to 240 VAC, 50/60 Hz, Output 30 V 1.66 A 50 W

Weight	21 lb (9.09 kg)
Dimensions (L x D x H)	11 x 15 x 8" (28 x 39 x 21 cm)
Classification	Class I
Pollution	Degree 1
Installation	Category II
Regulatory Certifications	CE, ETL (UL & CSA), CB Scheme, EU RoHS, WEEE

Order #	Product
PC6 70-3333	Pump 33 DDS Dual Independent Syringe Pump
PC6 70-2215	Footswitch (with phone plug)

## Syringe Pumps

### PHD 22/2000 Advanced Syringe Pumps

PHD 22/2000  
Infusion/Withdrawal  
with Standard  
2-Syringe-Rack



PHD 22/2000  
Infusion Only  
with Standard  
2-Syringe Rack



PHD 22/2000  
Infusion/Withdrawal  
with 6/10 Multi-Rack



PHD 22/2000  
Push/Pull Syringe Pump



PC6 61-0270  
Continuous Flow Tubing Segment

#### KEY FEATURES

- High accuracy and precision
- Multiple configuration available
- Smooth flow over a wide flow rate range
- Multi-syringe racks for large capacity reservoir
- Legendary reliability – 2 year warranty

#### APPLICATIONS

- Drug/Nutritional Delivery
- Electrosinping
- Microfluidics/Nanofluidics
- Mass Spec Calibration

Over forty years ago Harvard Apparatus perfected the leadscrew principle and created the first syringe pump. Since that time, tens of thousands of Harvard Apparatus pumps have earned a reputation as the most reliable research pumps in every major laboratory in the World. The PHD 22/2000 syringe pump series gives you the lowest flow rates, the highest accuracy, the smoothest flow, advanced programmability from the keypad and yet, is very easy to use. It is also incredibly quiet so it won't disturb your experimental subjects.

#### Configurations

This pump is available as a **standard, push/pull, remote, high pressure, or with multi-racks.**

#### Upgrade

We offer pumps that can be upgraded. If you buy an infusion/withdrawal pump and later decide you want programmability you can upgrade it, see page 31.

### Syringe Racks

The PHD 22/2000 is offered with a variety of syringe racks to meet your specific application. Multi-syringe racks provide multi-channel operation or serve as a large capacity reservoir.

- The push/pull syringe pump holds 4 syringes, 2 in each direction, for syringe sizes 0.5  $\mu$ l to 140 ml\*

#### Syringe Racks (continued)

- The standard 2-syringe rack holds 2 syringes from 0.5  $\mu$ l or 140 ml
- The 4 x 140 multi-rack holds four 60 ml or 140 ml plastic syringes only
- 6/10 multi-rack will hold up to 10 syringes from 0.5  $\mu$ l to 20 ml and up to 6 syringes from 30 ml to 60 ml
- The microliter syringe rack independently holds 4 microliter syringes, from 0.5  $\mu$ l to 10 ml, enabling syringes of different sizes to run simultaneously

#### PHD 22/2000 Specifications

TYPE	Microprocessor, multiple syringe, infusion only, infusion/withdrawal or infusion/withdrawal programmable
ACCURACY	$\pm 0.35\%$
SYRINGE:	
Type	Plastic, glass or stainless steel
Size Minimum	0.5 $\mu$ l
Size Maximum	140 ml (30 ml for push/pull models)*
FLOW RATE:	
Minimum	0.0001 $\mu$ l/hr
Maximum	220.82 ml/min
NON VOLATILE MEMORY	Stores all settings
CONNECTORS:	
RS-232	RJ11-4 conductor
TTL	9-pin D-Sub Connector
AVERAGE LINEAR FORCE:	
Standard	22.7 kg (50 lb)
High Pressure	29.9 kg (66 lb)
STEP RESOLUTION	0.082 $\mu$ m/ $\mu$ step
POWER	65 W, 0.5 A fuse
VOLTAGE RANGE	Universal input 100 to 240 VAC; 50/60 Hz
CABLE LENGTH	9.1 m (30 ft) for remote models only
DIMENSIONS, H x W x D	15.9 x 22.8 x 27.9 cm (6.3 x 9 x 11 in)
WEIGHT	4.5 kg (10 lb)

\*Push/Pull pump can hold syringes up to 140 ml if full stroke is not required. Larger syringes will not fully infuse or withdraw.

## PHD 22/2000 Advanced Syringe Pumps

PHD 22/2000 Syringe Pumps						
	Infusion Only*		Infusion/Withdrawal		Programmable	
SYRINGE PUMP VERSIONS	Standard Force	High Force	Standard Force	High Force	Standard Force	High Force
Standard Syringe Pumps						
STANDARD 2-SYRINGE	PC6 70-2000	PC6 71-2000	PC6 70-2001	PC6 71-2001	PC6 70-2002	PC6 71-2002
6/10 MULTI-RACK	PC6 70-2003	PC6 71-2003	PC6 70-2006	PC6 71-2006	PC6 70-2009	PC6 71-2009
4 X 140 MULTI-RACK	PC6 70-2004	PC6 71-2004	PC6 70-2007	PC6 71-2007	PC6 70-2010	PC6 71-2010
MICROLITER RACK	PC6 70-2005	PC6 71-2005	PC6 70-2008	PC6 71-2008	PC6 70-2011	PC6 71-2011
Remote Syringe Pumps						
STANDARD 2 SYRINGE	PC6 70-2100	PC6 71-2100	PC6 70-2101	PC6 71-2101	PC6 70-2102	PC6 71-2102
6/10 MULTI-RACK	PC6 70-2103	PC6 71-2103	PC6 70-2106	PC6 71-2106	PC6 70-2109	PC6 71-2109
4 X 140 MULTI-RACK	PC6 70-2104	PC6 71-2104	PC6 70-2107	PC6 71-2107	PC6 70-2110	PC6 71-2110
MICROLITER RACK	PC6 70-2105	PC6 71-2105	PC6 70-2108	PC6 71-2108	PC6 70-2111	PC6 71-2111
Push/Pull Syringe Pumps						
STANDARD	–	–	PC6 70-2020	PC6 71-2020	PC6 70-2019	PC6 71-2019
REMOTE	–	–	PC6 70-2120	PC6 71-2120	PC6 70-2119	PC6 71-2119

\*Infusion Only models do not include an anti-siphon bracket or a retaining bracket. These can be ordered as a special.

### Harvard PHD 22/2000 Pump Series Kits & Upgrades

ORDER #	PRODUCT
Syringe Rack Kits <sup>1</sup>	
PC6 70-2012	PHD 22/2000 6/10 Multi Syringe Rack
PC6 70-2013	PHD 22/2000 4 x 140 Multi Syringe Rack
PC6 70-2014	PHD 22/2000 Microliter Multi Syringe Rack
PC6 70-2015	PHD 22/2000 Anti-Siphon Kit (Infusion Only Pump)
Upgrades <sup>2</sup>	
PC6 70-2016	PHD 22/2000 Infusion Only to Infusion/Withdrawal
PC6 70-2017	PHD 22/2000 Infusion/Withdrawal to Programmable
PC6 70-2018	PHD 22/2000 Infusion Only to Programmable

<sup>1</sup> These multiple syringe racks will fit any PHD 22/2000 series syringe pump listed above and are easily interchangeable.

<sup>2</sup> Upgrades are available for Infusion Only and Infusion/Withdrawal models of PHD 22/2000 series pumps. All upgrades must be factory installed.

### Remote Extension Cables

Replacement cables for PHD 22/2000 Remote Syringe Pumps including the PHD 22/2000 Hpsi, see page 33, are available in 1.5 m (5 ft) and 9.1 m (30 ft) lengths. These cables can also be used to increase or decrease the distance between the syringe pumping mechanism and the control box.

Order #	Product
PC6 72-0199	Remote Extension Cable, 1.5 m (5 ft)
PC6 72-1405	Remote Extension Cable, 9.1 m (30 ft)
PC6 72-2022	RS-232 D-Sub 9-pin to RJ11-4 Connection Cable

\* Push/Pull pump can hold syringes up to 140 ml if full stroke is not required. Larger syringes will not fully infuse or withdraw. Max of 50 ml syringe if full stroke is required.

### Continuous Flow Tubing Segment

This continuous flow tubing segment is used with the PHD 22/2000 or PHD ULTRA™ Push/Pull Syringe Pumps. When used with the programmable model it makes continuous 24/7 flow possible.

#### Tubing Segment Specifications

TUBING	0.062 in. ID Tygon® tubing
TUBING LENGTH	3 x 112 in sections
MAX. PRESSURE	15 p.s.i.
VALVE MATERIALS	Polycarbonate, silicone

#### Order # Product

PC6 61-0270	Continuous Flow Tubing Segment
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#### PHD 22/2000 References

Mazutis, L., et al., Droplet-Based Microfluidic Systems for High-Throughput Single DNA Molecule Isothermal Amplification and Analysis, *Anal. Chem.*, 2009, Vol. 81, 4813-4821

Yeoma, J., et al., Microfabrication and characterization of a silicon-based millimeter scale, PEM fuel cell operating with hydrogen, methanol, or formic acid, *Sensors and Actuators*, 2005, Vol. B107, 882-891.

Guillot, P., et al., Towards a continuous microfluidic rheometer, *Microfluid Nano-fluid*, 2008, Vol. 5, 619-630.

Utada, A.S., et al., Monodisperse Double Emulsions Generated from a Microcapillary Device, *Science*, 2005, Vol. 308, 537.

Liu Tsang, V., et al., Fabrication of 3D hepatic tissues by additive photopatterning of cellular hydrogels, *FASEB Journal*, 2007, Vol. 21, 790-801.



# Syringe Pumps

## PHD 22/2000 MRI Compatible Syringe Pump

SYRINGE PUMPS PHD 22/2000 MRI Compatible Syringe Pump



Control Box

Syringe Holder

### KEY FEATURES

- High accuracy and precision
- Can be placed near an imaging magnet
- Holds 0.5  $\mu$ l to 140 ml glass or plastic syringes
- Legendary reliability – 2 year warranty

### BENEFITS

- Injecting Anesthesia
- Drug Delivery
- Injecting Dyes

The MRI Compatible Pump is based on the design of one of our most tried and trusted syringe pumps. The PHD 22/2000. This pump is made of mostly non-magnetic materials and can be placed near to an imaging magnet when it is in use! **The syringe pumping mechanism should be positioned at least 5 feet away from the opening of the magnet and not in direct line of the opening.** The exact distance is dependent upon the strength of the magnet. This will now make drug or dye perfusions possible while the magnet is on. This pump is a remote model where the syringe pumping mechanism is separated from the control box by a 30 foot cable. This allows the pump to be started and stopped near the magnet, via a RUN/STOP switch that was added to the syringe holder. If additional space is required between the control box and pumping mechanism, a 60 foot cable is also available. For more details on the PHD 22/2000 Pump line, see pages 30 to 33.

### Program Description

The programming functions of this pump provide powerful capabilities for advanced experiments. While in program mode this pump can perform the following tasks at a predetermined time or when prompted by a signal from an external device:

- Start or stop pumping
- Change pumping direction (infusion/withdrawal)
- Change flow rates
- Pump a precise volume and stop
- Pause operation
- Ramp up or down flow rates

In program mode the above tasks can be linked together into powerful programs to simplify your automation projects.

### PHD 22/2000 Specifications

TYPE	Microprocessor dual syringe infusion/withdrawal or infusion/withdrawal programmable
ACCURACY	$\pm 0.35\%$
SYRINGE:	
Type	Plastic or glass
Size Minimum	0.5 $\mu$ l
Size Maximum	140 ml
FLOW RATE:	
Minimum	0.0001 $\mu$ l/hr
Maximum	220.82 ml/min
NON VOLATILE MEMORY	Stores all settings
CONNECTORS:	
RS-232	RJ11-4 conductor
TTL	9-pin D-Sub Connector
AVERAGE LINEAR FORCE	22.7 kg (50 lb)
STEP RESOLUTION	0.082 $\mu$ m/ $\mu$ step
VOLTAGE RANGE	Universal input 100 to 240 VAC, 50/60 Hz
CABLE LENGTH	9.1 m (30 ft)
DIMENSIONS, H x W x D:	
Control Box	9.5 x 27.9 x 22.9 cm (3.75 x 11 x 9 in)
Syringe Holder	22.9 x 43.2 x 30.5 cm (9 x 17 x 12 in)

Order #	Product
PC6 70-2130	PHD 22/2000 MRI Compatible Remote Infusion/Withdrawal Dual Syringe
PC6 70-2131	PHD 22/2000 MRI Compatible Remote Infusion/Withdrawal Programmable Dual Syringe

## Syringe Pumps

# PHD 4400 Hpsi High Volume & Pressure Programmable Syringe Pumps

PHD 4400 HPSI Programmable



### KEY FEATURES

- Accurate and smooth flow
- Easy-to-use interface
- RS-232 serial port for computer control
- Delivers over 200 lb of pumping force across a wide flow rate range
- Legendary reliability – 2 year warranty

### APPLICATIONS

- High Pressure Injections
- Drug Delivery
- Pumping Highly Corrosive Fluids
- Injecting into High Pressure Reaction Vessels

The Harvard PHD 4400 HPSI is a single syringe version of our precision PHD syringe pump series with a higher-pressure motor. It provides 200 pounds of linear pumping force for high-pressure applications. It can hold syringes from 0.5 microliters to 140 milliliters provide a wide flow rate range from 0.0001  $\mu\text{l}/\text{hour}$  up to 220.82 ml/minute. It is programmable from the keypad providing exceptional versatility in a single pump.

### PHD 4400 Hpsi Specifications

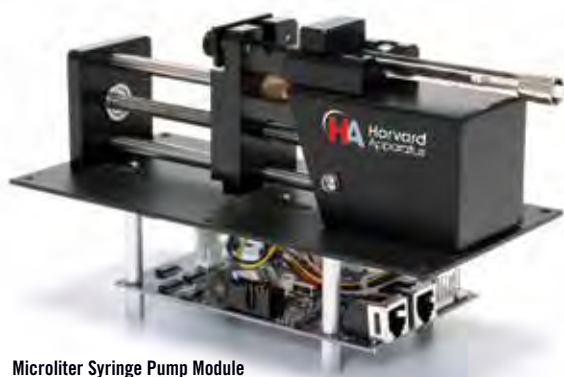
TYPE	Microprocessor single syringe, infusion/withdrawal programmable
ACCURACY	$\pm 0.35\%$
SYRINGE:	
Type	Stainless steel**
Size Minimum	2.5 ml
Size Maximum	100 ml
FLOW RATE:	
Minimum	0.0001 $\mu\text{l}/\text{hr}$
Maximum	220.82 ml/min
RS-232	RJ-11 4-conductor
TTL	9-pin D-Sub Connector
AVERAGE LINEAR FORCE	91 kg (>200 lb)**
STEP RESOLUTION	0.082 $\mu\text{m}/\text{step}$
VOLTAGE RANGE	Universal input 100 to 240 VAC, 50/60 Hz
DIMENSIONS, H x W x D	17 x 23 x 29 cm (6.7 x 9.0 x 11.4 in)
WEIGHT	6.4 kg (14 lb)
REMOTE CABLE	9.1 m (30 ft) Length

\*\* Plastic and glass syringes are not recommended because of high force.

Order #	Product
PC3 70-2200	PHD 4400 Hpsi Programmable Single Syringe Pump
PC3 70-2201	PHD 4400 Hpsi Remote Programmable Single Syringe Pump

# Syringe Pumps

## Customized Solutions -OEM and Special Syringe Pumps



Microliter Syringe Pump Module



PHD ULTRA™ Syringe Pump Module

**H**arvard Apparatus offers a full line of OEM Pumps which can be integrated into an existing system or operate independently via computer control. Harvard Apparatus has a wealth of experience in the development and manufacture of specialized fluidic systems.

We offer the broadest selection of fluidics components, systems and specials. Whether your requirement is for a single order/one time study or you need a fluidic module to integrate into your system, we have the solution. With our extensive experience and variety of stand alone pumps and modules we can customize a product for your application. If you do not find what you are looking for, please contact our expert technical staff so we can review your specifications and work with you to develop or modify a product to meet your needs.

### AMONG THE APPLICATION AREAS WHERE WE HAVE DEVELOPED OEM SOLUTIONS ARE:

- Mass Spectrometer Calibration Systems
- Medical Injection Devices
- Microfluidic Systems
- Drug Deposition Systems
- And More!

All of the Harvard Apparatus OEM modules are based upon our proven digital syringe pumps. They deliver the same accuracy and reproducibility as our stand alone pumps. We offer a wide range of flow rates and applied forces ranging from 6 lb to 1,800 lb.

Syringe diameter, flow rates and target volumes are stored in non-volatile memory. Serial communication is handled through either the RS-232 or USB ports depending upon the module. Every module is supplied with a serial cable. Some of the modules are available with or without a power supply while others come standard with a power supply.

**Our manufacturing facilities in Massachusetts are registered with the U.S. Food and Drug Administration as manufacturer and contract manufacturing facilities.**

### OEM Syringe Pump Modules

	Order #	Flow Rate	Average Linear Force	Control	Communications
PUMP 11 ELITE MODULE	PC6 70-4800	1.28 pl/min to 88.28 ml/min	35 lb at 100% Force Selection	PC or other external controller	USB input
MICROLITER SYRINGE PUMP MODULE	PC6 70-2220 or PC6 70-2225	0.001 µl/hr to 1.33 ml/min	6 lb at 100% Force Selection	PC or other external controller	RS-232 serial input
MILLILITER SYRINGE PUMP MODULE	PC6 70-2219 or PC6 70-2226	0.001 ml/hr to 44.28 ml/min	25 lb at 100% Force Selection	PC or other external controller	RS-232 serial input
HIGH PRESSURE SYRINGE PUMP MODULE	PC6 70-2202	0.0001 µl/hr to 220.82 ml/min	200 lb at 100% Force Selection	PC or other external controller	RS-232 serial input
PHD ULTRA™ SYRINGE PUMP MODULE	PC6 70-3506	3.06 pl/min to 215.8 ml/min	75 lb at 100% Force Selection	PC or other external controller	RS-232 and USB serial input
PHD ULTRA™ PUSH/PULL SYRINGE PUMP MODULE	PC6 70-3508	3.06 pl/min to 215.8 ml/min	75 lb at 100% Force Selection	PC or other external controller	RS-232 and USB serial input
PHD ULTRA™ 4400 SYRINGE PUMP MODULE	PC6 70-3510	3.06 pl/min to 215.8 ml/min	200 lb at 100% Force Selection	PC or other external controller	RS-232 and USB serial input

# Syringe Pumps

## Customized Solutions -OEM and Special Syringe Pumps



### Pump 11 Elite/Pico Plus Elite OEM Module

#### KEY FEATURES

- Accuracy of  $\pm 0.35\%$  or  $\pm 0.5\%$
- Footprint of 16.25 x 24.1 x 10.8 cm (6.5 x 9.5 x 4.25 in)
- 1.28 pl/min to 88.28 ml/min
- CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

### General Features and Capabilities

- All of our OEM modules are based upon our proven digital syringe pump technology delivering the same accuracy and reproducibility as our stand alone pumps.
- The modules consist of 3 basic components – a drive mechanism assembly, a motor assembly, and a circuit board assembly. In standard configurations, all are mounted to a base plate. These sub-assemblies can be purchased individually if required.
- All units have the ability to run in either direction (infuse/withdraw) at separate rates and target volumes.
- Although computer control is most commonly used for communication, a voltage level control for start/stop and change of direction is available. Our newer PHD ULTRA™ and Pump 11 Elite based modules can be rate controlled using an external DC 0-10 volt signal.
- All systems will accept input voltages over the range of 12-30 volts DC.
- Modification to accommodate existing designs or future designs is available.
- Modules can be linked together in a daisy chain fashion for complete computer control of up to 16 separate pumps at once. The PHD ULTRA™ based versions can control up to 99 pumps simultaneously.
- Our newest model, based upon our new PHD ULTRA™ syringe pump design, incorporates a stable mechanism, has an extended pushing block, larger guide rods, and easily adjustable capturing brackets and limit stops which fully protect the syringe and prevent siphoning. Models with either 75 or 200 pounds of adjustable force are available. These also offer a more enhanced I/O control and a USB serial port.
- We can configure our modules to support directional control valves, heating and cooling devices, custom syringes, and more.

#### Pump 11 Elite OEM Module Specifications

<b>TYPE</b>	Microprocessor dual syringe, infusion/withdrawal	
<b>ACCURACY</b>	$\pm 0.5\%$ (Pump 11 Elite)	$\pm 0.35\%$ (Pico Plus Elite)
<b>SYRINGE TYPE</b>	Plastic or glass	
<b>SYRINGE SIZE</b>		
<b>Minimum</b>	0.5 $\mu$ l	
<b>Maximum</b>	60 ml (10 ml dual)	
<b>FLOW RATE:</b>		
<b>Minimum</b>	1.28 pl/min (Pump 11 Elite)	0.54 pl/min (Pico Plus Elite)
<b>Maximum</b>	88.28 ml/min (Pump 11 Elite Single Syringe Version) 26.02 ml/min (Pump 11 Elite Dual Syringe Version) 39.77 ml/min (Pico Plus Elite Single Syringe Version) 11.70 ml/min (Pico Plus Elite Dual Syringe Version)	
<b>AVERAGE LINEAR FORCE</b>	16 kg (35 lb) at 100% force selection	
<b>CONNECTORS:</b>	RS-485 IEEE-1394, 6 position	
<b>USB</b>	Type B	
<b>I/O &amp; TTL</b>	15-pin D-Sub Connector	
<b>OVERALL DIMENSIONS, H X W X D</b>	16.25 x 24.1 x 10.8 cm (6.5 x 9.5 x 4.25 in)	
<b>WEIGHT</b>	2.7 kg (6 lb)	
<b>REGULATORY CERTIFICATIONS</b>	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme	

Order #	Product
PC6 70-4800	Pump 11 Elite OEM Module (Single Syringe)
PC6 70-4801	Pump 11 Elite OEM Module (Dual Syringe)
PC6 70-4802	Pico Plus Elite OEM Module (Dual Syringe)
PC6 70-4803	Pico Plus Elite OEM Module (Single Syringe)





# Syringe Pumps

## Customized Solutions -OEM and Special Syringe Pumps

### OEM Modules: Microliter Syringe Pump Module



CE

#### KEY FEATURES

- Accuracy of  $\pm 0.5\%$
- Footprint of 11.4 x 23.5 x 8.3 cm (4.5 x 9.25 x 3.25 in)
- 0.001  $\mu\text{l}$  to 1.33 ml/min
- CE, WEEE, EU & RoHS

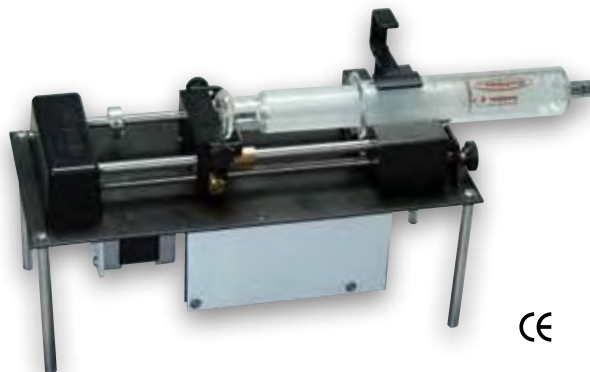
#### Microliter Syringe Pump Module Specifications

Type	Microprocessor single syringe, infusion/withdrawal
Accuracy	$\pm 0.5\%$
Syringe Type	Glass or plastic
Syringe Size:	
Size Minimum	0.5 $\mu\text{l}$
Size Maximum	1 ml
Flow Rate:	
Minimum	0.001 $\mu\text{l/hr}$
Maximum	1.33 ml/min
Average Linear Force	2.73 kg (6 lb) at 100% force selection
Connectors:	
RS-232	4-pin RJ-11 telephone jack; dual RS-232 ports
DC Power	2-pin Header (friction lock)
Power	+12 to +40 VDC, 5%, 1A (12W) (User supplied)
Dimensions:	
Overall, H x W x D	11.4 x 23.5 x 8.3 cm (4.5 x 9.25 x 3.25 x 4.5 in)
Mounting	22.2 x 7.0 cm (8.75 x 2.75 in), Mounting holes for (4) #8 screws
Weight	0.84 kg (1.85 lb)

#### Order # Product

PC6 70-2220	Microliter Syringe Pump Module without Power Supply
PC6 70-2225	Microliter Syringe Pump Module with Power Supply
PC6 70-2228	Power Supply

### OEM Modules: Milliliter Syringe Pump Module



CE

#### KEY FEATURES

- Accuracy of  $\pm 0.5\%$
- Footprint of 13.5 x 24.1 x 10.8 cm (5.3 x 9.5 x 4.25 in)
- 0.001  $\mu\text{l/hr}$  to 44.28 ml/min
- CE, WEEE, EU & RoHS

#### Milliliter Syringe Pump Module Specifications

Type	Microprocessor single syringe, infusion/withdrawal
Accuracy	$\pm 0.5\%$
Syringe Type	Glass or plastic
Syringe Size:	
Size Minimum	0.5 $\mu\text{l}$
Size Maximum	50/60 ml
Flow Rate:	
Minimum	0.001 ml/hr
Maximum	44.283 ml/min
AVERAGE Linear Force	11.36 kg (25 lb) at 100% force selection
Connectors:	
RS-232	4-pin RJ11 telephone jack; dual RS-232 ports
DC Power	2-pin Header (friction lock)
Power	+12 to +40 VDC (12 W min) (user supplied)
Dimensions:	
Overall, H x W x D	13.5 x 24.1 x 10.8 cm (5.3 x 9.5 x 4.25 in)
Mounting	22.9 x 9.5 cm (9.0 x 3.75 in), Mounting holes for (4) #8 Screws
Weight	1.27 kg (2.8 lb)

#### Order # Product

PC6 70-2219	Milliliter Syringe Pump Module without Power Supply
PC6 70-2226	Milliliter Syringe Pump Module with Power Supply

# Syringe Pumps

## Customized Solutions -OEM and Special Syringe Pumps

### OEM Modules: PHD ULTRA™ High Force Syringe Pump Module



CE

#### KEY FEATURES

- Accuracy of  $\pm 0.5\%$
- Average Linear Force of 90.91 kg (200 lb)
- 0.001  $\mu\text{l/hr}$  to 220.82 ml/min
- WEEE, Eu RoHS, ETL (UL, CSA)

#### High Pressure Syringe Pump Module Specifications

TYPE	Microprocessor single syringe, infusion/withdrawal
ACCURACY	$\pm 0.5\%$
SYRINGE TYPE	Plastic, glass or stainless steel
SYRINGE SIZE:	
Size Minimum	0.5 $\mu\text{l}$
Size Maximum	140 ml
FLOW RATE:	
Minimum	3.06 pl/min
Maximum	220.82 ml/min
AVERAGE LINEAR FORCE	90.91 kg (200 lb)
CONNECTORS:	
RS-232	9-pin D-Sub Connector
RS-485	IEEE-1394, 6 pos
USB	Type B
I/O & TTL	15-pin D-Sub Connector

#### DIMENSIONS & WEIGHT:

Contact Harvard Apparatus for specifications.

Order #	Product
70-3610	PHD ULTRA™ 4400 Pump Component

### OEM Modules: PHD ULTRA™ Syringe Pump Module



CE

#### KEY FEATURES

- Accuracy of  $\pm 0.25\%$
- Footprint of 29.8 x 14.0 x 16.5 cm (11.75 x 5.5 x 6.5 in)
- 3.06 pl/min to 215.8 ml/min
- CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

#### PHD ULTRA™ Syringe Pump Module Specifications

TYPE	Microprocessor dual syringe, infusion/withdrawal
ACCURACY	$\pm 0.25\%$
SYRINGE TYPE	Plastic, glass or stainless steel
SYRINGE SIZE:	
Size Minimum	0.5 $\mu\text{l}$
Size Maximum	140 ml
FLOW RATE:	
Minimum	3.06 pl/min
Maximum	215.8 ml/min
AVERAGE LINEAR FORCE	34 kg (75 lb) @ 100% Force Selection 30 VDC Input
CONNECTORS:	
RS-232	9-pin D-Sub Connector
RS-485	IEEE-1394, 6 position
USB	Type B
I/O & TTL	15-pin D-Sub Connector

#### DIMENSIONS

Overall, H x W x D 29.8 x 14.0 x 16.5 cm (11.75 x 5.5 x 6.5 in)

WEIGHT 5.1 kg (11.2 lb)

REGULATORY CERTIFICATIONS CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

Order #	Product
PC6 70-3506	PHD ULTRA™ Syringe Pump Module with Power Supply

# Syringe Pumps

## Customized Solutions -OEM and Special Syringe Pumps

### OEM Modules: PHD ULTRA™ Push/Pull Syringe Pump Module



CE

#### KEY FEATURES

- Accuracy of  $\pm 0.25\%$
- Footprint of 29.8 x 14 x 16.5 cm (11.75 x 5.5 x 6.5 in)
- 3.06  $\mu\text{l/min}$  to 215.8  $\text{ml/min}$
- CE, ETL (UL, CSA), WEEE, EU RoHS and CB Scheme

#### PHD ULTRA™ Push/Pull Syringe Pump Module Specifications

TYPE	Microprocessor four syringe, push/pull infusion/withdrawal
ACCURACY	$\pm 0.25\%$
SYRINGE TYPE	Plastic, glass or stainless steel
SYRINGE SIZE:	
Size Minimum	0.5 $\mu\text{l}$
Size Maximum	140 ml
FLOW RATE:	
Minimum	3.06 $\mu\text{l/min}$
Maximum	215.8 $\text{ml/min}$
AVERAGE LINEAR FORCE	34 kg (75 lb) @ 100% Force Selection 30 VDC Input
CONNECTORS:	
RS-232	9-pin D-Sub Connector
RS-485	IEEE-1394, 6 position
USB	Type B
I/O & TTL	15-pin D-Sub Connector
DIMENSIONS	
Overall, H x W x D	29.8 x 14.0 x 16.5 cm (11.75 x 5.5 x 6.5 in)
WEIGHT	5.1 kg (11.2 lb)
REGULATORY CERTIFICATIONS	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

Order #	Product
PC6 70-3508	PHD ULTRA™ Push/Pull Syringe Pump Module with Power Supply

### OEM Modules: PHD ULTRA™ 4400 Syringe Pump Module



CE

#### KEY FEATURES

- Accuracy of  $\pm 0.35\%$
- Footprint 29.8 x 14 x 16.5 cm (11.75 x 5.5 x 6.5 in)
- 3.06  $\mu\text{l/min}$  to 215.8  $\text{ml/min}$
- CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

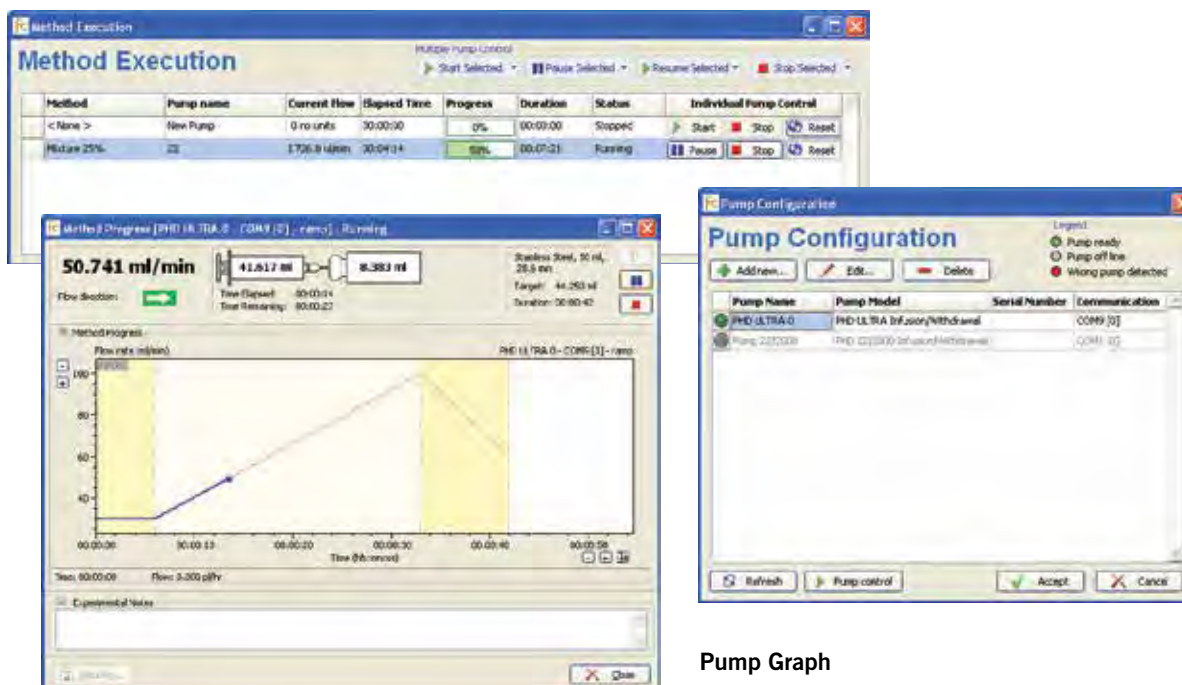
#### PHD ULTRA™ 4400 Syringe Pump Module Specifications

TYPE	Microprocessor single syringe, infusion/withdrawal
ACCURACY	$\pm 0.35\%$
SYRINGE TYPE	Plastic, glass or stainless steel
SYRINGE SIZE:	
Size Minimum	0.5 $\mu\text{l}$
Size Maximum	140 ml
FLOW RATE:	
Minimum	3.06 $\mu\text{l/min}$
Maximum	215.8 $\text{ml/min}$
AVERAGE LINEAR FORCE	91 kg (200 lb) @ 100% Force Selection
CONNECTORS:	
RS-232	9-pin D-Sub Connector
RS-485	IEEE-1394, 6 position
USB	Type B
I/O & TTL	15-pin D-Sub Connector
DIMENSIONS	
Overall, H x W x D	29.8 x 14.0 x 16.5 cm (11.75 x 5.5 x 6.5 in)
WEIGHT	5.3 kg (11.2 lb)
REGULATORY CERTIFICATIONS	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

Order #	Product
PC6 70-3510	PHD ULTRA™ 4400 Syringe Pump Module with Power Supply

# Syringe Pump Software

## FlowControl™ Software



### KEY FEATURES

- Single or multiple pump control
- Easily create simple Methods or more advanced multi-step Methods
- Run multiple pumps in a chain or via USB hub
- Displays all of the pump operating parameters
- Control the same or different pump models
- Graphically track pump progress
- Printable data log

FlowControl™ is an easy to use software program that is run on your PC. It is designed to work with key Harvard Apparatus Syringe Pumps that have an RS-232 or USB serial input including: PHD ULTRA™ Series and Pump 11 Elite Series of pumps.

### Single or Multiple Pump Control

FlowControl™ has the ability to control single or multiple pumps. Multiple pumps are controlled in a daisy chain or via USB hub. The number of pumps allowed in a daisy chain is dependent upon the model.

Individual syringe pumps can be controlled by entering syringe data, flow rate and choosing a flow direction (infusion or withdrawal). Flow rate and flow direction can be changed while the pump is running.

FlowControl™ allows you to create, review, edit, save, recall and download Methods. You can create simple to complex Methods to control one or more pumps individually or simultaneously.

### Pump Status

The pump configuration screen tells you the status of all defined pumps. If the light is green, the pump is ready. If the light is gray the pump is off line. If the light is red the software is detecting the wrong pump requiring you to check your connection.

### Pump Graph

In addition to the run time execution information in the Method Execution window, FlowControl™ allows you to graphically monitor the real flow progress of each independent pump in the Method Progress window. The Method Progress screen displays all of the pumping parameters for the individual pump in an easy to read format. This allows you to monitor infuse and refill rates and volume dispensed.

### Data Log

FlowControl™ creates a data log that tracks the activity of your pump based on a specific Method. When a data log is created three different files are generated with the same name but different extensions; excel report (\*.xls), bitmap report (\*.bmp) and experimental notes (\*.txt). The bitmap report shows a screen shot of the pump flow evolution chart from the Method Progress window. Experimental Notes are notes typed in the Method Progress window by the user. The Excel report provides details about the Method parameters.

### FlowControl™ Specifications

<b>COMPUTER REQUIREMENTS</b>	1GHz Pentium® processor or higher, 512 MB of RAM (1 GB recommended)
<b>SYSTEM REQUIREMENTS</b>	Windows XP, 7

### Order # Product

<b>PC6 70-6000</b>	FlowControl™ Software
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## Valves, Cables, Footswitches and Alarms

**PC6 55-7007**  
Continuous  
Delivery Valve  
Box -High  
Pressure



**PC6 55-7009 Continuous Delivery  
Valve Box-Normal Pressure**



Continuous Delivery and Auto Fill Valve Boxes are used with Harvard Apparatus PHD ULTRA™, Pump 11 Elite/Pico Plus Elite, Pump 33 DDS and PHD 22/2000/4000 syringe pumps. The Continuous Delivery Valve Box has two valves mounted and is used with our PHD ULTRA push/pull and Pump 33 DDS syringe pumps.

The Continuous Delivery Valve Box for normal pressure is supplied with 1.6 mm ID x 3.2 mm OD (1/16 x 1/8) silastic tubing and a syringe pump connector cable. Maximum pressure is 30 PSI.

The Continuous Delivery Valve Box for medium pressure is supplied with 3-port valves containing 1/4-28 thread with 1.6 mm (1/16 in) OD for plastic tubing. The maximum pressure is 100 psi and all wetted parts are PTFE.

### 'Auto Fill' Valve Boxes

**PC6 55-7012**  
'Auto Fill' Valve Box-  
Medium Pressure



**PC6 55-7008**  
'Auto Fill' Valve  
Box-High Pressure



The Continuous Delivery Valve Box for high pressure has the valve assembly with lines for two syringe connections. Made of 304 stainless steel throughout it terminates in 6.4 mm (1/4 in) OD SWAGELOK® fittings and syringe pump connector cable. Maximum pressure is 200 psi.

For the 30 and 200 psi. models all wetted parts are stainless steel and perfluoroelastomer.

The 'Auto Fill' Valve Boxes for normal, medium and high pressure have the same material and specifications as the Continuous Delivery Valve boxes. The Auto Fill Valve boxes have a single valve which is used to reload the syringe once it is empty or partially empty.

Order #	Product
<b>PC6 55-7009</b>	Continuous Delivery Valve Box, Normal Pressure, 30 psi
<b>PC6 55-7013</b>	Continuous Delivery Valve Box, Medium Pressure, 100 psi
<b>PC6 55-7007</b>	Continuous Delivery Valve Box, High Pressure, 200 psi

Order #	Product
<b>PC6 55-7010</b>	'Auto Fill' Valve Box, Normal Pressure, 30 psi
<b>PC6 55-7012</b>	'Auto Fill' Valve Box, Medium Pressure, 100 psi
<b>PC6 55-7008</b>	'Auto Fill' Valve Box, High Pressure, 200 psi

### Foot Switch

**PC6 55-4144**



The PC6 55-4144 foot switch is for use with all Versions of the PHD 22/2000, all Versions of the Pump 4400 Hpsi.

### RS-232 and RJ-11 Daisy Chain Cables

The PC6 70-2022 RS-232 Connection Cable is for use with all Harvard Apparatus Syringe Pumps except for the Pump 22 and the PHD ULTRA™. The PC6 70-4004 RS-232 Connection Cable is for use with the PHD ULTRA™ Syringe Pumps.

The PC6 55-7760 and PC6 72-2478 Daisy Chain Cables are for use with all Harvard Apparatus Syringe Pumps except for the PHD ULTRA™ without the legacy RS-232 (RJ-11 ports).

The PHD ULTRA™ daisy chain via RS-485 instead of RS-232. When controlling a syringe pump using a computer, a single RS-232 cable is required to connect the computer to the pump. If multiple pumps are being controlled by one computer then one Daisy Chain Cable is required for each additional pump.

Order #	Product
<b>PC6 70-2022</b>	RS-232 Connection Cable, 7 ft, 9-pin D-Sub/RJ11
<b>PC6 70-4004</b>	RS-232 Connection Cable, 6 ft, 9-pin D-Sub/D-Sub
<b>PC6 55-4145</b>	RS-232 Connection Cable, 7 ft, 25-pin D-Sub, Pump 22 ONLY. Do Not Use for Daisy Chaining
<b>PC6 55-7760</b>	Daisy Chain Cable, (2 ft) Need 1 Per Pump RJ-11
<b>PC6 72-2478</b>	Daisy Chain Cable, (7 ft) Need 1 Per Pump RJ-11

# SYRINGE PUMP ACCESSORIES

## SWS-10, SWS-60 and SWS-140 Syringe Warmers



### KEY FEATURES

- Independent temperature control for individual syringes
- Designed for use on a syringe pump or support stand
- Syringe warmers work with 10 & 60 cc BD plastic syringes and 140 cc Monoject syringes
- Scale marking ports permit volume monitoring during use
- Can be powered from 12 volt battery for sensitive electrophysiology applications

The SWS-Series Syringe Warmers provide a simple and effective method for maintaining a stable temperature within a syringe. The compact design of this warmer allows it to be used either with a syringe pump or mounted on a support stand.

The thermally controlled heater housing slides onto a 10, 60, or 140 cc syringe and is held in place with a self adjusting friction band. The housing incorporates a resistive element and thermistor, which when connected to a TC-124 temperature controller, allows the syringe warmer to be maintained at a constant temperature.

The heater housing is made of anodized aluminum which is both corrosion resistant and serves as an excellent thermal conductor. Solutions usually reach the set temperature approximately 15 minutes after application of power.

Be sure to order the TC-124 temperature controller with your syringe warmer.

### Syringe Warmer Specifications

HEATER RESISTANCE	18 $\Omega$
VOLTAGE REQUIREMENT	Variable to 12 V maximum
TEMPERATURE RANGE	Ambient to 37°C
TEMPERATURE ACCURACY	$\pm 1^\circ\text{C}$
CABLE LENGTH	2.4 m (7.9 ft)
WARRANTY	One year

MODEL	WEIGHT	LENGTH	OD	ID	SYRINGE TYPE
SWS-10	32.7 g	38.2 mm	22.2 mm	16.2 mm	Becton Dickinson
SWS-60	76 g	83.7 mm	35.0 mm	29.1 mm	Becton Dickinson
SWS-140	192 g	109.5 mm	51.0 mm	41.4 mm	Monoject

Order #	Model	Product
PC6 64-1584	SWS-10	Syringe Heater for 10 cc Syringes
PC6 64-1560	SWS-60	Syringe Heater for 60 cc Syringes
PC6 64-1585	SWS-140	Syringe Heater for 140 cc Syringes
PC6 64-1545	TC-124A	Temperature Controller, 120 to 240 VAC
PC6 64-1655	TC-144	Temperature Controller
PC6 64-1606	BAC-1	Battery Adapter Cable

For full product offering on syringe warmers and temperature control, go to [www.warmeronline.com](http://www.warmeronline.com)

# SYRINGE PUMP ACCESSORIES

## Pressure Transducers for PHD ULTRA™ CP Syringe Pump

### Transducer Amplifier Module (TAM-A and TAM-D)



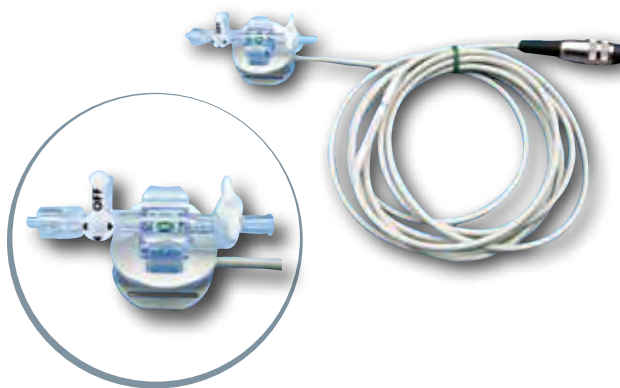
The Transducer Amplifier Module is a DC amplifier with bridge. It is used to amplify signals from transducers that are based on a resistive Wheatstone bridge. Transducers with a built-in preamplifier can also be connected. The TAM series amplifies the signal to a 0-10 V range making it ideal for use with the CP Pump series, which operates best with a full 0-10 V input range. As they are modular, a power supply case needs to be chosen. Cases are available that hold up to 2, 5, or 10 TAM modules. Choose from two: TAM-A (analog) and TAM-D (digital). The TAM-A is equipped with an analog LED bar graph signal indicator and is best suited for applications which require the monitoring of dynamic signals/phasic waveforms (e.g. blood pressure). The TAM-D has a digital numeric display and is best suited for applications with slowly changing signals, e.g. perfusion pressure, isometric or isotonic contractions, or intracranial pressures. For applications involving the CP Pump, the TAM-D is the appropriate choice. We have a range of transducers that interface directly with the TAM amplifiers.

