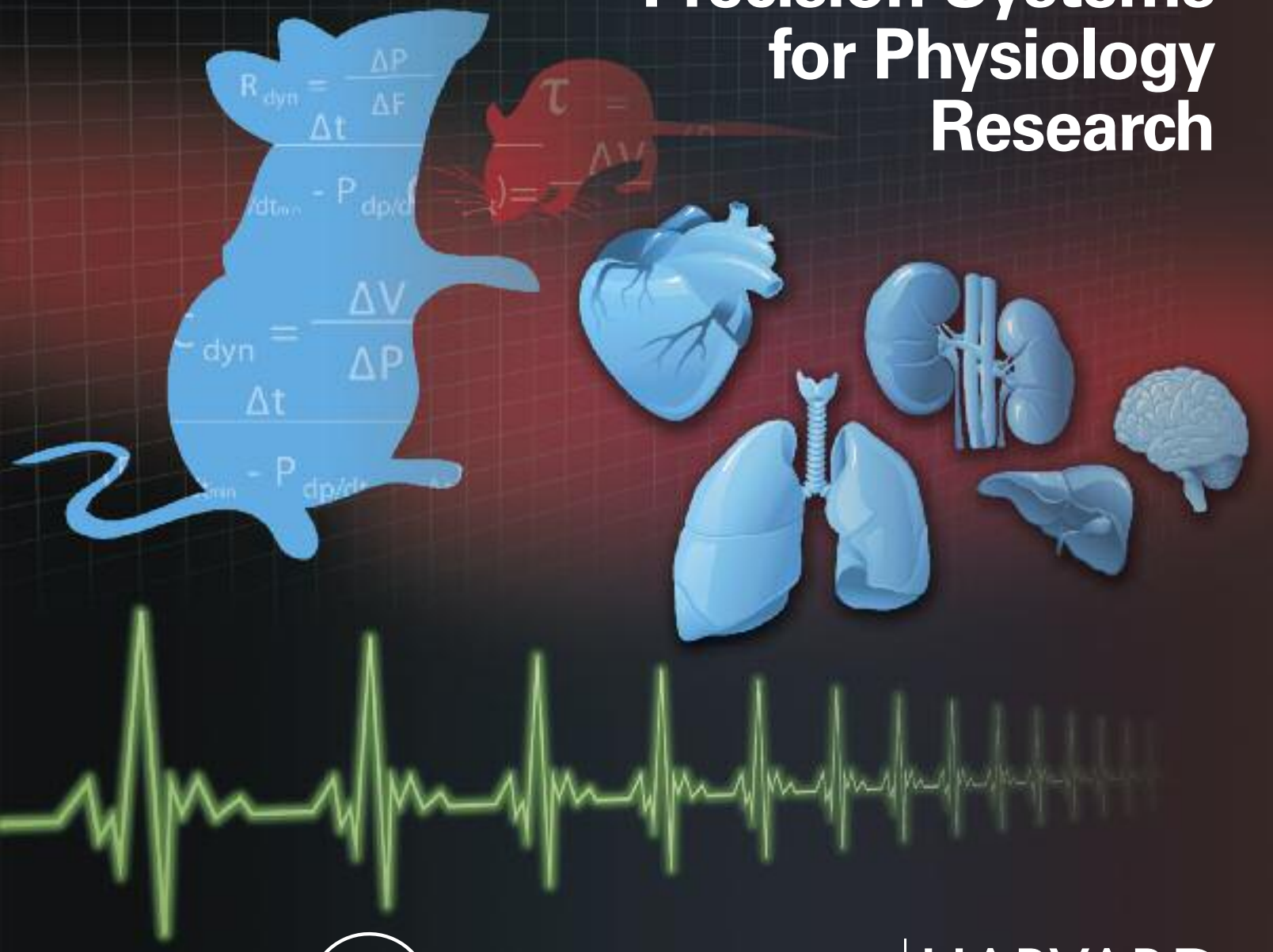
Tissue Bath & Perfusion Systems Selection Guide