#### Transducer Amplifier Module Specifications

<b>TRANSDUCER INPUT</b>	6-pin socket with screw lock (binder, Amphenol Tuchel) Differential input circuit, input impedance $10^{10} \Omega$
<b>GAIN</b>	Selectable Ranges by Internal Jumper: 0.2 to 10, 0.4 to 20, 1 to 50, 2 to 100, 4 to 500, 20 to 1,000, 100 to 5,000, 200-10000. Fine Adjustment Through 10-Turn Trimmer
<b>SIGNAL OUTPUT</b>	a) On front panel through BNC socket $\pm 10$ V pulsatile filtered or mean signal output internally selectable b) Through bus connector to PLUGSYS measuring system through links $\pm 10$ V pulsatile filtered and mean signal voltage
<b>OUTPUT LOW-PASS FILTER</b>	a) Selectable by switch on front panel for pulsatile output signal: 30, 100, 300 Hz b) Selectable by internal jumper for mean output signal: 0.1, 0.3 Hz
<b>ELECTRICAL CALIBRATION</b>	Selectable by switch on front panel: a) 0 V output signal with switch in position '0' b) Positive or negative calibration output voltage adjustable with 10-turn trimmer if switch is in position 'CAL'
<b>PLUGSYS WIDTH</b>	2 slot units

Order #	Product
PC6 73-0065	Transducer Amplifier Module TAM-A
PC6 73-1793	Transducer Amplifier Module TAM-D
PC6 73-1523	PLUGSYS Minicase, Type 609

### APT300 Blood Pressure Transducer



The APT300 transducer is an inexpensive pressure transducer which can be used to measure arterial blood pressures in all species, even on mice with a high heart rate.

It can be used for measurement of arterial pressure in vivo as well as for perfusion pressures in isolated perfused organs such as heart or kidney. It can also be used to measure isovolumetric left ventricular (using a balloon) pressures in isolated hearts from mice up to rabbits or pigs.

The transducer consists of a contact plate with cable and the exchangeable transducer head, which can easily be replaced. Contact plates with cables for different amplifier types are available.

#### APT300 Blood Pressure Transducer Specifications

<b>OPERATING PRESSURE</b>	-300 to 300 mmHg
<b>OVERPRESSURE</b>	4,000 mmHg
<b>SENSITIVITY</b>	5 $\mu$ V/mmHg ( $\pm 1\%$ )
<b>TEMPERATURE COEFFICIENT</b>	< 0.1% /°C
<b>ZERO DRIFT</b>	< 0.2 mmHg /°C
<b>ZERO OFFSET</b>	< 25 mmHg
<b>EXCITATION VOLTAGE</b>	2 – 15 V DC (or AC up to 5kHz)
<b>ISOLATION AGAINST FLUID</b>	> 5,000 V
<b>OPERATING TEMPERATURE</b>	15° to 40°C
<b>STORAGE TEMPERATURE</b>	-25° to 70°C
<b>VOLUME DISPLACEMENT</b>	< 0.04 mm <sup>3</sup> /100 mmHg
<b>OUTPUT IMPEDANCE</b>	356 Ohm $\pm 1\%$
<b>FREQUENCY RESPONSE</b>	> 1 KHz
<b>CABLE LENGTH</b>	3 m (9.8 ft)

Order #	Product
PC6 73-3862	APT300 Pressure Transducer for PLUGSYS TAM Amplifier
PC6 73-3869	Holder for APT300 Transducer, 8 mm Rod, Length 75 mm (3 in)
PC6 73-0500	Lab Stand with Triangular Base Plate with 30 cm (11.8 in) Rod
PC6 73-4140	Lab Stand with Triangular Base Plate with 16 cm (6.3 in) Rod
PC6 73-4479	Manual Pressure Calibration Kit, Range 0 to 300 mmHg

## Pressure Transducers for PHD ULTRA™ CP Syringe Pump (continued)

### P75 Venous Pressure Transducer & P1500 Pressure Transducer



#### P75 Venous Pressure Transducer

The P75 has a removable Macrolon® dome with a pressure connection and a vent connection at the side, so that it can be filled free of air bubbles. The dome connections have a male Luer taper so that suitable stopcocks\* can be attached. The transducer has a metal housing. The actual pressure sensor inside is made from ceramic and therefore has excellent resistance to different media. The transducer's rugged construction can withstand pressure overloads up to 4000 mmHg without damage. It works together with any DC bridge amplifier (e.g., PLUGSYS TAM-A).

#### P1500 Pressure Transducer

For applications requiring constant pressure control in the 0-30 PSI (0-2 bar) range, we offer the P1500 Pressure Transducer. Like the P75, it has a removable Macrolon® dome with a 90° pressure connection and 45° vent connection on the top side for filling the dome bubble free. The dome connections have a male Luer lock so that suitable stopcocks\* can be attached. The transducer has a metal housing. The actual pressure sensor inside is made from ceramic and therefore has excellent resistance to different media. The transducer works with any DC bridge amplifier (e.g. PLUGSYS TAM-A) but is supplied with the connector for the TAM. Configurations for other amplifiers available upon request.

*\*Use one each of PC6 73-0096 three-way stopcock and PC6 73-0097 one-way stopcock*

Order #	Product
PC6 73-0020	Blood Pressure Transducer P75 for PLUGSYS TAM Amplifier
PC6 73-3806	Blood Pressure Transducer P1500 for PLUGSYS TAM Amplifier

### Millar Pressure Catheters



2F Pressure Catheter SPR-407

Millar pressure catheters continue to represent the gold standard for high-fidelity pressure measurements for both systematic and intraventricular applications.

Adapters and cables are available to connect catheters directly to the range of Harvard Apparatus pressure amplifiers.

Order #	Model	Product
<b>Adapters and Cables</b>		
PC6 72-9842	HEC-10C	Pressure Catheter with <b>Viking Connector</b> to PLUGSYS TAM Amplifier
PC6 72-9843	HEC-10D	Pressure Catheter with <b>Low Profile Connector</b> to PLUGSYS TAM Amplifier
<b>Millar Pressure Catheters</b>		
PC6 72-9781	SPR-1000	1F, Single pressure, 20 cm, Straight, Non-repairable ( <b>Low Profile</b> )
PC6 72-9779	SPR-671	1.4F Single pressure, 1.1F-2F body 15 cm from tip, 65 cm ( <b>Low Profile</b> )
PC6 72-9775	SPR-407	2F Sensor, 1.5F Body, Single Pressure, 140 cm, Straight ( <b>Viking</b> )
PC6 72-9777	SPR-524	3.5F Single pressure, 100 cm, Straight, Non-repairable ( <b>Viking</b> )

### P75 and P1500 Pressure Transducers Specifications

Model	P75 Pressure Transducer	P1500 Pressure Transducer
PRESSURE RANGE	±75 mmHg (±100 cmH <sub>2</sub> O)	±1,500 mmHg (±30 PSI)
OVERLOAD	-760 (=vacuum) to 4,000 mmHg	13,500 mmHg
SENSITIVITY	1 mV/mmHg, nominal	0.05 mV/mmHg, nominal
TEMPERATURE RANGE	0° to 50°C	-20° to 80°C
ZERO DRIFT	±0.04 mmHg/10°C (0° to 50°C)	±0.5% FS (-20° to 80°C)
RANGE DRIFT	±0.04 mV/10°C (±0.04 mmHg/10°C) (0° to 50°C)	±0.5% FS (-20° to 80°C)
LONG-TERM DRIFT	±0.04 mmHg FS/Year	±0.1% FS/Year
VOLUME DISPLACEMENT	0.06 mm <sup>3</sup> /10 mmHg	0.004 mm <sup>3</sup> /10 mmHg
FREQUENCY RANGE	0 to 100 Hz	0 to 300 Hz
OUTPUT RESISTANCE	300 Ω, nominal	
EXCITATION VOLTAGE	5 V (4.5 to 5.5 V) DC only	
PRESSURE CONNECTIONS	Male Luer Lock	
CONNECTION CABLE	1.5 m (4.9 ft) long	
MOUNTING ROD, OD x L	8 x 70 mm (0.31 x 2.76 in)	



# SYRINGE PUMP ACCESSORIES

## Pressure Transducers for PHD ULTRA™ CP Syringe Pump (continued)

### Electronic Pressure Calibrator



#### KEY FEATURES

- Maintenance free precision pressure generation
- 4 units available:
  - 0 to 200 mmHg
  - 0 to 300 mmHg
  - 0 to 20 mmH<sub>2</sub>O
  - 0 to 200 mmH<sub>2</sub>O
- Calibration certificate on request

The calibrator KAL 84 is used for calibrating pressure sensors. A critical step in properly calibrating the CP pump across the appropriate output range of the amplifier involves the generation of a known stable pressure. The KAL 84 represents a combination of a pressure generator (hand pump) and a pressure meter with digital display. The instrument provides a simple means for testing and calibrating both pressure sensors and complete pressure measuring equipment.

After the unit has been switched on and connected to the pressure sensor to be calibrated (test object), the required pressure is set with the small hand-wheel. The built-in pressure meter measures the set pressure accurately and indicates it in digital form. Since the generated pressure is identical at the built-in pressure meter and at the test object, the pressure measured by the test object corresponds exactly to the pressure indicated by the KAL 84.

Models with different pressure ranges are available. Each model has an application-specific range (range 1) and can be switched to a corresponding SI range (range 2) in Pascal (Pa) or Kilopascal (kPa).

#### Electronic Pressure Calibrator Specifications

<b>RANGE</b>	Measurement and calibration range for appropriate model (see table below)
<b>LINEARITY</b>	±0.5% FS ±1 digit for mercury models, ±1% FS ±1 digit for water models
<b>HYSTERESIS</b>	0.1% FS
<b>OVERPRESSURE LIMIT</b>	200% FS for mercury models 500% FS for water models
<b>RESPONSE TIME</b>	TE = 20 ms, time constant can be switched to 0.1 sec or 1 sec
<b>ANALOG OUTPUT</b>	0 to 1 V for 100% nominal range, load resistance at least 2 kΩ
<b>TEMPERATURE RANGE:</b>	
<b>NOMINAL</b>	+10°C to +50°C
<b>OPERATING</b>	0°C to +60°C
<b>PRESSURE CONNECTIONS</b>	6.5 mm OD for 5 mm ID tubing
<b>POWER SUPPLY</b>	9 V rechargeable battery, mains adapter
<b>DIMENSIONS, H X W X D</b>	100 x 260 x 180 mm (3.9 x 10.2 x 7.1 in)
<b>WEIGHT</b>	Approx. 3 kg (6.6 lb)
<b>OPTIONAL CERTIFICATE</b>	Linearity test certificate, DKD (German calibration service, see below)

Order #	Product
PC6 73-0977	Calibration Certificate with KAL84 Purchase
PC6 73-2918	Recalibration of KAL84 with Certificate (Requires Return of Unit)

#### Electronic Pressure Calibrators

115 VAC, 60 HZ	230 VAC, 50 HZ	MODEL	LIQUID	RANGE 1	RANGE 2	USED FOR CALIBRATION OF
PC6 73-0012	PC6 73-0013	KAL 84 H	Mercury	0 to 199.9 mmHg	0 to 26.66 kPa	Blood Pressure Transducers
PC6 73-0014	PC6 73-0015	KAL 84 SH	Mercury	0 to 300.0 mmHg	0 to 39.99 kPa	Blood Pressure Transducers
PC6 73-0016	PC6 73-0017	KAL 84 L	Water	0 to 19.99 mmH <sub>2</sub> O	0 to 196.0 Pa	Low-Range Differential Pressure Transducers
PC6 73-0018	PC6 73-0019	KAL 84 M	Water	0 to 199.9 mmH <sub>2</sub> O	0 to 1960 Pa	Low-Range Differential Pressure Transducers

## Pressure Transducers for PHD ULTRA™ CP Syringe Pump (continued)

### Disposable Pressure Transducer TRA023HS



The Harvard Apparatus Research TRA023HS is a lower-cost semi-disposable pressure transducer with an in-line configuration which is suitable for use with most arterial and venous blood pressure measurements.

The TRA023HS is designed to work with the PLUGSYS TAM-A or TAM-D amplifiers and is supplied with an instruction manual and a calibration certificate.

#### Disposable Pressure Transducer Specifications

<b>PRESSURE RANGE</b>	-50 to 300mmHg
<b>OVERLOAD</b>	-500 to 5000 mmHg
<b>SENSITIVITY</b>	5 $\mu$ V/V/mmHg
<b>OPERATING TEMPERATURE</b>	15°C to 40°C
<b>EIGHT HOUR DRIFT</b>	1 mmHg after 10 min. warm-up.
<b>EXCITATION VOLTAGE</b>	2 to 5 VDC
<b>STORAGE TEMPERATURE RANGE</b>	30°C to 60°C
<b>OPERATING LIFE</b>	500 hours

Order #	Product
PC6 76-0498	TRA023 Disposable Research Pressure Transducer for PLUGSYS TAM Amplifier

### Research Grade Blood Pressure Transducer



#### KEY FEATURES:

- An extremely versatile and accurate pressure transducer
- Simple to use and robust
- Transducer and Amplifier in a single compact unit
- BNC output for connection to virtually any data acquisition system

Because the maximum voltage output of the built-in amplifier is 3V, the RGBP transducer is only suitable for use with the CP Pump series if the expected flow rate range for the selected syringe size falls within the bottom 30% of the pusher block speed of the pump. Using a larger syringe size allows a higher flow rate in the lower 30% and may be necessary if larger flows are required to reach the desired pressure setpoint.

The RGBP uses a unique electronic circuit (US Patent #4,142,144) which is extremely sensitive and stable, producing a signal suitable for direct connection to records, oscillographs, computers, and the CP Pump series. The transducer has a 3-digit backlit display, measures signals in the physiological range of -50 to 300 mmHg, and is small enough to fit in any lab space.

The Transducer uses a semi-disposable dome of medical grade Silastic® with an integral silicone rubber diaphragm which are supplied sterile and can be re-sterilized with no effects on performance. The transducer has a built-in rod designed to be mounted on a clamp and stand (such as PC6 73-0500 Triangular Stand with Clamp), and is not supplied with stopcocks (sold separately)\*.

Please note that replacement domes listed on this page are for Harvard Apparatus' newer model transducer only which is distinguished by the white ring at the base of the dome. Replacement domes for older units are not available.

*\*Use one each of PC6 73-0096 three-way stopcock and PC6 73-0097 one-way stopcock*

#### Research Grade Blood Pressure Transducer Specifications

<b>OUTPUT VOLTAGE</b>	Factory set at 1.0 V/100 mmHg via BNC connector; calibrated up to 200 mmHg
<b>LINEARITY</b>	$\pm 1.5\%$ of full scale
<b>COMPLIANCE</b>	14 $\mu$ l displacement /100 mmHg, including 305 mm (12 in) of standard 3 mm (1/8 in) ID vinyl tubing
<b>DOMES VOLUME</b>	300 $\mu$ l
<b>PRESSURE RANGE</b>	-50 to +300 mmHg
<b>OVERLOAD PRESSURE</b>	3000 mmHg
<b>ZERO OFFSET CONTROL</b>	-50 to +100 mmHg
<b>NATURAL FREQUENCY</b>	> 500 Hz, dry
<b>ELECTRICAL ISOLATION</b>	> 1 kV
<b>CARRIER FREQUENCY</b>	2 MHz
<b>OUTPUT IMPEDANCE</b>	2 k $\Omega$
<b>INPUT LIQUID CONNECTOR</b>	Dual transparent male Luer Lock
<b>DRIFT</b>	Negligible after 5 min. warm-up
<b>STERILIZATION OF TRANSDUCER</b>	Chemical: Alcide, Cidex, etc.
<b>DIMENSIONS:</b>	
Transducer, H x W x D	43 x 30 x 55 mm (1-1/2 x 1-1/8 x 2-1/4 in)
Handle, OD x L	9.7 x 76.2 mm (3/8 x 3 in)
Amplifier, H x W x D	51 x 95 x 886 mm (2 x 3-3/4 x 3-3/8 in)
<b>DISPLAY</b>	LCD, 7.6 mm (0.3 in) high numbers
<b>WEIGHT</b>	908 g (2 lb)

Order #	Product
PC6 72-4496	Research Blood Pressure Transducer, 115 VAC, 60 Hz
PC6 72-4497	Research Blood Pressure Transducer, 230 VAC, 50 Hz
PC6 72-4498	Replacement Dome, pkg. of 1 (Older units require retrofit)

## Harvard Apparatus Stainless Steel Syringes



### KEY FEATURES

- 7500 psi peak pressure (with 2.5 ml syringes)
- Fits most Harvard Apparatus pumps
- Electron beam welded
- Fully autoclavable
- 1/16 inch SWAGELOK® fitting for low dead volume

### High Pressure Stainless Steel Syringes

Harvard Apparatus offers a complete line of Stainless Steel Syringes intended for high pressure applications with good resistance to most aggressive liquids. Wetted parts are #316 stainless steel or Viton. Syringes are available in 2.5, 8, 20, 50, 100 and 200 ml sizes with removable, replaceable tips. Genuine SWAGELOK® syringe to tube fittings are available in 1/16, 1/8 and 1/4 inch sizes. A Luer lock end fitting is also available. All tips are interchangeable with all syringes (20 to 200 ml) in the series.

### High Pressure 2.5 ml and 8 ml Stainless Steel Syringes

These syringes have been designed to utilize the high forces available in our syringe pumps to produce pressures up to 7,500 psi and 1,500 psi respectively. The 8 ml syringe is constructed entirely of #316 stainless steel. The barrel of the 2.5 ml syringe is #316 stainless steel and the plunger is #400C stainless steel. The 2.5 ml stainless steel syringe contains one Perfluoroelastomer O-Ring

seal and one Ball seal. This syringe is available with a 1/16 inch SWAGELOK® tip only. The 8 ml stainless steel syringe contains two Perfluoroelastomer O-Ring seals and two PTFE O-Ring seals. This syringe is available with a 1/16 inch or 1/8 inch SWAGELOK® tip.

### High Pressure 20 ml to 200 ml Stainless Steel Syringes

Both syringe barrel end plungers are #316 stainless steel. A Viton O-Ring between top and end of the barrel insures against leakage. Syringes are guaranteed to be leak free for pressures up to 750 psi.

All syringes are supplied with inside diameter dimensions for use with Harvard Apparatus microprocessor controlled pumps and rate charts for use with older 'classic' pumps. Replacement Viton O-Rings are available, as are the more chemically resistant Perfluoroelastomer O-Rings.

For illustration and syringe dimensions, see next page.

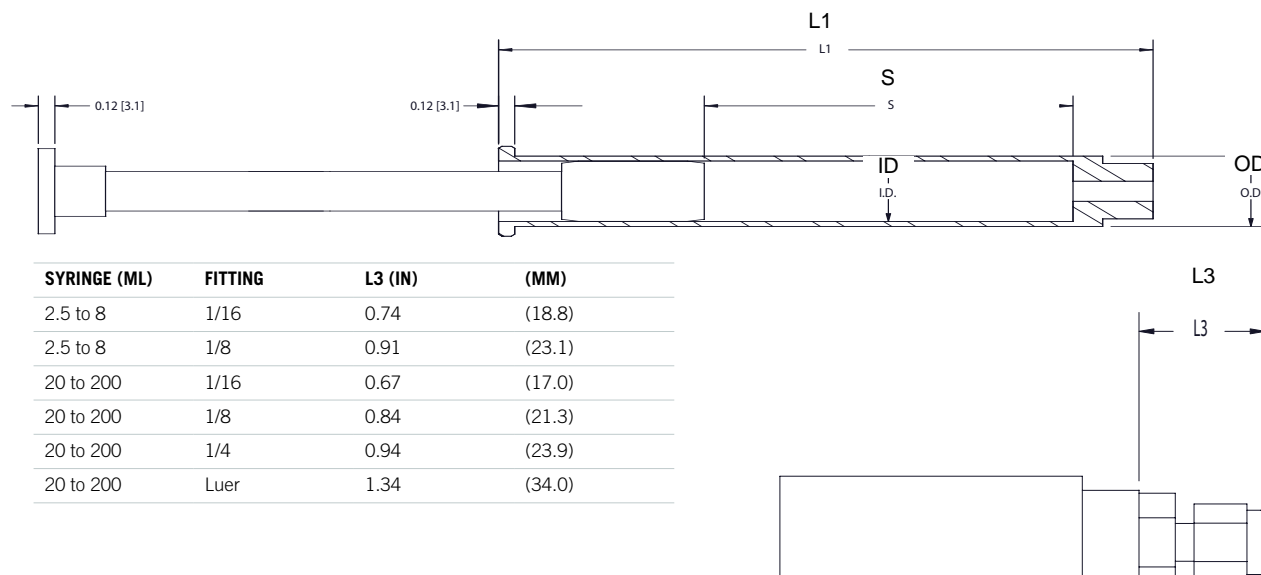
Order #	Product
<b>Replacement Parts</b>	
<b>Chemraz 505</b>	
PC6 5013-087	Perfluoroelastomer Barrel O-Ring 8 ml
PC6 5013-089	Perfluoroelastomer Barrel O-Ring 20 ml
PC6 5013-090	Perfluoroelastomer Barrel O-Ring 50 ml
PC6 5013-091	Perfluoroelastomer Barrel O-Ring 100 ml
PC6 5013-092	Perfluoroelastomer Barrel O-Ring 200 ml
PC6 5013-110*	Perfluoroelastomer Tip Seal O-Ring 2.5 ml and 8 ml
PC6 5013-109	Perfluoroelastomer Tip Seal O-Ring 20 ml to 200 ml
<b>Viton</b>	
PC6 72-2472	Replacement Viton O-Ring 20 ml, pkg. of 10
PC6 72-2473	Replacement Viton O-Ring 50 ml, pkg. of 10
PC6 72-2474	Replacement Viton O-Ring 100 ml, pkg. of 10
PC6 72-2475	Replacement Viton O-Ring 200 ml, pkg. of 10
PC6 72-2616	Replacement Viton Tip Seal O-Ring, 20 ml to 200 ml, pkg. of 20
<b>Other</b>	
PC6 70-2271	Replacement Ball Seal for 2.5 ml
PC6 5013-088	Replacement Backup PTFE O-Ring, 8 ml
PC6 72-2617	Stainless Steel Plunger Button to Adapt Syringe for Use with PHD ULTRA HPSI/XF, see page 26 (Required for 50 and 100 ml Syringes Only)

\*Note: 2.5 ml and 8 ml stainless steel syringes cannot be used with the PHD ULTRA HPSI/XF due to overpressure conditions.

### High Pressure Stainless Steel Syringes

		With SWAGELOK®			With Luer Lock
SYRINGE SIZE	THREAD	DIAMETER 1/16 INCH	DIAMETER 1/8 INCH	DIAMETER 1/4 INCH	
2.5 ml	1/4 -28 inch	PC6 70-2269	N/A	N/A	N/A
8 ml	1/4 -28 inch	PC6 70-2267	PC6 70-2268	N/A	N/A
20 ml	3/8 -24 inch	PC6 70-2251	PC6 70-2252	PC6 70-2253	PC6 70-2254
50 ml	3/8 -24 inch	PC6 70-2255	PC6 70-2256	PC6 70-2257	PC6 70-2258
100 ml	3/8 -24 inch	PC6 70-2259	PC6 70-2260	PC6 70-2261	PC6 70-2262
200 ml	3/8 -24 inch	PC6 70-2263	PC6 70-2264	PC6 70-2265	PC6 70-2266
<b>Replacement Tips, Furnished with Sealing O-Ring</b>					
2.5 ml	N/A	PC6 70-2246	N/A	N/A	N/A
8 ml	N/A	PC6 70-2246	PC6 70-2245	N/A	N/A
20 to 200 ml	N/A	PC6 70-2247	PC6 70-2248	PC6 70-2249	PC6 70-2250

## Harvard Apparatus Stainless Steel Syringes (continued)



### Harvard Apparatus Stainless Steel Syringes Specifications

VOLUME	2.5 ml	8 ml	20 ml	50 ml	100 ml	200 ml
MAXIMUM TEST PRESSURE	9,000 psi	4,000 psi	1,500 psi	1,500 psi	1,500 psi	1,500 psi
WORKING PRESSURE	7,000 psi	1,500 psi	750 psi	750 psi	750 psi	750 psi
DIMENSIONS	in (mm)	in (mm)	in (mm)	in (mm)	in (mm)	in (mm)
OVERALL LENGTH OF BARREL -(L1)	6.625 (168.3)	6.73 (170.8)	4.73 (120.1)	5.49 (139.3)	6.73 (170.9)	81.48 (215.4)
PLUNGER EXCURSION -(S)	4.75 (120.6)	4.42 (112.4)	3.56 (90.3)	4.14 (105.2)	5.67 (143.9)	7.20 (182.8)
OUTSIDE DIAMETER -(OD)	0.50 (12.7)	0.50 (12.7)	0.88 (22.2)	1.25 (31.8)	1.50 (38.1)	1.88 (47.63)
INSIDE DIAMETER -(ID)	0.191 (4.85)	0.375 (9.525)	0.753 (19.13)	1.126 (28.60)	1.374 (34.90)	1.762 (44.75)



## Hamilton™ Glass Syringes

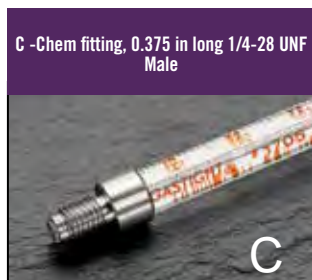
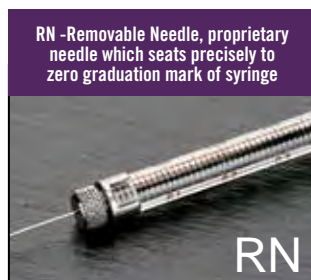
**H**arvard Apparatus offers a complete line of syringes in a variety of styles and sizes. We have introduced a broad selection of Hamilton™ microliter and specialty syringes along with an extensive selection of Kendall Monoject® plastic syringes. Our syringe selection continues to grow. Please visit our website or contact our technical support department for the latest offerings.

### KEY FEATURES

- Sizes from 0.5 µl to 100 ml syringes available
- Nine different styles of Hamilton™ syringes from which to choose
- 5 different terminations
- Standard and instrument plunger styles available
- Standard and GASTIGHT® syringes
- Specialty syringes and accessories

### Syringe Terminations

Syringes end in one of the following configurations:



### Point Styles

RN and KH needles are available in two different point styles. Point style 2 is a non-coring Huber-like bevel. Point style 3 is blunt.

#### Point Style 2



#### Point Style 3

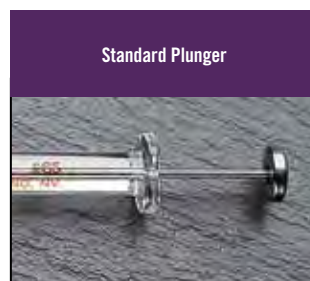


Hamilton syringes are considered the industry standard for precision fluid delivery. Harvard Apparatus offers a broad selection of these precision syringes which, when combined with our syringe pumps, offer fluid delivery with unparalleled accuracy and precision. A variety of syringe terminations are available to interface with virtually any system or experimental protocol. Hamilton microliter syringe options include: reinforced syringe plungers, reinforced syringe barrels, and GASTIGHT® syringes with syringe volumes from 0.5 µl to 100 ml (for standard glass syringes). Many syringes have replaceable plungers and barrels. Several accessories are also available for the microliter syringes including syringe guides for added plunger stability and cleaning wires and solution to maximize the life of your syringe.

All Hamilton™ glass syringes are autoclavable when disassembled except for syringes with cemented needles.

### Syringe Plungers

Most are fine wire with button plungers. Some are interchangeable/replaceable



### X Suffix (e.g. TLLX & CX)

Indicates syringe with Instrument stop, recommended for use with syringe pumps or drives for microliter syringes to prevent damage. Only available for 1700 series GASTIGHT® syringes.

### Special Needle Sizes

An "s" following the needle gauge indicates a special size, see below.

Special Needle Sizes (mm)			
GAUGE THICKNESS	OD	ID	WALL
22s	0.72	0.15	0.28
25s	0.51	0.15	0.18
26s	0.47	0.13	0.18

All other gauges listed are standard dimensions, see page 114 for needle size chart. Custom needle tips, gauges and lengths are available, call for more information.

## Hamilton™ Glass Syringes

### Some additional suggestions to assist you in selecting the best syringe for your application.

- **Reinforced Plunger** – Select this style if your setup or application may cause the plunger to bend (Series 800 and 1800 syringes, see pages 50 and 51).
- **Replaceable Barrel Syringes** – Select this style if your setup or application may cause the barrel to break or bend (Series 800, 1000 and 1700 syringes, see pages 50 and 51).
- **Removable Needles** – Select syringes with LT or TLL termini along with either disposable or reusable needles. For our complete selection of Luer needles including sterile disposable, non-sterile and specialty needles, please visit our website.
- **Chem Terminus** – Select syringes with a C terminus if you require a threaded fitting for high pressure applications.

### Hamilton™ Neuros™ Syringes.

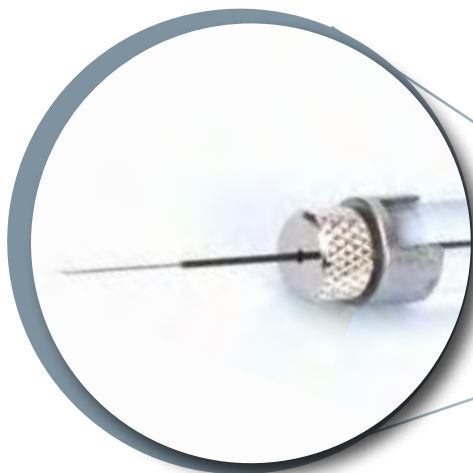
- Accurately dispenses 50 nl to 100 µl of liquid to an exact location
- Maintains rigidity and creates the smallest injection site possible
- Little to no dead volume which eliminates sample loss and saves money

See next page for full product details.

Syringe Graduations								
100 LINE SCREENS								
7000 SERIES MODIFIED MICROLITER SYRINGES	0.5 µl	1 µl	2 µl	5 µl				
Scale Length, cm	6	6	6	6				
Total Scale Divisions	100	100	100	100				
Major Graduations, µl	0.05	0.1	0.2	0.5				
Minor Graduations, µl	0.01	0.02	0.04	0.1				
Sub-Minor Graduations, µl	0.005	0.01	0.02	0.05				
700 & 800 SERIES MICROLITER SYRINGES	5 µl	10 µl	25 µl	50 µl	100 µl	250 µl	500 µl	
	75, 85	701, 801	702, 802	705, 805	710, 810	725, 825	750	
Scale Length, cm	5.41	5.41	6	6	6	6	6	
Total Scale Divisions	100	100	100	100	100	100	100	
Major Graduations, µl	0.5	1	2.5	5	10	25	50	
Minor Graduations, µl	0.1	0.2	0.5	1	2	5	10	
Sub-Minor Graduations, µl	0.05	0.1	0.25	0.5	1	2.5	5	
1700 & 1800 SERIES GASTIGHT SYRINGES	10 µl	25 µl	50 µl	100 µl	250 µl	500 µl		
	1701, 1801	1702, 1802	1705, 1805	1710, 1810	1725, 1825	1750		
Scale Length, cm	6	6	6	6	6	6		
Total Scale Divisions	100	100	100	100	100	100		
Major Graduations, µl	1	2.5	5	10	25	50		
Minor Graduations, µl	0.2	0.5	1	2	5	10		
Sub-Minor Graduations, µl	0.1	0.25	0.5	1	2.5	5		
1000 SERIES GASTIGHT SYRINGES	1 ml	1.25 ml	2.5 ml	5 ml	10 ml	25 ml	50 ml	100 ml
	1001	1001.25	1002	1005	1010	1025	1050	1100
Scale Length, cm	6	6	6	6	6	6	6	12
Total Scale Divisions	100	100	100	100	100	100	100	200
Major Graduations, ml	0.1	0.125	0.25	0.5	1	2.5	5	5
Minor Graduations, ml	0.02	0.025	0.05	0.1	0.2	0.5	1	1
Sub-minor Graduations, ml	0.01	0.0125	0.025	0.05	0.1	0.25	0.5	0.5
SUPER SYRINGES	500 ml	1000 ml	1500 ml	2000 ml				
	S0500	S1000	S1500	S2000				
Scale Length, inches	6.53	6.57	9.85	13.13				
Total Scale Divisions	25	50	75	100				
Major graduations, ml	100	100	100	100				
Minor graduations, ml	20	20	20	20				

## Hamilton™ Glass Syringes (continued)

### Neuros™ Syringes



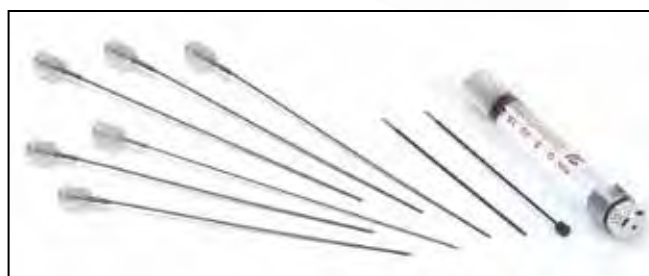
#### KEY FEATURES

- Accurately dispenses 50 nl to 100 µl of liquid to an exact location
- Maintains rigidity and creates the smallest injection site possible
- Little to no dead volume which eliminates sample loss and saves money
- Two sleeve options – one with a blind stop for cannulated animals and another without for stereotaxic holders
- Adjustable needle exposure of 0 to 20 mm gives you full control
- Compatibility with most stereotaxic holders and infusion pumps means an easy integration into your process

Hamilton Neuros™ syringe technology provides unprecedented functionality for controlled animal injections. The Neuros accurately dispenses volumes between 50 nl to 100 µl through an ultrafine needle with a blunt point (point style 3).

Developed specifically for neuroscience applications, the Neuros syringe enables the delivery of microvolumes to an exact location while minimizing injection site damage. Neuros syringes come with two types of protective needle sleeves. The sleeve with a blind stop is perfect for cannulated applications and ensures targeted administration with an adjustable penetration depth. The version without a blind stop works best with stereotaxic holders. Both types provide an adjustable needle exposure of 0 to 20 mm.

These new Neuros™ Syringes are compatible with Harvard Apparatus syringe pumps.



Order #	Product
PC6 75-0015	0.5 µl Neuros 7000 Series KH Syringe
PC6 75-0016	1.0 µl Neuros 7000 Series KH Syringe
PC6 75-0017	2.0 µl Neuros 7000 Series KH Syringe
PC6 75-0018	5.0 µl, Model 75 RN Neuros Syringe
PC6 75-0019	10 µl 1700 Series RN Syringe and Neuros Adapter Kit
PC6 75-0020	25 µl 1700 Series RN Syringe and Neuros Adapter Kit
PC6 75-0021	50 µl 1700 Series RN Syringe and Neuros Adapter Kit
PC6 75-0022	100 µl 1700 Series RN Syringe and Neuros Adapter Kit
PC6 75-0023	Neuros Adapter Kit for 100 µl RN Syringe and smaller
PC6 75-0024	Neuros Replacement Needle, 33 gauge, Small Hub RN Needle, 3.03 in, point style 3, 6/pk

## Hamilton™ Glass Syringes (continued)

### 800 Series Syringes



Syringe sizes from 5 to 250 µl available. Reinforced plunger:  
Replaceable plunger barrel assembly. Syringes supplied individually.

#### 800 Series Syringes

ORDER #	Vol.	Ter.	Point Style	Ga.*	Replacement Parts	
					Needle (pkg. of 6)	Plunger Barrel Assembly
PC6 72-1724	5 µl	RN	2	26s	PC6 72-5744	PC6 72-1730
PC6 72-1725	10 µl	RN	2	26s	PC6 72-5744	PC6 72-1731
PC6 72-1726	25 µl	RN	2	22s	PC6 72-5745	PC6 72-1732
PC6 72-1727	50 µl	RN	2	22s	PC6 72-5745	PC6 72-1733
PC6 72-1728	100 µl	RN	2	22s	PC6 72-5745	PC6 72-1734
PC6 72-1729	250 µl	RN	2	22s	PC6 72-5746	PC6 72-1735

\* Note: An 's' after the gauge size refers to a special needle size, see chart on page 50.

### 7000 Series Modified Microliter™ Syringes



Ultra low volume syringes: 0.5 to 5 µl. No Dead Volume – sample contained entirely in needle. Replaceable syringe barrels and parts. The KH repair kit includes KH needle, KH ferrule, plunger wire and instruction sheet. Cannot substitute different size needles. Syringes supplied individually.

#### 7000 Series Modified Microliter™ Syringes

ORDER #	Volume	Terminus	Point Style	Gauge	KH Repair Kit
PC6 72-1736	0.5 µl	KH	2	25	PC6 72-1749
PC6 72-1737	1 µl	KH	2	25s	PC6 72-1750
PC6 72-1738	1 µl	KH	2	22s	PC6 72-1751
PC6 72-1739	2 µl	KH	2	25	PC6 72-1752
PC6 72-1740	2 µl	KH	2	23	PC6 72-1753
PC6 72-1741	5 µl	KH	2	24	PC6 72-1754
PC6 72-1742	0.5 µl	KH	3	32	PC6 72-1755
PC6 72-1743	0.5 µl	KH	3	25	PC6 72-1756
PC6 72-1744	1 µl	KH	3	25s	PC6 72-1757
PC6 72-1745	1 µl	KH	3	22s	PC6 72-1758
PC6 72-1746	2 µl	KH	3	25	PC6 72-1759
PC6 72-1747	2 µl	KH	3	23	PC6 72-1760
PC6 72-1748	5 µl	KH	3	24	PC6 72-1761

\* Note: An 's' after the gauge size refers to a special needle size, see chart on page 50.

### 1700 Series GASTIGHT® Syringes



PTFE tipped plungers. Replaceable plungers and needles. Sizes: 10 to 500 µl. Syringes supplied individually. Replacement needles are sold in packages of 6.

#### 1700 Series GASTIGHT® Syringes

ORDER #	Vol.	Ter.	Point Style	Ga.*	Replacement Parts		
					Needle (pkg. of 6)	Plunger	Barrel
PC6 72-1762	10 µl	LT	–	–	–	PC6 72-1785	–
PC6 72-1763	25 µl	LT	–	–	–	PC6 72-1786	–
PC6 72-1764	50 µl	LT	–	–	–	–	–
PC6 72-1765	100 µl	LT	–	–	–	–	–
PC6 72-1766	250 µl	LT	–	–	–	PC6 72-1789	–
PC6 72-1767	500 µl	LT	–	–	–	–	–
PC6 72-1824	5 µl	RN	3	32	PC6 72-5743	–	–
PC6 72-1825	10 µl	RN	3	32	PC6 72-5743	PC6 72-1785	–
PC6 72-1768	10 µl	RN	2	26s	PC6 72-5744	PC6 72-1785	–
PC6 72-1769	25 µl	RN	2	22s	PC6 72-5745	PC6 72-1786	–
PC6 72-1770	50 µl	RN	2	22s	PC6 72-5745	PC6 72-1792	–
PC6 72-1771	100 µl	RN	2	22s	PC6 72-5745	PC6 72-1793	–
PC6 72-1772	250 µl	RN	2	22s	PC6 72-5746	PC6 72-1794	–
PC6 72-1773	500 µl	RN	2	22	PC6 72-7139	PC6 72-1795	–
PC6 72-1774	10 µl	RN	3	22s	PC6 72-5751	PC6 72-1785	–
PC6 72-1775	25 µl	RN	3	22s	PC6 72-5751	PC6 72-1786	–
PC6 72-1776	50 µl	RN	3	22s	PC6 72-5751	PC6 72-1792	–
PC6 72-1777	100 µl	RN	3	22s	PC6 72-5751	PC6 72-1793	–
PC6 72-1778	250 µl	RN	3	22s	PC6 72-5753	PC6 72-1794	–
PC6 72-1779	500 µl	RN	3	22	PC6 72-5752	PC6 72-1795	–
PC6 72-1781	50 µl	TLL	–	–	–	PC6 72-1792	–
PC6 72-1782	100 µl	TLL	–	–	–	PC6 72-1793	PC6 72-1798
PC6 72-1783	250 µl	TLL	–	–	–	PC6 72-1794	PC6 72-1799
PC6 72-1784	500 µl	TLL	–	–	–	PC6 72-1795	PC6 72-1800
PC6 72-1780	25 µl	TLLX	–	–	–	PC6 72-1791	–
PC6 72-1901	50 µl	TLLX	–	–	–	PC6 72-1808	–
PC6 72-1902	100 µl	TLLX	–	–	–	PC6 72-1809	PC6 72-1798
PC6 72-1903	250 µl	TLLX	–	–	–	PC6 72-1810	PC6 72-1799
PC6 72-1904	500 µl	TLLX	–	–	–	PC6 72-1811	PC6 72-1800
PC6 72-1801	10 µl	CX	1/4-28	–	–	–	–
PC6 72-1802	25 µl	CX	1/4-28	–	–	PC6 72-1791	–
PC6 72-1803	50 µl	CX	1/4-28	–	–	PC6 72-1808	PC6 72-1907
PC6 72-1804	100 µl	CX	1/4-28	–	–	PC6 72-1809	PC6 72-1908
PC6 72-1805	250 µl	CX	1/4-28	–	–	PC6 72-1810	PC6 72-1909
PC6 72-1806	500 µl	CX	1/4-28	–	–	PC6 72-1811	PC6 72-1910

\* Note: An 's' after the gauge size refers to a special needle size, see chart on page 50.



## Hamilton™ Glass Syringes (continued)

### 700 Series Syringes



Economical Microliter Syringes. Barrels and plungers are NOT interchangeable or replaceable. Syringe sizes from 5 to 500 µl available. Syringes supplied individually.

#### 700 Series Syringes\*\*

ORDER #	Volume	Terminus	Point Style	Gauge*	Replacement Needle (pkg. of 6)
PC6 72-1717	5 µl	RN	2	26s	PC6 72-5744
PC6 72-1822	5 µl	RN	3	32	PC6 72-5743
PC6 72-1718	10 µl	RN	2	26s	PC6 72-5744
PC6 72-1823	10 µl	RN	3	32	PC6 72-5743
PC6 72-1719	25 µl	RN	2	22s	PC6 72-5745
PC6 72-1720	50 µl	RN	2	22s	PC6 72-5745
PC6 72-1721	100 µl	RN	2	22s	PC6 72-5745
PC6 72-1722	250 µl	RN	2	22s	PC6 72-5746
PC6 72-1723	500 µl	RN	2	22	PC6 72-7139
PC6 72-1711	10 µl	LT	—	—	—
PC6 72-1712	25 µl	LT	—	—	—
PC6 72-1713	50 µl	LT	—	—	—
PC6 72-1714	100 µl	LT	—	—	—
PC6 72-1715	250 µl	LT	—	—	—
PC6 72-1716	500 µl	LT	—	—	—

\* Note: An "s" after the gauge size refers to a special needle size, see chart on page 50.

### 1800 Series GASTIGHT® Syringes



Reinforced, PTFE tipped plungers. Replaceable plunger assembly and needle. Syringe sizes from 10 to 250 µl available. Syringes supplied individually.

#### 1800 Series GASTIGHT® Syringes

ORDER #	Volume	Terminus	Point Style	Gauge*	Replacement Needle (pkg. of 6)
PC6 72-1812	10 µl	RN	2	26s	PC6 72-5744
PC6 72-1813	25 µl	RN	2	22s	PC6 72-5745
PC6 72-1814	50 µl	RN	2	22s	PC6 72-5745
PC6 72-1815	100 µl	RN	2	22s	PC6 72-5745
PC6 72-1816	250 µl	RN	2	22s	PC6 72-5746

\* Note: An "s" after the gauge size refers to a special needle size, see chart on page 50.

### 1000 Series GASTIGHT® Syringes



PTFE tipped plungers. Replaceable plungers and needles sizes: 1 to 100 ml, Terminus: LT, TLL, RN, C. Syringes supplied individually.

#### 1000 Series GASTIGHT® Syringes

					Replacement Parts	
ORDER #	Volume	Ter.	Point Style	Gauge	Needle (pkg. of 6)	Plunger Assembly
PC6 72-1826	1 ml	LT	—	—	—	PC6 72-1894
PC6 72-1828	2.5 ml	LT	—	—	—	PC6 72-1896
PC6 72-1829	5 ml	LT	—	—	—	PC6 72-1897
PC6 72-1830	10 ml	LT	—	—	—	PC6 72-1898
PC6 72-1831	1 ml	TLL	—	—	—	PC6 72-1894
PC6 72-1832	2.5 ml	TLL	—	—	—	PC6 72-1896
PC6 72-1833	5 ml	TLL	—	—	—	PC6 72-1897
PC6 72-1834	10 ml	TLL	—	—	—	PC6 72-1898
PC6 72-1835	25 ml	TLL	—	—	—	PC6 72-1899
PC6 72-1836	50 ml	TLL	—	—	—	PC6 72-1900
PC6 72-1837	100 ml	TLL	—	—	—	—
PC6 72-1838	1 ml	RN	2	22	PC6 72-7139	PC6 72-1894
PC6 72-1839	2.5 ml	RN	2	22	PC6 72-7139	PC6 72-1896
PC6 72-1840	5 ml	RN	2	22	PC6 72-7139	PC6 72-1897
PC6 72-1841	10 ml	RN	2	22	PC6 72-7139	PC6 72-1898
PC6 72-1842	1 ml	C	—	1/4-28	—	PC6 72-1894
PC6 72-1843	2.5 ml	C	—	1/4-28	—	PC6 72-1896
PC6 72-1844	5 ml	C	—	1/4-28	—	PC6 72-1897
PC6 72-1845	10 ml	C	—	1/4-28	—	PC6 72-1898

\* Note: If using with a Harvard Apparatus syringe pump and withdrawal is required, please order plunger adaptor PC6 55-8000 for Hamilton syringe sizes 25 ml and greater.

### Constant Rate Syringes



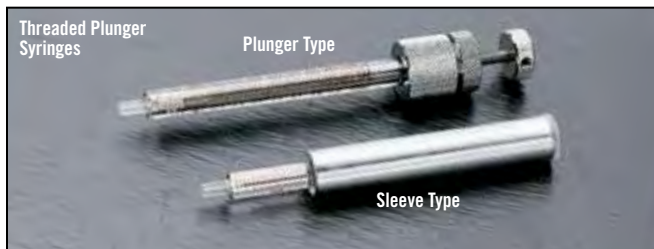
Spring-driven plunger injects samples at a constant rate. Incremental volumes are selectable with mm precision. Volumes: 20, 50, 200 µl. Syringes supplied individually.

Order #	Product	Gauge*	Length	Point Style
PC6 72-1854	Constant Rate Syringe, 20 µl	22s	2 in	3
PC6 72-1855	Constant Rate Syringe, 50 µl	22	2 in	3
PC6 72-1856	Constant Rate Syringe, 200 µl	22	2 in	3

\* Note: An "s" after the gauge size refers to a special needle size, see chart on page 50.

## Specialty Syringes and Accessories

### Threaded Plunger Syringes



For applications requiring extremely precise plunger movement or minute fluid manipulation, LT (Luer Tip) Terminus Volumes from 25  $\mu$ l to 1 ml. Syringes supplied individually.

#### Threaded Plunger Syringes

ORDER #	Volume	Description	Dispense Volume
PC6 72-1857	25 $\mu$ l	Sleeve Type	0.33 $\mu$ l/revolution
PC6 72-1859	100 $\mu$ l	Sleeve Type	1.32 $\mu$ l/revolution
PC6 72-1862	500 $\mu$ l	Plunger Type	5.29 $\mu$ l/revolution
PC6 72-1863	1 ml	Plunger Type	13.23 $\mu$ l/revolution

### Cadence Science Glass Syringes

These are standard glass Syringes with Luer Lock tips. The barrels and plungers of the same-sized Syringes are interchangeable. Syringes supplied individually.

#### Cadence Science (formerly Popper & Sons) Micro-Mate Glass Syringes

ORDER #	Syringe Size	ORDER #	Syringe Size
PC6 75-1010	5 cc	PC6 75-1012	30 cc
PC6 75-1011	10 cc	PC6 75-1013	50 cc
		PC6 75-1014	100 cc

### Glass Syringe with Robb Tip, 100 ml

The plunger and barrel of this glass Syringe are ground and mated for a tight fit. They are not interchangeable with other barrels or plungers. The parts are numbered for easy reassembly.

This Syringe dispenses large volumes in short time periods. Therefore, it has a Robb tip (Luer Lock) with a 12 gauge bore of 0.223 cm (0.088 in). 100 ml size only. Syringes supplied individually.

Order #	Product
PC6 55-1002	Becton-Dickinson Yale Glass Syringe with Robb Tip, 100 ml



### Syringe Guides

Prevent syringe plunger from bending. For manual (hand held) operation only. Adjustable Stop.

Works with 700, 1700 and 7000 series syringes.

#### Syringe Guides

For Use with Syringe Series				
ORDER #	Volume	700	1700	7000
PC6 72-1868	0.5 to 5 $\mu$ l			•
PC6 72-1867	5 to 10 $\mu$ l	•		
PC6 72-1867	5 to 10 $\mu$ l		•	
PC6 72-1868	25 to 500 $\mu$ l	•		
PC6 72-1868	25 to 500 $\mu$ l		•	



### Needle Cleaning Kit

Fine gauge tungsten wires used to clear plugged needles. Biodegradable cleaning solutions are used to remove residues from syringe needles and barrels. All cleaning wires are 7 inches long and are sold in packages of 10. Cleaning concentrate is sold separately.

Order #	Product	
	Cleaning Wires	
	To Clean Needle Gauge	Wire Size OD
PC6 72-1873	23s, 26s, 31 to 33	0.0762 mm (0.00300 in)
PC6 72-1874	26s, 31 to 33	0.0889 mm (0.00350 in)
PC6 72-1875	22s, 25s, 28 to 30	0.1262 mm (0.00497 in)
PC6 72-1876	27	0.1674 mm (0.00659 in)
PC6 72-1877	24 to 26	0.2070 mm (0.00815 in)
PC6 72-1878	22, 23	0.3066 mm (0.01207 in)
PC6 72-1879	Cleaning Concentrate, 70 ml	
PC6 72-1880	Cleaning Concentrate, 500 ml	
PC6 72-1872	All Cleaning Wires and 70 ml of Cleaning Concentrate	



### Removable (RN) Adapters

Provides connection of Luer fittings to RN syringes > 250  $\mu$ l.

Order #	Product
PC6 72-1869	RN Hub to Female Luer
PC6 72-1870	RN Hub to Male Luer
PC6 72-1871	RN Hub to Male Luer Lock

## Plastic Syringes

### Super Syringes



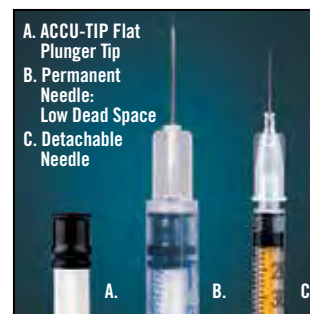
For air sampling, preparing gas standards and calibration of pneumotachs and spirometers. Special Termination: Tracheal Adapter (accepts 5/8 inch ID tubing)

Order #	Volume	Terminus
PC6 72-1846	500 ml	TLL
PC6 72-1847	1000 ml	TLL
PC6 72-1848	1500 ml	TLL
PC6 72-1849	2000 ml	TLL

### Single Use Monoject® Plastic Syringes



Plastic Syringes with Rigid Pack (R)



A. ACCU-TIP Flat Plunger Tip  
B. Permanent Needle: Low Dead Space  
C. Detachable Needle



Plastic Syringes with Blister Pack (B)

#### APPLICATIONS

- Syringe volumes from 0.3 to 1 cc
- Rigid or blister packaging
- Permanent or detachable needle
- ACCU-TIP syringe plunger

These syringes feature a new resin which provides greater clarity while still possessing all the same functional characteristics and biocompatibility requirements as traditional polypropylene syringes. They are packaged either Sterile or Non-Sterile. Rigid pack syringes feature a tamper-evident heat stake. There are five different syringe tip styles from which to choose.

Single Use Monoject Plastic Syringes								
						Box of 100	Case of Syringes	
Volume	Needle Gauge	Needle Length	Needle* Attachment	Pack Type	Safety Shield	ORDER #	ORDER #	Qty
0.3 cc	29	0.5 in	P	Blister	—	PC6 72-2419	PC6 72-2437	300
0.3 cc	29	0.5 in	P	Rigid	Yes	PC6 72-2420	PC6 72-2438	500
0.5 cc	28	0.5 in	P	Rigid	—	PC6 72-2421	PC6 72-2439	500
0.5 cc	28	0.5 in	P	Blister	—	PC6 72-2422	PC6 72-2440	300
0.5 cc	29	0.5 in	P	Blister	—	PC6 72-2424	PC6 72-2442	300
0.5 cc	29	0.5 in	P	Rigid	Yes	PC6 72-2425	PC6 72-2443	500
1 cc	25	0.625 in	D	Rigid	—	PC6 72-2426	PC6 72-2444	500
1 cc	25	0.625 in	P	Rigid	—	PC6 72-2427	PC6 72-2445	500
1 cc	25	0.625 in	P	Rigid	Yes	—	PC6 72-2447	500
1 cc	26	0.375 in	D	Rigid	—	PC6 72-2429	PC6 72-2448	500
1 cc	27	0.5 in	D	Rigid	—	PC6 72-2430	PC6 72-2449	500
1 cc	28	0.5 in	P	Rigid	—	PC6 72-2432	PC6 72-2451	500
1 cc	28	0.5 in	P	Blister	—	PC6 72-2433	PC6 72-2452	300
1 cc	28	0.5 in	P	Rigid	Yes	—	PC6 72-2454	500
1 cc	29	0.5 in	P	Blister	—	PC6 72-2435	PC6 72-2455	300
1 cc	29	0.5 in	P	Rigid	Yes	PC6 72-2436	PC6 72-2456	500

\*Note: P -Permanent; D -Detachable

## Plastic Syringes (continued)

### Becton Dickinson Plastic Syringes



These individually packaged plastic sterile syringes come standard with a Luer Lock connector. They are available in six sizes. See the table below for size and quantity information.

Becton Dickinson Plastic Syringes			
ORDER #	Syringe Size	Graduation	Qty./Box
PC6 59-8377	3 ml	1/10 ml	100
PC6 59-8378	5 ml	1/5 ml	125
PC6 59-8379	10 ml (3/4 oz)	1/5 m (1/8 oz)	100
PC6 59-8380	20 ml (1 oz)	1 ml (1/8 oz)	40
PC6 59-8381	30 ml (2 oz)	1 ml (1/4 oz)	40
PC6 59-8382	60 ml	1 ml	40

### Threaded Unions, Ferrules and Nuts

Threaded unions are used to join any 1/4-28 male threaded fitting to tubing. These adapters are ideal for connecting threaded Chem terminus Hamilton Gastight® syringes, see pages 50 to 55. PEEK Unions should be used for high pressure applications. ETFE Unions should be used with softer tubing types like FEP, PFA, and PVDF Tubing, see pages 93 and 96. Delrin unions can be used with most other tubing. Each union has 1/4-28 female threads. PEEK and ETFE Unions come complete with two ferrules and nuts. Ferrules and nuts must be purchased separately for the Delrin and Polypropylene Unions.

Order #	Fitting Type	Qty.	Material	For Tubing OD
PC6 72-2851	Union, Complete	1	PEEK	1/16 in
PC6 72-2852	Union, Complete	1	PEEK	1/8 in
PC6 72-2855	Union, Only	5	Delrin	—
PC6 72-2856	Union, Only	5	Polypropylene	—
PC6 72-2857	Ferrule	10	ETFE	1/16 in
PC6 72-2859	Ferrule	10	ETFE	1/8 in
PC6 72-2860	Nut	5	PEEK	1/16 in
PC6 72-2861	Nut	10	ETFE	1/16 in
PC6 72-2862	Nut	10	Delrin	1/16 in
PC6 72-2863	Nut	10	Polypropylene	1/16 in
PC6 72-2864	Nut	5	PEEK	1/8 in
PC6 72-2865	Nut	10	ETFE	1/8 in
PC6 72-2866	Nut	10	Delrin	1/8 in
PC6 72-2867	Nut	10	Polypropylene	1/8 in
PC6 75-0430	Female Luer	1	ETFE	—



Sterile Monoject® Syringes without Needles*					
		Box of Syringes		Case of Syringes	
Volume	Tip	ORDER #	Qty.	ORDER #	Qty.
1 ml	Luer (long barrel)	PC6 72-2359	100	PC6 72-2379	500
1 ml	Luer	PC6 72-2360	100	PC6 72-2380	500
3 ml	Luer	PC6 72-2361	100	PC6 72-2381	1000
6 ml	Luer	PC6 72-2362	50	PC6 72-2382	500
6 ml	Luer Lock	PC6 72-2363	50	PC6 72-2383	500
12 ml	Luer	PC6 72-2364	80	PC6 72-2384	480
12 ml	Luer Lock	PC6 72-2365	80	PC6 72-2385	480
12 ml	Eccentric Luer	PC6 72-2366	80	PC6 72-2386	480
20 ml	Luer	PC6 72-2367	50	PC6 72-2387	300
20 ml	Luer Lock	PC6 72-2368	50	PC6 72-2388	300
20 ml	Eccentric Luer	PC6 72-2369	50	PC6 72-2389	300
35 ml	Luer	PC6 72-2370	30	PC6 72-2390	180
35 ml	Luer Lock	PC6 72-2371	30	PC6 72-2391	180
35 ml	Eccentric Luer	PC6 72-2372	30	PC6 72-2392	180
35 ml	Catheter	PC6 72-2373	30	PC6 72-2393	180
60 ml	Luer	PC6 72-2374	20	PC6 72-2394	100
60 ml	Luer Lock	PC6 72-2375	20	PC6 72-2395	100
60 ml	Eccentric Luer	PC6 72-2376	20	PC6 72-2396	100
60 ml	Catheter	PC6 72-2377	20	PC6 72-2397	100
60 ml	Toomey	PC6 72-2378	20	PC6 72-2398	100

Non-Sterile Monoject® Syringes without Needles*					
		Box of Syringes		Case of Syringes	
Volume	Tip	ORDER #	Qty.	ORDER #	Qty.
3 ml	Luer	PC6 72-2400	250	PC6 72-2408	1000
6 ml	Luer	PC6 72-2401	100	PC6 72-2409	500
12 ml	Luer	PC6 72-2402	100	PC6 72-2410	500
12 ml	Eccentric Luer	PC6 72-2403	100	PC6 72-2411	500
20 ml	Luer	PC6 72-2404	50	PC6 72-2412	250
20 ml	Eccentric Luer	PC6 72-2405	50	PC6 72-2413	250
35 ml	Luer	PC6 72-2406	25	PC6 72-2414	100
60 ml	Luer	PC6 72-2407	31	PC6 72-2415	155



## Choosing the Right Pump for Your Application & Budget

### KEY FEATURES

- Broad selection of pumps for every application
- Wide range of flow rates ml/hr to L/min
- Single and multi-channel models available with up to 24 channels
- Continuous delivery and batch mode dispensing

### PERISTALTIC PUMP QUESTIONS

- How many channels (tubes) will be used simultaneously?
- What size tubing will be used (inner diameter)?
- What flow rate(s) will be used?
- What is the total volume to be delivered?
- Do you need continuous flow?
- Does the pump need to be battery operated?
- Do you need to control the pump with a computer?
- Do you need to weigh your dispenses?
- Do you need analog control?
- Does the pump need to have TTL capabilities (external control of valves, use of footswitch etc)?

### Peristaltic Pump Selection Guide

PUMP MODEL	Model P-70	Model P-230	Model P-1500	NEW Model P-1500 with weight scale integration	MPII	Model 720	Model 720
ORDER #	PC6 70-7000	PC6 70-7001	PC6 70-7002	PC6 70-7008	PC6 70-2027	PC6 72-0001	PC6 61-0098
NUMBER OF CHANNELS	5	4	1	1	1 to 2	1 to 2	1 to 2
NUMBER OF ROLLERS	8	8	4	4	4	3	3
TUBE SIZE (INNER DIAMETER)	0.13 to 2.79 mm (0.005 to 0.11 in)	0.13 to 3.17 mm (0.005 to 0.13 in)	0.8 to 4.8 mm (0.03 to 0.19 in)	0.8 to 8 mm (0.03 to 0.314 in)	1.6 mm (1/16 in)	0.38 to 2.4 mm (0.015 to 0.093 in)	0.38 to 2.4 mm (0.015 to 0.093 in)
FLOW RATE (ML/MIN/PER CHANNEL):							
Minimum	0.001	0.001	0.01	0.001	0.8	0.07	0.008
Maximum	70	230	1,500	1,500	12.25/24.50	18	2.4
COMPUTER CONTROL	Yes (USB)	Yes (USB)	Yes (USB)	Yes (USB)	No	No	No
TTL CONTROL	Yes	Yes	Yes	Yes	No	No	No
ANALOG CONTROL	Yes	Yes	Yes	Yes	No	Yes	Yes
POWER	100 to 240 VAC, 50/60 Hz	100 to 240 VAC, 50/60 Hz	100 to 240 VAC, 50/60 Hz	100 to 240 VAC, 50/60 Hz	115 to 230 VAC, 50/60 Hz	120 VAC, 50 Hz, 230 VAC, 60 Hz	120 VAC, 50 Hz, 230 VAC, 60 Hz
BATTERY BACKUP	No	No	No	No	No	No	No
DIMENSIONS (H x W x D)	11.5 x 25.4 x 11.8 cm (4.5 x 10 x 4.63 in)	16 x 23.6 x 11.8 cm (6.3 x 9.3 x 4.6 in)	11.5 x 24.1 x 11.8 cm (4.5 x 9.5 x 4.6 in)	11.5 x 24.1 x 11.8 cm (4.5 x 9.5 x 4.6 in)	18.9 x 11.4 x 10.5 cm (3.5 x 4.5 x 4 in)	6.4 x 5.7 x 10.2 cm (2.5 x 2.25 x 4 in)	6.4 x 5.7 x 10.2 cm (2.5 x 2.25 x 4 in)
WEIGHT	2.27 kg (10.55 lb)	2.5 kg (5.5 lb)	2.5 kg (5.5 lb)	2.5 kg (5.5 lb)	0.96 kg (2.1 lb)	375 g (13.2 oz)	375 g (13.2 oz)
CATALOG PAGE	61	61	61	62	63	64	64

\* Depends upon Pump Drive.

## Choosing the Right Pump for Your Application & Budget

(continued)

Harvard Apparatus offers an extensive selection of peristaltic pumps to suit the needs of a wide range of research applications. Pumps which offer features such as multi-channel pumping, computer control, analog control, low electrical noise and a wide range of fluid flow rates are now available. The following table was designed to answer most questions regarding our continuous flow pumps. Please contact our technical support department for further assistance.

### Peristaltic and Continuous Flow Pumps

Traditional peristaltic pumps utilize a series of rollers to push fluid through tubing held within a pump head. Peristaltic flow is typically pulsatile, but can be made smoother with the use of more rollers in the pumping head. Our Mini-Peristaltic Pump (MPII, see page 61) features two speed ranges, reversability and dual channel pumping at a very reasonable price. Many pumps offer external control either through the input of an analog signal proportional to the speed or by RS-232 (serial) communication.

Model 720	Model 720	IP/IPC	REGLO Analog and Digital	REGLO ICC	Ecoline 4 and 8-Channel	Gentle Pump Heads	Pump Head 380AD	SB Pump Head
<b>PC6 72-4048</b>	<b>PC6 72-4049</b>	<b>SEE PAGE 68</b>	<b>SEE PAGE 65 &amp; 66</b>	<b>SEE PAGE 67</b>	<b>SEE PAGE 68</b>	<b>SEE PAGE 74</b>	<b>PC6 73-3026</b>	<b>SEE PAGE 76</b>
1 to 2	1 to 2	4 to 24	2 or 4	2, 3 or 4	4 or 8	1	1	1 to 3
3	3	8	6, 8 or 12	6, 8 or 12	6 or 12	2 or 3	3	6
0.38 to 2.4 mm (0.015 to 0.093 in)	0.38 to 2.4 mm (0.015 to 0.093 in)	0.13 to 3.17 mm (0.01 to 0.12 in)	0.13 to 3.17 mm (0.01 to 0.12 in)	0.13 to 3.17 mm (0.01 to 0.12 in)	0.13 to 3.17 mm (0.01 to 0.12 in)	1.6 to 11.1 mm (0.06 to 0.44 in)	0.8 to 11.1 mm (0.03 to 0.44 in) or 4.8 to 6.4 mm (0.19 to 0.25 in)	0.8 to 6.4 mm (0.03 to 0.25 in) or 3.2 to 8.0 mm (0.13 to 0.31 in)
0.0008	0.0002	0.002	0.001	0.0002	0.005	0.45	0.41	0.09 or 1.1
0.20	0.058	44	68	43	150	3,700	1,500	870 or 1,100
No	No	Yes (RS-232)	Yes (Digital)	Yes (USB/RS-232)	No	n/a*	n/a*	n/a*
No	No	Yes	No	No	No	n/a*	n/a*	n/a*
Yes	Yes	Yes	Yes (Analog)	No	Yes	n/a*	n/a*	n/a*
120 VAC, 50 Hz, 230 VAC, 60 Hz	120 VAC, 50 Hz, 230 VAC, 60 Hz	120 VAC, 50 Hz, 230 VAC, 60 Hz	115 to 230 VAC, 50/60 Hz	115 to 230 VAC, 50/60 Hz	115 to 230 VAC, 50/60 Hz	n/a*	n/a*	n/a*
9 V Lithium Battery up to 30 hours	9 V Lithium Battery up to 30 hours	No	No	No	No	n/a*	n/a*	n/a*
6.4 x 5.7 x 10.2 cm (2.5 x 2.25 x 4 in)	6.4 x 5.7 x 10.2 cm (2.5 x 2.25 x 4 in)	n/a*	14 x 10 x 19 cm (5.3 x 3.9 x 7.5 in)	14 x 17 x 29 cm (5 x 7 x 11 in)	14 x 17 x 31 cm (5 x 7 x 12 in)	n/a*	n/a*	n/a*
375 g (13.2 oz)	375 g (13.2 oz)	n/a*	2.1 kg (4.6 lb)	5.3 kg (11.7 lb)	5.5 kg (12.1 lb)	n/a*	n/a*	n/a*
64	64	68	65 & 66	67	68	74	71	76

## Harvard Peristaltic Pumps



Pump with P-1500  
Motor Drive  
PC6 70-7005



Pump with P-70  
Motor Drive  
PC6 70-7003

Pump with P-230  
Motor Drive  
PC6 70-7004



Harvard Peristaltic Pump  
Control Box  
PC6 70-7006

### KEY FEATURES

- Remote Design
- Interchangeable Pumps
- Programmable

The Harvard Peristaltic Pump series offers unparalleled accuracy, reproducibility, and ease of use over a broad range of flow rates. Other benefits include:

- The ability to separate the motor drive from the controller to facilitate use and save space in incubators and fume hoods
- A library of tubing sizes is stored in the pump's memory minimizing set up time
- Custom tubing can be used allowing complete flexibility
- A full range of interchangeable motor drives to allow for economical ease of use over a broad flow rate range.

The Harvard Peristaltic Pump consists of a control unit and a series of motor drives. The pump can deliver solutions over a range of flow rates from 0.001 to 1,500 ml/min depending on the motor drive used. Three interchangeable motor drive modules provide flow over the following ranges:

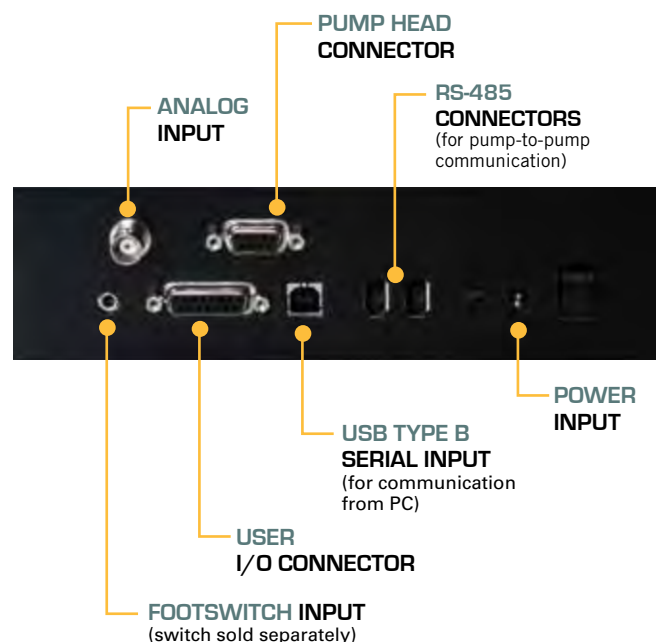
- P – 70 drive provides flow rates from 0.001 to 70 ml/min
- P – 230 drive provides flow rates from 0.001 to 230 ml/min
- P – 1500 drive provides flow rates from 0.001 to 1,500 ml/min

A complete range of programmable functions allow the pump to be easily adapted to a wide range of dispensing applications. The pump has pre-programmed flow profiles for:

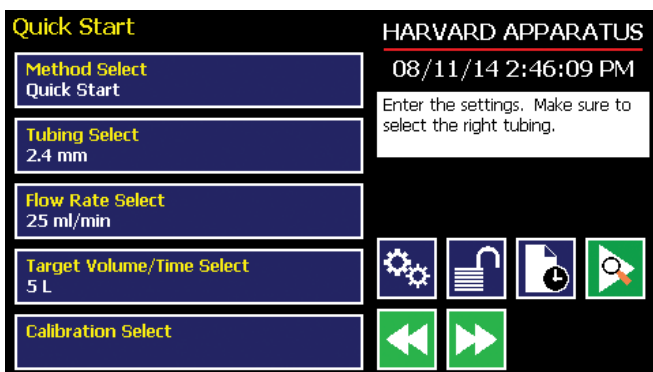
- Constant Flow
- Flow Ramps
- Pulsatile Flow
- Concentration Based Fluid Delivery

In addition to the flow profiles, the pump has advanced user options that permit the pump to be controlled by a PC from its USB inputs as well as a range of options such as:

- Remote initiated start/stop times.
- Communication with external devices through 15-pin I/O
- Constant pressure through BNC



## Harvard Peristaltic Pumps (continued)



Harvard Peristaltic Pump Quick Start Screen

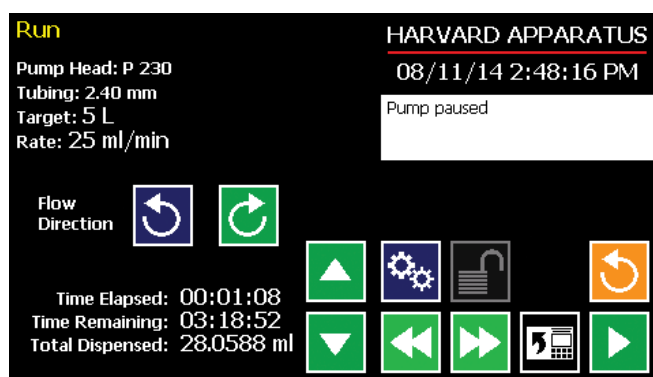
All settings can easily be saved as user generated methods in the pump's memory. The method can be easily recalled and run very quickly, saving researchers valuable time.

Connectivity to a wide range of external input or output devices is easily accomplished.

The pump will automatically rotate at the proper RPM for the tube selection and flow rate chosen. To further increase the accuracy, Harvard Peristaltic Pumps offer a rapid calibration routine to further optimize flow accuracy by entering a measured volume of fluid collected.

### OTHER CAPABILITIES INCLUDE:

- Single Channel or combined channel mode for setting flow rate
- Timed Dispense: Dispenses for a fixed time at a set flow rate
- Volume Dispense: Dispenses a fixed volume on start
- Foot Switch Control Option
- Analog Control Option
- Biodirectional Delivery



Harvard Peristaltic Pump Run Screen

### Harvard Peristaltic Pump Specifications, Control Box and Pump with Motor Drive

DESCRIPTION	PUMP WITH P-70 MOTOR DRIVE	PUMP WITH P-230 MOTOR DRIVE	PUMP WITH P-1500 MOTOR DRIVE
Type	8 rollers, 5 channels	8 rollers, 4 channels	4 rollers, 1 channel
Accuracy	±1.0%	±1.0%	±1.0%
TTL Connector	15-pin D-sub	15-pin D-sub	15-pin D-sub
Computer Interface	USB Type 'B'	USB Type 'B'	USB Type 'B'
Pump-to-Pump	IEEE 1394	IEEE 1394	IEEE 1394
Back pressure	15 psi	15 psi	30 psi
Tubing ID	0.13 to 2.79 mm (0.005 to 0.11 in)	0.13 to 3.17 mm (0.005 to 0.13 in)	0.8 to 8 mm (0.03 to 0.314 in)
Flow Rate Range*	0.001 to 70 ml/min	0.001 to 230 ml/min	0.001 to 1,500 ml/min
Dimensions: Control Box	20.7 x 13 x 9.6 cm (8.13 x 5.13 x 3.75 in)	20.7 x 13 x 9.6 cm (8.13 x 5.13 x 3.75 in)	20.7 x 13 x 9.6 cm (8.13 x 5.13 x 3.75 in)
Dimensions: Pump Head	11.5 x 25.4 x 11.8 cm (4.5 x 10 x 4.63 in)	16 x 23.6 x 11.8 cm (6.3 x 9.3 x 4.63 in)	11.5 x 24.1 x 11.8 cm (4.5 x 9.5 x 4.63 in)
Weight	4.7 kg (10.5 lb)	5 kg (11 lb)	5 kg (11 lb)
Pump Voltage	30 VDC, 1.67 A	30 VDC, 1.67 A	30 VDC, 1.67 A
Power Supply	100 to 240 VAC, 50/60 Hz	100 to 240 VAC, 50/60 Hz	100 to 240 VAC, 50/60 Hz
For Compatible Tubing	See page 81	See page 81	See page 81
ORDER #	PC6 70-7000	PC6 70-7001	PC6 70-7002

### Replacement Parts

ORDER #	PRODUCT
PC6 70-7003	P-70 Motor Drive, 8 rollers, 5 channel
PC6 70-7004	P-230 Motor Drive, 8 rollers, 4 channel
PC6 70-7005	P-1500 Motor Drive, 4 rollers, 1 channel
PC6 70-7006	Control Box for all P Series Motor Drives
PC6 70-7009	Control Box with Weight Scale Integration
PC6 72-0604	Replacement Cartridge/Cassette for P-70
PC6 73-3052	Replacement Cartridge/Cassette for P-230



## NEW Harvard Peristaltic Pump P-1500 with Weight Scale Integration



### KEY FEATURES

- Intuitive touchscreen with integrated weight scale control
- Automatically dispenses to predefined sample weight
- User selectable auto-tare, slow-down and anti-drip features
- Key pump and scale parameters clearly displayed
- Remote pump head can be palced up to 5 ft (1.5 M) from controller
- Weight scale command set for system integration

### APPLICATIONS

- Reproductive biotechnology sampling
- Organic solvent dispensing
- Automated weighing of food samples

The Harvard Apparatus P-1500 Peristaltic Pump with Weight Scale integration allows the user to dispense fluids based on units of weight. The peristaltic controller provides scale communication allowing the pump to query the scale during operation for precise dispensing. The Weight Scale option is compatible with the Ohaus Defender, Ranger, Explorer, Adventurer and Scout (with RS-232 option) series along with the Mettler Toledo (with RS-232 option).

### Specifications

<b>PUMP MODEL</b>	P-1500 with Weight Scale Integration
<b>NUMBER OF CHANNELS</b>	1
<b>NUMBER OF ROLLERS</b>	4
<b>TUBE SIZE (INNER DIAMETER)</b>	0.8 to 8mm (0.03 to 0.314 in)
<b>FLOW RATE (ML/MIN/CHANNEL)</b>	Tubing Size Dependent
<b>MIN/MAX</b>	0.001 ; 1.500
<b>COMPUTER CONTROL</b>	Yes
<b>ITL CONTROL</b>	Yes
<b>ANALOG CONTROL</b>	Yes
<b>POWER</b>	100 to 240 VAC, 50/60 Hz
<b>WEIGHT</b>	2.5 kg (5.5 lb)

*\*Note: P70 and P230 Motor Drives are also compatible with weight scale control. The feature will only work with one or combined channels. Please consult the factory for additional information.*

### Order Information

Order #	Product
<b>PC6 70-7008</b>	P-1500 with Weight Scale Integration
Replacement Parts	
<b>PC6 70-7005</b>	P-1500 Motor Drive, 4 rollers, 1 channel
<b>PC6 70 7009</b>	Control box with Weight Scale Integration
<b>PC6 2601046</b>	Scale to Controller Cable (DB9 to RJ-11)

## MP II Mini-Peristaltic Pump



### KEY FEATURES

- Continuous low flow rates ideal for:
  - Slow perfusion studies
  - Controlled animal feeding
- Pump can take one or two tubes simultaneously, 1/16 inch ID
- Toggle switches for direction and x1 or x2 speed range selection
- Low electrical and mechanical noise
- Small size

The Harvard MP II Mini-Peristaltic Pump takes only one size of tubing, 1.6 mm ID x 3.2 mm OD (1/16 x 1/8 in). It can be used with either a single tube or two tubes simultaneously. Two of the PC6 55-4148 Pump Head Tubing Pieces are included with the pump. Additional Pump Head Tubing Pieces (PC6 55-4148) may be purchased separately.

Two front panel controls provide flow rates from approximately 0.8 to 24.5 ml/min. The control knob provides variable adjustment from 0 to 100% of the selected flow rate range. The second control is a two position toggle switch marked x1, x2 which selects low or high flow rates, see table to right.

The easy-loading four-roller pump head is on top of the stout metal box. The back of the pump head effortlessly rotates into an 'open' position and either one or two tubes can be dropped into slots. The loaded section simply rotates back against spring loaded jaws and locks into place. The tubing is automatically in proper wiping contact with the pump head rollers. Each Pump is provided with a 12.5 mm (0.5 in) rod clamp on the back so that multiple pumps can be mounted vertically on a lattice rod.

### MP II in ml/min Flow Rates

Switch Setting	WITH ONE TUBE		WITH TWO TUBES	
	Minimum	Maximum	Minimum	Maximum
x1	0.8 ml/min	7.00 ml/min	1.6 ml/min	14.00 ml/min
x2	1.5 ml/min	12.25 ml/min	3.0 ml/min	24.50 ml/min

### MP II Specifications

OUTPUT PRESSURE	In excess of 20 p.s.i.
POWER	12 VDC 800 mA, 2.5 mm Connector, 115-230 VAC, 50/60 Hz, Universal power supply, 10 W
DIMENSIONS, H x W x D	189 x 114 x 105 mm (3.5 x 4.5 x 4 in)
WEIGHT	0.96 kg (2.1 lb)
TUBING ID	1/16 in

### Order # Product

PC6 70-2027	MP II, 115/230 VAC, 50/60 Hz
PC6 55-4148	Pump Head Tubing Pieces. These Silicone Pump Head Tubing Pieces Have Connectors on Each End for 1/16 in ID Tubing 2.5 in, pkg. of 10

## Harvard/Instech Model 720

### Compact Peristaltic Pumps and Tubing



#### KEY FEATURES

- Continuous infusion
- Battery back-up (30 hrs)
- Compact pump
- Minimal electromagnetic radiation

The Instech Model 720 Compact Peristaltic Pumps are a stand-alone pump series with flow rates of 0.2  $\mu\text{l}/\text{min}$  to 18  $\text{ml}/\text{min}$  (0.04 to 1100  $\text{ml}/\text{hr}$ ) depending upon the pump and tubing selected. These pumps deliver the accurate low flow rates of syringe pumps without the limits on delivered volume. They are ideal for animal IV infusion, tissue perfusion, and other low-flow laboratory applications.

Instech offers this pump with four different motors; choose the motor and tube set that best match your flow rate requirements. In general, use the standard 61-0098 for flows between 0.05 and 1  $\text{ml}/\text{min}$ , the lower flow 72-4048 for rates between 5 and 100  $\mu\text{l}/\text{min}$ , the ultra low flow 72-4049 for rates as low as 0.2  $\mu\text{l}/\text{min}$ , and then the higher-flow 72-0001 for rates up to 18  $\text{ml}/\text{min}$  (1  $\text{l}/\text{hr}$ ). With a given tube set, the pump performs best over a 10:1 flow control range.

The pump's analog circuitry has been carefully designed to minimize electromagnetic radiation; for this reason, the pump is often used for tissue perfusion even in the presence of sensitive intracellular recordings. It is also an ideal pump for applications which require limited size or weight, the versatility of single and dual tubes sets and/or external analog control.

An internal 9V lithium battery (supplied with 61-0098, 72-4048 and 72-4049) will run the pump for up to 30 hours, protecting your experiment in the event of a power failure. Due to its power requirements, the high flow version (72-0001) is not available with battery backup.

The pump is typically powered by a 1.25 V internal reference voltage.

An external reference voltage can be used to regulate flow rate and direction (pump direction can only be reversed by analog control). Under external control the speed dials serve as voltage attenuators to limit the external voltage to  $\pm 1.25$  volts.

Tube sets must be purchased separately. Please see our website or contact technical support if you need assistance choosing the right tube set. For use with saline and most drugs, use silicone tubing. For use with solutions containing fats, such as IV diets, use C-FLEX<sup>®</sup> tubing. For use with petroleum-based fluids, use VITON<sup>®</sup> tubing.

#### Model 720 Specifications

ACCURACY	$\pm 5\%$
REPEATABILITY	$\pm 3\%$
FLOW CONTROL RANGE	20:1
POWER SOURCE	Universal 15 VDC 1A adapter, 2.5 mm male plug & tip
DIMENSIONS, H x W x D	6.4 x 5.7 x 10.2 cm (2.5 x 2.3 x 4 in)
WEIGHT	375 g (1 lb)
VOLTAGE RANGE	Universal input 100 to 240 VAC, 50/60 Hz

*\*\*Tube sets are not supplied with the pump. They must be purchased separately.*

#### Tube Sets



A wide variety of tube sizes, tube materials and connector types allows you to tailor your peristaltic pump to your particular application. Tube sets typically last about one month under continuous operation.

Dual channel tube sets

place more stress on the pump than do single channel tube sets, which may shorten the life of your pump's motor.

#### Silicone Tubing Sets

Order #	Product
PC5 61-0241	1-Ch, 0.015" ID tubing, FLL to 22ga Luer 0.016" ID x 0.028" OD stub, pkg. of 5
PC5 61-0242	1-Ch, 0.020" ID tubing, FLL to 20ga Luer 0.024" ID x 0.036" OD stub, pkg. of 5
PC5 61-0243	1-Ch, 0.031" ID tubing, 0.062" ID Barbs, pkg. of 5
PC5 61-0244	1-Ch, 0.093" ID tubing, 0.062" ID Barbs, pkg. of 5
PC5 61-0245	2-Ch, 0.062" ID tubing, 0.062" ID Barbs, pkg. of 5

#### Flow Rate Ranges

	ORDER #	ORDER #	ORDER #	ORDER #
Tube ID	PC6 72-4049 Ultra Low Flow	PC6 72-4048 Very Low Flow	PC6 61-0098 Low Flow	PC6 72-0001 High Flow
0.015"	0.2 -2.2 $\mu\text{l}/\text{min}$	0.8 - 7.5 $\mu\text{l}/\text{min}$	8 -83 $\mu\text{l}/\text{min}$	70 -700 $\mu\text{l}/\text{min}$
0.020"	0.4 -4.6 $\mu\text{l}/\text{min}$	1.6 -16 $\mu\text{l}/\text{min}$	18 -180 $\mu\text{l}/\text{min}$	0.15 -1.5 $\text{ml}/\text{min}$
0.031"	0.9 -8.7 $\mu\text{l}/\text{min}$	3 -30 $\mu\text{l}/\text{min}$	35 -350 $\mu\text{l}/\text{min}$	0.3 - 2.8 $\text{ml}/\text{min}$
0.062"	3 -30 $\mu\text{l}/\text{min}$	10 -100 $\mu\text{l}/\text{min}$	125 -1,250 $\mu\text{l}/\text{min}$	0.9 - 9 $\text{ml}/\text{min}$
0.093"	6 -58 $\mu\text{l}/\text{min}$	20 -200 $\mu\text{l}/\text{min}$	240 -2,400 $\mu\text{l}/\text{min}$	1.8 -18 $\text{ml}/\text{min}$

## REGLO Analog Peristaltic Pumps

PC6 73-2951



### KEY FEATURES

- Small footprint
- Low pulsation with 12 rollers
- High repeatability
- 2 or 4 channels with 6, 8 or 12 rollers

### REGLO Analog 2 Channel, 6, 8 or 12 Roller Pump

Roller head with 2 snap-on MS/CA Click 'n' Go Cassettes included for 3-stop collared tubing. See page 79.

### REGLO Analog 4 Channel, 6, 8 or 12 Roller Pump

Roller head with 4 snap-on MS/CA Click 'n' Go Cassettes included for 3-stop collared tubing. See page 79.

REGLO Specifications			
REGLO Analog 2 Channel			
	MS-2/6-160	MS-2/8-160	MS-2/12-160
<b>CHANNELS</b>	2	2	2
<b>PUMP ROLLERS</b>	6	8	12
<b>FLOW RATES, MINIMUM</b>	0.002 ml/min	0.002 ml/min	0.002 ml/min
<b>FLOW RATES, MAXIMUM</b>	68 ml/min	57 ml/min	38 ml/min
<b>SPEED RANGE</b>	1.6 to 160 rpm		
<b>MAINS CONNECTION</b>	115 VAC / 50 Hz or 230 VAC / 50 Hz		
<b>POWER CONSUMPTION</b>	20 W		
<b>REVERSIBLE FLOW</b>	Yes		
<b>SPEED SETTING</b>	3 to 99% resolution 1% 2 digit potentiometer		
<b>ANALOG INTERFACE INPUT</b>	Speed control 0-5 V or 0-10 V and 0-20 mA or 4-20 mA respectively		
<b>DISPLAY INPUT (TTL LEVEL)</b>	Run/Stop, AutoStart		
<b>BACK PRESSURE, MAX.</b>	1.0 bar (14.5 PSI)		
<b>SUCTION HEIGHT</b>	7-8 m		
<b>PROTECTION RATING</b>	IP 30		
<b>TUBING CASSETTE</b>	MS/CA Click 'n' Go -Cassettes are included		
<b>DIMENSIONS, H x W x D</b>	143 x 100 x 178 mm (5.6 x 3.9 x 7.0 in)		
<b>WEIGHT</b>	2.0 kg (4.4 lb)		

### REGLO Specifications

#### REGLO Analog 4 Channel

	MS-4/6-100	MS-4/8-100	MS-4/12-100
<b>CHANNELS</b>	4	4	4
<b>PUMP ROLLERS</b>	6	8	12
<b>FLOW RATES, MINIMUM</b>	0.002 ml/min	0.002 ml/min	0.001 ml/min
<b>FLOW RATES, MAXIMUM</b>	43 ml/min	35 ml/min	24 ml/min
<b>SPEED RANGE</b>	1 to 100 rpm		
<b>MAINS CONNECTION</b>	115 VAC / 60 Hz or 230 VAC / 50 Hz		
<b>POWER CONSUMPTION</b>	20 W		
<b>REVERSIBLE FLOW</b>	Yes		
<b>SPEED SETTING</b>	3 to 99% resolution 1% 2 digit potentiometer		
<b>ANALOG INTERFACE INPUT</b>	Speed control 0-5 V or 0-10 V and 0-20 mA or 4-20 mA respectively		
<b>DISPLAY INPUT (TTL LEVEL)</b>	Run/Stop, AutoStart		
<b>BACK PRESSURE, MAX.</b>	1.0 bar (14.5 PSI)		
<b>SUCTION HEIGHT</b>	7-8 m		
<b>PROTECTION RATING</b>	IP 30		
<b>TUBING CASSETTE</b>	MS/CA Click 'n' Go -Cassettes are included		
<b>DIMENSIONS, H x W x D</b>	143 x 100 x 190 mm (5.3 x 3.9 x 7.5 in)		
<b>WEIGHT</b>	2.1 kg (4.6 lb)		

Order #	Product
PC6 73-3054	Replacement MS/CA Click 'n' Go Cassette
PC6 73-3055	MS/CA Pressure Lever Cassette
PC6 73-2951	REGLO Analog 2 Channel MS-2/6-160, 115 VAC, 60 Hz
PC6 73-2952	REGLO Analog 2 Channel MS-2/8-160, 115 VAC, 60 Hz
PC6 73-3294	REGLO Analog 2 Channel MS-2/12-160, 115 VAC, 60 Hz
PC6 73-2447	REGLO Analog 2 Channel MS-2/6-160, 230 VAC, 50 Hz
PC6 73-2448	REGLO Analog 2 Channel MS-2/8-160, 230 VAC, 50 Hz
PC6 73-3295	REGLO Analog 2 Channel MS-2/12-160, 230 VAC, 50 Hz
PC6 73-2953	REGLO Analog 4 Channel MS-4/6-100, 115 VAC, 60 Hz
PC6 73-0113	REGLO Analog 4 Channel MS-4/8-100, 115 VAC, 60 Hz
PC6 73-3292	REGLO Analog 4 Channel MS-4/12-100, 115 VAC, 60 Hz
PC6 73-2449	REGLO Analog 4 Channel MS-4/6-100, 230 VAC, 50 Hz
PC6 73-0114	REGLO Analog 4 Channel MS-4/8-100, 230 VAC, 50 Hz
PC6 73-3293	REGLO Analog 4 Channel MS-4/12-100, 230 VAC, 50 Hz



## REGLO Digital Programmable Peristaltic Pumps



PC6 73-3296

### KEY FEATURES

- Flow rates from 0.002 to 68 ml/min
- Snap-on MS/CA click 'n' go cassette included
- RS-232 interface for PC control
- Adjust and calibrate dispensing volumes in ml and flow rates in ml/min for accurate and reproducible results
- Easy to use with pre-programmed flow rates for all available tube sizes
- Dispensing by volume, time or intervals for each unique application
- Overload protection and indicator automatically stops pump to prevent damage
- Display readout: speed in 1% steps and flow rate in ml/min
- Motor and ventilation permit 24 hour continuous operation

### REGLO Digital 2 Channel, 6, 8 or 12 Roller Pumps

Tube-bed with 2 snap-on MS/CA Click 'n' Go Cassettes included for 3-stop collared tubing. See page 79.

### REGLO Digital 4 Channel, 6, 8 or 12 Roller Pumps

Tube-bed with 4 snap-on MS/CA Click 'n' Go Cassettes included for 3-stop collared tubing. See page 79.

### REGLO Specifications

#### REGLO Digital 2 Channel

	MS-2/6-160	MS-2/8-160	MS-2/12-160
<b>CHANNELS</b>	2	2	2
<b>PUMP ROLLERS</b>	6	8	12
<b>FLOW RATES, MINIMUM</b>	0.003 ml/min	0.002 ml/min	0.002 ml/min
<b>FLOW RATES, MAXIMUM</b>	68 ml/min	57 ml/min	38 ml/min
<b>SPEED RANGE</b>	1.6 to 160 rpm		
<b>MAINS CONNECTION</b>	115 VAC / 60 Hz or 230 VAC / 50 Hz		
<b>POWER CONSUMPTION</b>	20 W		
<b>REVERSIBLE FLOW</b>	Yes		
<b>SET POINT</b>	Digital. 3-4 digits according to function (mode), LED display		
<b>RS-232 INTERFACE</b>	for control of all functions		
<b>DISPLAY INPUT (TTL LEVEL)</b>	Run/Stop, AutoStart		
<b>BACK PRESSURE, MAX.</b>	1.0 bar (14.5 PSI)		
<b>SUCTION HEIGHT</b>	7-8 m		
<b>PROTECTION RATING</b>	IP 30		
<b>TUBING CASSETTE</b>	MS/CA Click 'n' Go -Cassettes are included		
<b>DIMENSIONS, H x W x D</b>	135 x 100 x 178 mm (5.3 x 3.9 x 7 in)		
<b>WEIGHT</b>	2.0 kg (4.4 lb)		

#### REGLO Digital 24 Channel

	MS-4/6-100	MS-4/8-100	MS-4/12-100
<b>CHANNELS</b>	4	4	4
<b>PUMP ROLLERS</b>	6	8	12
<b>FLOW RATES, MINIMUM*</b>	0.002 ml/min	0.002 ml/min	0.001 ml/min
<b>FLOW RATES, MAXIMUM*</b>	43 ml/min	35 ml/min	24 ml/min
<b>SPEED RANGE</b>	1 to 100 rpm		
<b>MAINS CONNECTION</b>	115 VAC / 60 Hz or 230 VAC / 50 Hz		
<b>POWER CONSUMPTION</b>	20 W		
<b>REVERSIBLE FLOW</b>	Yes		
<b>SET POINT</b>	Digital. 3-4 digits according to function (mode), LED display		
<b>RS-232 INTERFACE</b>	for control of all functions		
<b>DISPLAY INPUT (TTL LEVEL)</b>	Run/Stop, AutoStart		
<b>BACK PRESSURE, MAX.</b>	1.0 bar (14.5 PSI)		
<b>SUCTION HEIGHT</b>	7-8 m		
<b>PROTECTION RATING</b>	IP 30		
<b>TUBING CASSETTE</b>	MS/CA Click 'n' Go -Cassettes are included		
<b>DIMENSIONS, H x W x D</b>	135 x 100 x 190 mm (5.3 x 3.9 x 7.5 in)		
<b>WEIGHT</b>	2.1 kg (4.6 lb)		

\* See page 113 for complete flow rate chart

Order #	Product	Order #	Product
PC6 73-2948	MS-2/6-160 REGLO Digital 2 Channel, 115 to 230 VAC, 50/60Hz	PC6 73-3296	MS-4/12-100 REGLO Digital 2 Channel, 115 to 230 VAC, 50/60Hz
PC6 73-2949	MS-2/8-160 REGLO Digital 2 Channel, 115 to 230 VAC, 50/60Hz	PC6 73-3054	Replacement MS/CA Click 'n' Go Cassette
PC6 73-3298	MS-2/12-160 REGLO Digital 2 Channel, 115 to 230 VAC, 50/60Hz	PC6 73-3055	MS/CA Pressure Lever Cassette
PC6 73-2950	MS-4/6-160 REGLO Digital 2 Channel, 115 to 230 VAC, 50/60Hz	PC6 73-3050	Foot Switch for Reglo Digital Pumps
PC6 73-2915	MS-4/8-160 REGLO Digital 2 Channel, 115 to 230 VAC, 50/60Hz		

## REGLO Independent Channel Control (ICC) Peristaltic Pumps



PC6 75-0511

### KEY FEATURES

- Continuous pumping or precision dispensing
- Flexibility of bi-directional flow in each channel
- Flow rate 0.002ml/min to 43 ml/min (model/tube size dependent)
- Easy-to-use tubing cassettes allow quick changeovers
- USB interface for quick connections
- Uses 3-stop tubing (see page 80)

The REGLO Independent Channel Control (ICC) Digital Multi-Channel Peristaltic Pumps allow individual control of the flow and direction of each fluidic channel. Each channel is independently programmable from the pump's intuitive keypad or via the computer.

### REGLO Specifications

#### REGLO Analog 2 Channel

	75-0513	75-0510	75-0512	75-0514	75-0070	75-0515	75-0511
<b>CHANNELS</b>	2	2	2	3	3	3	4
<b>PUMP ROLLERS</b>	6	8	12	6	8	12	12
<b>FLOW RATES</b>	See Chart Below						
<b>SPEED RANGE</b>	0.1-100 rpm (0.01 rpm resolution)						
<b>MAINS CONNECTION</b>	100 to 240 VAC, 50/60 Hz						
<b>POWER CONSUMPTION</b>	30 W						
<b>REVERSIBLE FLOW</b>	30 W						
<b>ACCURACY</b>	±1						
<b>USB 2.0 AND RS-232 INTERFACE</b>	Remote control of all functions						
<b>BACK PRESSURE, MAX.</b>	1.0 bar (14.5 PSI)						
<b>PROTECTION RATING</b>	IP 30						
<b>TUBING CASSETTE</b>	MS/CA Click 'n' Go -Cassettes are included						
<b>DIMENSIONS, H x W x D</b>	170 x 125 x 205 mm (6.7 x 5.0 x 8.1 in)						
<b>WEIGHT</b>	2.7 kg (6 lbs)						

Order #	Product
<b>PC6 75-0070</b>	REGLO ICC Digital 3 Channels, 8 Rollers
<b>PC6 75-0510</b>	REGLO ICC Digital 2 Channels, 8 Rollers
<b>PC6 75-0512</b>	REGLO ICC Digital 2 Channels, 12 Rollers
<b>PC6 75-0513</b>	REGLO ICC Digital 2 Channels, 6 Rollers
<b>PC6 75-0514</b>	REGLO ICC Digital 3 Channels, 6 Rollers
<b>PC6 75-0515</b>	REGLO ICC Digital 3 Channels, 12 Rollers
<b>PC6 75-0511</b>	REGLO ICC Digital 4 Channels, 12 Rollers

### REGLO ICC Peristaltic Pumps using 3-Stop Collard Tubing Flow Rates (mL/min per channel)

	PC6 75-0513 AND PC6 75-0514	PC6 75-0070 AND PC6 75-0510	PC6 75-0511, 75-0512 AND PC6 75-0515
<b>TUBING ID (MM)</b>	<b>6 ROLLERS</b>	<b>8 ROLLERS</b>	<b>12 ROLLERS</b>
0.13	0.0002 to 0.14	0.0002 to 0.11	0.0001 to 0.093
0.51	0.0019 to 1.9	0.0017 to 1.7	0.0016 to 1.6
0.57	0.0024 to 2.4	0.0021 to 2.1	0.0019 to 1.9
0.64	0.0030 to 3.0	0.0026 to 2.6	0.0024 to 2.4
0.95	0.0064 to 6.4	0.0056 to 5.6	0.0050 to 5.0
1.02	0.0073 to 7.3	0.0063 to 6.3	0.0056 to 5.6
1.42	0.013 to 13	0.011 to 11	0.0094 to 9.4
1.75	0.019 to 19	0.016 to 16	0.013 to 13
1.85	0.021 to 21	0.017 to 17	0.014 to 14
2.54	0.033 to 33	0.027 to 27	0.019 to 19
2.79	0.036 to 36	0.031 to 31	0.021 to 21
3.17	0.043 to 43	0.035 to 35	0.024 to 24

## Ecoline Microprocessor Controlled Tubing Pumps

VC-280, VC-380, VC-360 & VC-Easy-Load

PC6 72-6426



### KEY FEATURES

- Economical and powerful
- Stackable pumps for dosing and filling applications requiring variable flow rates
- Robust stainless steel housing for long life
- Convex rollers treat the liquid and tubing gently
- Reproducible fluid transfer in laboratories and industry
- Analog interface
- Suitable pump for SCP controller, part of the universal servo control perfusion system

### APPLICATIONS

- Re-circulating pump for coolant thermostat baths

### Standard Tygon® R-3603/R-3607 Tubing, 15 m Roll

ORDER #	IDMM	WTMM	Min. and Max. Flow Rates with Pump (ml/min)							
			VC-280		VC-380		VC-360		VC-EASY-LOAD	
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
PC6 73-1806	0.8	1.6	-	-	-	-	0.25	25	0.23	23
PC6 73-1807	1.6	1.6	1.7	170	1.6	160	0.9	90	0.86	86
PC6 73-1808	3.2	1.6	6.6	660	5.9	590	3.5	350	3.2	320
PC6 73-1809	4.8	1.6	5.1	1500	13	1300	7.7	770	6.5	650
PC6 73-1810	6.4	1.6	25	2500	23	2300	13	1300	11	1060
PC6 73-1811	8.0	1.6	37	3700	34	3400	-	-	16	1600
PC6 73-1814	9.5	1.6	48	4800	44	4400	-	-	-	-
PC6 73-1815	11.1	1.6	54	5400	50	5000	-	-	-	-

### VC-280 and VC-380

Both pumps feature exchangeable rotors with either 2 or 3 rollers providing lower pulsation, higher flow rates or elevated differential pressures. These pumps are supplied with the rotor that accepts 1.6 mm WT tubing. One pump is supplied with the 2 roller rotor and the other is supplied with the 3 roller rotor. They both have a safety cutout feature that stops the rotation of the rotor when the rotor cover is opened. Using standard tubing they provide flow rate ranges from 1.6 to 5,000 ml/minute with a differential pressure of 1.5 bar (22 PSI)\*.

### VC-360

This pump features 3 convex rollers providing lower pulsations than the other two pumps. Its rotor is not interchangeable with other rotors. It has a hinged tube bed with wide opening angle allowing rapid tube change over. It uses standard pump tubing and provides a flow rate range from 0.25 to 1,300 ml/minute with a differential pressure of 1.5 bar (22 PSI)\*.

### VC-Easy-Load

This pump features 3 rollers and an easily accessible pump head that allows rapid tube change-over. It has a Polysulfone pump head housing and uses standard pump tubing. This pump provides a flow rate range from 0.23 to 1,600 ml/min with a differential pressure of 1.5 bar (22 PSI)\*.

*\*Note: This is the possible differential pressure using appropriate tubing material; tubing with smaller inner diameters may enable higher pressure.*

### VC-280, VC-380, VC-360 and VC-Easy-Load Specifications

#### FLOW RATES:

VC-280	1.7 to 5400 ml/min
VC-380	1.6 to 5000 ml/min
VC-360	0.25 to 1300 ml/min
VC-EASY-LOAD	0.23 to 1600 ml/min
CHANNELS	1
SPEED	3.5 to 350 rpm
SPEED SETTING/CONTROL	1 to 99%, resolution 1%, 2-digit potentiometer
MOTOR TYPE	DC motor
POWER CONSUMPTION	100 W
MAINS CONNECTION	115 VAC, 60 Hz or 230 VAC, 50 Hz, adjustable
PROTECTION RATING	IP 30
REMOTE CONTROL	Analog interface

### Ecoline Microprocessor Controlled Tubing Pumps

ORDER #	PRODUCT	# ROLLERS	FLOW RATE RANGE	DIMENSIONS, H x W x D	WEIGHT	VOLTAGE
PC6 72-6426	Ecoline VC-280	2	1.7-5,400 ml/min	138 x 169 x 256 mm (5.4 x 6.7 x 10.1 in)	5.2 kg (11.5 lb)	230 VAC, 50 Hz
PC6 72-6427	Ecoline VC-280	2	1.7-5,400 ml/min	138 x 169 x 256 mm (5.4 x 6.7 x 10.1 in)	5.2 kg (11.5 lb)	115 VAC, 60 Hz
PC6 72-6428	Ecoline VC-380	3	1.6-5,000 ml/min	138 x 169 x 256 mm (5.4 x 6.7 x 10.1 in)	5.3 kg (11.7 lb)	230 VAC, 50 Hz
PC6 72-6429	Ecoline VC-380	3	1.6-5,000 ml/min	138 x 169 x 256 mm (5.4 x 6.7 x 10.1 in)	5.3 kg (11.7 lb)	115 VAC, 60 Hz
PC6 72-6430	Ecoline VC-360	3	0.25-1,300 ml/min	138 x 169 x 238 mm (5.4 x 6.7 x 9.4 in)	4.8 kg (10.6 lb)	230 VAC, 50 Hz
PC6 72-6431	Ecoline VC-360	3	0.25-1,300 ml/min	138 x 169 x 238 mm (5.4 x 6.7 x 9.4 in)	4.8 kg (10.6 lb)	115 VAC, 60 Hz
PC6 72-6436	Ecoline VC-Easy-Load	3	0.23-1,600 ml/min	138 x 169 x 285 mm (5.4 x 6.7 x 11.2 in)	5.2 kg (11.5 lb)	230 VAC, 50 Hz
PC6 72-6437	Ecoline VC-Easy-Load	3	0.23-1,600 ml/min	138 x 169 x 285 mm (5.4 x 6.7 x 11.2 in)	5.2 kg (11.5 lb)	115 VAC, 60 Hz
PC6 72-6439	Repl. Rotor for VC-280	2	-	-	-	-
PC6 72-6440	Repl. Rotor for VC-380	3	-	-	-	-
PC6 72-6438	Drive for VC-Easy Load	-	-	-	-	-

## Ecoline 4-Channel and 8-Channel Microprocessor Controlled Tubing Pumps

PC6 72-6434



PC6 72-6432



### KEY FEATURES

- Economical and powerful
- Stackable pumps for dosing and filling applications requiring variable flow rates
- MS/CA click 'n' go cassettes included
- Uses 3-stop collared tubing, see page 80
- Differential pressure 1.0 bar
- Analog interface
- Robust stainless steel housing
- Suitable pump for SCP controller, part of the universal servo control perfusion system

### APPLICATIONS

- Organ perfusion non-monitored long-term use
- Ideal for complex multi-channel pumping applications like recirculating organ/tissue bath systems

The Ecoline 4-Channel and 8-Channel Tubing Pumps are economical, compact, multi-channel pumps with wider flow rate ranges than the IP/IPN, see page 69 and REGLO Analog/Digital pump lines, see pages 66 and 67, and an alternative to the MCP/BVP multi-channel pump configurations. They are ideal for complex pumping applications like recirculating organ perfusion systems. The wide range of flow rates makes them useful for organ perfusion applications from Mice to Rabbits. Multiple channels can also be coupled together with Y-adapters to increase single line flow rates.

These pumps feature the MS/CA Click 'n' Go Cassettes (included). These new, innovative tubing cassettes provide the following advantages:

- Automatic tubing pressure
- Pumping conditions that are defined and repeatable at a later date
- Long term channel-to-channel conformity
- Calibrated, fatigue-free spring guarantees optimal, reproducible tubing pressure independent of diameter, material and state of tubing

### Ecoline VC-MS/CA8-6 and VC-MS/CA4-12 Flow Rates

AME #	ID MM	VC-MS/CA 8-6		VC-MS/CA4-12	
		MIN.	MAX.	MIN.	MAX.
0	0.13	0.005	0.49	0.003	0.32
02	0.25	0.017	1.7	0.013	1.3
05	0.51	0.067	6.7	0.055	5.5
08	0.76	0.15	15	0.12	12
11	1.02	0.26	26	0.20	20
14	1.22	0.36	36	0.26	26
17	1.52	0.53	53	0.36	36
20	1.85	0.73	73	0.47	47
23	2.54	1.2	120	0.68	68
25	3.17	1.5	150	0.83	83

Note: Approx. values: determined with water at 22°C, no differential pressure, with Tygon® Tubing

### Ecoline 4-and 8-Channel Specifications

<b>FLOW RATE:</b>	
Ecoline 4-Channel	0.003 to 83 ml/min per channel
Ecoline 8-Channel	0.005 to 150 ml/min per channel
<b>CHANNELS:</b>	
Ecoline 4-Channel	4
Ecoline 8-Channel	8
<b>NUMBER OF ROLLERS:</b>	
Ecoline 4-Channel	12
Ecoline 8-Channel	6
<b>MOTOR TYPE</b>	
DC motor	
<b>SPEED SETTING/CONTROL</b>	
1 to 99%, resolution 1%, 2-digit potentiometer	
<b>SPEED</b>	
3.5 to 350 rpm	
<b>POWER CONSUMPTION</b>	
100 W	
<b>MAINS CONNECTION</b>	
115 VAC, 60 Hz or 230 VAC, 50 Hz, adjustable	
<b>PROTECTION RATING</b>	
IP 30	
<b>REMOTE CONTROL</b>	
Analog interface	
<b>TUBING CASSETTES</b>	
MS/CA Click 'n' Go Cassettes, Cassettes are included	
<b>DIMENSIONS, H x W x D:</b>	
Ecoline 4-Channel	138 x 169 x 281 mm (5.4 x 6.6 x 11.4 in)
Ecoline 8-Channel	138 x 169 x 313 mm (5.4 x 6.6 x 12.3 in)
<b>WEIGHT:</b>	
Ecoline 4-Channel	5.4 kg (11.9 lb)
Ecoline 8-Channel	5.5 kg (12.1 lb)

Order #	Product
PC6 72-6434	Ecoline Roller Pump VC-MS/CA4-12, 4-Channels, 230 VAC, 50 Hz
PC6 72-6435	Ecoline Roller Pump VC-MS/CA4-12, 4-Channels, 115 VAC, 60 Hz
PC6 72-6432	Ecoline Roller Pump VC-MS/CA8-6, 8-Channels, 230 VAC, 50 Hz
PC6 72-6433	Ecoline Roller Pump VC-MS/CA8-6, 8-Channels, 115 VAC, 60 Hz
PC6 73-3054	Replacement MS/CA , Click 'n' Go, Cassette
PC6 73-3055	Replacement MS/CA, Pressure Lever, Cassette
PC6 73-3051	Foot Switch for Ecoline Pump
PC6 72-6438	Drive for VC-MS/CA4-12 and VC-MS/CA8-6 (without Pump-Head)



## Microprocessor Controlled Pumps with or without Dispensing

PC6 73-3132



Figure A

### KEY FEATURES

- Extremely low pulsation
- Highest Accuracy
- Very high repeatability on all channels
- Lacquered stainless steel housing for long life
- Available with 4, 8, 12, 16 or 24 channels
- Flow rate and dispensing volume (dispensing models only) can be calibrated
- CA click 'n' go cassettes provide defined and repeatable occlusion conditions
- Cassettes are included
- RS-232 interface for PC control – dispensing models only

### APPLICATIONS

- Perfusion of animal tissue slices
- Toxicological in-vitro use
- Flow injection analyzers
- Low-flow, multi-channel fluid transfer and dosing or filling applications

These tubing pumps are ideal for a wide variety of applications including perfusion of animal tissue slices and in-vitro toxicological procedures. They are available in a variety of channel configurations and have two flow rate ranges. Each pump is also available in two models. Select from a pump with or without a dispensing function.

These pumps feature a unique planetary drive system where the sun wheel drives each roller directly (see Figure A). This prevents axial push-pull friction on the tubing which results in increased service-life of the tubing, lower pulsation and high repeatability.

### Microprocessor Controlled Pumps Specifications

#### OPERATING MODES:

<b>IPC With Dispensing</b>	11 operating modes and calibrating functions
<b>IP Without Dispensing</b>	Run/Stop, Speed Control and Direction only, no dispensing features or calibrating functions

#### FLOW RATES (PER CHANNEL):

<b>IPC With Dispensing</b>	0.0004 to 11 ml/min
<b>IP Without Dispensing</b>	0.002 to 44 ml/min

<b>CHANNELS</b>	4, 8, 12, 16 or 24
-----------------	--------------------

<b>ROLLERS</b>	8
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#### OPERATING PANEL: 6-BUTTON MEMBRANE KEY-PAD WITH LED DISPLAY

<b>IPC With Dispensing</b>	Various operating modes for dosing applications
<b>IP Without Dispensing</b>	2 LEDs indicating LOCAL or REMOTE operation

#### SPEED SETTING:

<b>IPC With Dispensing</b>	1-100%, resolution 0.1% (rpm) or in µl/min or ml/min (flow rate)
<b>IP Without Dispensing</b>	1-100%, resolution 0.1% rpm, resolution 0.1 rpm, resolution 0.03 rpm

<b>SPEED CONTROL</b>	Closed loop control for load independent speed
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#### REMOTE CONTROL

<b>IPC With Dispensing</b>	RS-232 "in" and "out" Digital inputs (TTL level) Analog input for speed control Analog output for speed monitoring
<b>IP Without Dispensing</b>	Analog interface (no RS-232)

### Microprocessor Controlled Pumps with or without Dispensing Flow Rates

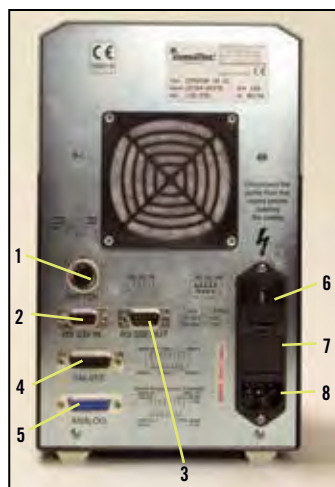
2-STOP TUBING		IP AND IPC PUMPS FLOW RATES ML/MIN PER CHANNEL		IP-N AND IPC-N PUMPS FLOW RATES ML/MIN PER CHANNEL	
ENE#	ID MM	Min.	Max.	Min.	Max.
00	0.13	0.002	0.15	0.0004	0.039
02	0.25	0.005	0.41	0.001	0.10
05	0.51	0.015	1.5	0.004	0.38
08	0.76	0.032	3.2	0.009	0.81
11	1.02	0.057	5.7	0.014	1.4
14	1.22	0.079	7.9	0.020	2.0
17	1.52	0.12	12	0.030	3.0
20	1.85	0.17	17	0.043	4.3
23	2.54	0.30	30	0.075	7.5
25	3.17	0.44	44	0.11	11

\*Note: Approximate values: determined with water at 22°C, no differential pressure, with Tygon® Tubing

## Microprocessor Controlled Pumps with or without Dispensing (continued)

Microprocessor Controlled Tubing Pumps					
Order #	# Channels	Flow Rate Range	Dimensions H x W x D	Weight	Power
<b>IPC Pumps With Dispensing Channels</b>					
PC6 73-3129	4	0.002 to 44 ml/min	130 x 175 x 180 mm (5.1 x 6.9 x 7.1 in)	4.6 kg (10.1 lb)	230 VAC, 50 Hz
PC6 73-3130	4	0.002 to 44 ml/min	130 x 175 x 180 mm (5.1 x 6.9 x 7.1 in)	4.6 kg (10.1 lb)	115 VAC, 60 Hz
PC6 73-3131	8	0.002 to 44 ml/min	130 x 175 x 220 mm (5.1 x 6.9 x 7.1 in)	5.1 kg (11.2 lb)	230 VAC, 50 Hz
PC6 73-3132	8	0.002 to 44 ml/min	130 x 175 x 220 mm (5.1 x 6.9 x 7.1 in)	5.1 kg (11.2 lb)	115 VAC, 60 Hz
PC6 73-3133	12	0.002 to 44 ml/min	130 x 175 x 260 mm (5.1 x 6.9 x 7.1 in)	5.8 kg (12.8 lb)	230 VAC, 50 Hz
PC6 73-3134	12	0.002 to 44 ml/min	130 x 175 x 260 mm (5.1 x 6.9 x 7.1 in)	5.8 kg (12.8 lb)	115 VAC, 60 Hz
PC6 73-2450	16	0.002 to 44 ml/min	130 x 175 x 300 mm (5.1 x 6.9 x 7.1 in)	6.5 kg (14.3 lb)	230 VAC, 50 Hz
PC6 73-3135	16	0.002 to 44 ml/min	130 x 175 x 300 mm (5.1 x 6.9 x 7.1 in)	6.5 kg (14.3 lb)	115 VAC, 60 Hz
PC6 73-3136	24	0.002 to 44 ml/min	130 x 175 x 380 mm (5.1 x 6.9 x 7.1 in)	7.9 kg (17.4 lb)	230 VAC, 50 Hz
PC6 73-3137	24	0.002 to 44 ml/min	130 x 175 x 380 mm (5.1 x 6.9 x 7.1 in)	7.9 kg (17.4 lb)	115 VAC, 60 Hz
<b>IPC-N Pumps With Dispensing Channels</b>					
PC6 73-3138	4	0.0004 to 11 ml/min	130 x 175 x 180 mm (5.1 x 6.9 x 7.1 in)	4.6 kg (10.1 lb)	230 VAC, 50 Hz
PC6 73-3139	4	0.0004 to 11 ml/min	130 x 175 x 180 mm (5.1 x 6.9 x 7.1 in)	4.6 kg (10.1 lb)	115 VAC, 60 Hz
PC6 73-3140	8	0.0004 to 11 ml/min	130 x 175 x 220 mm (5.1 x 6.9 x 8.7 in)	5.1 kg (11.2 lb)	230 VAC, 50 Hz
PC6 73-3141	8	0.0004 to 11 ml/min	130 x 175 x 220 mm (5.1 x 6.9 x 8.7 in)	5.1 kg (11.2 lb)	115 VAC, 60 Hz
PC6 73-2421	12	0.0004 to 11 ml/min	130 x 175 x 260 mm (5.1 x 6.9 x 10.2 in)	5.8 kg (12.8 lb)	230 VAC, 50 Hz
PC6 73-3142	12	0.0004 to 11 ml/min	130 x 175 x 260 mm (5.1 x 6.9 x 10.2 in)	5.8 kg (12.8 lb)	115 VAC, 60 Hz
PC6 73-3143	16	0.0004 to 11 ml/min	130 x 175 x 300 mm (5.1 x 6.9 x 11.8 in)	6.5 kg (14.3 lb)	230 VAC, 50 Hz
PC6 73-3144	16	0.0004 to 11 ml/min	130 x 175 x 300 mm (5.1 x 6.9 x 11.8 in)	6.5 kg (14.3 lb)	115 VAC, 60 Hz
PC6 73-3145	24	0.0004 to 11 ml/min	130 x 175 x 380 mm (5.1 x 6.9 x 15 in)	7.9 kg (17.4 lb)	230 VAC, 50 Hz
PC6 73-3146	24	0.0004 to 11 ml/min	130 x 175 x 380 mm (5.1 x 6.9 x 15 in)	7.9 kg (17.4 lb)	115 VAC, 60 Hz
<b>IP Pumps Without Dispensing Channels</b>					
PC6 73-3147	4	0.002 to 44 ml/min	130 x 175 x 180 mm (5.1 x 6.9 x 7.1 in)	4.6 kg (10.1 lb)	230 VAC, 50 Hz
PC6 73-3148	4	0.002 to 44 ml/min	130 x 175 x 180 mm (5.1 x 6.9 x 7.1 in)	4.6 kg (10.1 lb)	115 VAC, 60 Hz
PC6 73-3149	8	0.002 to 44 ml/min	130 x 175 x 220 mm (5.1 x 6.9 x 8.7 in)	5.1 kg (11.2 lb)	230 VAC, 50 Hz
PC6 73-3150	8	0.002 to 44 ml/min	130 x 175 x 220 mm (5.1 x 6.9 x 8.7 in)	5.1 kg (11.2 lb)	115 VAC, 60 Hz
PC6 73-3151	12	0.002 to 44 ml/min	130 x 175 x 260 mm (5.1 x 6.9 x 10.2 in)	5.8 kg (12.8 lb)	230 VAC, 50 Hz
PC6 73-3152	12	0.002 to 44 ml/min	130 x 175 x 260 mm (5.1 x 6.9 x 10.2 in)	5.8 kg (12.8 lb)	115 VAC, 60 Hz
PC6 73-3153	16	0.002 to 44 ml/min	130 x 175 x 300 mm (5.1 x 6.9 x 11.8 in)	6.5 kg (14.3 lb)	230 VAC, 50 Hz
PC6 73-3154	16	0.002 to 44 ml/min	130 x 175 x 300 mm (5.1 x 6.9 x 11.8 in)	6.5 kg (14.3 lb)	115 VAC, 60 Hz
PC6 73-3155	24	0.002 to 44 ml/min	130 x 175 x 380 mm (5.1 x 6.9 x 15 in)	7.9 kg (17.4 lb)	230 VAC, 50 Hz
PC6 73-3156	24	0.002 to 44 ml/min	130 x 175 x 380 mm (5.1 x 6.9 x 15 in)	7.9 kg (17.4 lb)	115 VAC, 60 Hz
<b>IP-N Pumps Without Dispensing Channels</b>					
PC6 73-3157	4	0.0004 to 11 ml/min	130 x 175 x 180 mm (5.1 x 6.9 x 7.1 in)	4.6 kg (10.1 lb)	230 VAC, 50 Hz
PC6 73-3158	4	0.0004 to 11 ml/min	130 x 175 x 180 mm (5.1 x 6.9 x 7.1 in)	4.6 kg (10.1 lb)	115 VAC, 60 Hz
PC6 73-3159	8	0.0004 to 11 ml/min	130 x 175 x 220 mm (5.1 x 6.9 x 8.7 in)	5.1 kg (11.2 lb)	230 VAC, 50 Hz
PC6 73-3160	8	0.0004 to 11 ml/min	130 x 175 x 220 mm (5.1 x 6.9 x 8.7 in)	5.1 kg (11.2 lb)	115 VAC, 60 Hz
PC6 73-3161	12	0.0004 to 11 ml/min	130 x 175 x 260 mm (5.1 x 6.9 x 10.2 in)	5.8 kg (12.8 lb)	230 VAC, 50 Hz
PC6 73-3162	12	0.0004 to 11 ml/min	130 x 175 x 260 mm (5.1 x 6.9 x 10.2 in)	5.8 kg (12.8 lb)	115 VAC, 60 Hz
PC6 73-3163	16	0.0004 to 11 ml/min	130 x 175 x 300 mm (5.1 x 6.9 x 11.8 in)	6.5 kg (14.3 lb)	230 VAC, 50 Hz
PC6 73-3164	16	0.0004 to 11 ml/min	130 x 175 x 300 mm (5.1 x 6.9 x 11.8 in)	6.5 kg (14.3 lb)	115 VAC, 60 Hz
PC6 73-3165	24	0.0004 to 11 ml/min	130 x 175 x 380 mm (5.1 x 6.9 x 15 in)	7.9 kg (17.4 lb)	230 VAC, 50 Hz
PC6 73-3166	24	0.0004 to 11 ml/min	130 x 175 x 380 mm (5.1 x 6.9 x 15 in)	7.9 kg (17.4 lb)	115 VAC, 60 Hz

## MCP Pump Drive



### Rear panel of MCP

1. Foot Switch/Hand Dispenser
2. RS-232 Interface (in)
3. RS-232 Interface (out)
4. Valve Connector
5. Analog Interface
6. Voltage Selector
7. Fuse Holder
8. Mains Supply Socket

All functions of the MCP drive can be controlled via PC via the RS-232 interface

### KEY FEATURES

- Stores 4 programs in memory
- Dispensing volumes in ml and flow rates in ml/min
- Calibrate in ml/min
- Various dispensing modes (time, volume, interval and flow rate, drip-free)
- MAX-key for priming and rapid filling or emptying of the tube system

### APPLICATIONS

- Filling of bottles and test tubes
- Dispensing of pre-defined volumes

This programmable pump drive offers various dispensing modes, providing highly reproducible and accurate results. Pump head must be purchased separately. A wide selection of pump heads with single or multi-channel capabilities are available for the MCP pump drive. See pages 74 to 77.

### Multi-functional Display

For tube sizes, speed, flow-rates, dispensing time, dispensing volume, interval duration and totally delivered volume as well as operational mode, flow direction and MAX-key for priming.

### Calibration: Dispensing Volume/Flow Rate

Volume and flow rate can be pre-set and calibrated in ml or ml/min. The drives are pre-calibrated according to the pre-programmed pump heads and tube sizes.

### MCP Pump Drive Specifications

MODEL	MCP pump drive only, pump head must be purchased separately
SPEED	1 to 240 rpm with 0.1 rpm resolution
BACK PRESSURE	1.5 bar maximum (22 PSI)
MAINS CONNECTION	115 VAC (50/60 Hz) or 230 VAC (50/60 Hz)
POWER CONSUMPTION	100 W maximum
RS-232 INTERFACE 8 PUMPS	Baud rate 9600 or 1200 baud, 8 bit, 1 stop bit, no parity for complete computer control for cascade control or up to 8 pumps
ANALOG INTERFACE	Speed control 0–5 V or 0–10 V respectively 0–20 mA or 4–20 mA
DIGITAL INPUT (TTL LEVEL)	Flow direction, start/stop, speed control
VALVE PLUG	1 for 24 V valve
PROTECTION RATING	IP 30
ELECTRO MAGNETIC IMMUNITY	EN 50082-1
ELECTRO MAGNETIC RADIATION	EN 55022 Class B
OPERATING CONDITIONS	0° to 40°C (normal environmental conditions)
DIMENSIONS, H x W x D	260 x 155 x 220 mm (10.2 x 6.1 x 8.7 in) without pump head
WEIGHT	6.4 kg (14.1 lb)

### Order # Product

PC6 73-3026	MCP Pump Drive, 230 VAC, 50/60 Hz
PC6 73-3029	MCP Pump Drive, 115 VAC, 50/60 Hz
PC6 73-3048	Foot Switch for MCP Pump Drive

## BVP Pump Drive



### KEY FEATURES

- Smooth operation at a low noise level
- Robust drive for long-term operations
- Small footprint, 2 drives are stackable
- 3 digit potentiometer speed selector, adjustable in 0.1% steps, 1 to 99%
- MAX-Switch (e.g. for priming of the tubing system)
- Switchable flow direction for clockwise and counter-clockwise operation
- Suitable pump for SCP controller, part of the universal servo control perfusion system

The BVP pump drive is very robust and designed for continuous operation. It is equipped with a 3 digit potentiometer speed selector and an analog interface.

Pump Head must be purchased separately. A wide selection of pump heads with single or multi-channel capabilities are available for the BVP pump drive. See pages 74 to 78. Pump heads can be rapidly interchanged so that a single pump drive with multi-heads can fulfill a diverse range of pumping applications. The following table lists the single and multi-channel pump head options for the MCP/BVP drives with page references to the available tubing.



### BVP Pump Drive Specifications

<b>MODEL</b>	BVP pump drive only, pump head must be purchased separately
<b>SPEED</b>	2.4 to 240 rpm, adjustable in 0.1 % steps
<b>BACK PRESSURE</b>	1.5 bar maximum (22 PSI)
<b>MAINS CONNECTION</b>	115 VAC (50/60 Hz) or 230 VAC (50/60 Hz)
<b>POWER CONSUMPTION</b>	100 W maximum
<b>ANALOG INTERFACE</b>	Speed control 0–5 V or 0–10 V respectively 0–20 mA or 4–20 mA
<b>DIGITAL INPUT (TTL LEVEL)</b>	Flow direction, start/stop
<b>PROTECTION RATING</b>	IP 30
<b>ELECTRO MAGNETIC IMMUNITY</b>	EN 50082-1
<b>ELECTRO MAGNETIC RADIATION</b>	EN 55022, Class B
<b>OPERATING CONDITIONS</b>	0° to 40 °C (normal environmental conditions)
<b>DIMENSIONS, H x W x D</b>	260 x 155 x 220 mm (9.8 x 6.1 x 8.7 in) without pump-head
<b>WEIGHT</b>	5.7 kg (12.6 lb)

Order #	Product
PC6 73-3028*	BVP Pump Drive, 230 VAC, 50/60 Hz
PC6 73-3027*	BVP Pump Drive, 115 VAC, 50/60 Hz
PC6 73-3049	Foot Switch for BVP Pump Drive
<b>Single Channel Pump Head, see pages 74 and 75</b>	
PC6 73-3035	380AD
PC6 73-3119	PRO-280
PC6 73-3120	PRO-380
PC6 73-3121	PRO-281
PC6 73-3122	PRO-381
<b>Multi-Channel Pump Head, see pages 76 to 78</b>	
PC6 73-3031	CA-4
PC6 73-3036	CA-8
PC6 73-3037	CA-12
PC6 73-3040	SB (Requires Tube Bed Set)
PC6 73-3030	MS3
PC6 73-3038	MS/CA4-12
PC6 73-3033	MS/CA8-6

\* Pump head must be purchased separately.



## Gentle Pumping Pump Heads

PC6 73-3119



PC6 73-3120



### KEY FEATURES

- Unique convex rollers cause minimal cell lysis
- Installs rapidly
- Easily interchanged with other MCP/BVP pump heads
- Elevated differential pressures (PRO-281 and PRO-381)
- Ideal for mammalian cell inoculating, harvesting or cell suspension transfers
- Suitable for viscous fluids and fluids containing a high content of sensitive solids
- Applications requiring hygienic conditions, durability and reliability

### PRO-280

- Coated aluminum pump head
- Can be dismantled for cleaning
- Stainless steel rollers
- Self-centering tube track, allows tube to lie in the optimum position, which considerably lengthens the tube life
- For applications which require hygienic conditions, reliability and durability
- Ideal for use in chemical, biotechnological and pharmaceutical processes and in food industry

### PRO-281

- Same as PRO-280 but
- For tubing with 2.4 mm wall thickness
- Especially recommended for:
  - Elevated differential pressures
  - Viscous fluids

### PRO-380

- Same as PRO-280 but
- Less pulsation thanks to 3 rollers
- Slightly lower flow rate

### PRO-381

- Same as PRO-380 but
- For tubing with 2.4 mm wall thickness
- Especially recommended for:
  - Elevated differential pressures
  - Viscous fluids

These pump heads provide gentle pumping action and are suitable for many applications, including cell suspensions.

The model PRO-280 pump head is gentle enough to use for highly viscous liquids with concentrated viable cells. Comparisons to gear, piston and centrifugal pumps proved that peristaltic pumps are the only suitable and sterilizable pump system for gently pumping media containing living cells.

### Gentle Pumping Pump Heads Specifications

PUMP HEAD	PRO-280	PRO-380	PRO-281	PRO-381
NUMBER OF CHANNELS	1	1	1	1
NUMBER OF ROLLERS	2	3	2	3
TUBING WALL THICKNESS	1.6 mm	1.6 mm	2.4 mm	2.4 mm
FLOW RATE RANGE ML/MIN	0.49 -3,700	0.45 -3,400	3.6 -3,100	3.3 -2,900

### Gentle Pumping Pump Heads Flow Rates

Standard Tygon® R-3603/R-3607					
		PRO-280 FLOW RATE, ML/MIN FLOW RATE, ML/MIN		PRO-380 FLOW RATE, ML/MIN FLOW RATE, ML/MIN	
Tubing ID mm	Wall mm	Min.	Max.	Min.	Max.
1.6	1.6	0.49	120	0.45	110
3.2	1.6	1.9	450	1.7	400
4.8	1.6	4.2	1,000	3.7	890
6.4	1.6	7.2	1,700	6.5	1,600
9.5	1.6	14	3,300	13	3,000
11.1	1.6	16	3,700	14	3,400
Standard Tygon® R-3603/R-3607					
		PRO-281 FLOW RATE, ML/MIN FLOW RATE, ML/MIN		PRO-381 FLOW RATE, ML/MIN FLOW RATE, ML/MIN	
Tubing ID mm	Wall mm	Min.	Max.	Min.	Max.
4.8	2.4	3.6	870	3.3	800
6.4	2.4	6.5	1,600	5.8	1,400
8	2.4	9.9	2,400	8.8	2,100
9.5	2.4	13	3,100	12	2,900

\*Note: Approximate values: determined with water at 22°C, no differential pressure, with Tygon® Tubing

Order #	Product
PC6 73-3119	PRO-280 Gentle Pumping Head
PC6 73-3120	PRO-380 Gentle Pumping Head
PC6 73-3121	PRO-281 Gentle Pumping Head
PC6 73-3122	PRO-381 Gentle Pumping Head

## Pump Head 380AD

Single-Channel  
Pump Head 380AD



### KEY FEATURES

- Installs rapidly
- Easily interchanged with other MCP/BVP pump heads
- Ideal for chemical, biotechnological and pharmaceutical applications
- Suitable for viscous fluids and fluids containing a high content of sensitive solids
- Applications requiring hygienic conditions, durability and reliability

This pump head features 3 convex rollers revolving in a concave tube bed which allows cells or particles to escape through a gap towards tubing wall to minimize damage. It is ideal for inoculating or harvesting mammalian cells.

### Adjustable Pump Rollers

On this pump head, the 3 convex rollers can be adjusted and pressed symmetrically against the concave tube bed, enabling the use of pump tubing with various wall thicknesses.

Adjustable roller pressure accommodates wide range of tubing durometers (stiffness).

Very simple tube loading. This pump head accepts tubing with different diameters and wall thicknesses with ease. Thanks to the adjustable pump rollers, this is an ideal pump head for media with high viscosity, or with a certain level of solid content.

### 380AD Pump Head Specifications

PUMP HEAD	380AD
CHANNELS	1
PUMP ROLLERS	3
FLOW RATES	0.41 to 3600 ml/min
BACK PRESSURE	1.5 bar (22 PSI) maximum with 1.6 mm wall thickness tubing 2.5 bar (36 PSI) maximum with 2.4 mm wall thickness tubing
TUBING TYPE	Standard Tubing
TUBING ID	0.8 to 11.1 mm; 4.8 to 6.4 mm
TUBING WALL THICKNESS	1.6 mm or 2.4 mm

### 380AD Pump Head Using Standard Tubing Flow Rates

Tubing ID	Wall Thickness	FLOW RATES, ML/MIN	
		Minimum	Maximum
1.6 mm	1.6 mm	0.41	99
3.2 mm	1.6 mm	1.5	370
4.8 mm	1.6 mm	3.4	830
6.4 mm	1.6 mm	6.2	1,500
8.0 mm	1.6 mm	9.5	2,300
9.5 mm	1.6 mm	13	3,000
11.1 mm	1.6 mm	15	3,600
4.8 mm	2.4 mm	3.4	830
6.4 mm	2.4 mm	6.2	1,500

*\*Note: Approximate values: determined with water at 22°C, no differential pressure, with Tygon® Tubing*

Order #	Product
PC6 73-3035	380AD Single-Channel Pump Head for MCP/BVP Pump Drives



## SB Pump Head with Tube Bed Sets, 2V or 3V

SB Pump Head with 2V Tube Bed Set



SB Pump Head with 3V Tube Bed Set



### KEY FEATURES

- Ideal for sensitive substances requiring a smooth pressure adjustment
- Uses spring-loaded tube bed set – choice of 1, 2 or 3 channels
- Tube bed sets are interchangeable
- 0.009 to 1100 ml/min flow rates depending on tube bed set
- 6 rollers
- Individual and continuously adjustable pressure setting per channel
- Back pressure has maximum of 1.5 bar (22 PSI)

### SB Pump Head Specifications

#### SB Pump Head with 2V Tube Bed Set

PUMP HEAD	SB
TUBE BED SET	2V
CHANNELS	1 – 2
PUMP ROLLERS	6
FLOW RATES	1.1 to 1100 ml/min
BACK PRESSURE	1.5 bar (22 PSI) maximum
TUBING TYPE	Standard tubing
TUBE ID	3.2 to 8.0 mm
TUBING WALL THICKNESS	1.6 mm

#### SB Pump Head with 3V Tube Bed Set

PUMP HEAD	SB
TUBE BED SET	3V
CHANNELS	1 – 3
PUMP ROLLERS	6
FLOW RATES	0.09 to 870 ml/min
BACK PRESSURE	1.5 bar (22 PSI) maximum
TUBING TYPE	Standard tubing
TUBE ID	0.8 to 6.4 mm
TUBING WALL THICKNESS	1.6 mm

### SB Pump Head using Standard Tubing, 1.6 mm Wall Thickness Flow Rates

Standard Tubing ID mm	2V TUBE BED SET, ML/MIN		3V TUBE BED SET, ML/MIN	
	min	max	min	max
0.8	—	—	0.09	22
1.6	—	—	0.26	63
3.2	1.1	260	0.99	240
4.8	2.3	550	2.2	530
6.4	3.7	890	3.6	870
8.0	4.6	1100	—	—

Note: For BVP-Standard drive, the min. flow rate values must be multiplied by factor 2.4

\*Note: Approximate values: determined with water at 22°C, no differential pressure, with Tygon® Tubing

### Order # Product

PC6 73-3040	SB Pump Head for BVP/MCP Pump Drives*
PC6 73-3045	2V Tube Bed Set for SB Pump Head
PC6 73-3046	3V Tube Bed Set for SB Pump Head

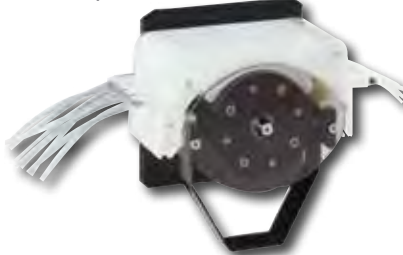
\*Note: Requires selection of Tube Bed Set.

## CA Pump Heads

PC6 73-3031  
CA-4 Pump Head



PC6 73-3036  
CA-8 Pump Head



PC6 73-3037  
CA-12 Pump Head



### KEY FEATURES

- For use with MCP and BVP Pump Drive, see pages 72 and 73
- CA Click 'n' Go Cassettes are included
- Automatic pressure setting
- Easy and rapid tube change-over; each channel separately, even while pump is running
- 8 rollers
- 4, 8, or 12 channels, each channel can take different tube sizes
- Uses 2-stop collared tubing 0.13 to 3.17 mm ID, see page 81
- 0.002 to 230 ml/min flow rate range

The CA pump heads for the MCP/BVP pump drives, see pages 72 and 73, offer the widest flow rate range of any multi-channel pump head series available.

Other multi-channel pump heads include the MS/CA 4-12 and 8-6, see page 74. The MS/CA 4-12 and 8-6 multi-channel pump head series offer 8 rollers, and stackable head assemblies that allow you to increase the number of tubing channels per pump drive.

### CA Pump Drive Specifications

<b>PUMP ROLLERS</b>	8
<b>FLOW RATES</b>	0.002 to 230 ml/min
<b>BACK PRESSURE</b>	1.0 bar maximum
<b>TUBING TYPE</b>	2-Stop Collared Tubing
<b>TUBING ID</b>	0.13 to 3.17 mm

### CA Pump Heads Flow Rate Range

#### 2-Stop Collared Tubing

ENE#	Tubing ID mm	ML/MIN PER CHANNEL	
		Minimum	Maximum
00	0.13	0.002	0.31
01	0.19	0.004	0.94
02	0.25	0.008	1.8
03	0.38	0.019	4.5
04	0.44	0.025	6.1
05	0.51	0.034	8.2
06	0.57	0.042	10
07	0.64	0.053	13
08	0.76	0.074	18
09	0.89	0.1	24
10	0.95	0.11	27
11	1.02	0.13	31
12	1.09	0.14	35
13	1.14	0.16	38
14	1.22	0.18	42
15	1.3	0.2	47
16	1.42	0.23	55
17	1.52	0.26	62
18	1.65	0.3	71
19	1.75	0.33	78
20	1.85	0.36	86
21	2.06	0.43	100
22	2.29	0.51	120
23	2.54	0.62	150
24	2.79	0.74	180
25	3.17	0.94	230

Note: For BVP-Standard drive, the minimum flow rate values must be multiplied by factor 2.4.

### Order # Product

<b>PC6 73-3035</b>	CA-4 Pump Head 4 Channel for BVP/MCP Pump Drives
<b>PC6 73-3036</b>	CA-8 Pump Head 8 Channel for BVP/MCP Pump Drives
<b>PC6 73-3037</b>	CA-12 Pump Head 12 Channel for BVP/MCP Pump Drives
<b>PC6 73-3052</b>	Replacement CA Cassette, Click 'n' Go



## MS Multi-Channel Pump Heads for MCP & BVP Pump Drives

PC6 73-3030  
MS-3 Pump Head



PC6 73-3033  
MS/CA 8-6 Pump Head



PC6 73-3038  
MS/CA 4-12 Pump Head



### MS-3 PUMP HEAD

- Ideal for sensitive substances requiring a gentle pressure setting
- Uses spring-loaded tube bed set
- Transparent protection cover for easy monitoring of the pump head
- 0.002 to 100 ml/min flow rates
- Uses 3-stop collared tubing, 0.13 to 3.17 mm ID, see page 80
- Back pressure has max of 1.5 bar (22 PSI)

### MS/CA 4-12 PUMP HEAD

- MS/CA Click 'n' Go Cassettes are included
- 12 Rollers for extremely low pulsation
- Each channel can take different tube sizes
- Easy and rapid tube change-over; even while pump is running
- 0.001 to 57 ml/min flow rates
- Uses 3-stop collared tubing, 0.13 to 3.17 mm ID, see page 80
- Back pressure has maximum of 1.0 bar (14.5 PSI)

### MS/CA 8-6 PUMP HEAD

- MS/CA Click 'n' Go Cassettes are included
- Each channel can take different tube sizes
- Easy and rapid tube change-over; even while pump is running
- 6 rollers
- 0.002 to 100 ml/min Flow Rates
- Uses 3-stop collared tubing, 0.13 to 3.17 mm ID, see page 80
- Back pressure has maximum of 1.0 bar (14.5 PSI)

### MS and MS/CA Cassettes Flow Rate Range

3-Stop Collared Tubing ID mm	MS-3 3 Channels PC6 73-3030 Flow Rates ml/min per Channel		MS/CA 4-12 4, 8, 12 or 16 Channels PC6 73-3038 Flow Rates ml/min per Channel		MS/CA 8-6 8, 16, or 24 Channels PC6 73-3033 Flow Rates ml/min per Channel	
	Min.	Max.	Min.	Max.	Min.	Max.
0.13	0.002	0.4	0.001	0.22	0.002	0.33
0.19	0.003	0.73	0.003	0.51	0.003	0.67
0.25	0.005	1.2	0.004	0.91	0.005	1.1
0.38	0.011	2.6	0.009	2.1	0.011	2.6
0.44	0.014	3.4	0.012	2.8	0.014	3.5
0.51	0.019	4.5	0.016	3.8	0.019	4.6
0.57	0.023	5.5	0.019	4.7	0.024	5.7
0.64	0.029	6.9	0.024	5.8	0.03	7.2
0.76	0.04	9.6	0.033	8.0	0.042	10
0.89	0.053	13	0.044	11	0.057	14
0.95	0.06	14	0.050	12	0.064	15
1.02	0.69	17	0.056	13	0.073	18
1.09	0.078	19	0.063	15	0.083	20
1.14	0.084	20	0.067	16	0.090	22
1.22	0.10	23	0.075	18	0.10	24
1.3	0.11	26	0.083	20	0.11	27
1.42	0.12	30	0.094	23	0.13	32
1.52	0.14	34	0.10	25	0.15	36
1.65	0.16	39	0.12	28	0.17	42
1.75	0.18	42	0.13	30	0.19	46
1.85	0.19	47	0.13	32	0.21	50
2.06	0.23	55	0.15	37	0.25	59
2.29	0.27	65	0.17	41	0.29	69
2.54	0.32	76	0.19	46	0.33	79
2.79	0.36	87	0.21	52	0.37	89
3.17	0.42	100	0.24	57	0.43	100

\*Note: Approximate values: determined with water at 22°C, no differential pressure, with Tygon® Tubing

Order #	Product
PC6 73-3030	MS-3 Pump Head for BVP/MCP Pump Drives
PC6 73-3038	MS/CA 4-12 Pump Head for BVP/MCP Pump Drives
PC6 73-3046	3V Tube Bed Set for SB Pump Head
PC6 73-3039	MS/CA 4-12 Extension Block, 4 Channel
PC6 73-3033	MS/CA 8-6 Pump Head for BVP/MCP Pump Drives
PC6 73-3034	MS/CA 8-6 Extension Block, 8 Channel

## Tubing Cassettes and Accessories

### Click 'n' Go Cassettes



Supplied standard with all cassette pumps, these innovative tubing cassettes offer the following advantages:

- **Automatic pressure mechanism to set tubing pressure**
- **Calibrated, fatigue-free spring guarantees optimal, reproducible tubing pressure independent of diameter, material and state of tubing**
- **Long term channel-to-channel conformity**

These cassettes are not suitable for Tygon® MH2075 tubing (or other hard tubing materials) or for differential pressure greater than 1 bar (14.5 PSI). Pressure lever cassettes are recommended for these conditions.

Order #	Product
PC6 73-3054	MS/CA Cassette, Click 'n' Go
PC6 73-3052	CA Cassette, Click 'n' Go
PC6 73-3303	Spare POM-C Adaptor for CA Cassettes

### Pressure Lever Cassettes



The Pressure Lever Cassettes are designed to allow the user to set a different tubing pressure for each channel. This adjustment allows an optimal tubing pressure to be set depending on the tubing material and diameter as well as the application. Since it may be necessary to periodically adjust the tubing pressure to maintain constant flow rates, these successful cassettes are now available as an option rather than supplied standard. These cassettes are still recommended over the automatic Click 'n' Go cassettes under the following conditions:

- **Varying or high differential pressure**
- **For hard tubing material, such as Tygon® MH2075**

Order #	Product
PC6 73-3055	MS/CA Cassette, Pressure Lever
PC6 73-3053	CA Cassette, Click 'n' Go
PC6 73-3303	Spare POM-C Adaptor for CA Cassettes

### Foot Switches



Foot switches provide the start/stop signal required for the pump. This accessory is very practical for use with dispensing systems such as those required for filling tubes or bottles.

Order #	Product
PC6 73-3048	Foot Switch for MCP IP, IPC, IP-N, IPC-N
PC6 73-3049	Foot Switch for BVP and REGLO Analog Pumps
PC6 73-3050	Foot Switch for REGLO Digital Pumps
PC6 73-3051	Foot Switch for Ecoline Pumps

### Rotors for Ecoline VC-280 and VC-380 Pumps, see page 68



Order #	Product
PC6 73-3114	Rotor, 3 Rollers, Black, Accepts 2.4 mm Tubing Wall Thickness
PC6 73-3115	Rotor, 2 Rollers, Black, Accepts 2.4 mm Tubing Wall Thickness
PC6 73-3116	Rotor, 2 Rollers, Red, Accepts 1.6 mm Tubing Wall Thickness
PC6 73-3117	Rotor, 3 Rollers, Red, Accepts 1.6 mm Tubing Wall Thickness

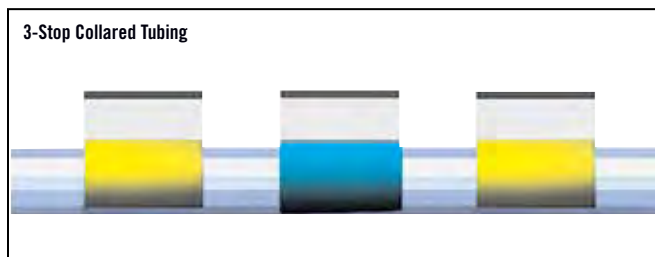
### Pump Accessories

PUMP MODEL	FOOTSWITCH #	CASSETTE TYPE*	ORDER #
REGLO Digital	PC6 73-3050	MS/CA CNG	PC6 73-3054
REGLO Analog	PC6 73-3049	MS/CA CNG	PC6 73-3054
Ecoline VC-MS/CA8-6	PC6 73-3051	MS/CA CNG	PC6 73-3054
Ecoline VC-MS/CA4-12	PC6 73-3051	MS/CA CNG	PC6 73-3054
Ecoline VC-280, VC-380	PC6 73-3051	Exchangeable Rotors	
Ecoline VC-360	PC6 73-3051	N/A	—
IP, IP-N	PC6 73-3048	CA CNG	PC6 73-3052
IPC, IPC-N	PC6 73-3048	CA CNG	PC6 73-3052
MCP	PC6 73-3048	Depends on pump head	
BVP	PC6 73-3049	Depends on pump head	

\*CNG = Click 'n' Go

## Pump Tubing

### 3-Stop Collared Pump Tubing for MS/CA Cassettes



This 3-stop collared tubing is for use with the REGLO Pumps and other pumps. Each length of E-Lab tubing measures 381 mm (15 in), each length of E-LFL, Silicone & BPT tubing measures 406 mm (16 in). Either 12 or 6 lengths are supplied per package. Select your required tubing size and tubing material from the chart below. The distance between the collars is 73 mm (2.9 in). The tubing is available in four different materials. Select the material based on your application.

3-Stop Collared Tubing is required for the following:

- Pumps
  - Ecoline VC-MS/CA4-12 and VC-MS/CA8-6, see page 68
  - All REGLO Digital, see page 66
  - All REGLO Analog, see page 65
- Pump Heads
  - MS-3, see page 78
  - MS/CA 4-12, see page 78
  - MS/CA 8-6, see page 78

3-Stop Collared Pump Tubing						
AME #	TUBING ID	Color Code	Tygon® E-Lab	Tygon® E-LFL	Silicone (platinum cured)	PharMed® BPT
			ORDER #	ORDER #	ORDER #	ORDER #
00	0.13 mm	orange-black	PC6 73-1816	–	–	–
01	0.19 mm	orange-red	PC6 73-1817	–	–	–
02	0.25 mm	orange-blue	PC6 73-1818	PC6 73-3214	–	PC6 73-3175
03	0.38 mm	orange-green	PC6 73-1819	PC6 73-3215	–	PC6 73-3176
04	0.44 mm	green-yellow	PC6 73-1820	–	–	–
05	0.51 mm	orange-yellow	PC6 73-1821	PC6 73-3216	–	PC6 73-3177
06	0.57 mm	white-yellow	PC6 73-1822	–	–	–
07	0.64 mm	orange-white	PC6 73-1823	PC6 73-3217	PC6 73-3263	PC6 73-3178
08	0.76 mm	black-black	PC6 73-1824	PC6 73-3218	PC6 73-3264	PC6 73-3179
09	0.89 mm	orange-orange	PC6 73-1825	PC6 73-3219	PC6 73-3265	PC6 73-3180
10	0.95 mm	white-black	PC6 73-1826	–	–	–
11	1.02 mm	white-white	PC6 73-1827	PC6 73-3220	PC6 73-3266	PC6 73-3181
12	1.09 mm	white-red	PC6 73-1828	–	–	–
13	1.14 mm	red-red	PC6 73-1829	PC6 73-3221	PC6 73-3267	PC6 73-3182
14	1.22 mm	red-grey	PC6 73-0126	–	–	–
15	1.3 mm	grey-grey	PC6 73-1830	PC6 73-3222	PC6 73-3268	PC6 73-3183
16	1.42 mm	yellow-yellow	PC6 73-1831	PC6 73-3223	PC6 73-3269	PC6 73-3184
17	1.52 mm	yellow-blue	PC6 73-1832	PC6 73-3224	PC6 73-3270	PC6 73-3185
18	1.65 mm	blue-blue	PC6 73-1833	PC6 73-3225	PC6 73-3271	PC6 73-3186
19	1.75 mm	blue-green	PC6 73-1834	–	–	–
20	1.85 mm	green-green	PC6 73-1835	PC6 73-3226	PC6 73-3272	PC6 73-3187
21	2.06 mm	purple-purple	PC6 73-1836	PC6 73-3227	PC6 73-3273	PC6 73-3188
22	2.29 mm	purple-black	PC6 73-1837	PC6 73-3228	PC6 73-3274	PC6 73-3189
23	2.54 mm	purple-orange	PC6 73-1838	PC6 73-3229	PC6 73-3275	PC6 73-3190
24	2.79 mm	purple-white	PC6 73-0155	PC6 73-3230	PC6 73-3276	PC6 73-3191
25	3.17 mm	black-white	PC6 73-1839	–	–	–
Pack Size			12 pieces	12 pieces	6 pieces	12 pieces

## Pump Tubing

### 2-Stop Tygon® Pump Tubing for CA Cassettes & Harvard Peristaltic Pump



This is 2-stop collared tubing. Each length of tubing measures 406 mm (16 in). Either 12 or 6 lengths are supplied per package. Select your required tubing size and tubing material from the chart below. The distance between the collars is 153 mm (6.1 in). The tubing is available in four different materials. Select the material based on your application.

2-Stop Collared Tubing is required for the following:

- Harvard Peristaltic Pump P-230, see page 61
- Pumps
  - IP, IPC, IP-N, IPC-N, see page 71
- Pump Heads
  - CA-4, see page 77
  - CA-8, see page 77
  - CA-12, see page 77

2-Stop Collared Pump Tubing			Tygon® E-LAB	Tygon® LFL	Silicone (platinum cured)	PharMed® BPT
ENE #	Tubing ID	Color Code	ORDER #	ORDER #	ORDER #	ORDER #
00	0.13 mm	orange-black	PC6 73-3174	–	–	–
01	0.19 mm	orange-red	PC6 73-1840	–	–	–
02	0.25 mm	orange-blue	PC6 73-1841	PC6 73-3231	–	PC6 73-3192
03	0.38 mm	orange-green	PC6 73-1842	PC6 73-3232	–	PC6 73-3193
04	0.44 mm	green-yellow	PC6 73-1843	–	–	–
05	0.51 mm	orange-yellow	PC6 73-1844	PC6 73-3233	–	PC6 73-3194
06	0.57 mm	white-yellow	PC6 73-1845	–	–	–
07	0.64 mm	orange-white	PC6 73-1846	PC6 73-3234	–	PC6 73-3195
08	0.76 mm	black-black	PC6 73-1847	PC6 73-3235	PC6 73-3278	PC6 73-3196
09	0.89mm	orange-orange	PC6 73-1848	PC6 73-3236	PC6 73-3279	PC6 73-3197
10	0.95 mm	white-black	PC6 73-1849	–	–	–
11	1.02 mm	white-white	PC6 73-1850	PC6 73-3237	PC6 73-3280	PC6 73-3198
12	1.09 mm	white-red	PC6 73-1851	–	–	–
13	1.14 mm	red-red	PC6 73-1852	PC6 73-3238	PC6 73-3281	PC6 73-3199
14	1.22 mm	red-grey	PC6 73-1853	–	–	–
15	1.3 mm	grey-grey	PC6 73-1854	PC6 73-3239	PC6 73-3282	PC6 73-3200
16	1.42 mm	yellow-yellow	PC6 73-1855	PC6 73-3240	PC6 73-3283	PC6 73-3201
17	1.52 mm	yellow-blue	PC6 73-1856	PC6 73-3241	PC6 73-3284	PC6 73-3202
18	1.65 mm	blue-blue	PC6 73-1857	PC6 73-3242	PC6 73-3285	PC6 73-3203
19	1.75 mm	blue-green	PC6 73-1858	–	–	–
20	1.85 mm	green-green	PC6 73-1859	PC6 73-3243	PC6 73-3286	PC6 73-3204
21	2.06 mm	purple-purple	PC6 73-1860	PC6 73-3244	PC6 73-3287	PC6 73-3205
22	2.29 mm	purple-black	PC6 73-1861	PC6 73-3245	PC6 73-3288	PC6 73-3206
23	2.54 mm	purple-orange	PC6 73-1862	PC6 73-3246	PC6 73-3289	PC6 73-3207
24	2.79 mm	purple-white	PC6 73-1863	PC6 73-3247	PC6 73-3290	PC6 73-3208
25	3.17 mm	black-white	PC6 73-1864	–	–	–
Pack Size			12 pieces	12 pieces	6 pieces	12 pieces



## Pump Tubing

### 3-Stop Tubing for the Harvard Peristaltic Pump P-70 (see page 60)

Harvard Peristaltic Pumps P-70 3-Stop Tubing						
Tube Bore mm (in)	Color Code	Max Flow Rate (ml/min)				Connector <sup>2</sup> Size
		8-Roller	Silicone (pkg. of 6)	Marpren (pkg. of 6)	PVC (pkg. of 6)	Gauge/Barb Size
0.13 mm (0.005 in)	Orange/Black	0.15	–	–	PC6 72-0653	32 g
0.19 mm (0.007 in)	Orange/Red	0.32	–	–	PC6 72-0654	31 g
0.25 mm (0.010 in)	Orange/Blue	0.56	–	PC6 72-0621	PC6 72-0655	28 g
0.38 mm (0.015 in)	Orange/Green	1.30	–	PC6 72-0622	PC6 72-0656	25 g
0.50 mm (0.020 in)	Orange/Yellow	2.25	–	PC6 72-0623	PC6 72-0657	23 g
0.63 mm (0.025 in)	Orange/White	3.57	PC6 72-0638	PC6 72-0624	PC6 72-0658	22 g
0.76 mm (0.030 in)	Black/Black	5.19	PC6 72-0639	PC6 72-0625	PC6 72-0659	20 g
0.88 mm (0.035 in)	Orange/Orange	6.96	PC6 72-0640	PC6 72-0626	PC6 72-0660	19 g
1.02 mm (0.040 in)	White/White	9.36	PC6 72-0641	PC6 72-0627	PC6 72-0661	18 g
1.14 mm (0.045 in)	Red/Red	11.69	PC6 72-0642	PC6 72-0628	PC6 72-0662	1/16 inch
1.29 mm (0.050 in)	Gray/Gray	14.96	PC6 72-0643	PC6 72-0629	PC6 72-0663	1/16 inch
1.42 mm (0.055 in)	Yellow/Yellow	18.13	PC6 72-0644	PC6 72-0630	PC6 72-0664	1/16 inch
1.47 mm (0.058 in)	Translucent	19.43	–	–	–	1/16 inch
1.52 mm (0.060 in)	Yellow/Blue	20.78	PC6 72-0646	PC6 72-0631	PC6 72-0665	1/16 inch
1.65 mm (0.065 in)	Blue/Blue	24.48	PC6 72-0647	PC6 72-0632	PC6 72-0666	1/16 inch
1.85 mm (0.070 in)	Green/Green	30.78	PC6 72-0648	PC6 72-0633	PC6 72-0667	3/32 inch
2.05 mm (0.080 in)	Purple/Purple	37.79	PC6 72-0649	PC6 72-0634	PC6 72-0668	3/32 inch
2.38 mm (0.095 in)	Purple/Black	50.94	PC6 72-0650	PC6 72-0635	PC6 72-0669	3/32 inch
2.54 mm (0.100 in)	Purple/Orange	58.02	PC6 72-0651	PC6 72-0636	PC6 72-0670	1/8 inch
2.79 mm (0.110 in)	Purple/White	70.00	PC6 72-0652	PC6 72-0637	PC6 72-0671	1/8 inch

<sup>2</sup> Size of hypodermic tubing (g. gauge) or barbed connector (in.) needed. Connection with tubing segment requires hypodermic tubing or barbed connector; see page 101 to 106.

### Tygon® Standard Pump Tubing

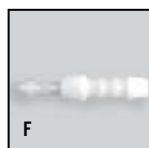
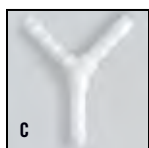
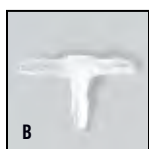
This tubing is offered in 4 varieties. Select the tubing material based on your application. It is supplied in either 7.5 or 15 meter lengths.

Standard Tubing is required for the following:

- Pumps
  - For use with Harvard Peristaltic Pump P-1500
  - Ecoline VC-280
  - Ecoline VC-380
  - Ecoline VC-360
  - Ecoline VC-Easy-Load
- Pump Heads
  - PRO-280
  - PRO-380
  - PRO-281
  - PRO-381
  - 380AD
  - SB-2V
  - SB-3V

Standard Pump Tubing					
		Tygon® ST R-3603	Tygon® E-LFL	Platinum Cured Silicone	PharMed® BPT
Tubing ID	Wall Thickness	ORDER #	ORDER #	ORDER #	ORDER #
Harvard Peristaltic Pump P-1500 can only use standard tubing with a wall thickness of 1.6 mm, see page 60.					
0.8 mm	1.6 mm	PC6 73-1806	–	–	PC6 72-0958
1.6 mm	1.6 mm	PC6 72-1016	PC6 72-0983	PC6 73-3255	PC6 72-0960
3.2 mm	1.6 mm	PC6 72-1020	PC6 72-0984	PC6 73-3256	PC6 72-0963
4 mm	1.6 mm	PC6 72-1022	–	–	–
4.8 mm	1.6 mm	PC6 72-1024	PC6 72-0985	PC6 73-3257	PC6 72-0964
6.4 mm	1.6 mm	PC6 72-1026	PC6 72-0986	PC6 73-3259	PC6 72-0965
8 mm	1.6 mm	PC6 72-1027	PC6 72-0988	PC6 73-3261	PC6 72-0967
Length Supplied		15 m (49 ft)	7.5 m (24.6 ft)	15 m (49 ft)	7.5 m (24.6 ft)

## Extension Tubing & Connectors



### Standard Tube Connectors, Plastic

The Plastic Tube Connectors are designed to assist you in quickly and easily making connections between 2 and 3-Stop Collared Tubing of similar sizes. There are five different connector types available. They are supplied non-sterile in packages of 10.

	Straight Connector (A)	T-Connector (B)	Y-Connector (C)	Angle Connector (D)	Cross Connector (E)
Tube ID	ORDER #	ORDER #	ORDER #	ORDER #	ORDER #
1.5 mm	PC6 72-9262	PC6 72-9275	–	PC6 72-9306	–
2.5 mm	PC6 72-9263	PC6 72-9276	–	PC6 72-9307	–
3.0 mm	PC6 72-9264	PC6 72-9282	PC6 72-9295	PC6 72-9308	–
4.0 mm	PC6 72-9265	PC6 72-9283	PC6 72-9296	PC6 72-9309	PC6 72-9320
5.0 mm	PC6 72-9266	PC6 72-9284	PC6 72-9297	PC6 72-9310	–
6.0 mm	PC6 72-9267	PC6 72-9285	PC6 72-9298	PC6 72-9311	PC6 72-9322
7.0 mm	–	–	–	–	–
8.0 mm	PC6 72-9268	PC6 72-9287	PC6 72-9299	PC6 72-9312	–
10.0 mm	PC6 72-9269	PC6 72-9288	PC6 72-9300	PC6 72-9313	–
12.0 mm	PC6 72-9270	PC6 72-9289	PC6 72-9301	PC6 72-9314	–
13.0 mm	PC6 72-9271	PC6 72-9290	PC6 72-9302	PC6 72-9315	–
14.0 mm	PC6 72-9272	PC6 72-9291	PC6 72-9303	PC6 72-9316	–
15.0 mm	–	–	–	–	–
16.0 mm	PC6 72-9273	PC6 72-9293	PC6 72-9304	PC6 72-9318	–
19.0 mm	PC6 72-9274	PC6 72-9294	–	PC6 72-9319	–

### Plastic, Reducer Tube Connectors

The Plastic Tube Connectors are designed to assist you in quickly and easily making connections between 2 and 3-Stop Collared Tubing of dissimilar sizes. There are three different connector types available. They are supplied non-sterile in packages of 10.

Straight Connector (F)			T-Connector (G)			Y-Connector (H)		
ORDER #	Tube ID	Tube ID	ORDER #	Tube ID	Tube ID	ORDER #	Tube ID	Tube ID
PC6 72-9324	1.5 mm	3.0 mm	PC6 72-9334	3.0 mm	4.0 mm	PC6 72-9349	4.0 mm	6.0 mm
PC6 72-9325	2.5 mm	3.0 mm	PC6 72-9335	4.0 mm	6.0 mm	PC6 72-9350	6.0 mm	8.0 mm
PC6 72-9328	4.0 mm	8.0 mm	PC6 72-9336	6.0 mm	4.0 mm			
PC6 72-9329	6.0 mm	8.0 mm	PC6 72-9337	8.0 mm	4.0 mm			
PC6 72-9331	8.0 mm	10.0 mm	PC6 72-9338	8.0 mm	6.0 mm			
PC6 72-9332	8.0 mm	12.0 mm	PC6 72-9339	8.0 mm	12.0 mm			
PC6 72-9333	10.0 mm	12.0 mm	PC6 72-9340	10.0 mm	6.0 mm			
			PC6 72-9341	10.0 mm	8.0 mm			
			PC6 72-9342	10.0 mm	13.0 mm			
			PC6 72-9343	12.0 mm	8.0 mm			
			PC6 72-9344	12.0 mm	10.0 mm			
			PC6 72-9345	15.0 mm	6.0 mm			
			PC6 72-9346	15.0 mm	8.0 mm			
			PC6 72-9347	18.0 mm	10.0 mm			
			PC6 72-9348	18.0 mm	15.0 mm			

## Extension Tubing & Connectors (continued)

### Extension Tubing for 2 and 3-Stop Collared Tubing

Extension Tubing is required for extending the tube line on the suction and discharge side of 2 and 3-stop tubing.

There are four materials available; Tygon® E-Lab, PharMed® BPT, PVC Solvent Ready and Silicone Peroxide

	Tygon® E-Lab (1 Roll of 30 m)	PharMed® BPT (1 Roll of 30 m)	PVC Solvent Ready (1 Roll of 15 m)	Silicone Peroxide (1 Roll of 15 m)
Tube ID (mm)	ORDER #	ORDER #	ORDER #	ORDER #
0.13	PC6 72-9174	—	—	—
0.19	PC6 72-9175	—	—	—
0.25	PC6 72-9176	PC6 72-9200	PC6 72-9223	—
0.38	PC6 72-9177	PC6 72-9201	PC6 72-9224	—
0.44	PC6 72-9178	—	—	—
0.51	PC6 72-9179	PC6 72-9202	PC6 72-9225	—
0.57	PC6 72-9180	—	—	—
0.64	PC6 72-9181	PC6 72-9203	PC6 72-9226	PC6 72-9240
0.76	PC6 72-9182	PC6 72-9204	PC6 72-9227	PC6 72-9241
0.89	PC6 72-9183	PC6 72-9205	PC6 72-9228	PC6 72-9242
0.95	PC6 72-9184	—	—	—
1.02	PC6 72-9185	PC6 72-9206	PC6 72-9229	PC6 72-9243
1.09	PC6 72-9186	—	—	—
1.14	PC6 72-9187	PC6 72-9207	PC6 72-9230	PC6 72-9244
1.22	PC6 72-9188	—	—	—
1.30	PC6 72-9189	PC6 72-9208	PC6 72-9231	PC6 72-9245
1.42	PC6 72-9190	PC6 72-9209	PC6 72-9232	PC6 72-9246
1.52	PC6 72-9191	PC6 72-9210	PC6 72-9233	PC6 72-9247
1.65	PC6 72-9192	PC6 72-9211	PC6 72-9234	PC6 72-9248
1.85	PC6 72-9194	PC6 72-9212	PC6 72-9235	PC6 72-9249
2.06	PC6 72-9195	PC6 72-9213	PC6 72-9236	PC6 72-9250
2.29	PC6 72-9196	PC6 72-9214	PC6 72-9237	PC6 72-9251
2.54	PC6 72-9197	PC6 72-9215	PC6 72-9238	PC6 72-9252
2.79	PC6 72-9198	PC6 72-9216	PC6 72-9239	PC6 72-9253
3.17	PC6 72-9199	—	—	—



### Stainless Steel Standard Tube Connectors

The Stainless Steel Tube Connectors are designed to assist you in quickly and easily making connections between 2 and 3-Stop Collared Tubing of similar sizes. They are supplied non-sterile in packages of 6.

ORDER #	Tube ID (mm)	Tube OD (mm)	Connector Length (mm)
PC6 72-9254	0.30	0.63	15
PC6 72-9255	0.58	0.90	15
PC6 72-9256	0.58	0.90	11
PC6 72-9257	0.84	1.27	11
PC6 72-9258	0.84	1.27	16
PC6 72-9259	0.30	0.63	25
PC6 72-9260	0.58	0.90	25
PC6 72-9261	0.58	0.90	19

## Centrifugal Pump for Blood

Centrifugal Pump



### KEY FEATURES

- Low hemolysis
- Flow rates up to 16 L/min
- Little to no pulsation
- Smooth run, producing only low noise
- Pump heads interchangeable without tool
- Speed setting by a digital switch in 0.1% steps
- “Max Speed” button for quick fill or ventilate
- Robust construction for long life
- Analog interface for remote control

The centrifugal pump is specifically designed for pumping blood and/or erythrocyte suspension solutions in the physiological or pharmacological laboratory. It consists of the pump drive BVP-ZX and a centrifugal pump head which can be replaced without tools. The Pump Drive and Pump Head must be purchased separately. Pump heads are hermetically sealed. The coupling to the motor of the pump drive is carried out via magnetic force; there is no axle.

The pump speed is set using a 3-digit potentiometer switch (000 to 999) or via an analog interface.

The drive is very robust and suitable for continuous speed selection operation.

### Centrifugal Pump Specifications

#### Pump Drive

TYPE	BVP-ZX
SPEED	3 to 3000 rpm, adjustable in 0.1% steps
MAINS CONNECTION	230 (50/60Hz) 115 V (50/60Hz)
POWER CONSUMPTION	120 W maximum
ANALOG INTERFACE	Speed control 0–5 V or 0–10 V or 0–20 mA or 4–20 mA, start/stop (TTL contacts)
PROTECTION RATING	IP 30
OPERATING CONDITIONS	0° to 40°C (normal environmental conditions)
DIMENSIONS, H x W x D	260 x 155 x 260 mm (10.2 x 6.1 x 10.2 in) without pump-head
WEIGHT	7 kg (15.4 lb) without pump head

#### Centrifugal Pump Heads

TYPE	BP-80	BP-50	SP-45
MANUFACTURER	Medtronic	Medtronic	Terumo
PUMP TECHNOLOGIES	Centrifugal	Centrifugal	Impeller (Centrifugal)
MAXIMUM FLOW RATE	10 l/min at 50 mmHg – 16 l/min at 50 mmHg 3 l/min at 300 mmHg – 13 l/min at 300 mmHg		
PULSATION	no	no	yes
PRIMING VOLUME	80 ml	50 ml	45 ml
INLET/OUTLET ID	9.5 mm	6.4 mm	9.5 mm
FITTING TO BVP-ZX	Direct	Direct	Adaper SP-03 Required

Order #	Product
PC6 73-2963	BVP-ZX Centrifugal Pump Drive, 115 VAC, 50/60 Hz
PC6 73-2470	BVP-ZX Centrifugal Pump Drive, 230 VAC, 50/60 Hz
PC6 73-2807	BP-80 Centrifugal Pump Head
PC6 73-2954	BP-50 Centrifugal Pump Head
PC6 73-2955	SP-45 Centrifugal Pump Head
PC6 73-2956	SP-03 Adaptor for SP-45 Head

*Note: Pump Drive and Pump Head must be purchased separately.*



## Harvard Apparatus Pulsatile Blood Pumps

Pulsatile  
Blood  
Pump



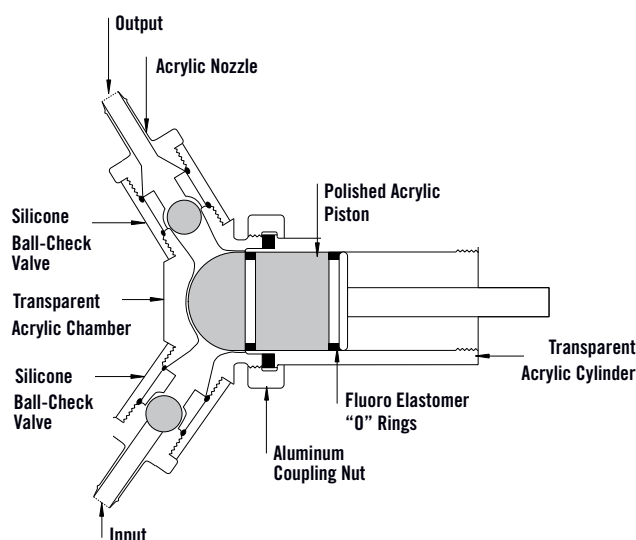
### KEY FEATURES

- Pulsatile output truly simulates the ventricular action of the heart
- Minimal hemolysis
- Models for mice to large animals
- Ideal for moving emulsions, suspensions, and non-Newtonian fluids such as blood

If you are performing cardiovascular work, this is the pump for you. It truly simulates the pumping action of the heart. It features silicone rubber-covered heart-type ball valves and smooth flow paths which minimize hemolysis. Only inert materials like silicone rubber, acrylic plastic, and PTFE contact the fluid. The pumping head is easy to take apart and reassemble and can be sterilized.

### Outstanding Performance

The pulsatile output closely simulates the ventricular action of the heart. This action provides physiological advantages in blood flow for perfusion in cardiovascular and haemodynamic studies. It is ideal for isolated organ perfusion, whole body perfusion, blood transfers, hydration/dehydration procedures, and blood cellular profile studies.



### Pump Mechanism

A positive piston actuator and ball check valves provide the proportioning action. The product of stroke rate times stroke volume is an accurate indicator of the flow rate. Positive piston action prevents changes in flow rates, regardless of variations in resistance or back pressure. The piston always travels to the end of the ejection stroke, independent of the volume pumped. The Pump completely empties at each cycle.

Harvard Apparatus now offers the pumping head in polysulfone which is autoclavable. The standard models use acrylic which must be sterilized using ethylene oxide or other methods. This new material makes it much easier to maintain sterility.

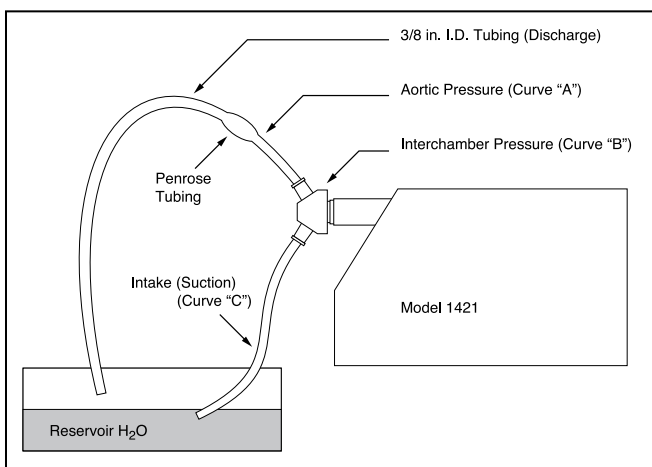
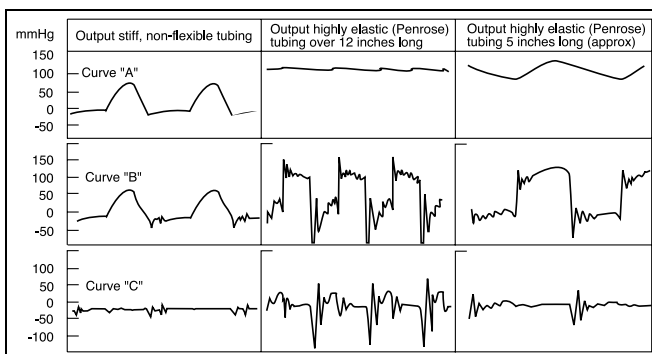
Harvard Apparatus now also offers a new control method for the blood pumps. Now the pump can be controlled from an external voltage source; 0 to 10 volt DC signal can be used to control the stroke rate and phasing of the pump. External control interfaces the blood pump with a computer to generate advanced cardiovascular waveforms and more control over pressure curves. Please call for more information.

### Harvard Apparatus Pulsatile Blood Pump Specifications

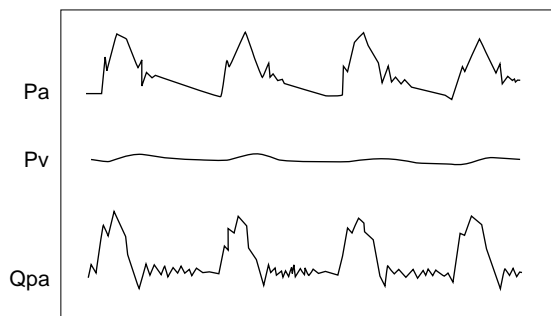
	Mice/Rats: Model 1407	Rabbits: Model 1405	Dogs/Monkeys: Model 1421	Large Animals; Hemodynamic Studies: Model 1423
<b>STROKE VOLUME, ADJUSTABLE</b>	0.05 to 1.0 ml	0.5 to 10 ml	4 to 30 ml	15 to 100 ml
<b>RATE, STROKE/MIN.</b>	20 to 200	20 to 200	20 to 200	10 to 100
<b>MINUTE VOLUME, STROKE VOL. x RATE</b>	1 to 200 ml	10 to 2,000 ml	80 to 6,000 ml	150 to 10,000 ml
<b>PHASING</b>	Fixed Phase	Fixed Phase	Adjustable Phase	Adjustable Phase
<b>SYSTOLE/DIASTOLE RATIO</b>	35% systole,	35% systole,	35% to 50%	35% to 50%
<b>TUBE ID</b>	8 mm (0.31 in)	8 mm (0.31 in)	11 mm (0.437 in)	14 mm (0.551 in)
<b>DIMENSIONS, H x W x D</b>	312 x 156 x 250 mm (12.3 x 6.1 x 9.9 in)	312 x 156 x 250 mm (12.3 x 6.1 x 9.9 in)	500 x 212 x 337 mm (19.7 x 8.4 x 13.4 in)	500 x 212 x 337 mm (19.7 x 8.4 x 13.4 in)
<b>WEIGHT</b>	7.3 kg (16 lb)	7.3 kg (16 lb)	13.6 kg (30 lb)	14.5 kg (32 lb)
<b>VOLTAGE</b>	115 VAC, 50/60 Hz or 230 VAC, 50/60 Hz UK and EU Models	115 VAC, 50/60 Hz or 230 VAC, 50/60 Hz UK and EU Models	115 VAC, 50/60 Hz or 230 VAC, 50/60 Hz UK and EU Models	115 VAC, 50/60 Hz or 230 VAC, 50/60 Hz UK and EU Models
<b>ORDER #</b>	<b>PC6 52-9552</b>	<b>PC6 55-1838</b>	<b>PC6 55-3321</b>	<b>PC6 55-3305</b>

## Harvard Apparatus Pulsatile Blood Pumps

(continued)



### Pressure and Flow Curves Using Harvard Pulsatile Blood Pump for Dogs/Monkeys in Isolated Perfusion of Left Lower Lobe of Dog Lung\*



**Pa** Pulmonary Artery Pressure  
**Pv** Pulmonary Venous Pressure  
**Qpa** Pulmonary Artery Blood Flow

#### Instrumentation:

**Pressure** Statham  
**Flow** Biotronex Electromagnetic Flowmeter  
**Recording** Electronics for Medicine

*\*Note: The above data is supplied through the courtesy of Cardiorespiratory laboratory Columbia-Presbyterian Medical Center New York, New York, Dr. Alfred P. Fishman, Director.*

### Pressure Curves

The shape of the output pressure curve is a function of both the pump action and the characteristics of the external system on the output valve side. The following set of curves were obtained with Model 1421, using water as the pumped medium. In the tests, "Sanborn" pressure transducers were inserted in three places, and continuous records obtained under varying conditions.

- Curve A** Pressure just beyond the output valve
- Curve B** Pressure within the pump chamber
- Curve C** Pressure just before the intake valve

By variation of parameters involved (peripheral resistance, stroke rate, stroke volume and phase ratio), an infinite number of output flow characteristics can be obtained.

### Hemolysis Test Conditions Models for Dog/Monkey (PC6 55-5321) and Large Animals (PC6 55-3305)

Hemolysis ranged from 0.114 mg% to 0.29 mg% per pass through the various pumps, with an error of  $\pm 10\%$ .

To put these results in perspective, most physiological perfusions are run with flow rates and total blood primes, such that the number of passes through the pump will range from about 1/4 to 3/4 per minute. Assuming one pass in two minutes and no physiological removal of the products of hemolysis, then hemolysis rates would range from 3.4 mg% to 8.7 mg% per hour of pump use.

In these studies a reservoir of 500-800 cc of fresh dog blood was used, connected to the pump by 3/8" PVC tubing. Samples at room temperature were taken at 15 and 30 minute intervals for 4 to 5 hours. Samples were spun down and hemolysis measured immediately using the method of Flink and Watson. Since the rate of hemolysis depends on the amount of blood in the system and the flow rate, the results are reported as mg% per pass. The flow rate divided by the volume of blood in the system determines the number of passes through the pump per minute.

## Priming Kit, Compression Fittings and PEEK Tubing

### Priming Kit



The Priming Kit provides the necessary tools to ensure that the syringe and needle connection is completely primed. Trapped air can cause inaccurate dispenses and standard priming techniques are not sufficient when using capillary tubing. The glass capillary tubing traps a large volume of liquid that can only be overcome by using the priming kit. The Priming Kit contains one 250 µl Syringe, one 6 pack of 30 gauge needles, and one pack of septa.

The 1 mm RN Compression Fitting is designed to attach pulled glass pipettes directly to a small hub RN connection. The RN nut compresses the conical PFA ferrule into the PEEK cup ferrule creating a seal between the syringe barrel and the glass capillary tubing. The connection requires no modifications to the glass capillary tubing.

The 1/16 in RN Compression Fitting is designed to attach 1/16 in PEEK tubing directly to a small hub RN connection. Tightening the RN nut compresses the conical PFA ferrule into the PEEK cup ferrule creating a seal between the syringe barrel and the PEEK tubing. The connection requires no modifications to the PEEK tubing. The RN Compression Fittings consist of one large bore RN nut, 5 PFA ferrules and 5 PEEK cup ferrules. They are compatible with 2.5-100 µl RN syringes.

The Dual Small Hub RN Coupler is constructed from model 1702 glass with a small hub RN termination on either end. It uses a standard glass size for compatibility with most stereotaxic instrumentation. The coupler is ideal for remotely connecting a syringe to a needle via PEEK tubing. It is also used with the Luer to RN adaptor for connection of custom needles to a 7000 series syringe. The Dual RN Coupler consists of two large bore RN nuts, and one dual RN barrel.

The Luer to Small Hub RN Adaptor consists of a Metal Luer Lock Hub and a Small Removable Needle Hub combined in a single needle. The Luer to RN Adaptor and the Dual RN Coupler can be used to connect a 7000 series syringe to any Small Hub Removable Needle or to a Pulled Glass Pipette. The Adaptor creates a rigid connection between the syringe and the needle as well as compatibility with stereotaxic instrumentation. The Luer to RN Adaptor consists of one RN to Luer Needle and a sealing ferrule for a 25 gauge 7000 series needle.

Order #	Model	Product
PC6 72-9354	PRMKIT	Priming Kit
PC6 72-9353	55750-01	RN Compression Fitting 1 mm
PC6 72-9376	55751-01	RN Compression Fitting 1/16 in
PC6 72-9377	55752-01	Dual Small Hub RN Coupler
PC6 72-9378	55753-01	Luer to Small Hub RN Adaptor

### PEEK Semi-Flexible Tubing

PEEK semi-rigid tubing is manufactured from a unique, high temperature engineering thermoplastic that is suitable for a wide range of demanding applications. Designed to withstand high pressure and temperature levels, PEEK Tubing resists even the harshest environmental conditions. Semi-rigid PEEK tubing is insoluble in virtually all organic and inorganic solvents as well as having good dielectric properties. It can be cut to length, accepts pressure fittings and readily stands up to shock, abrasion and impacts. PEEK can be sterilized with Gamma, ETO and is autoclavable.

Order #	Product
PC6 72-5332	PEEK Semi-Flexible Tubing, 0.006 in ID x 0.062 in OD x 0.028 in Wall Thickness, 5 ft
PC6 72-5333	PEEK Semi-Flexible Tubing, 0.010 in ID x 0.062 in OD x 0.026 in Wall Thickness, 5 ft
PC6 72-5334	PEEK Semi-Flexible Tubing, 0.020 in ID x 0.062 in OD x 0.021 in Wall Thickness, 5 ft
PC6 72-5335	PEEK Semi-Flexible Tubing, 0.030 in ID x 0.062 in OD x 0.016 in Wall Thickness, 5 ft
PC6 72-5336	PEEK Semi-Flexible Tubing, 0.040 in ID x 0.062 in OD x 0.011 in Wall Thickness, 5 ft

## Laboratory Tubing

**H**arvard Apparatus offers an extensive selection of tubing and connectors for all of your laboratory application needs. We offer a wide range of tubing and connectors for virtually every bioscience application. Tubing is available in a variety of materials and dimensions. Sizes in addition to that which is presented here are listed on our Website or contact our technical support for a complete list of available tubing. Tubing connectors with barbed or Luer ends come in several different material types to suit a wide range of research applications. In addition, many valves and manifolds are now available to simplify tubing connections and flow control even in the most demanding experimental protocols. Tubing connector kits feature a selection of similarly sized connectors in one convenient container. All the individual kit components can be reordered.

## Tygon® Long Flex Life Pump Tubing (E-LFL)

Tygon® E-LFL



### KEY FEATURES

- Longest flex life of any clear Tygon® tubing
- Extremely low particulate spallation
- Broad chemical resistance
- Meets USP Class VI and FDA criteria

Specifically developed for bulk transfer applications, Tygon® Long Flex Life Tubing offers the longest peristaltic pump life of any clear Tygon® tubing formulation.

Crystal-clear Tygon® Long Flex Life Pump Tubing is formulated specifically for use in peristaltic pump applications. With its superior flex life characteristics, manufacturing processes can be simplified by reducing production downtime due to pump tubing failure.

The excellent wear properties of Tygon® Long Flex Life Pump Tubing also lead to a reduction of particulate spallation. This feature limits the risk of sensitive-fluid contamination critical to the pharmaceutical, cosmetic, food and beverage industries.

Non-aging characteristics and broad chemical resistance provide users with versatility in use for a wide variety of applications. Safe and non-toxic Tygon® Long Flex Life Pump Tubing can be produced in up to a 6 inch ID, making it the ideal choice in bulk transfer applications. Durometer hardness: Shore A, 56.\*

### Tygon® Long Flex Life Pump Tubing (E-LFL)

ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 72-0983	1.6	4.8	1/16	3/16	7.6	25
PC6 72-0984	3.2	6.4	1/8	1/4	7.6	25
PC6 72-0985	4.8	7.9	3/16	5/16	7.6	25
PC6 72-0986	6.4	9.5	1/4	3/8	7.6	25
PC6 72-0987	6.4	12.7	1/4	1/2	7.6	25
PC6 72-0988	7.9	11.1	5/16	7/16	7.6	25
PC6 72-0989	9.5	15.9	3/8	5/8	7.6	25
PC6 72-0990	12.7	19.1	1/2	3/4	7.6	25
PC6 72-0991	19.1	31.8	3/4	1-1/4	3.0	10
PC6 72-0992	25.4	34.9	1	1-3/8	3.0	10

\* Note: Higher durometer values correlate with stiffer less flexible tubing.

## Tygon® Norprene® Tubing

Tygon® Norprene®



### KEY FEATURES

- Best choice for long term peristaltic pump accuracy
- Repeatably autoclavable
- Wide temp. range -60° to 275°F
- Opaque

Formulated to withstand high temperatures frequently, Norprene® Tubing will outlast and outperform virtually all other food grade tubings. Even following extended exposure to heat and ozone, Norprene® Tubing will not crack or deteriorate which is common when using traditional rubber tubings.

Extremely flexible, Norprene® Tubing resists kinks and retains its shape while installing quickly and easily. Its excellent flexural fatigue resistance makes it the absolute best choice for use in peristaltic pumps.

Repeatedly autoclavable, Norprene® Tubing can be steam cleaned in place, eliminating the need for frequent tubing replacement. When harsh sanitizing solutions are used, it exhibits exceptional chemical resistance and is entirely unaffected by a wide variety of cleaning solutions. Durometer hardness: Shore A, 61.\*

### Tygon® Norprene® Tubing

ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 72-0946	1.6	4.8	1/16	3/16	15.2	50
PC6 72-0947	3.2	6.4	1/8	1/4	15.2	50
PC6 72-0948	4.8	7.9	3/16	5/16	15.2	50
PC6 72-0949	6.4	9.5	1/4	3/8	15.2	50
PC6 72-0950	6.4	12.7	1/4	1/2	15.2	50
PC6 72-0951	7.9	11.1	5/16	7/16	15.2	50
PC6 72-0952	9.5	12.7	3/8	1/2	15.2	50
PC6 72-0953	9.5	15.9	3/8	5/8	15.2	50
PC6 72-0954	12.7	19.1	1/2	3/4	15.2	50
PC6 72-0955	15.9	22.2	5/8	7/8	15.2	50
PC6 72-0956	19.1	25.4	3/4	1	15.2	50

\* Note: Higher durometer values correlate with stiffer less flexible tubing.



## Laboratory Tubing (continued)

## Tygon® Laboratory Tubing (E-3603)

Tygon® E-3603



## KEY FEATURES

- Outstanding chemical resistance
- Lot-to-lot consistency for reproducible results
- Increases productivity in peristaltic pumps -outlasts other clear tubing 2 to 1

The most consistently reliable tubing for the transfer of liquids and gases, Tygon® Laboratory Tubing handles virtually all inorganic chemicals found in today's laboratories. Crystal-clear and flexible, it's non-oxidizing and non-contaminating. Long-lasting and crack-resistant, Tygon® Laboratory Tubing is less permeable than rubber tubing. The glassy-smooth inner bore helps prevent buildup so that cleaning is facilitated. Coils are marked at 1-foot intervals for easy measuring. Autoclavable. Remains flexible at -45°F (-43°C). Durometer hardness: Shore A, 55.\*

## Tygon® Laboratory Tubing (E-3603)

ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 72-1014	0.8	2.4	1/32	3/32	15.2	50
PC6 72-1015	1.6	3.2	1/16	1/8	15.2	50
PC6 72-1016	1.6	4.8	1/16	3/16	15.2	50
PC6 72-1017	2.4	4.0	3/32	5/32	15.2	50
PC6 72-1018	2.4	5.6	3/32	7/32	15.2	50
PC6 72-1019	3.2	4.8	1/8	3/16	15.2	50
PC6 72-1020	3.2	6.4	1/8	1/4	15.2	50
PC6 72-1021	4.0	5.6	5/32	7/32	15.2	50
PC6 72-1022	4.0	7.1	5/32	9/32	15.2	50
PC6 72-1023	4.8	6.4	3/16	1/4	15.2	50
PC6 72-1024	4.8	7.9	3/16	5/16	15.2	50
PC6 72-1026	6.4	9.5	1/4	3/8	15.2	50
PC6 72-1027	7.9	11.1	5/16	7/16	15.2	50
PC6 72-1028	7.9	14.3	5/16	9/16	15.2	50
PC6 72-4621	9.5	12.7	3/8	1/2	15.2	50
PC6 72-1029	9.5	14.3	3/8	9/16	15.2	50
PC6 72-1030	9.5	15.9	3/8	5/8	15.2	50
PC6 72-4622	11.1	14	7/16	9/16	15.2	50
PC6 72-1031	11.1	15.9	7/16	5/8	15.2	50
PC6 72-1032	11.1	17.5	7/16	11/16	15.2	50
PC6 72-1033	12.7	17.5	1/2	11/16	15.2	50
PC6 72-1034	12.7	19.1	1/2	3/4	15.2	50
PC6 72-1035	14.3	19.1	9/16	3/4	15.2	50
PC6 72-1036	14.3	20.6	9/16	13/16	15.2	50
PC6 72-1037	15.9	20.6	5/8	13/16	15.2	50
PC6 72-1038	15.9	22.2	5/8	7/8	15.2	50
PC6 72-1039	17.5	22.2	11/16	7/8	15.2	50
PC6 72-1040	19.1	25.4	3/4	1	15.2	50
PC6 72-1041	19.1	27.0	3/4	1-1/16	15.2	50

\* Note: Higher durometer values correlate with stiffer less flexible tubing.

## Tygon® B-44-4X Tubing

Tygon® B-44-4X



## KEY FEATURES

- Non-wetting surface permits thorough cleaning and complete drainage
- Smooth, non-porous bore will not trap particulates or promote bacterial growth
- Broad chemical resistance to virtually all non-solvent chemicals. Resistant to harsh alkaline cleaners and sanitizers.
- Excellent alternative to rigid piping systems but still lightweight and flexible enough for easy and quick installation
- Meets FDA, 3-A and NSF criteria

With its smooth, non-porous bore, B-44-4X Tubing ensures a bacteria-free fluid path in a wide variety of processing applications. Offers dependable performance in countless filling, draining, transfer and processing applications. Its smooth, non-porous bore inhibits particle entrapment, promoting a sanitary fluid path by minimizing potential for bacterial growth. It has outstanding resistance to harsh alkaline cleaners and is equally unaffected by commonly used sanitizers. Complete clarity for positive visual inspection and flow control. Autoclavable and Gas (Ethylene Oxide) sterilizable. Durometer Hardness Shore A, 65.\*

## Tygon® B-44-4X Tubing

ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 72-0921	0.8	2.4	1/32	3/32	15.2	50
PC6 72-0922	1.6	3.2	1/16	1/8	15.2	50
PC6 72-0923	1.6	4.8	1/16	3/16	15.2	50
PC6 72-0924	2.4	4.0	3/32	5/32	15.2	50
PC6 72-0926	3.2	4.8	1/8	3/16	15.2	50
PC6 72-0927	3.2	6.4	1/8	1/4	15.2	50
PC6 72-0928	4.0	5.6	5/32	7/32	15.2	50
PC6 72-0929	4.0	7.1	5/32	9/32	15.2	50
PC6 72-0930	4.8	6.4	3/16	1/4	15.2	50
PC6 72-0931	4.8	7.9	3/16	5/16	15.2	50
PC6 72-0932	6.4	7.9	1/4	5/16	15.2	50
PC6 72-0933	6.4	9.5	1/4	3/8	15.2	50
PC6 72-0934	7.9	11.1	5/16	7/16	15.2	50
PC6 72-0935	7.9	12.7	5/16	1/2	15.2	50
PC6 72-0936	9.5	14.3	3/8	9/16	15.2	50
PC6 72-0937	9.5	15.9	3/8	5/8	15.2	50
PC6 72-0938	11.1	14.3	7/16	9/16	15.2	50
PC6 72-0940	12.7	17.5	1/2	11/16	15.2	50
PC6 72-0941	12.7	19.1	1/2	3/4	15.2	50
PC6 72-0942	14.3	19.1	9/16	3/4	15.2	50
PC6 72-0943	15.9	20.6	5/8	13/16	15.2	50
PC6 72-0944	15.9	22.2	5/8	7/8	15.2	50
PC6 72-0945	19.1	25.4	3/4	1	15.2	50

\* Note: Higher durometer values correlate with stiffer less flexible tubing.

## Laboratory Tubing (continued)

## Tygon® PharMed® Tubing

Tygon® PharMed® Tubing



## KEY FEATURES

- Outlasts silicone tubing in peristaltic pumps by up to 30 times
- Opaque
- Can be autoclaved repeatedly
- Heat weldable for sterile access in closed systems
- Meets USP Class VI, FDA and NSF criteria

Created with a unique combination of long flex life and biocompatibility, PharMed® Tubing is ideal for life science applications employing peristaltic pumps. PharMed® Tubing is less permeable to gases and vapors than silicone tubing. It is ideal for cell culture, fermentation, synthesis, separation, purification and process monitoring and control. Independent tests show that PharMed® Tubing is safe for use in sensitive cell culture applications. It has very good general chemical resistance and excellent acid, alkali and oxidation resistance. Opaque to visible and UV light, it helps protect sensitive fluids. Continuous service temperature range is -60°F (-51°C) to 275°F (135°C). Durometer hardness: Shore A, 64.\*

## Tygon® PharMed® Tubing

ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 72-0957	0.5	3.7	0.020	0.144	7.6	25
PC6 72-0958	0.8	4.0	1/32	5/32	7.6	25
PC6 72-0959	1.6	3.2	1/16	1/8	7.6	25
PC6 72-0960	1.6	4.8	1/16	3/16	7.6	25
PC6 72-0961	2.4	5.6	3/32	7/32	7.6	25
PC6 72-0962	3.2	4.8	1/8	3/16	7.6	25
PC6 72-0963	3.2	6.4	1/8	1/4	7.6	25
PC6 72-0964	4.8	7.9	3/16	5/16	7.6	25
PC6 72-0965	6.4	9.5	1/4	3/8	7.6	25
PC6 72-0966	6.4	12.7	1/4	1/2	7.6	25
PC6 72-0967	7.9	11.1	5/16	7/16	7.6	25
PC6 72-0968	9.5	12.7	3/8	1/2	7.6	25
PC6 72-0969	9.5	15.9	3/8	5/8	7.6	25
PC6 72-0970	12.7	19.1	1/2	3/4	7.6	25
PC6 72-0971	15.9	22.2	5/8	7/8	7.6	25
PC6 72-0972	19.1	25.4	3/4	1	7.6	25

\* Note: Higher durometer values correlate with stiffer less flexible tubing.

## Tygon® Medical/Surgical Tubing (ND100-65)

Tygon® ND100-65



## KEY FEATURES

- Crystal clear
- Ideal for blood contact
- Flexible and resilient with established performance in peristaltic pump
- Fully characterized to ISO 10993 and FDA guidelines for biocompatibility
- Meets USP Class VI criteria

Crystal clear Tygon® Medical/ Surgical Tubing provides proven performance in countless medical device applications.

Originally developed for use in cardiac surgery, Tygon® Medical/ Surgical Tubing's consistent quality provides dependable performance in medical device applications. It has been fully tested for biological safety to the ISO 10993 standard.

Tygon® Medical/Surgical Tubing can be sterilized by radiation, ethylene oxide, steam or chemical methods.

Durometer hardness: Shore A, 65.\*

## Tygon® Medical/Surgical Tubing (ND100-65)

ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 75-0440	0.8	2.4	1/32	3/32	15.2	50
PC6 75-0441	1.6	3.2	1/16	1/8	15.2	50
PC6 75-0442	1.6	4.7	1/16	3/16	15.2	50
PC6 75-0443	2.4	3.9	3/32	5/32	15.2	50
PC6 75-0444	2.4	5.5	3/32	7/32	15.2	50
PC6 75-0445	3.2	4.7	1/8	3/16	15.2	50
PC6 75-0446	3.2	6.3	1/8	1/4	15.2	50
PC6 75-0447	3.9	5.5	5/32	7/32	15.2	50
PC6 75-0448	3.9	7.1	5/32	9/32	15.2	50
PC6 75-0449	4.7	6.3	3/16	1/4	15.2	50
PC6 75-0450	4.7	7.9	3/16	5/16	15.2	50
PC6 75-0451	6.3	7.9	1/4	5/16	15.2	50
PC6 75-0452	6.3	9.5	1/4	3/8	15.2	50
PC6 75-0453	7.9	11.0	5/16	7/16	15.2	50
PC6 75-0454	7.9	12.6	5/16	1/2	15.2	50
PC6 75-0455	9.5	14.2	3/8	9/16	15.2	50
PC6 75-0456	9.5	15.8	3/8	5/8	15.2	50
PC6 75-0457	11.0	14.2	7/16	9/16	15.2	50
PC6 75-0458	11.0	15.8	7/16	5/8	15.2	50
PC6 75-0459	12.6	17.3	1/2	11/16	15.2	50
PC6 75-0460	12.6	18.9	1/2	3/4	15.2	50
PC6 75-0461	14.2	18.9	9/16	3/4	15.2	50
PC6 75-0462	15.8	20.5	5/8	13/16	15.2	50
PC6 75-0463	15.8	22.1	5/8	7/8	15.2	50
PC6 75-0464	18.9	25.2	3/4	1	15.2	50

\* Note: Higher durometer values correlate with stiffer less flexible tubing.

## Laboratory Tubing (continued)

## Tygon® Ultra-Soft Tubing (E-1000)

Tygon® E-1000



## KEY FEATURES

- Ultra-soft and flexible
- Performs well at low temperatures (to -100°F)
- Excellent for use in low-torque pump applications

Tygon® Ultra-Soft Tubing provides unmatched flexibility and drapability-characteristics beneficial to numerous laboratory set-ups.

Tygon® Ultra-Soft Tubing resists a broad range of aqueous chemicals and provides an excellent alternative to silicone tubing in applications where corrosive chemicals are used. Its minimal resistance to compression permits use in low-torque pump applications including battery driven types. Tygon® Ultra-Soft Tubing stays flexible at temperatures as low as -100°F (-73°C). Its smooth bore facilitates easy cleaning and helps prevent possible buildup.

Do not autoclave. Durometer hardness: Shore A, 40.\*

## Tygon® Ultra-Soft Tubing (E-1000)

ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 72-0998	1.6	4.8	1/16	3/16	15.2	50
PC6 72-0999	3.2	6.4	1/8	1/4	15.2	50
PC6 72-1000	4.8	7.9	3/16	5/16	15.2	50
PC6 72-1001	6.4	9.5	1/4	3/8	15.2	50
PC6 72-1002	6.4	12.7	1/4	1/2	15.2	50
PC6 72-1003	7.9	11.1	5/16	7/16	15.2	50
PC6 72-1004	9.5	12.7	3/8	1/2	15.2	50
PC6 72-1005	9.5	15.9	3/8	5/8	15.2	50
PC6 72-1006	12.7	15.9	1/2	5/8	15.2	50
PC6 72-1007	12.7	19.1	1/2	3/4	15.2	50

\* Note: Higher durometer values correlate with stiffer less flexible tubing.

## Tygon® Ultra Chemical Resistant Tubing (2375)

Tygon® 2375



## KEY FEATURES

- Suitable for most gas anesthesia applications
- Temperature resistant from -60° to 275°F
- Compatible with virtually all common sanitizers and cleaners
- Meets FDA, 3-A and NSF criteria

After being immersed in aggressive MEK for 16 hours (plus 4 hours drying time), Tygon® Ultra Chemical Resistant Tubing is still clear and flexible while PVC tubing is completely degraded and rendered useless.

Tygon® Ultra Chemical Resistant Tubing offers an unequaled combination of chemical resistance, clarity and flexibility. It is virtually unaffected by acids, bases, ketones, salts and alcohols, fitting the requirements of many applications from acids to hazardous material handling. It's entirely plasticizer-free, eliminating fluid contamination and the premature embrittlement and cracking common with many types of flexible tubing. Its exceptionally smooth inner surface inhibits particulate buildup and reduces the potential for contamination. Do not autoclave. Durometer hardness: Shore A, 75.\*

## Tygon® Ultra Chemical Resistant Tubing (2375)

ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 72-4119	1.6	4.8	1/16	3/16	15.2	50
PC6 72-4120	3.2	6.4	1/8	1/4	15.2	50
PC6 72-4121	4.8	7.9	3/16	5/16	15.2	50
PC6 72-4122	6.4	9.5	1/4	3/8	15.2	50
PC6 72-4123	7.9	11.1	5/16	7/16	15.2	50
PC6 72-4124	9.5	12.7	3/8	1/2	15.2	50
PC6 72-4125	12.7	19.1	1/2	3/4	15.2	50
PC6 72-4126	15.9	22.2	5/8	7/8	15.2	50
PC6 72-4127	19.1	25.4	3/4	1	15.2	50

\* Note: Higher durometer values correlate with stiffer less flexible tubing.

## Laboratory Tubing (continued)

## FEP Semi-Flexible Tubing

## KEY FEATURES

- Excellent chemical resistance even at extreme temperatures from -348° to 392°F
- UV and ozone resistant
- Low protein adsorption
- FDA compliant/USP Class VI

With excellent resistance to chemicals, ozone and UV radiation, FEP tubing maintains its chemical resistance even at extreme temperatures. Its superior non-stick characteristics ease the transfer of product lowering the incidence of protein binding/absorption. Ideal for the transfer of fluids like synthetic peptides and antibodies whose protein composition must be maintained to exacting tolerances. Durometer hardness: Shore D, 55.\*

## FEP Semi-Flexible Tubing

ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 72-1169	1.6	3.2	1/16	1/8	7.6	50
PC6 72-1189	3.2	6.4	1/8	1/4	7.6	50
PC6 72-1179	4.0	6.4	5/32	1/4	7.6	50
PC6 72-1173	4.8	6.4	3/16	1/4	7.6	50
PC6 72-1190	4.8	7.9	3/16	5/16	7.6	50
PC6 72-1171	6.4	7.9	1/4	5/16	7.6	50
PC6 72-1191	6.4	9.5	1/4	3/8	7.6	50
PC6 72-1178	7.9	9.5	5/16	3/8	3.0	50
PC6 72-1193	9.5	12.7	3/8	1/2	3.0	50
PC6 72-1176	11.1	12.7	7/16	1/2	3.0	50
PC6 72-1195	12.7	15.9	1/2	5/8	3.0	50
PC6 72-1197	15.9	19.1	5/8	3/4	3.0	50

\* Note: Higher durometer values correlate with stiffer less flexible tubing.

## PFA Semi-Flexible Tubing

## KEY FEATURES

- Excellent chemical resistance
- UV and ozone resistant
- Suitable for a wide range of temperature applications from -320° to 500°F
- FDA compliant/USP Class VI

PFA tubing has better flex life and mechanical characteristics at elevated temperatures versus traditional PTFE tubing. Like FEP tubing it has superior chemical and environmental (UV and Ozone) resistance with a higher working temperature range than FEP. Durometer hardness: Shore D, 60.\*

## PFA Semi-Flexible Tubing

ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 72-1134	1.6	3.2	1/16	1/8	7.6	50
PC6 72-1136	3.2	4.8	1/8	3/16	7.6	50
PC6 72-1154	3.2	6.4	1/8	1/4	7.6	50
PC6 72-1137	4.0	6.4	5/32	1/4	7.6	25
PC6 72-1138	4.8	6.4	3/16	1/4	7.6	50
PC6 72-1139	6.4	7.9	1/4	5/16	3.0	25
PC6 72-1156	6.4	9.5	1/4	3/8	3.0	50
PC6 72-1140	7.9	9.5	5/16	3/8	3.0	50
PC6 72-1158	9.5	12.7	3/8	1/2	3.0	50
PC6 72-1166	15.9	19.1	5/8	3/4	3.0	50
PC6 72-1167	22.2	25.4	7/8	1	3.0	50

\* Note: Higher durometer values correlate with stiffer less flexible tubing.

## Laboratory Tubing (continued)

Tygon® Fluran®  
Severe Environment Tubing

Tygon® Fluran®



## KEY FEATURES

- Provides continuous service at temperatures up to 400°F (204°C)
- Excellent resistance to corrosive chemicals, oils, fuels and solvents
- Resists ozone, sunlight and weathering
- Opaque black color helps protect light sensitive fluids

Resistant to corrosive chemicals and solvents, Fluran® Severe Environment Tubing is designed to handle the most aggressive solutions at temperatures as high as 400°F.

Made of a proprietary fluoroelastomer, Fluran® Severe Environment Tubing has both the physical and chemical properties that make it ideal for severe environments, such as dry cleaning fluid lines and solvent recovery systems, where other flexible tubings fail. Fluran® Severe Environment Tubing can be used in continuous service with temperatures as high as 400°F (204°C) and has excellent resistance to corrosive chemicals, oils, fuels, solvents and most mineral acids.

This opaque black tubing helps protect light-sensitive materials being transferred and will not prematurely crack and age when exposed to ozone, sun and weather. It is highly flexible and resilient, making it the ideal choice in peristaltic pumping of extremely corrosive materials. A food grade formulation is available upon request. Durometer hardness: Shore A, 60.\*

## Tygon® Fluran® Severe Environment Tubing

ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 72-1008	1.6	3.2	1/16	1/8	15.2	50
PC6 72-1009	3.2	6.4	1/8	1/4	15.2	50
PC6 72-1010	4.8	7.9	3/16	5/16	15.2	50
PC6 72-1011	6.4	9.5	1/4	3/8	15.2	50
PC6 72-1012	7.9	11.1	5/16	7/16	15.2	50
PC6 72-1013	9.5	12.7	3/8	1/2	15.2	50

\* Note: Higher durometer values correlate with stiffer less flexible tubing.

## Platinum Cured Silicone Tubing

Platinum Cured Silicone



## KEY FEATURES

- Excellent for use as catheters, drains and IV drug delivery
- Ultra-pure biocompatible tubing
- Autoclavable
- Resistant to temperature extremes

This Platinum Cured Silicone tubing is ultra-flexible and can be sterilized by autoclaving. It is an ultra-pure biopharmaceutical grade tubing which imparts no tastes or odors to fluids transferred. Resistant to temperature extremes, ozone, radiation, moisture, compression sets, weathering, and chemical attack. Ideal for applications such as sterile fill and transfers, biocompatible for use as catheters, drains and intravenous drug delivery and blood withdrawal. Non-toxic and non-hemolytic.

## Platinum Cured Silicone Tubing

ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 72-1042	0.3	0.6	0.012	0.024	7.6	25
PC6 72-1043	0.5	0.9	0.020	0.036	7.6	25
PC6 72-1044	0.6	1.2	0.025	0.047	7.6	25
PC6 72-1045	0.8	1.7	0.030	0.066	7.6	25
PC6 72-1046	0.8	4.1	0.030	0.160	7.6	25
PC6 72-4189	0.8	2.4	1/32	3/32	15.2	50
PC6 72-1047	1.0	2.2	0.040	0.086	7.6	25
PC6 72-1048	1.5	1.9	0.058	0.076	7.6	25
PC6 72-1050	1.6	3.2	1/16	1/8	7.6	25
PC6 72-1049	1.6	4.8	1/16	3/16	7.6	25
PC6 72-1054	1.6	6.4	1/16	1/4	7.6	25
PC6 72-1052	1.6	7.9	1/16	5/16	7.6	25
PC6 72-1053	1.6	11.1	1/16	7/16	7.6	25
PC6 72-1051	1.6	14.3	1/16	9/16	7.6	25
PC6 72-1056	2.0	3.6	5/64	9/64	7.6	25
PC6 72-1055	2.0	5.2	5/64	13/64	7.6	25
PC6 72-1060	2.0	6.7	5/64	17/64	7.6	25
PC6 72-1058	2.0	8.3	5/64	21/64	7.6	25
PC6 72-1059	2.0	11.5	5/64	29/64	7.6	25
PC6 72-1057	2.0	14.7	5/64	37/64	3.0	10
PC6 72-1062	2.4	4.0	3/32	5/32	7.6	25
PC6 72-1061	2.4	5.6	3/32	7/32	7.6	25
PC6 72-1066	2.4	7.1	3/32	9/32	7.6	25
PC6 72-1064	2.4	8.7	3/32	11/32	7.6	25

\* Note: Higher durometer values correlate with stiffer less flexible tubing.



## Laboratory Tubing (continued)

## Platinum Cured Silicone Tubing (continued)

Platinum Cured Silicone Tubing						
ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 72-1065	2.4	11.9	3/32	15/32	7.6	25
PC6 72-1063	2.4	15.1	3/32	19/32	7.6	25
PC6 72-1068	3.2	4.8	1/8	3/16	7.6	25
PC6 72-1067	3.2	6.4	1/8	1/4	7.6	25
PC6 72-1072	3.2	7.9	1/8	5/16	7.6	25
PC6 72-1070	3.2	9.5	1/8	3/8	7.6	25
PC6 72-1071	3.2	12.7	1/8	1/2	7.6	25
PC6 72-1069	3.2	15.9	1/8	5/8	7.6	25
PC6 72-1074	4.0	5.6	5/32	7/32	7.6	25
PC6 72-1073	4.0	7.1	5/32	9/32	7.6	25
PC6 72-1078	4.0	8.7	5/32	11/32	7.6	25
PC6 72-1076	4.0	10.3	5/32	13/32	7.6	25
PC6 72-1077	4.0	13.5	5/32	17/32	7.6	25
PC6 72-1075	4.0	16.7	5/32	21/32	3.0	10
PC6 72-1080	4.8	6.4	3/16	1/4	7.6	25
PC6 72-1079	4.8	7.9	3/16	5/16	7.6	25
PC6 72-1084	4.8	9.5	3/16	3/8	7.6	25
PC6 72-1082	4.8	11.1	3/16	7/16	7.6	25
PC6 72-1083	4.8	14.3	3/16	9/16	7.6	25
PC6 72-1081	4.8	17.5	3/16	11/16	3.0	10
PC6 72-1086	6.4	7.9	1/4	5/16	7.6	25
PC6 72-1085	6.4	9.5	1/4	3/8	7.6	25
PC6 72-1090	6.4	11.1	1/4	7/16	7.6	25
PC6 72-1088	6.4	12.7	1/4	1/2	7.6	25
PC6 72-1089	6.4	15.9	1/4	5/8	7.6	25
PC6 72-1087	6.4	19.1	1/4	3/4	3.0	10
PC6 72-1092	7.9	9.5	5/16	3/8	7.6	25
PC6 72-1091	7.9	11.1	5/16	7/16	7.6	25
PC6 72-1096	7.9	12.7	5/16	1/2	3.0	10
PC6 72-1094	7.9	14.3	5/16	9/16	3.0	10
PC6 72-1095	7.9	17.5	5/16	11/16	3.0	10
PC6 72-1093	7.9	20.6	5/16	13/16	3.0	10

\* Note: Higher durometer values correlate with stiffer less flexible tubing.

Platinum Cured Silicone Tubing						
ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 72-1097	9.5	12.7	3/8	1/2	7.6	25
PC6 72-1102	9.5	14.3	3/8	9/16	3.0	10
PC6 72-1100	9.5	15.9	3/8	5/8	3.0	10
PC6 72-1101	9.5	19.1	3/8	3/4	3.0	10
PC6 72-1099	9.5	22.2	3/8	7/8	3.0	10
PC6 72-1104	12.7	14.3	1/2	9/16	3.0	10
PC6 72-1103	12.7	15.9	1/2	5/8	3.0	10
PC6 72-1108	12.7	17.5	1/2	11/16	3.0	10
PC6 72-1106	12.7	19.1	1/2	3/4	3.0	10
PC6 72-1107	12.7	22.2	1/2	7/8	7.6	25
PC6 72-1105	12.7	25.4	1/2	1	3.0	10
PC6 72-1109	15.9	17.5	5/8	11/16	3.0	10
PC6 72-1110	15.9	19.1	5/8	3/4	3.0	10
PC6 72-1112	15.9	20.6	5/8	13/16	3.0	10
PC6 72-1113	15.9	22.2	5/8	7/8	3.0	10
PC6 72-1111	15.9	25.4	5/8	1	3.0	10
PC6 72-1115	19.1	20.6	3/4	13/16	3.0	10
PC6 72-1120	19.1	22.2	3/4	7/8	3.0	10
PC6 72-1118	19.1	23.8	3/4	15/16	3.0	10
PC6 72-1119	19.1	25.4	3/4	1	3.0	10
PC6 72-1116	19.1	28.6	3/4	1-1/8	3.0	10
PC6 72-1117	19.1	28.6	3/4	1-1/4	3.0	10
PC6 72-1121	22.2	23.8	7/8	15/16	3.0	10
PC6 72-1126	22.2	25.4	7/8	1	3.0	10
PC6 72-1124	22.2	27.0	7/8	1-1/16	3.0	10
PC6 72-1125	22.2	28.6	7/8	1-1/8	3.0	10
PC6 72-1122	22.2	31.8	7/8	1-1/4	3.0	10
PC6 72-1123	22.2	31.8	7/8	1-3/8	3.0	10
PC6 72-1130	25.4	31.8	1	1-1/4	3.0	10
PC6 72-1128	25.4	34.9	1	1-3/8	3.0	10
PC6 72-1129	25.4	38.1	1	1-1/2	3.0	10

\* Note: Higher durometer values correlate with stiffer less flexible tubing.

## Laboratory Tubing (continued)

Kynar/PVDF Tubing  
(Polyvinylidene Fluoride)

## KEY FEATURES

- High Purity
- Excellent chemical and environmental resistance
- Low permeability with most gases and liquids
- FDA compliant/USP Class VI

PVDF tubing is ideal for fluid applications which require a high degree of purity such as the transfer of ultra-pure deionized water. Thinner walled PVDF tubing is translucent making it easier to confirm fluid movement. Thin wall PVDF tubing is also more flexible than FEP and PFA tubing but does not have as broad a working temperature range. Durometer hardness: Shore D, 65.\*

## Kynar/PVDF Tubing

ORDER #	ID (mm)	OD (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 72-1205	1.6	3.2	1/16	1/8	15.2	50
PC6 72-1206	3.2	4.8	1/8	3/16	15.2	50
PC6 72-1211	3.2	6.4	1/8	1/4	15.2	50
PC6 72-1208	4.3	6.4	8/47	1/4	15.2	50
PC6 72-1212	4.8	7.9	3/16	5/16	15.2	50
PC6 72-1213	6.4	9.5	1/4	3/8	15.2	50
PC6 72-1209	7.9	9.5	5/16	3/8	15.2	50
PC6 72-1214	7.9	11.1	5/16	7/16	15.2	50
PC6 72-1215	9.5	12.7	3/8	1/2	15.2	50
PC6 72-1216	12.7	15.9	1/2	5/8	15.2	50
PC6 72-1217	15.9	19.1	5/8	3/4	15.2	50
PC6 72-1218	19.1	22.2	3/4	7/8	15.2	50

\* Note: Higher durometer values correlate with stiffer less flexible tubing.

## Tygon® Microbore Tubing (ND 100-80)



## KEY FEATURES

- Stiff enough for easy handling, soft enough to resist puncturing
- Micro-diameter sizes fit needle gauges 30 to 17
- Ideal for precision injection and dispensing applications
- Meets USP Class VI criteria

Tygon® Microbore Tubing is designed for precision injection and dispensing in surgical and laboratory applications.

Select Tygon® Microbore Tubing for intravenous and arterial infusion as well as other surgical and laboratory applications. It is flexible enough to permit the use of a single size tubing with several different needle gauges, yet sufficiently rigid to minimize the danger of wall collapse. Tygon® Microbore Tubing is non-toxic, non-pyrogenic and biocompatible. Tygon® Microbore Tubing can be sterilized by radiation, ethylene oxide, steam or chemical methods. Durometer hardness: Shore A, 80.\*

## Tygon® Microbore Tubing (ND 100-80)

ORDER #	ID (mm)	ID (in)	OD (in)	length (m)	length (ft)
PC6 75-0465	0.25	0.010	0.030	152.4	500
PC6 75-0466	0.51	0.020	0.060	152.4	500
PC6 75-0467	0.76	0.030	0.090	152.4	500
PC6 75-0468	1.02	0.040	0.070	152.4	500
PC6 75-0469	1.27	0.050	0.090	152.4	500

\* Note: Higher durometer values correlate with stiffer less flexible tubing.

## Laboratory Tubing (continued)

## Micro-Line™ Tubing

This remarkable new cross-linked Ethyl Vinyl Acetate Tubing is ideal for biological use. It is stable, non-contaminating and contains no plasticizers that could migrate or leach out.

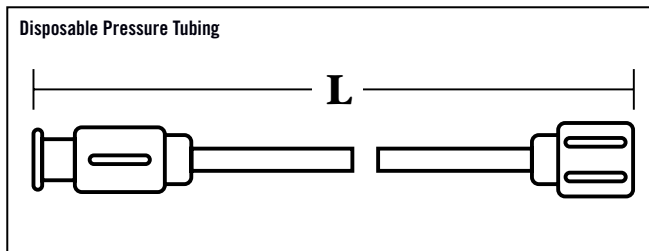
The mechanical properties of this material are unique. It has virtually 100% elastic memory and will return to its original shape after stretching by gentle heating. It will stretch to fit over tubes and fittings. Micro-Line™ Tubing can be shaped with heat to form various shapes or can be cold-stretched to reduce the internal diameter by 40%. Tubing is flexible and non-kinking from below zero to 180°F.

The Tubing can be sterilized by autoclaving, dry heat, radiation or ethylene oxide gas sterilization and is supplied in 30 m (100 ft) spools.

## Micro-Line™ Tubing

ORDER #	ID (mm)	OD (mm)	ID (in.)	OD (in.)	length (m)	length (ft.)
PC6 59-8644	1.0	1.8	0.040	0.070	30.5	100
PC6 59-8645	1.3	2.3	0.050	0.090	30.5	100
PC6 59-8646	Set of 2 spools					

## Disposable Pressure Tubing



## KEY FEATURES

- Ideal for infusion studies
- Easily extend infusion lines from syringe to needle or catheter

This Pressure Tubing is the ideal way to connect the output from a syringe to the delivery mechanism for an infusion study. It has a male Luer Lock connector on one end and a female Luer Lock connector on the other. This tubing has an ID of 1.6 mm (1/16 in) and an OD of 3.2 mm (1/8 in). Tubing volume is 0.6 ml per 12 inches of tubing. It is available in 8 lengths and is supplied sterile in packages of 25.

## Disposable Pressure Tubing

Order #	Product
PC6 63-0281	Disposable Pressure Tubing, 15.2 cm (6 in)
PC6 63-0282	Disposable Pressure Tubing, 30.5 cm (12 in)
PC6 63-0283	Disposable Pressure Tubing, 61 cm (24 in)
PC6 63-0284	Disposable Pressure Tubing, 91.4 cm (36 in)
PC6 63-0286	Disposable Pressure Tubing, 152.4 cm (60 in)
PC6 63-0287	Disposable Pressure Tubing, 182.9 cm (72 in)
PC6 63-0288	Disposable Pressure Tubing, 213.4 cm (84 in)

## Disposable High Pressure Tubing

This Tubing is similar to the tubing described above except it can withstand pressures up to 1000 p.s.i. It has a male Luer Lock connector on one end and a female on the other. This tubing has an ID of 1.6 mm (1/16 in) and an OD of 3.2 mm (1/8 in). Supplied as straight pieces of tubing in a package of 10.

## Disposable High Pressure Tubing

Order #	Product
PC6 63-0297	Disposable High Pressure Tubing, 25.4 cm (10 in)
PC6 63-0299	Disposable High Pressure Tubing, 76.2 cm (30 in)

## PolyE Polyethylene Tubing

Harvard Apparatus' PolyE polyethylene tubing is an excellent tubing choice for a variety of applications requiring small ID or OD tubing. It is available in both sterile and non-sterile packages. It can be used for infusions, tracheotomies or other surgical operations in rodents from mice to rabbits. Cross reference numbers to PE tubing is provided. Blunt probe needles can be used with this tubing to make custom cannulae. Information in the table will assist in needle selection. One column lists the size of needle which will fit into the tubing while the other column lists the size of needle through which each tubing size will pass.

### Sterile PolyE Polyethylene Tubing

NEEDLE GAUGE				
ORDER #	PE No.	Diameter ID x OD	Needle In Tubing	Tubing In Needle
Length 30.5 cm (12 in)				
PC6 59-8357	50	0.58 x 0.965 mm (0.023 x 0.038 in)	23 g	17 g
Length 91.45 cm (36 in)				
PC6 59-8358	50	0.58 x 0.965 mm (0.023 x 0.038 in)	23 g	17 g
PC6 59-8360	90	0.86 x 1.27 mm (0.034 x 0.050 in)	20 g	15 g
PC6 59-8364	190	1.19 x 1.70 mm (0.047 x 0.067 in)	18 g	13 g
PC6 59-8370	240	1.67 x 2.42 mm (0.066 x 0.095 in)	15 g	10 g

### PolyE Tubing Size Cross Reference Chart

Use this chart below to determine comparable sizes of PolyE and French scale tubing

French* Number	PolyE Number	OD (in)	French* Number	PolyE Number	OD (in)
1	-	0.013	6.2	420	0.082
1.8	100	0.024	7	-	0.092
2	-	0.026	7.2	460	0.095
2.4	140	0.031	8	-	0.105
2.9	200	0.038	8.1	380	0.106
3	160	0.039	9.0	500	0.118
3.2	120	0.043	9.8	520	0.128
3.8	260	0.050	10	-	0.131
4	-	0.052	11	540	0.145
4.6	280	0.060	11.6	605	0.153
4.7	320	0.062	12.3	580	0.161
5	-	0.066	13	-	0.171
5.1	340	0.067	14	-	0.184
5.9	300	0.078	15	-	0.197
6	-	0.079	16	-	0.210
			17	-	0.223
			17.9	680	0.236

\* French Scale = OD (in) x 76.211 - 0.0014

### Non-Sterile PolyE Polyethylene Tubing

Tubing Length 3m (10 ft)	30.5 m (100 ft)	PE No.	Diameter ID x OD mm (in)	Needle Gauge French Scale*	Needle Gauge Needle into Tubing	PE # Tubing into Needle	PolyE Equiv.
PC6 59-8323	PC6 59-8324	20	0.38 x 1.09 (0.015 x 0.042)	3.2	27 g	16 g	120
PC6 72-0191	PC6 72-0192	-	0.40 x 0.80 (0.016 x 0.031)	2.4	26 g	18 g	140
PC6 59-8325	PC6 59-8326	50	0.58 x 0.96 (0.023 x 0.038)	2.9	23 g	17 g	200
PC6 59-8329	-	90	0.86 x 1.27 (0.034 x 0.050)	3.8	20 g	15 g	260
PC6 72-0195	PC6 72-0196	-	1.02 x 1.98 (0.04 x 0.078)	5.9	18 g	12 g	300
PC6 59-8341	PC6 59-8342	240	1.67 x 2.42 (0.066 x 0.095)	7.2	14 g	10 g	460
PC6 59-8343	PC6 59-8344	260	2.0 x 3.0 (0.079 x 0.118)	9.0	14 g	8 g	500
PC6 59-8351	PC6 59-8352	350	3.0 x 3.88 (0.118 x 0.153)	11.6	10 g	6 g	605
PC6 59-8355	PC6 59-8356	380	4.0 x 6.0 (0.157 x 0.236)	17.9	9 g	NA	680

\* French Scale = OD (in) x 76.211 - 0.0014

## Barbed Tubing Connectors

## Tubing Connector Kits &amp; Stopcocks

**H**arvard Apparatus offers a complete line of tubing connector kits to assist you in quickly and easily making connections between syringes and tubing and between tubing of similar and dissimilar sizes. Kit types include: barbed connector kits (small, medium and large), Kent® Systems Quick Disconnect Kits, Luer connector kits, a stopcock kit, a tubing clamp kit, fitting and tubing kit and a tubing manifold kit. Some kits are available in multiple material types where chemical compatibility may be a concern. Each kit is supplied in a convenient storage box and kit component are also sold separately. Our line of connectors grows continually. Visit our website for the latest offerings.



Luer and Barbed Connector Kits

## Kent® Systems Quick Disconnect Kits



These kits feature the Kent® Systems quick disconnect (KSQD) fittings. Fittings are available as either male or female KSQD. Fitting styles include integral male or female, swivel male (with or without lock), locking male fitting, male to female KSQD shut-off valve, male plug, male/female plug, male flush plug, female cap, male flush plug and the modular manifold. The modular manifold has three female and one male KSQD fittings. Modular manifolds can be interconnected with any fitting including other modular manifolds to quickly and easily interconnect a number of tubes of similar or dissimilar sizes. The unique barbs are sized to accommodate a range of tube sizes and tube types. Each kit is supplied in a convenient box. All kit components are also sold separately.

## Kent® Systems Quick Disconnect Kits Barb Size Chart

Barb No.	Barb OD	Barb Bore		Tube ID Range
		Lower	Upper	
004	0.102 in	0.06 in	0.063 in	0.078 in
007	0.129 in	0.076 in	0.078 in	0.109 in
013	0.164 in	0.096 in	0.094 in	0.141 in
025	0.208 in	0.122 in	0.125 in	0.188 in
035	0.264 in	0.155 in	0.156 in	0.234 in
055	0.335 in	0.197 in	0.188 in	0.297 in

Order #	Barb Size	Kit Size	Tube ID Range
PC6 72-1613	004, 007, 013	Small	1/16, 3/32 and 1/8 in
PC6 72-1614	025, 035, 055	Large	5/32, 3/16 and 1/4 in



## Barbed Tubing Connectors (continued)

## Barbed Connector Kits



These barbed connector kits come in three different sizes. Small and medium kits have 10 pieces of each component and large kits have 5 pieces of each component. Connectors join tubing of similar sizes while reducing adapters join tubing of different sizes. These kits are available in black nylon, polypropylene, and Kynar®, a chemically resistant autoclavable plastic. Each kit is supplied in a convenient box. All kit components are also sold separately.

## Barbed Tubing Connector Kits

ORDER #	PRODUCT	TUBE ID	MATERIAL
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## PC6 72-1409 Small Black Nylon Barbed Connector Kit

## KIT COMPONENTS:

PC6 72-1475	Barbed Connector	1/16 to 1/16 in	Black Nylon
PC6 72-1476	Barbed Connector	3/32 to 3/32 in	Black Nylon
PC6 72-1477	Barbed Connector	1/8 to 1/8 in	Black Nylon
PC6 72-1478	Barbed Connector	1/16 to 3/32 in	Black Nylon
PC6 72-1479	Barbed Connector	1/16 to 1/8 in	Black Nylon
PC6 72-1480	Barbed Connector	3/32 to 1/8 in	Black Nylon
PC6 72-1481	L Barbed Connector	1/16 to 1/16 in	Black Nylon
PC6 72-1482	L Barbed Connector	3/32 to 3/32 in	Black Nylon
PC6 72-1483	L Barbed Connector	1/8 to 1/8 in	Black Nylon
PC6 72-1486	L Barbed Connector	3/32 to 1/8 in	Black Nylon
PC6 72-1487	T Barbed Connector	1/16 to 1/16 in	Black Nylon
PC6 72-1488	T Barbed Connector	3/32 to 3/32 in	Black Nylon
PC6 72-1489	T Barbed Connector	1/8 to 1/8 in	Black Nylon
PC6 72-1491	T Barbed Connector	1/16 to 1/8 in	Black Nylon
PC6 72-1492	T Barbed Connector	3/32 to 1/8 in	Black Nylon
PC6 72-1493	Y Barbed Connector	1/16 to 1/16 in	Black Nylon
PC6 72-1494	Y Barbed Connector	3/32 to 3/32 in	Black Nylon
PC6 72-1495	Y Barbed Connector	1/8 to 1/8 in	Black Nylon
PC6 72-1498	Barbed PLUG Connector	1/8 in	Black Nylon

## PC6 72-1410 Small Polypropylene Barbed Connector Kit

## KIT COMPONENTS:

PC6 72-1499	Barbed Connector	1/16 to 1/16 in	Polypropylene
PC6 72-1500	Barbed Connector	3/32 to 3/32 in	Polypropylene
PC6 72-1501	Barbed Connector	1/8 to 1/8 in	Polypropylene
PC6 72-1502	Barbed Connector	1/16 to 3/32 in	Polypropylene
PC6 72-1503	Barbed Connector	1/16 to 1/8 in	Polypropylene
PC6 72-1504	Barbed Connector	3/32 to 1/8 in	Polypropylene
PC6 72-1505	L Barbed Connector	1/16 to 1/16 in	Polypropylene
PC6 72-1506	L Barbed Connector	3/32 to 3/32 in	Polypropylene
PC6 72-1507	L Barbed Connector	1/8 to 1/8 in	Polypropylene
PC6 72-1508	L Barbed Connector	1/16 to 3/32 in	Polypropylene
PC6 72-1509	L Barbed Connector	1/16 to 1/8 in	Polypropylene
PC6 72-1510	L Barbed Connector	3/32 to 1/8 in	Polypropylene
PC6 72-1511	T Barbed Connector	1/16 to 1/16 in	Polypropylene
PC6 72-1512	T Barbed Connector	3/32 to 3/32 in	Polypropylene
PC6 72-1513	T Barbed Connector	1/8 to 1/8 in	Polypropylene
PC6 72-1514	T Barbed Connector	1/16 to 3/32 in	Polypropylene
PC6 72-1515	T Barbed Connector	1/16 to 1/8 in	Polypropylene
PC6 72-1516	T Barbed Connector	3/32 to 1/8 in	Polypropylene
PC6 72-1517	Y Barbed Connector	1/16 to 1/16 in	Polypropylene
PC6 72-1518	Y Barbed Connector	3/32 to 3/32 in	Polypropylene
PC6 72-1519	Y Barbed Connector	1/8 to 1/8 in	Polypropylene
PC6 72-1520	Barbed PLUG Connector	1/16 in	Polypropylene
PC6 72-1521	Barbed PLUG Connector	3/32 in	Polypropylene
PC6 72-1522	Barbed PLUG Connector	1/8 in	Polypropylene

## Barbed Tubing Connectors (continued)

## Barbed Tubing Connector Kits (Continued)

ORDER #	PRODUCT	TUBE ID	MATERIAL
<b>PC6 72-1411</b>	<b>Small Kynar® Barbed Connector Kit</b>		
<b>KIT COMPONENTS:</b>			
<b>PC6 72-1523</b>	Barbed Connector	1/16 to 1/16 in	Kynar®
<b>PC6 72-1524</b>	Barbed Connector	3/32 to 3/32 in	Kynar®
<b>PC6 72-1525</b>	Barbed Connector	1/8 to 1/8 in	Kynar®
<b>PC6 72-1526</b>	Barbed Connector	1/16 to 3/32 in	Kynar®
<b>PC6 72-1527</b>	Barbed Connector	1/16 to 1/8 in	Kynar®
<b>PC6 72-1528</b>	Barbed Connector	3/32 to 1/8 in	Kynar®
<b>PC6 72-1530</b>	L Barbed Connector	3/32 to 3/32 in	Kynar®
<b>PC6 72-1531</b>	L Barbed Connector	1/8 to 1/8 in	Kynar®
<b>PC6 72-1533</b>	L Barbed Connector	1/16 to 1/8 in	Kynar®
<b>PC6 72-1535</b>	T Barbed Connector	1/16 to 1/16 in	Kynar®
<b>PC6 72-1536</b>	T Barbed Connector	3/32 to 3/32 in	Kynar®
<b>PC6 72-1537</b>	T Barbed Connector	1/8 to 1/8 in	Kynar®
<b>PC6 72-1539</b>	T Barbed Connector	1/16 to 1/8 in	Kynar®
<b>PC6 72-1540</b>	T Barbed Connector	3/32 to 1/8 in	Kynar®
<b>PC6 72-1541</b>	Y Barbed Connector	1/16 to 1/16 in	Kynar®
<b>PC6 72-1542</b>	Y Barbed Connector	3/32 to 3/32 in	Kynar®
<b>PC6 72-1543</b>	Y Barbed Connector	1/8 to 1/8 in	Kynar®

**PC6 72-1412 Medium Black Nylon Barbed Connector Kit**

<b>KIT COMPONENTS:</b>			
<b>PC6 72-1547</b>	Barbed Connector	1/4 to 1/4 in	Black Nylon
<b>PC6 72-1548</b>	Barbed Connector	5/16 to 5/16 in	Black Nylon
<b>PC6 72-1549</b>	Barbed Connector	3/8 to 3/8 in	Black Nylon
<b>PC6 72-1550</b>	Barbed Connector	1/4 to 5/16 in	Black Nylon
<b>PC6 72-1551</b>	Barbed Connector	1/4 to 3/8 in	Black Nylon
<b>PC6 72-1552</b>	Barbed Connector	5/16 to 3/8 in	Black Nylon
<b>PC6 72-1553</b>	L Barbed Connector	1/4 to 1/4 in	Black Nylon
<b>PC6 72-1554</b>	L Barbed Connector	5/16 to 5/16 in	Black Nylon
<b>PC6 72-1555</b>	L Barbed Connector	3/8 to 3/8 in	Black Nylon
<b>PC6 72-1556</b>	T Barbed Connector	1/4 to 1/4 in	Black Nylon
<b>PC6 72-1557</b>	T Barbed Connector	5/16 to 5/16 in	Black Nylon
<b>PC6 72-1558</b>	Y Barbed Connector	3/8 to 3/8 in	Black Nylon
<b>PC6 72-1559</b>	Y Barbed Connector	1/4 to 1/4 in	Black Nylon
<b>PC6 72-1560</b>	Y Barbed Connector	3/8 to 3/8 in	Black Nylon

## Barbed Tubing Connector Kits (Continued)

ORDER #	PRODUCT	TUBE ID	MATERIAL
<b>PC6 72-1413</b>	<b>Medium Polypropylene Barbed Connector Kit</b>		
<b>KIT COMPONENTS:</b>			
<b>PC6 72-1561</b>	Barbed Connector	1/4 to 1/4 in	Polypropylene
<b>PC6 72-1562</b>	Barbed Connector	5/16 to 5/16 in	Polypropylene
<b>PC6 72-1563</b>	Barbed Connector	3/8 to 3/8 in	Polypropylene
<b>PC6 72-1564</b>	Barbed Connector	1/4 to 5/16 in	Polypropylene
<b>PC6 72-1565</b>	Barbed Connector	1/4 to 3/8 in	Polypropylene
<b>PC6 72-1566</b>	Barbed Connector	5/16 to 3/8 in	Polypropylene
<b>PC6 72-1567</b>	L Barbed Connector	1/4 to 1/4 in	Polypropylene
<b>PC6 72-1568</b>	L Barbed Connector	5/16 to 5/16 in	Polypropylene
<b>PC6 72-1569</b>	L Barbed Connector	3/8 to 3/8 in	Polypropylene
<b>PC6 72-1570</b>	T Barbed Connector	1/4 to 1/4 in	Polypropylene
<b>PC6 72-1571</b>	T Barbed Connector	5/16 to 5/16 in	Polypropylene
<b>PC6 72-1572</b>	T Barbed Connector	3/8 to 3/8 in	Polypropylene
<b>PC6 72-1573</b>	Y Barbed Connector	1/4 to 1/4 in	Polypropylene
<b>PC6 72-1574</b>	Y Barbed Connector	3/8 to 3/8 in	Polypropylene

**PC6 72-1414 Medium Kynar® Barbed Connector Kit**

<b>KIT COMPONENTS:</b>			
<b>PC6 72-1575</b>	Barbed Connector	1/4 to 1/4 in	Kynar®
<b>PC6 72-1576</b>	Barbed Connector	5/16 to 5/16 in	Kynar®
<b>PC6 72-1577</b>	Barbed Connector	3/8 to 3/8 in	Kynar®
<b>PC6 72-1578</b>	Barbed Connector	1/4 to 5/16 in	Kynar®
<b>PC6 72-1579</b>	Barbed Connector	1/4 to 3/8 in	Kynar®
<b>PC6 72-1580</b>	Barbed Connector	5/16 to 3/8 in	Kynar®
<b>PC6 72-1581</b>	L Barbed Connector	1/4 to 1/4 in	Kynar®
<b>PC6 72-1582</b>	L Barbed Connector	5/16 to 5/16 in	Kynar®
<b>PC6 72-1583</b>	L Barbed Connector	3/8 to 3/8 in	Kynar®
<b>PC6 72-1584</b>	T Barbed Connector	1/4 to 1/4 in	Kynar®
<b>PC6 72-1585</b>	T Barbed Connector	5/16 to 5/16 in	Kynar®
<b>PC6 72-1586</b>	T Barbed Connector	3/8 to 3/8 in	Kynar®
<b>PC6 72-1587</b>	Y Barbed Connector	1/4 to 1/4 in	Kynar®
<b>PC6 72-1588</b>	Y Barbed Connector	3/8 to 3/8 in	Kynar®

## Barbed Tubing Connectors (continued)



### Barbed Tubing Connector Kits (Continued)

ORDER #	PRODUCT	TUBE ID	MATERIAL
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#### PC6 72-1415 Large Black Nylon Barbed Connector Kit

##### KIT COMPONENTS:

PC6 72-1589	Barbed Connector	1/2 to 1/2 in	Black Nylon
PC6 72-1590	Barbed Connector	5/8 to 5/8 in	Black Nylon
PC6 72-1591	L Barbed Connector	1/2 to 1/2 in	Black Nylon
PC6 72-1592	L Barbed Connector	5/8 to 5/8 in	Black Nylon
PC6 72-1593	T Barbed Connector	1/2 to 1/2 in	Black Nylon
PC6 72-1594	T Barbed Connector	5/8 to 5/8 in	Black Nylon
PC6 72-1595	Y Barbed Connector	1/2 to 5/8 in	Black Nylon
PC6 72-1596	Y Barbed Connector	1/2 to 1/2 in	Black Nylon

#### PC6 72-1416 Large Polypropylene Barbed Connector Kit

##### KIT COMPONENTS:

PC6 72-1597	Barbed Connector	1/2 to 1/2 in	Polypropylene
PC6 72-1598	Barbed Connector	5/8 to 5/8 in	Polypropylene
PC6 72-1599	L Barbed Connector	1/2 to 1/2 in	Polypropylene
PC6 72-1600	L Barbed Connector	5/8 to 5/8 in	Polypropylene
PC6 72-1601	T Barbed Connector	1/2 to 1/2 in	Polypropylene
PC6 72-1602	T Barbed Connector	5/8 to 5/8 in	Polypropylene
PC6 72-1603	Y Barbed Connector	1/2 to 5/8 in	Polypropylene
PC6 72-1604	Y Barbed Connector	1/2 to 1/2 in	Polypropylene

#### PC6 72-1417 Large Kynar® Barbed Connector Kit

##### KIT COMPONENTS:

PC6 72-1605	Barbed Connector	1/2 to 1/2 in	Kynar®
PC6 72-1606	Barbed Connector	5/8 to 5/8 in	Kynar®
PC6 72-1607	L Barbed Connector	1/2 to 1/2 in	Kynar®
PC6 72-1608	L Barbed Connector	5/8 to 5/8 in	Kynar®
PC6 72-1609	T Barbed Connector	1/2 to 1/2 in	Kynar®
PC6 72-1610	T Barbed Connector	5/8 to 5/8 in	Kynar®
PC6 72-1611	Y Barbed Connector	1/2 to 5/8 in	Kynar®
PC6 72-1612	Y Barbed Connector	1/2 to 1/2 in	Kynar®



## Barbed Tubing Connectors (continued)

## Luer to Tube Kits



The Luer Connector Kits contain a selection of Luer fittings to interconnect Luer connectors (e.g. syringes, stopcocks and needles) with one another and with tubing. These kits are available in white nylon, polypropylene and Kynar®, a chemically resistant autoclavable plastic. Each kit is supplied in a convenient box. All kit components are also sold separately.

The Male Luer Taper kits contain a selection of Male Luer Taper fittings to barbed connectors as well as Male Luer Taper to Male Luer Taper fittings. These kits also contain color coded rotating Luer lock rings that securely snap onto the Male Luer Taper side of each connector. These kits are available in white nylon, polypropylene and Kynar®, a chemically resistant autoclavable plastic. Each kit is supplied in a convenient box. All kit components are also sold separately.

## Luer to Tube Kits

ORDER #	PRODUCT	TUBE ID	MATERIAL
<b>PC6 72-1406 White Nylon Luer Connector Kit</b>			
<b>KIT COMPONENTS:</b>			
<b>PC6 72-1418</b>	Barbed Connector	FLL to 1/16 in	White Nylon
<b>PC6 72-1419</b>	Barbed Connector	FLL to 3/32 in	White Nylon
<b>PC6 72-1420</b>	Barbed Connector	FLL to 1/8 in	White Nylon
<b>PC6 72-1421</b>	Barbed Connector	FLL to 5/32 in	White Nylon
<b>PC6 72-1422</b>	Barbed Connector	FLL to 3/16 in	White Nylon
<b>PC6 72-1423</b>	Barbed Connector	FLL to 1/4 in	White Nylon
<b>PC6 72-1424</b>	Barbed Connector	MLL to 1/16 in	White Nylon
<b>PC6 72-1425</b>	Barbed Connector	MLL to 3/32 in	White Nylon
<b>PC6 72-1426</b>	Barbed Connector	MLL to 1/8 in	White Nylon
<b>PC6 72-1427</b>	Barbed Connector	MLL to 5/32 in	White Nylon
<b>PC6 72-1428</b>	Barbed Connector	MLL to 3/16 in	White Nylon
<b>PC6 72-1429</b>	Barbed Connector	MLL to 1/4 in	White Nylon
<b>PC6 72-1430</b>	Cap Connector	MLL	White Nylon
<b>PC6 72-1431</b>	Cap Connector	FLL	White Nylon
<b>PC6 72-2735</b>	Coupler with Threaded FLL Connection	FLL to MLL	White Nylon
<b>PC6 72-1433</b>	Connector	MLT to MLT	White Nylon
<b>PC6 72-1434</b>	Connector	FLL to FLL	White Nylon
<b>PC6 72-1435</b>	Elbow Connector	FLL to FLL	White Nylon
<b>PC6 72-1436</b>	T Connector	3-Way FLL	White Nylon

## Luer to Tube Kits (Continued)

ORDER #	PRODUCT	TUBE ID	MATERIAL
<b>PC6 72-1407 Polypropylene Luer Connector Kit</b>			
<b>KIT COMPONENTS:</b>			
<b>PC6 72-1437</b>	Barbed Connector	FLL to 1/16	Polypropylene
<b>PC6 72-1438</b>	Barbed Connector	FLL to 3/32	Polypropylene
<b>PC6 72-1439</b>	Barbed Connector	FLL to 1/8	Polypropylene
<b>PC6 72-1440</b>	Barbed Connector	FLL to 5/32	Polypropylene
<b>PC6 72-1441</b>	Barbed Connector	FLL to 3/16	Polypropylene
<b>PC6 72-1442</b>	Barbed Connector	FLL to 1/4	Polypropylene
<b>PC6 72-1443</b>	Barbed Connector	MLL to 1/16	Polypropylene
<b>PC6 72-1444</b>	Barbed Connector	MLL to 3/32	Polypropylene
<b>PC6 72-1445</b>	Barbed Connector	MLL to 1/8	Polypropylene
<b>PC6 72-1446</b>	Barbed Connector	MLL to 5/32	Polypropylene
<b>PC6 72-1447</b>	Barbed Connector	MLL to 3/16	Polypropylene
<b>PC6 72-1448</b>	Barbed Connector	MLL to 1/4	Polypropylene
<b>PC6 72-1449</b>	Cap Connector	MLL	Polypropylene
<b>PC6 72-1450</b>	Cap Connector	FLL	Polypropylene
<b>PC6 72-2736</b>	Coupler w/ Threaded FLL Connection	FLL to MLL	Polypropylene
<b>PC6 72-1452</b>	Connector	MLT to MLT	Polypropylene
<b>PC6 72-1453</b>	Connector	FLL to FLL	Polypropylene
<b>PC6 72-1454</b>	Elbow Connector	FLL to FLL	Polypropylene
<b>PC6 72-1455</b>	T Connector	3-Way FLL	Polypropylene

## PC6 72-1408 Kynar® Luer Connector Kit

<b>KIT COMPONENTS:</b>			
<b>PC6 72-1456</b>	Barbed Connector	FLL to 1/16	Kynar®
<b>PC6 72-1457</b>	Barbed Connector	FLL to 3/32	Kynar®
<b>PC6 72-1458</b>	Barbed Connector	FLL to 1/8	Kynar®
<b>PC6 72-1462</b>	Barbed Connector	MLL to 1/16	Kynar®
<b>PC6 72-1464</b>	Barbed Connector	MLL to 1/8	Kynar®
<b>PC6 72-1465</b>	Barbed Connector	MLL to 5/32	Kynar®
<b>PC6 72-1466</b>	Barbed Connector	MLL to 3/16	Kynar®
<b>PC6 72-1467</b>	Barbed Connector	MLL to 1/4	Kynar®
<b>PC6 72-1468</b>	Cap Connector	MLL	Kynar®
<b>PC6 72-1469</b>	Cap Connector	FLL	Kynar®
<b>PC6 72-2737</b>	Coupler w/Threaded FLL Connection	FLL to MLL	Kynar®
<b>PC6 72-1471</b>	Connector	MLT to MLT	Kynar®
<b>PC6 72-1472</b>	Connector	FLL to FLL	Kynar®



## Barbed Tubing Connectors (continued)

## Luer to Tube Kits (Continued)

ORDER #	PRODUCT	TUBE ID	MATERIAL
<b>PC6 72-2738 White Nylon Male Luer Taper Kit</b>			
<b>KIT COMPONENTS:</b>			
<b>PC6 72-2731</b>	Snap Luer Lock Ring	Male	Red Nylon
<b>PC6 72-2732</b>	Snap Luer Lock Ring	Male	Green Nylon
<b>PC6 72-2733</b>	Snap Luer Lock Ring	Male	Polypropylene
<b>PC6 72-2695</b>	Barbed Connector	MLT to 1/16 in (R)*	White Nylon
<b>PC6 72-2696</b>	Barbed Connector	MLT to 3/32 in (R)*	White Nylon
<b>PC6 72-2741</b>	Luer Coupler	Male	White Nylon
<b>PC6 72-2697</b>	Barbed Connector	MLT to 1/8 in (R)*	White Nylon
<b>PC6 72-2698</b>	Barbed Connector	MLT to 5/32 in (R)*	White Nylon
<b>PC6 72-2699</b>	Barbed Connector	MLT to 3/16 in (R)*	White Nylon
<b>PC6 72-2700</b>	Barbed Connector	MLT to 1/4 in (R)*	White Nylon
<b>PC6 72-2701</b>	Barbed Connector	MLT to 1/16 in (S)*	White Nylon
<b>PC6 72-2747</b>	T Connector	FLL/MLT/MLT	White Nylon
<b>PC6 72-2702</b>	Barbed Connector	MLT to 3/32 in (S)*	White Nylon
<b>PC6 72-2703</b>	Barbed Connector	MLT to 1/8 in (S)*	White Nylon
<b>PC6 72-2704</b>	Barbed Connector	MLT to 5/32 in (S)*	White Nylon
<b>PC6 72-2705</b>	Barbed Connector	MLT to 1/8 in (S)*	White Nylon
<b>PC6 72-2706</b>	Barbed Connector	MLT to 1/4 in (S)*	White Nylon
<b>PC6 72-2744</b>	T Connector	FLL/MLT/FLL	White Nylon

**PC6 72-2739 Polypropylene Male Luer Taper Kit****KIT COMPONENTS:**

<b>PC6 72-2731</b>	Snap Luer Lock Ring	Male	Red Nylon
<b>PC6 72-2732</b>	Snap Luer Lock Ring	Male	Green Nylon
<b>PC6 72-2733</b>	Snap Luer Lock Ring	Male	Polypropylene
<b>PC6 72-2707</b>	Barbed Connector	MLT to 1/16 in (R)*	Polypropylene
<b>PC6 72-2708</b>	Barbed Connector	MLT to 3/32 in (R)*	Polypropylene
<b>PC6 72-2742</b>	Luer Coupler	Male	Polypropylene
<b>PC6 72-2709</b>	Barbed Connector	MLT to 1/8 in (R)*	Polypropylene
<b>PC6 72-2710</b>	Barbed Connector	MLT to 5/32 in (R)*	Polypropylene
<b>PC6 72-2711</b>	Barbed Connector	MLT to 3/16 in (R)*	Polypropylene
<b>PC6 72-2712</b>	Barbed Connector	MLT to 1/4 in (R)*	Polypropylene
<b>PC6 72-2713</b>	Barbed Connector	MLT to 1/16 in (S)*	Polypropylene
<b>PC6 72-2748</b>	T Connector	FLL/MLT/MLT	Polypropylene
<b>PC6 72-2714</b>	Barbed Connector	MLT to 3/32 in (S)*	Polypropylene
<b>PC6 72-2715</b>	Barbed Connector	MLT to 1/8 in (S)*	Polypropylene
<b>PC6 72-2716</b>	Barbed Connector	MLT to 5/32 in (S)*	Polypropylene
<b>PC6 72-2717</b>	Barbed Connector	MLT to 3/16 in (S)*	Polypropylene
<b>PC6 72-2718</b>	Barbed Connector	MLT to 1/4 in (S)*	Polypropylene
<b>PC6 72-2745</b>	T Connector	FLL/MLT/FLL	Polypropylene

\* (R) Allows rotation of tube on measured end.  
 (S) Does not allow rotation on measured end

## Luer to Tube Kits (Continued)

ORDER #	PRODUCT	TUBE ID	MATERIAL
<b>PC6 72-2740 Polycarbonate Male Luer Taper Kit</b>			
<b>KIT COMPONENTS:</b>			
<b>PC6 72-2731</b>	Snap Luer Lock Ring	Male	Red Nylon
<b>PC6 72-2732</b>	Snap Luer Lock Ring	Male	Green Nylon
<b>PC6 72-2734</b>	Snap Luer Lock Ring	Male	Polycarbonate
<b>PC6 72-2719</b>	Barbed Connector	MLT to 1/16 in (R)*	Polycarbonate
<b>PC6 72-2720</b>	Barbed Connector	MLT to 3/32 in (R)*	Polycarbonate
<b>PC6 72-2743</b>	Luer Coupler	Male	Polycarbonate
<b>PC6 72-2721</b>	Barbed Connector	MLT to 1/8 in (R)*	Polycarbonate
<b>PC6 72-2722</b>	Barbed Connector	MLT to 5/32 in (R)*	Polycarbonate
<b>PC6 72-2723</b>	Barbed Connector	MLT to 3/16 in (R)*	Polycarbonate
<b>PC6 72-2724</b>	Barbed Connector	MLT to 1/4 in (R)*	Polycarbonate
<b>PC6 72-2725</b>	Barbed Connector	MLT to 1/16 in (S)*	Polycarbonate
<b>PC6 72-2749</b>	T Connector	FLL/MLT/MLT	Polycarbonate
<b>PC6 72-2726</b>	Barbed Connector	MLT to 3/32 in (S)*	Polycarbonate
<b>PC6 72-2727</b>	Barbed Connector	MLT to 1/8 in (S)*	Polycarbonate
<b>PC6 72-2728</b>	Barbed Connector	MLT to 5/32 in (S)*	Polycarbonate
<b>PC6 72-2729</b>	Barbed Connector	MLT to 3/16 in (S)*	Polycarbonate
<b>PC6 72-2730</b>	Barbed Connector	MLT to 1/4 in (S)*	Polycarbonate
<b>PC6 72-2746</b>	T Connector	FLL/MLT/FLL	Polycarbonate

## Flow Control Pinch Valves



The Flow Control Pinch Valves work with tubing from 5/32 inch OD to 3/8 inch OD. The micrometer dial offers easy resetting of clamping distance. These valves are made of Delrin® and Acetal.

Order #	Clamp Size	Tubing Clamp Range
<b>PC6 72-2694</b>	Small	5/32 to 1/4 in OD Tubing
<b>PC6 72-8140</b>	Medium	5/32 to 3/8 in OD Tubing

## Tubing Clamp Kits



The clamps in the Tubing Clamp Kit feature a simple-to-use ratcheting design which provides positive and secure clamping of tubing to barbed and non-barbed connectors. Thirteen different clamps provide clamping for tubing sizes from 1/16 inch OD to 1.5 inches OD. This kit is supplied in a convenient box containing 5 of each clamp size.

Order #	Product
<b>PC6 72-1668</b>	Tubing Clamp Kit



## Kits and Valves (continued)

## Tubing Manifold Kit



The Tubing Manifold Kit contains several varieties of tubing manifolds for tube to tube connections. Many are compatible with MLT (male Luer taper) fittings. This kit is supplied in a convenient box. All kit components are also sold separately.

## Tubing Manifold Kit

ORDER #	PRODUCT
PC6 72-7481	Tubing Manifold Kit

## KIT COMPONENTS:

PC6 72-2665	Multiport Adapter 3 to 1 Modified Y Connector, 0.214" OD ports
PC6 72-2666	3-Way Y Connector FLL/FLL/FLL/MLL (ROTATING)
PC6 72-2672	Multiport Adapter 3 to 1 Modified Y Connector, 0.161" ID ports
PC6 72-2673	Y Connector FLL/FLL/MLL (Rotating)
PC6 72-2668	Multiport Adapter 3 to 1 Parallel Tube Connector, 0.154" ID x 0.215" OD ports
PC6 72-2675	Multiport Adapter 3 to 1 Parallel Tube Connector, 0.267" ID x 8.6mm OD ports
PC6 72-2667	Multiport Adapter 3 to 1 Parallel Tube Connector, 0.142" to 0.158" ID ports
PC6 72-7479	Multiport Adapter 2 to 1 Parallel Tube Connector, 0.142" to 0.158" ID ports
PC6 72-7480	Multiport Adapter 2 to 1 Parallel Tube Connector, 0.161" ID ports
PC6 72-2677	Multiport Adapter 6 to 1 Parallel Tube Connector, 0.161" ID ports

## Luer Stopcock Kit



The Luer Stopcock Kit includes a collection of 1-, 3- and 4-way stopcocks. Fittings include MLL (male Luer lock), FLL (female Luer lock) and Male Luer Slip. Some stopcocks have high pressure capabilities. This kit is supplied in a convenient box. All kit components are also sold separately.

## Luer Stopcock Kit

ORDER #	PRODUCT
PC6 72-1664	Luer Stopcock Kit

## KIT COMPONENTS:

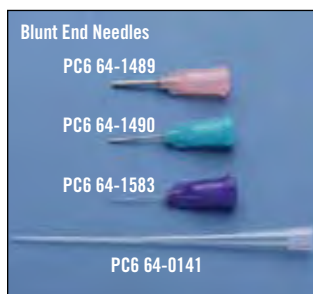
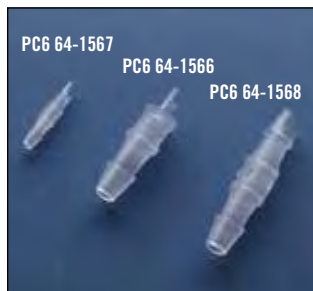
PC6 72-8327	One Way Stopcock (200 psi), FLL/Male Luer Slip
PC6 72-2647	One Way Stopcock (500 psi), FLL/MLL (Non-Rotating)
PC6 72-2648	3-Way Stopcock (1050 psi), FLL/FLL/MLL (Rotating)
PC6 72-2650	One Way Stopcock (1050 psi), FLL/MLL (Non-Rotating)
PC6 72-8326	One Way Stopcock (200 psi), FLL/MLL (Rotating)
PC6 72-8335	4-Way Stopcock, FLL/FLL/Male Luer Slip
PC6 72-2693	3-Way Stopcock (200 psi), FLL/FLL/Male Luer Slip
PC6 72-2654	4-Way Stopcock, FLL/FLL/MLL (Rotating)
PC6 72-2655	One Way Stopcock (1050 psi), FLL/MLL (Rotating)
PC6 72-2656	3-Way Stopcock, FLL/FLL/MLL (Rotating)
PC6 72-2657	One Way Stopcock (500 psi), FLL/MLL (Rotating)
PC6 72-2658	3-Way Stopcock (1050 psi), FLL/FLL/MLL (Non-Rotating)
PC6 72-2659	3-Way Stopcock, FLL/FLL/FLL
PC6 72-2660	3-Way Stopcock (500 psi), FLL/FLL/MLL (Non-Rotating)
PC6 72-2661	4-Way Stopcock, FLL/FLL/MLL (Rotating)
PC6 72-2662	3-Way Stopcock (200 psi), FLL/FLL/MLL (Rotating)
PC6 72-2663	One Way Stopcock, FLL/MLL (Rotating)
PC6 72-9473	3-Way Stopcock (130 psi), FLL/FLL/MLL (Non-Rotating)

## Micro Tubing and Connector Kit, Syringe Needles

### Parts and Accessories



Components listed at right are included in the tubing and connector kit. Components also sold separately.



The kit is comprised of barbed and Luer fittings, blunt end needles, and an assortment of PE and C-Flex tubing. All barbed and Luer fittings are made from polypropylene and include tube to tube, reducing, Y-, T-, Luer-to-Luer, and Luer-to-barb adapters.

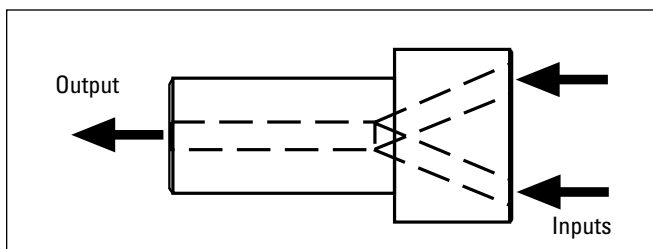
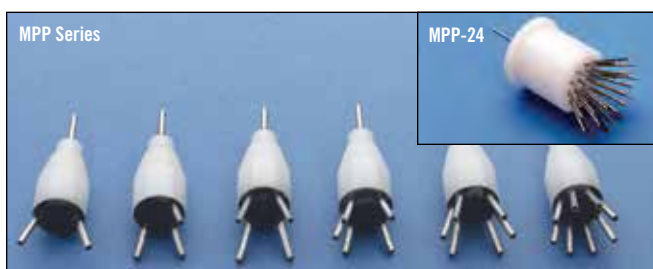
Comes in a convenient plastic storage box.

Order #	Model	Product
PC6 64-1565	KIT-1	Fitting and Tubing Kit

Order #	Product
PC6 64-1566	Tube Fitting Barb 1/8" to 1/16", pkg. of 10
PC6 64-1567	Tube Fitting Barb 1/16" to 1/16", pkg. of 10
PC6 64-1568	Tube Fitting Barb 1/8" to 1/8", pkg. of 10
PC6 64-1569	Tube Fitting Tee Barb 1/16", pkg. of 10
PC6 64-1570	Tube Fitting Tee Barb 1/8", pkg. of 10
PC6 64-1571	Tube Fitting Y Barb 1/16", pkg. of 10
PC6 64-1572	Tube Fitting Y Barb 1/8", pkg. of 10
PC6 64-1573	Tube Fitting Barb 1/16" to Luer Male, pkg. of 10
PC6 64-1574	Tube Fitting Barb 1/8" to Luer Male, pkg. of 10
PC6 64-1575	Tube Fitting Barb 1/16" to Luer Female, pkg. of 10
PC6 64-1576	Tube Fitting Barb 1/8" to Luer Female, pkg. of 10
PC6 64-1577	Tube Fitting Luer Male to Luer Female, pkg. of 10
PC6 64-1578	Tube Fitting Luer Tee Female, pkg. of 10
PC6 64-1579	Tube Fitting Luer Male to Luer Male, pkg. of 10
PC6 64-1580	Tube Fitting Luer Female to Luer Female, pkg. of 10
PC6 64-1581	Tube Fitting Luer Female Plug, pkg. of 10
PC6 64-1582	Tube Fitting Luer Male Plug, pkg. of 10
PC6 64-0141	LPE-50, Luer to PE-50 tubing adapter, pkg. of 8
PC6 64-0166	CFL-6, C-Flex tubing (1/32" ID x 6 ft) 3/32 OD mm, 6 ft
<b>BLUNT NEEDLE PLASTIC HUB</b>	
PC6 64-1489	SN-18, 18G, 0.5", pkg. of 12
PC6 64-1490	SN-23, 23G, 0.5", pkg. of 12
PC6 64-1583	SN-30, 30G, 0.5", pkg. of 12
PC6 64-1869	SN-20, 20G, 0.5", Pkg. of 12
<b>POLYETHYLENE TUBING</b>	
PC6 64-0750	PE-10/10., 0.28 ID x 0.61 OD mm, 3.1 m (10 ft) long
PC6 64-0752	PE-50/10., 0.58 ID x 0.97 OD mm, 3.1 (10 ft) long
PC6 64-0754	PE-90/10., 0.86 ID x 1.27 OD mm, 3.1 m (10 ft) long
PC6 64-0755	PE-160/10., 1.14 ID x 1.57 OD mm, 3.1 m (10 ft) long

## ML, MM, MP and MPP Series

### Manifolds and Flow Control Hardware



#### ML, MM, MP and MPP Series Material and Size Chart

	ML Series	MM Series	MP Series	MPP Series
<b>MATERIAL</b>	Delrin™	Delrin™	PTFE	Delrin™
<b>LARGE DIAMETER</b>	8.0 mm	8.0 mm	9.4 mm	9.4 mm
<b>SMALL DIAMETER</b>	4.7 mm	4.7 mm	6.3 mm	4.7 mm
<b>BODY LENGTH</b>	18 mm	18 mm	22 mm	21 mm
<b>INPUT TUBING</b>	PE-50	PE-50	PE-160	PE-160
<b>OUTPUT TUBING</b>	PE-50	PE-10	PE-160	PE-160

## Multi-in or multi-out manifolds for fluid management

Harvard Apparatus manifolds can be used in any application where from 2 to 8 perfusion lines are required to be connected to a chamber or other device. Manifold inputs converge to the common output with minimum dead space. Designed for use with polyethylene (PE) tubing, manifolds can be used with any other tubing of similar dimensions. When connected to a chamber via a short length of tubing, very rapid solution changes are possible.

### ML and MM Series

These miniature manifolds are useful for applications involving small volumes or slow flow rates. Small diameter tubing is used with these models; PE-50 tubing for the input ports, and PE-10 or PE-50 tubing for the MM or ML series output ports, respectively.

### MP Series

MP series manifolds are recommended low pressure (< 25 psi) systems. Input and output tubing are inserted with a friction fit. Manifolds should be ordered with inputs to match the number of solutions to be connected. Pin plugs to block unused inputs are also supplied. MP series manifolds are used with PE-160 tubing.

### MPP Series

These manifolds are suitable for systems in which solutions are pumped or at pressures < 25 psi. Input and output ports are 18 gauge stainless steel hypodermic tubing. PE-160 tubing slides over these ports to make a snug fit.

Order #	Model	Product
PC6 64-0200	ML-2	Miniature Manifold, 2 ports
PC6 64-0201	ML-4	Miniature Manifold, 4 ports
PC6 64-0202	ML-6	Miniature Manifold, 6 ports
PC6 64-0199	ML-8	Miniature Manifold, 8 ports
PC6 64-0203	MM-2	Miniature Manifold, 2 ports
PC6 64-0204	MM-4	Miniature Manifold, 4 ports
PC6 64-0205	MM-6	Miniature Manifold, 6 ports
PC6 64-0206	MP-2	MP Manifold, 2 ports
PC6 64-0207	MP-3	MP Manifold, 3 ports
PC6 64-0208	MP-4	MP Manifold, 4 ports
PC6 64-0209	MP-5	MP Manifold, 5 ports
PC6 64-0210	MP-6	MP Manifold, 6 ports
PC6 64-0211	MP-8	MP Manifold, 8 ports
PC6 64-0212	MPP-2	MPP Manifold, 2 ports
PC6 64-0213	MPP-3	MPP Manifold, 3 ports
PC6 64-0214	MPP-4	MPP Manifold, 4 ports
PC6 64-0215	MPP-5	MPP Manifold, 5 ports
PC6 64-0216	MPP-6	MPP Manifold, 6 ports
PC6 64-0217	MPP-8	MPP Manifold, 8 ports
PC6 64-0339	MPP-24	MPP Manifold, 24 ports

*All manifolds can be easily disassembled for cleaning.*

## How to Calculate the Pressure Requirement of Your Experiment

**T**he following chart will help you determine the pressure requirement of your experiment. This is important in selecting the correct pump with the proper psi capability for your application. Choose the selections that are the closest to your experimental conditions or write in your actual values. Once you have filled in the chart call us for technical assistance if needed.

- 1 Nature of the sample you are flowing into (Application)
- 2 The flow rate of the material
- 3 The surface area of the syringe and the linear force capability of the pump
- 4 The tubing diameter
- 5 The tubing length
- 6 Viscosity of the material being pumped
- 7 The temperature of the material being pumped

NORMAL PRESSURE	HIGH FORCE	EXTREME HIGH PRESSURE
0 to 30 psi (0 to 2 bar)	31 to 150 psi (2.1 to 10.2 bar)	151 to 2000 psi (10.3 to 137 bar)

### 1. Application

L O W	Flow into open containers, i.e. titrations, food trays filling		
	Inject into Tissue, i.e. Drug infusion into muscle, brain		
H I G H	Flow into closed container, i.e. Reaction Chamber 350 to 400 psi		
	High viscosity solutions at high flow rates in a short period of time, i.e. Corn syrup		

### 2. FLOW RATE -Pumping Speed (The faster the flow rate, the higher the pressure)

0.003 µl/hr to 140 ml/min		
141 ml/min to 220 ml/min		

### 3. SYRINGE SIZE (Syringe volume/plunger area + linear force of pump)

10 µl to 1 ml ie. 500 µl/min x 20 lb = 1500 psi		
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### 4. TUBING SIZE (Inner diameter, Smaller ID = higher pressure)

SMALL -Capillary (the longer more pressure)		
LARGE -Hose		

### 5. TUBING LENGTH -DISTANCE (Depends on ID Smaller ID = higher pressure)

Short, < 1M		
Long, > 1M		

### 6. VISCOSITY OF MATERIAL TO BE PUMPED (Higher viscosity = higher pressure)

AIR	18°C = 0.0182 cP		
WATER	20°C = 1.002 cP		
OLIVE OIL	20°C = 84 cP		
PANCAKE SYRUP	20°C = 2500 cP		
HONEY	20°C = 10000 cP		
PEANUT BUTTER	20°C = 250000 cP		

### 7. TEMPERATURE OF SOLUTIONS BEING PUMPED (Higher temperature = lower viscosity = lower pressure)

0 to 15°C		
15 to 80°C		

## Syringe Pump Pressure and Flow Rate

### How to Calculate the Pressure of Various Syringe Sizes

The pressure that a syringe pump can generate is a function of both the force of the pump (measured at the pusher block in pounds) as well as the physical characteristics of the syringe and setup used. The following table compares various syringe pumps and the pressures in PSI (pounds per square inch). Each data point was calculated by dividing the average pump force by the surface area (in square inches) of syringes with diameters from 0.1 to 50 mm. Diameters and surface areas for a variety of syringes can be found in the table on page 112. This table is intended to be a guide of total pressures generated. Actual values may be higher or lower than the listed pressures due to the influence of other factors such as tubing diameter and length. When using more than one syringe sharing the same pusher block, the pressure is calculated by dividing the force (lb) by the total surface area (square inches) of all syringes on the pump. For example, nominal pressure obtained using two 25 ml Hamilton Gastight® syringes on a PHD 22/2000 standard pressure syringe pump would be:

$$50 \text{ lb} / (0.644 \text{ in}^2 \times 2) = 38.81 \text{ PSI (2.68 bars)}.$$

### Minimum/Maximum Flow Rates by Pump and Syringe Size

Flow rates were calculated based on the pusher block travel rate for each pump (rate at which the syringe pump moves the syringe plunger) and the diameter of the syringe.

#### PHD 22/2000 HPSI Flow Rates

Syringe Size	Diameter **	Minimum	Maximum
20 ml	19.13 mm	1.5 µl/hr	20 ml/min
50 ml	28.60 mm	3.4 µl/hr	46 ml/min
100 ml	34.90 mm	5.0 µl/hr	68 ml/min
200 ml	44.75 mm	8.2 µl/hr	112 ml/min

\* The Rates listed are for single stainless steel syringe

\*\*Note: These figures have been rounded and therefore may not exactly match the Syringe Diameter Chart on page 112.

#### PHD ULTRA™ HPSI & XF Flow Rates

Syringe Size	Syringe ID **	Minimum Rate	Maximum Rate
20 ml	19.130 mm	50.7884 nl/min	26.3709 ml/min
30 ml	21.590 mm	64.6904 nl/min	33.5893 ml/min
50 ml	28.600 mm	113.519 nl/min	58.9423 ml/min
100 ml	34.900 mm	169.038 nl/min	87.7700 ml/min
130 ml	37.948 mm	199.854 nl/min	103.770 ml/min
200 ml	44.755 mm	277.983 nl/min	144.337 ml/min

\* The Rates listed are for single stainless steel syringe

\*\*Note: These figures have been rounded and therefore may not exactly match the Syringe Diameter Chart on page 112.

#### Pump 11 Elite Flow Rates

Nominal Minimum/Maximum Flow Rates for Various Syringes.  
(Actual Limits will vary depending on syringe manufacturer)

Syringe Size	Diameter *	Minimum	Maximum
0.5 µl	0.103 mm	1.26 pl/min	1.326 µl/min
1 µl	0.146 mm	2.52 pl/min	2.654 µl/min
2 µl	0.206 mm	5.10 pl/min	5.304 µl/min
5 µl	0.343 mm	14.160 pl/min	14.710 µl/min
10 µl	0.485 mm	28.260 pl/min	29.400 µl/min
25 µl	0.729 mm	63.960 pl/min	66.430 µl/min
50 µl	1.030 mm	127.700 pl/min	132.600 µl/min
100 µl	1.457 mm	255.500 pl/min	265.400 µl/min
250 µl	2.304 mm	638.900 pl/min	663.500 µl/min
500 µl	3.256 mm	1.276 nl/min	1.325 ml/min
1000 µl	4.608 mm	2.556 nl/min	2.654 ml/min
1 ml	4.699 mm	2.658 nl/min	2.760 ml/min
3 ml	8.585 mm	8.871 nl/min	9.213 ml/min
5 ml	11.99 mm	17.300 nl/min	17.970 ml/min
10 ml	14.43 mm	25.050 nl/min	26.020 ml/min
20 ml	19.05 mm	43.680 nl/min	45.360 ml/min
30 ml	21.59 mm	56.110 nl/min	58.270 ml/min
50 ml	26.59 mm	85.130 nl/min	88.400 ml/min
60 ml	26.59 mm	85.130 nl/min	88.400 ml/min

\* Note: These figures have been rounded and therefore may not exactly match the Syringe Diameter Chart on page 112.



## Syringe Pump Pressure and Flow Rate

## Minimum/Maximum Flow Rates By Pump and Syringe Size

## Pico Plus Elite Flow Rates

Nominal Minimum/Maximum Flow Rates for Various Syringes.  
(Actual Limits will vary depending on syringe manufacturer)

Syringe Size	Diameter *	Minimum	Maximum
0.5 µl	0.103 mm	0.54 pl/min	596.5 nl/min
1 µl	0.1457 mm	1.14 pl/min	1.194 µl/min
2 µl	0.206 mm	2.28 pl/min	2.386 µl/min
5 µl	0.343 mm	6.36 pl/min	6.615 µl/min
10 µl	0.485 mm	12.72 pl/min	13.230 µl/min
25 µl	0.729 mm	28.74 pl/min	29.880 µl/min
50 µl	1.030 mm	57.42 pl/min	59.650 µl/min
100 µl	1.457 mm	114.9 pl/min	119.4 µl/min
250 µl	2.304 mm	287.4 pl/min	298.5 µl/min
500 µl	3.256 mm	574.0 pl/min	596.1 µl/min
1000 µl	4.608 mm	1.150 nl/min	1.194 ml/min
1 ml	4.699 mm	1.196 nl/min	1.241 ml/min
3 ml	8.585 mm	3.990 nl/min	4.144 ml/min
5 ml	11.989 mm	7.782 nl/min	8.082 ml/min
10 ml	14.430 mm	11.270 nl/min	11.700 ml/min

\* Note: These figures have been rounded and therefore may not exactly match the Syringe Diameter Chart on page 112.

## Pump 11 Elite Nanomite &amp; PHD ULTRA™ Nanomite Flow Rates

Nominal Minimum/Maximum Flow Rates for Various Syringes.  
(Actual Limits will vary depending on syringe manufacturer)

Syringe Size	Diameter *	Minimum	Maximum
0.5 µl	0.103 mm	3.66 pl/min	1.909 µl/min
1 µl	0.146 mm	7.32 pl/min	3.819 µl/min
2 µl	0.206 mm	14.70 pl/min	7.635 µl/min
5 µl	0.343 mm	40.74 pl/min	21.17 µl/min
10 µl	0.485 mm	81.48 pl/min	42.32 µl/min
25 µl	0.729 mm	184.1 pl/min	95.62 µl/min
50 µl	1.030 mm	367.6 pl/min	190.9 µl/min
100 µl	1.457 mm	735.6 pl/min	381.9 µl/min
250 µl	2.304 mm	1.839 nl/min	955.1 µl/min
500 µl	3.256 mm	3.677 nl/min	1.907 ml/min
1000 µl	4.608 mm	7.358 nl/min	3.820 ml/min

\* Note: These figures have been rounded and therefore may not exactly match the Syringe Diameter Chart on page 112.

## NanoCool Injector Flow Rates

Nominal Minimum/Maximum Flow Rates for Various Syringes.  
(Actual Limits will vary depending on syringe manufacturer)

Syringe Size	Diameter *	Minimum	Maximum
0.5 µl	0.103 mm	3.66 pl/min	1.909 µl/min
1 µl	0.146 mm	7.32 pl/min	3.819 µl/min
2 µl	0.206 mm	14.70 pl/min	7.635 µl/min
5 µl	0.343 mm	40.74 pl/min	21.17 µl/min
10 µl	0.485 mm	81.48 pl/min	42.32 µl/min
25 µl	0.729 mm	184.1 pl/min	95.62 µl/min
50 µl	1.030 mm	367.6 pl/min	190.9 µl/min
100 µl	1.457 mm	735.6 pl/min	381.9 µl/min
250 µl	2.304 mm	1.839 nl/min	955.1 µl/min
500 µl	3.256 mm	3.677 nl/min	1.907 ml/min

\* Note: These figures have been rounded and therefore may not exactly match the Syringe Diameter Chart on page 112.

## PHD ULTRA™ 4400 Flow Rates

Nominal Minimum/Maximum Flow Rates for Various Syringes.  
(Actual Limits will vary depending on syringe manufacturer)

Syringe Size	Diameter *	Minimum	Maximum
0.5 µl	0.103 mm	3.0600 pl/min	1.59133 µl/min
1 µl	0.1457 mm	6.1200 pl/min	3.18423 µl/min
2 µl	0.206 mm	12.240 pl/min	6.36532 µl/min
5 µl	0.343 mm	33.960 pl/min	17.6471 µl/min
10 µl	0.485 mm	67.920 pl/min	35.2833 µl/min
25 µl	0.729 mm	153.480 pl/min	79.7151 µl/min
50 µl	1.030 mm	306.420 pl/min	159.133 µl/min
100 µl	1.457 mm	613.200 pl/min	318.423 µl/min
250 µl	2.304 mm	1.53348 nl/min	796.252 µl/min
500 µl	3.256 mm	3.06258 nl/min	1.59021 ml/min
1 ml	4.699 mm	6.37872 nl/min	3.31205 ml/min
2.5 ml	4.851 mm	6.79806 nl/min	3.52979 ml/min
3 ml	8.585 mm	21.915 nl/min	11.0552 ml/min
5 ml	11.989 mm	41.5232 nl/min	21.5601 ml/min
8 ml	9.525 mm	26.2093 nl/min	13.6087 ml/min
10 ml	14.427 mm	60.1280 nl/min	31.2204 ml/min
20 ml	19.050 mm	104.837 nl/min	54.4347 ml/min
30 ml	21.590 mm	134.658 nl/min	69.9183 ml/min
50 ml	26.594 mm	204.311 nl/min	106.085 ml/min
100 ml	34.900 mm	351.865 nl/min	182.699 ml/min
140 ml	37.950 mm	416.009 nl/min	216.005 ml/min

\* Note: These figures have been rounded and therefore may not exactly match the Syringe Diameter Chart on page 112.

## Syringe Pump Pressure and Flow Rate

## Minimum/Maximum Flow Rates By Pump and Syringe Size

## PHD ULTRA™ Flow Rates

Nominal Minimum/Maximum Flow Rates for Various Syringes.  
(Actual Limits will vary depending on syringe manufacturer)

Syringe Size	Diameter *	Minimum	Maximum
0.5 µl	0.103 mm	1.500 pl/min	1.59133 µl/min
1 µl	0.1457 mm	3.060 pl/min	3.18423 µl/min
2 µl	0.206 mm	6.120 pl/min	6.36532 µl/min
5 µl	0.343 mm	16.980 pl/min	17.6471 µl/min
10 µl	0.485 mm	33.960 pl/min	35.2833 µl/min
25 µl	0.729 mm	76.740 pl/min	79.7151 µl/min
50 µl	1.030 mm	153.180 pl/min	159.133 µl/min
100 µl	1.457 mm	306.600 pl/min	318.423 µl/min
250 µl	2.304 mm	766.740 pl/min	796.252 µl/min
500 µl	3.256 mm	1.53126 nl/min	1.59021 ml/min
1 ml	4.699 mm	3.18936 nl/min	3.31205 ml/min
2.5 ml	4.851 mm	3.3990 nl/min	3.52979 ml/min
3 ml	8.585 mm	10.645 nl/min	11.0552 ml/min
5 ml	11.989 mm	20.7616 nl/min	21.5601 ml/min
8 ml	9.525 mm	13.1046 nl/min	13.6087 ml/min
10 ml	14.427 mm	30.0640 nl/min	31.2204 ml/min
20 ml	19.050 mm	52.4186 nl/min	54.4347 ml/min
30 ml	21.590 mm	67.3288 nl/min	69.9183 ml/min
50 ml	26.594 mm	102.156 nl/min	106.085 ml/min
100 ml	35.700 mm	184.091 nl/min	191.171 ml/min
140 ml	37.948 mm	208.005 nl/min	216.005 ml/min

\* Note: These figures have been rounded and therefore may not exactly match the Syringe Diameter Chart on page 112.

## PHD 22/2000 and PHD 4400 Hpsi Flow Rates

Syringe Size	Diameter *	Minimum	Maximum
0.5 µl	0.10 mm	0.0001 µl/hr	95.330 µl/hr
1 µl	0.15 mm	0.0002 µl/hr	190.70 µl/hr
2 µl	0.21 mm	0.0004 µl/hr	381.30 µl/hr
5 µl	0.33 mm	0.0010 µl/hr	953.17 µl/hr
10 µl	0.46 mm	0.0019 µl/hr	1.901 ml/hr
25 µl	0.73 mm	0.0046 µl/hr	4.775 ml/hr
50 µl	1.03 mm	0.0092 µl/hr	9.551 ml/hr
100 µl	1.46 mm	0.0183 µl/hr	19.153 ml/hr
250 µl	2.30 mm	0.0454 µl/hr	47.532 ml/hr
500 µl	3.26 mm	0.0911 µl/hr	95.492 ml/hr
1000 µl	4.61 mm	0.0031 µl/min	190.950 ml/hr
1 ml	5.00 mm	0.0033 µl/min	205.30 ml/hr
2 ml	9.00 mm	0.0119 µl/min	747.35 ml/hr
2.5 ml	7.28 to 9.6 mm	0.0076 µl/min	476.21 ml/hr
3 ml	8.66 to 9.0 mm	0.0100 µl/min	11.231 ml/min
5 ml	10.3 to 13.0 mm	0.0208 µl/min	21.781 ml/min
10 ml	14.57 to 15.9 mm	0.0301 µl/min	31.486 ml/min
20 ml	19.13 to 20.05 mm	0.0523 µl/min	54.804 ml/min
30 ml	21.7 to 23.2 mm	0.0673 µl/min	70.518 ml/min
50 ml	26.7 to 32.6 mm	0.1019 µl/min	106.76 ml/min
100 ml	34.9 to 35.7 mm	0.1740 µl/min	182.40 ml/min
140 ml	38.40 mm	0.2106 µl/min	220.82 ml/min

\* Note: These figures have been rounded and therefore may not exactly match the Syringe Diameter Chart on page 112.

## Pump 33 DDS Flow Rates

Syringe Size	Diameter *	Minimum	Maximum
0.5 µl	0.103 mm	1.02 pl/min	1.06 µl/min
1 µl	0.146 mm	2.04 pl/min	2.13 µl/min
2 µl	0.206 mm	4.24 pl/min	4.08 µl/min
5 µl	0.343 mm	11.28 pl/min	11.75 µl/min
10 µl	0.485 mm	22.62 pl/min	23.5 µl/min
25 µl	0.729 mm	51.12 pl/min	53.09 µl/min
50 µl	1.030 mm	102.1 pl/min	106 µl/min
100 µl	1.457 mm	204.2 pl/min	212.1 µl/min
250 µl	2.304 mm	510.7 pl/min	530.2 µl/min
500 µl	3.256 mm	1.02 nl/min	1.059 ml/min
1000 µl	4.608 mm	2.043 nl/min	2.121 ml/min
1 ml	4.699 mm	2.124 nl/min	2.206 ml/min
3 ml	8.585 mm	7.091 nl/min	7.363 ml/min
5 ml	11.99 mm	13.83 nl/min	14.36 ml/min
10 ml	14.43 mm	20.03 nl/min	20.8 ml/min
20 ml	19.05 mm	34.91 nl/min	36.26 ml/min
30 ml	21.59 mm	44.84 nl/min	46.57 ml/min
50/60 ml	26.59 mm	68.02 nl/min	70.64 ml/min
50/60 ml	29.2 mm	82.03 nl/min	85.1 ml/min

\* Note: These figures have been rounded and therefore may not exactly match the Syringe Diameter Chart on page 112.

## Common Syringe Data

## Diameter and Plunger Surface Area

The following list is a guide to common syringes and their associated diameters and surface area. Syringe diameter data, in mm, is listed below for each syringe. All Harvard Apparatus microprocessor syringe pumps require the user to input syringe diameter information. The pump uses this diameter data to set flow rates. The PHD 22/2000 series of syringe pumps also has this information built into the pump memory in a handy Syringe Look Up Table. Surface area information

was used to calculate PSI (pounds per square inch) data for the pressure on page 111. Average pressures for any syringe pump and syringe combination can be calculated by dividing the average (nominal) syringe pump force by the syringe diameter (in square inches) to obtain PSI. Example, nominal pressure obtained using a 25 ml Hamilton Gastight® Syringe on a PHD 22/2000 standard pressure syringe pump would be: 50 lb / 0.644 in<sup>2</sup> = 77.6 PSI (5.35 bars).

## Common Syringe Diameters

Volume	Diameter (mm)	Surface Area (in <sup>2</sup> )
<b>BD Plastic</b>		
1 ml	4.699	0.026880
3 ml	8.585	0.089722
5 ml	11.989	0.174980
10 ml	14.427	0.253381
20 ml	19.05	0.441786
30 ml	21.59	0.567450
50/60 ml	26.594	0.860974
<b>BD Glass</b>		
0.5 ml	4.64	0.026209
1 ml	4.64	0.026209
2.5 ml	8.66	0.091297
5 ml	11.86	0.171235
10 ml	14.34	0.250335
20 ml	19.13	0.445505
30 ml	22.7	0.627298
50 ml	28.6	0.995760
100 ml	34.9	1.482768
<b>SGE Glass</b>		
25 µl	0.73	0.000649
50 µl	1.03	0.001292
100 µl	1.46	0.002595
250 µl	2.3	0.006440
500 µl	3.26	0.012938
1 ml	4.61	0.025872
2.5 ml	7.28	0.064519
5 ml	10.3	0.129151
10 ml	14.57	0.258429

## Common Syringe Diameters

Volume	Diameter (mm)	Surface Area (in <sup>2</sup> )
<b>Harvard Apparatus Stainless Steel</b>		
2.5 ml	4.851	0.027937
8 ml	9.525	0.110447
20 ml	19.13	0.445505
50 ml	28.6	0.995760
100 ml	34.9	1.482768
200 ml	44.75	2.438382
<b>Terumo Plastic</b>		
3 ml	8.95	0.097514
5 ml	13	0.205735
10 ml	15.8	0.303904
20 ml	20.15	0.494279
30 ml	23.1	0.649601
60 ml	29.1	1.030881
<b>Air-Tite All Plastic</b>		
2.5 ml	9.6	0.112193
5 ml	12.45	0.188695
10 ml	15.9	0.307763
20 ml	20.05	0.489386
30 ml	22.9	0.638401
50 ml	29.2	1.037979
<b>Cadence Science (formerly Popper &amp; Sons) Perfectum Glass</b>		
0.5 ml	3.45	0.014490
1 ml	4.5	0.024652
2 ml	8.92	0.096862
3 ml	8.99	0.098388
5 ml	11.7	0.166646
10 ml	14.7	0.263061
20 ml	19.58	0.466711
30 ml	22.7	0.627298
50 ml	29	1.023808
100 ml	35.7	1.551525

## Common Syringe Diameters

Volume	Diameter (mm)	Surface Area (in <sup>2</sup> )
<b>Hamilton Gastight Glass</b>		
0.5 µl	0.103	0.000013
1 µl	0.146	0.000026
2 µl	0.206	0.000052
5 µl	0.343	0.000129
10 µl	0.485	0.000258
25 µl	0.729	0.000647
50 µl	1.03	0.001294
100 µl	1.457	0.002595
250 µl	2.304	0.006440
500 µl	3.256	0.012938
1 ml	4.608	0.025872
2.5 ml	7.285	0.064519
5 ml	10.3	0.129151
10 ml	14.567	0.258429
25 ml	23.033	0.643989
50 ml	32.573	1.293772
100 ml	32.573	1.293772
<b>Covidien Monoject Plastic (formerly Kendall)</b>		
1 ml	4.674	0.026323
3 ml	8.865	0.097297
6 ml	12.600	0.196350
12 ml	15.621	0.307763
20 ml	20.142	0.506621
35 ml	23.571	0.689567
60 ml	26.568	0.861362
140 ml	37.948	1.795084

## Syringe Selection Guide and Reglo Digital/Analog Flow Rates

## Syringe Selection Guide

Syringe Type/ Size	Swage Lock	Luer Lock	RN	Threaded 1/4-28	Luer Slip Fit	Pressure Maximum p.s.i.	Compatibility with Substance in Syringe	Accuracy 1%	Accuracy 5%	Materials
<b>Stainless Steel Syringes, see pages 46 to 47</b>										
2.5 ml	•					7,500	Maximum	•		316 / St. Steel
8 ml	•					1,500	Maximum	•		316 / Perfluoroelastomer
20 ml	•	•				750	Maximum	•		316 / Viton or Perfluoroelastomer
50 ml	•	•				750	Maximum	•		316 / Viton or Perfluoroelastomer
100 ml	•	•				750	Maximum	•		316 / Viton or Perfluoroelastomer
200 ml	•	•				750	Maximum	•		316 / Viton or Perfluoroelastomer
<b>Glass GasTight Syringes, see pages 47 to 53</b>										
1 to 100 µl		•	•	•	•	1,000	Maximum	•		Glass and PTFE
250 to 500 µl		•	•	•	•	500	Maximum	•		Glass and PTFE
1 to 10 ml		•	•	•		200	Maximum	•		Glass and PTFE
25 to 100 ml		•	•	•		100	Maximum	•		Glass and PTFE
<b>Plastic Syringes, see pages 54 to 55</b>										
1 ml		•			•	125	Minimum		•	Polypropylene and Natural Rubber
5 ml		•			•	125	Minimum		•	Polypropylene and Natural Rubber
10 ml		•			•	125	Minimum		•	Polypropylene and Natural Rubber
20 ml		•			•	125	Minimum		•	Polypropylene and Natural Rubber
30 ml		•			•	125	Minimum		•	Polypropylene and Natural Rubber
50/60 ml		•			•	125	Minimum		•	Polypropylene and Natural Rubber
140 ml		•			•	125	Minimum		•	Polypropylene and Natural Rubber

## REGLO Analog and Digital Pumps using 3-Stop Collared Tubing Flow Rates

		REGLO Digital 2 Channel						REGLO Digital 4 Channel					
	3-STOP TUBING	MS-2/6-160 ML/MIN PER CHANNEL		MS-2/8-160 ML/MIN PER CHANNEL		MS-2/12-160 ML/MIN PER CHANNEL		MS-4/6-100 ML/MIN PER CHANNEL		MS-4/8-100 ML/MIN PER CHANNEL		MS-4/12-100 ML/MIN PER CHANNEL	
AME#	ID MM	Min.*	Max.	Min.*	Max.	Min.*	Max.	Min.*	Max.	Min.*	Max.	Min.*	Max.
00	0.13	0.003	0.22	0.002	0.17	0.002	0.15	0.002	0.14	0.002	0.11	0.001	0.093
01	0.19	0.005	0.45	0.004	0.37	0.004	0.34	0.003	0.28	0.003	0.23	0.003	0.21
02	0.25	0.008	0.76	0.007	0.65	0.007	0.6	0.005	0.48	0.005	0.41	0.004	0.38
03	0.38	0.017	1.7	0.015	1.5	0.014	1.4	0.011	1.1	0.01	0.94	0.009	0.88
04	0.44	0.023	2.3	0.020	2.0	0.019	1.9	0.014	1.4	0.013	1.3	0.012	1.2
05	0.51	0.061	3.1	0.027	2.7	0.025	2.5	0.019	1.9	0.017	1.7	0.016	1.6
06	0.57	0.038	3.8	0.033	3.3	0.031	3.1	0.024	2.4	0.021	2.1	0.019	1.9
07	0.64	0.048	4.8	0.042	4.2	0.039	3.9	0.03	3	0.026	2.6	0.024	2.4
08	0.76	0.067	6.7	0.058	5.8	0.053	5.3	0.042	4.2	0.036	3.6	0.033	3.3
09	0.89	0.090	9.0	0.079	7.9	0.071	7.1	0.057	5.7	0.049	4.9	0.044	4.4
10	0.95	0.10	10	0.089	8.9	0.079	7.9	0.064	6.4	0.056	5.6	0.05	5
11	1.02	0.12	12	0.10	10	0.090	9.0	0.073	7.3	0.063	6.3	0.056	5.6
12	1.09	0.13	13	0.11	11	0.10	10	0.083	8.3	0.072	7.2	0.063	6.3
13	1.14	0.14	14	0.12	12	0.11	11	0.09	9	0.078	7.8	0.067	6.7
14	1.22	0.16	16	0.14	14	0.12	12	0.1	10	0.088	8.8	0.075	7.5
15	1.3	0.18	18	0.16	16	0.13	13	0.11	11	0.1	10	0.083	8.3
16	1.42	0.21	21	0.18	18	0.15	15	0.13	13	0.11	11	0.094	9.4
17	1.52	0.24	24	0.20	20	0.17	17	0.15	15	0.13	13	0.1	10
18	1.65	0.28	28	0.23	23	0.19	19	0.17	17	0.15	15	0.12	12
19	1.75	0.31	31	0.26	26	0.20	20	0.19	19	0.16	16	0.13	13
20	1.85	0.34	34	0.28	28	0.21	21	0.21	21	0.17	17	0.13	13
21	2.06	0.40	40	0.33	33	0.24	24	0.25	25	0.2	20	0.15	15
22	2.29	0.46	46	0.38	38	0.27	27	0.29	29	0.24	24	0.17	17
23	2.54	0.53	53	0.44	44	0.31	31	0.33	33	0.27	27	0.19	19
24	2.79	0.59	59	0.50	50	0.34	34	0.37	37	0.31	31	0.21	21
25	3.1	0.68	68	0.57	57	0.38	38	0.43	43	0.35	35	0.24	24

\*Note: Flow rate for REGLO Analog= 2% of Max Flow Rate

Note: Approximate values: determined with water at 22°C, no differential pressure, with Tygon® Tubing.

# French Scale and Needle Gauge Cross Reference Chart

French Scale and Needle Gauge Cross Reference Chart								
French Scale	Exact French OD		Needle Gauge	Exact Gauge OD		Exact Gauge ID		Volume
	inches	mm		inches	mm	inches	mm	µl/in
–	0.0083	0.21	33	0.0083	0.21	0.0040	0.11	0.20
–	0.0093	0.24	32	0.0093	0.24	0.0043	0.11	0.20
–	0.0103	0.26	31	0.0103	0.26	0.0053	0.13	0.34
–	0.0123	0.31	30	0.0123	0.31	0.0063	0.16	0.45
1	0.013	0.33	29	0.013	0.33	–	–	–
–	0.014	0.36	28	0.014	0.36	0.0073	0.18	0.63
–	0.016	0.41	27	0.016	0.41	0.0083	0.21	0.80
–	0.018	0.46	26	0.018	0.46	0.0103	0.26	1.25
1.8	0.024	0.61	25	0.023	0.51	0.0103	0.26	1.25
–	0.022	0.57	24	0.022	0.57	0.0123	0.31	1.80
2	0.026	0.66	23	0.025	0.64	0.0133	0.34	2.17
–	0.028	0.72	22	0.028	0.72	0.0163	0.41	3.35
2.4	0.031	0.79	21	0.032	0.82	0.0203	0.51	5.19
2.9	0.038	0.97	20	0.036	0.91	0.0238	0.60	6.71
3	0.039	0.99	–	0.039	0.99	–	–	–
3.3	0.043	1.09	19	0.042	1.07	0.0270	0.69	–
3.7	0.048	1.22	–	0.048	1.22	–	–	–
3.8	0.050	1.27	18	0.050	1.27	0.0330	0.84	14.08
4	0.052	1.32	–	0.052	1.32	–	–	–
4.6	0.060	1.52	17	0.058	1.47	0.0420	1.07	22.84
4.7	0.062	1.57	–	0.062	1.57	–	–	–
5	0.066	1.68	16	0.065	1.65	0.0470	1.19	28.25
5.1	0.067	1.70	–	0.067	1.70	–	–	–
5.7	0.075	1.91	15	0.072	1.83	0.0540	1.37	–
5.9	0.078	1.98	–	0.078	1.98	–	–	–
6	0.079	2.01	–	0.079	2.01	–	–	–
6.2	0.082	2.08	14	0.083	2.11	0.0630	1.60	51.07
7	0.092	2.34	–	0.092	2.34	–	–	–
7.2	0.095	2.41	13	0.095	2.41	0.0710	1.80	64.63
8	0.105	2.67	–	0.105	2.67	–	–	–
8.1	0.106	2.69	–	0.106	2.69	–	–	–
–	0.109	2.77	12	0.109	2.77	0.0850	2.16	93.07
8.4	0.118	3.00	11	0.120	3.05	0.0940	2.39	113.00
9.8	0.128	3.25	–	0.128	3.25	–	–	–
10	0.131	3.33	10	0.134	3.40	0.1060	2.69	143.28
11	0.145	3.68	–	0.145	3.68	–	–	–
11.7	0.153	3.89	–	0.153	3.89	–	–	–
12.3	0.161	4.09	–	0.161	4.09	–	–	–
13	0.171	4.34	–	0.171	4.34	–	–	–
14	0.184	4.67	–	0.184	4.67	–	–	–
15	0.197	5.00	–	0.197	5.00	–	–	–
16	0.210	5.33	–	0.210	5.33	–	–	–
17	0.223	5.66	–	0.223	5.66	–	–	–
18	0.236	5.99	–	0.236	5.99	–	–	–

\* French Scale = OD (in) x 76.211 - 0.0014



## Pressure Unit Conversion Chart

Pressure Unit Cross Reference Chart

	atm	psi	cm H <sub>2</sub> O	mm Hg	kPa	inch H <sub>2</sub> O	inch Hg	mbar
1 atm =	1	14.696	1033.228	760	101.325	406.783	29.921	1013.25
1 psi =	0.068	1	70.307	51.715	6.895	27.68	2.036	68.948
1 cm H <sub>2</sub> O =	0.001	0.0142	1	0.7356	0.0981	0.3937	0.0291	0.9807
1 mm Hg =	0.0013	0.0193	1.36	1	0.133	0.5352	0.039	1.333
1 kPa =	0.0099	0.145	10.197	7500.616	1	4.015	0.295	10
1 inch H <sub>2</sub> O =	0.0025	0.036	2.54	1.868	0.2491	1	0.0736	2.491
1 inch Hg =	0.0334	0.4912	34.532	25399	3.386	13.595	1	33.864
1 mbar =	0.001	0.015	1.02	0.7501	0.1	0.4015	0.0295	1

Force Units Conversion Table

mN	mg-force	mp
0.1	10	10.2
0.2	20	20.39
0.3	30	30.59
0.4	40	40.79
0.5	50	50.99
0.6	60	61.18
0.7	70	71.38
0.8	80	81.58
0.9	90	91.77
1	100	101.97
2	200	203.94
3	300	305.91
4	400	407.89
5	500	509.86
6	600	611.83
7	700	713.8
8	800	815.77
9	900	917.74
<i>1N = 1 Newton = 1 kg m/s<sup>2</sup></i>		
<i>1p = 1 Pond</i>		

# Harvard Apparatus Peristaltic Minimum/Maximum Flow Rate by Tubing Size

## Flow Rate by Tubing Size P-70

Tubing Outer Diameter	Tubing Wall Thickness	Tubing Inner Diameter	Minimum	Maximum
(mm)	(mm)	(mm)	Flow, ml/min	Flow, nl/min
1.73	1.6	0.13	0.525	0.166
1.79	1.6	0.19	1.121	0.356
1.85	1.6	0.25	1.942	0.616
1.93	1.6	0.38	4.487	1.425
2.1	1.6	0.5	7.769	2.467
2.23	1.6	0.63	12.33	3.918
2.36	1.6	0.76	17.95	5.701
2.48	1.6	0.88	24.06	7.644
2.62	1.6	1.02	32.33	10.27
2.74	1.6	1.14	40.38	12.82
2.89	1.6	1.29	57.71	16.42
3.02	1.6	1.42	62.66	19.9
3.12	1.6	1.52	71.8	22.8
3.25	1.6	1.65	84.6	26.87
3.45	1.6	1.85	106.3	33.78
3.65	1.6	2.05	130.6	41.48
3.98	1.6	2.38	176	55.91
4.14	1.6	2.54	200.5	63.68
4.39	1.6	2.79	241.9	76.84

## Flow Rate by Tubing Size P-230

Tubing Outer Diameter	Tubing Wall Thickness	Tubing Inner Diameter	Minimum	Maximum
(mm)	(mm)	(mm)	Flow, ml/min	Flow, nl/min
1.95	1.82	0.13	1.35	0.521
2.01	1.82	0.19	2.88	1.112
2.07	1.82	0.25	4.99	1.926
2.2	1.82	0.38	11.5	4.451
2.26	1.82	0.44	15.4	5.967
2.33	1.82	0.51	20.7	8.017
2.39	1.82	0.57	25.9	10.01
2.46	1.82	0.64	37.7	12.62
2.48	1.72	0.76	46.1	17.08
2.61	1.72	0.89	63.3	24.41
2.67	1.72	0.95	72.1	27.81
2.74	1.72	1.02	83.1	32.06
2.81	1.72	1.09	94.9	36.62
2.86	1.72	1.14	103.8	40.05
2.94	1.72	1.22	118.9	45.87
3.02	1.72	1.3	135	52.09
3.14	1.72	1.42	161.1	62.15
3.24	1.72	1.52	184.6	71.21
3.37	1.72	1.65	217.5	83.91
3.47	1.72	1.75	244.7	94.39
3.57	1.72	1.85	273.5	105.4
3.78	1.72	2.06	339.1	130.8
4.01	1.72	2.29	419	161.6
4.26	1.72	2.54	515.5	198.8
4.51	1.72	2.79	622	239.9
4.99	1.72	3.17	803	309.7

## Flow Rate by Tubing Size P-1500

Tubing inner Diameter	Minimum	Maximum
(mm)	Flow, ml/min	Flow, nl/min
0.8	0.028	15.34
1.6	0.113	61.37
3.2	0.454	245.4
4	0.71	383.5
4.8	1.022	552.3
6.4	1.818	981.9
8	2.841	1534.36

## Catalogs and Guides



### Behavioral Research Catalog

Coulbourn Instruments and Panlab, both divisions of Harvard Apparatus, specialize in the manufacturing and distribution of high quality systems for behavioral research. With over 30 years of experience, Coulbourn and Panlab provide the most comprehensive and trusted solutions for behavioral studies and research.

Our new catalog offers the highest quality equipment in order to provide superior results. Application areas covered in this catalog include: Video Tracking, Operant Conditioning, Locomotor Activity & Exploration, Circadian Biology, Sensory Motor, Analgesia, Social Interaction, Learning, Memory & Attention, Anxiety & Depression, Reward & Addiction and Food & Drink/Metabolism. Our team is eager to learn more about your goals and how we can assist you in your research success.



### Warner Electrophysiology and Cell Biology Catalog

For the electrophysiological, cellular, and neurological sciences. Our extensive product line includes voltage and current clamp amplifiers for whole-cell and patch applications. Bessel filters, chambers for imaging and recording systems, perfusion control systems and steppers,

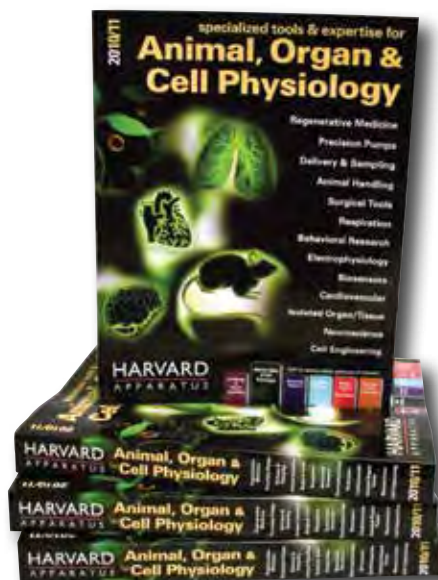
solution heating systems, microscope translation tables, microelectrodes and holders, and glass capillary tubing, plus now includes electroporation and transfection systems from BTX.



### CMA Microdialysis Catalog

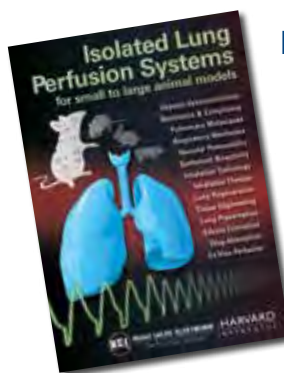
CMA Microdialysis has been the world's leading microdialysis provider for more than 25 years. Microdialysis is a valuable tool for in vivo evaluation studies on drug delivery, drug metabolism, PK/PD, bioavailability, bioequivalence and pharmacological efficacy.

As part of Harvard Apparatus, we can offer you complete systems solutions for all your research needs. Check out our new microdialysis catalog!



### Animal, Organ & Cell Physiology

This catalog features a broad range of products, including our legendary line of infusion and perfusion pumps, ventilators anesthesia systems, surgical instruments, equipment for small to larger animals, and isolated organ and tissue systems for all levels of research and education. These products are designed to help you achieve better research results in less time.



### Hugo Sachs Elektronik Guide to Isolated Lung Perfusion Systems

The IPL method has been found to be invaluable in characterizing the non-respiratory capabilities of pulmonary tissues such as pulmonary metabolic activity as well as the activities of various components (pulmonary alveolar macrophage, alveolar tissue, endothelial tissue, etc) in response to inhaled/ airborne particulates/therapies. Isolated lung systems are equally useful for evaluating respiratory functions such as respiratory mechanics and gas exchange.

## Catalogs and Guides (continued)



### BTX Electroporation & Transfection Catalog

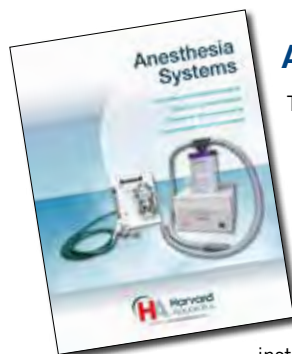
BTX offers a comprehensive line of instruments and accessories for both electroporation and electrofusion of mammalian, bacterial, yeast, fungi, insect and plant cells and tissues. BTX specializes in providing research tools for novel cutting edge applications such as adherent cell electroporation, high-throughput cloning, in vivo gene delivery, in ovo gene delivery, and in & ex utero gene delivery.



### Warner Guide to Live Cell Imaging

Warner's open bath recording chambers are a family of chambers designed to fill a large number of imaging and recording needs. The modular design consists of two parts; a polycarbonate chamber (insert) and an anodized aluminum platform (holder). The platform clamps the chamber

providing a seal between the chamber and coverslip. Heated platforms are used where chamber warming is required. The design of the platforms permits quick removal of the chamber for exchange of the coverslip.



### Anesthesia Systems

This Anesthesia Systems brochure provides an overview of our small animal anesthesia product offering. Anesthesia is a vital part of any surgery and we offer a wide array of products to suit your specific needs. In addition to anesthesia, Harvard Apparatus also offers a large selection of related products including surgical

instruments, temperature control, operating tables, lighting, magnification, ventilators, and vital sign monitoring equipment.



### Guide to Cell Modification

Choose the best Harvard Apparatus Technology to accomplish your cell modifications and re-engineering. This guide explains Liposomes, Pneumatic Injection, Iontophoresis, Electroporation and Mechanical Injectors.



### Guide to Micro and Nano Fluidics

Guide to Micro and Nano Fluidics This guide to Micro and Nanofluidics can help you study more variables simultaneously per time period and study smaller phenomenon for greater understanding. Reduced sample sizes can also increase experimental productivity and help provide

incrementally more data and thus more information per experiment.



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