Precision Systems for Physiology Research



HUGO SACHS ELEKTRONIK
The Physiology Specialists

HARVARD APPARATUS

isolated organ & tissue

Marsh Ganglion Bath, see page 21

Moist Chamber with Edema Balance, see page 24

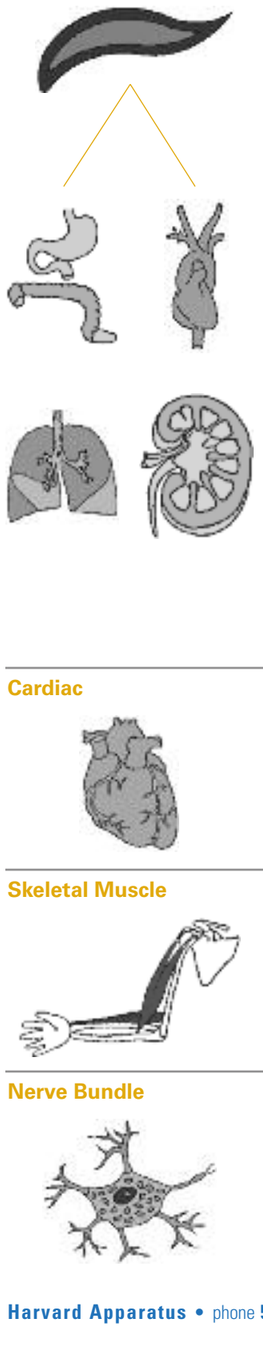
UP-100 Universal Perfusion System, see page 25

IH-SR Isolated Heart for Small Rodents, see page 29

IPL-16 Isolated Perfused Lung for Pigs and Large Animals, see page 46

Systems & Applications Overview

Perfusion and Tissue Bath Systems Overview

organs	systems for organs	tissues	systems for tissues	applications
Smooth Muscle 				
Gastro-intestinal Tract • ***Esophagus*** • ***Stomach*** • ***Liver/Pancreas*** • ***Intestine***	> Moist Chamber, Perfusion System for Liver, etc. > UP-100, perfusion of isolated liver... in-situ or ex-vivo > PBTO, Intestine perfusion > Servo Controlled Perfusion System, Perfusion of Isolated Liver: In-Situ or Ex-Vivo > IPR, Perfusion Bath for Ileum Peristaltic Reflex Studies	• ***Ileum*** • ***Stomach*** • ***Duodenum*** • ***Telia Coli***	> Schuler Vertical Tissue Bath for > Graz Vertical Tissue Bath > Mayflower Horizontal Tissue Bath > Modular Organ Bath for Isolated Tissues > Compact Organ Bath for Isolated Tissues > M Series Myograph	**Frequently Used for Studying** • ***Spasm*** • ***Spasmolysis*** • ***Vascular tone*** • ***Edema***
Vascular Musculature • ***Hind Quarter*** • ***Mesenteric Bed*** • ***Coronary Vasculature***	> IH-SR, HA-PL, UP-100, IH-5, IH-9 Isolated Heart System for Small Rodents, Rabbit, Small Pig > Moist Chamber With Edema Balance > PBTO, Blood Vessel Perfusion	• ***Aorta*** • ***Artery*** • ***Vein***	> Schuler Vertical Tissue Bath > Graz Vertical Tissue Bath > Mayflower Horizontal Tissue Bath > Modular Organ Bath for Isolated Tissues > Compact Organ Bath for Isolated Tissues > M Series Myograph	
Bronchial Musculature • ***Lung***	> IPL-4, IPL-2, IPL-4, IPL-16 Isolated Perfused Lung of Mouse, Rat and Guinea Pig, Rabbit, Pig > PBTO, Intraluminal Trachea Perfusion > PCLS, Precision Cut Lung Slice Chamber	• ***Trachea*** • ***Lung*** • ***Bronchi***	> Schuler Vertical Tissue Bath > Graz Vertical Tissue Bath > Mayflower Horizontal Tissue Bath > Coleman Superfusion Bath > Modular Organ Bath for Isolated Tissues > Compact Organ Bath for Isolated Tissues > M Series Myograph	
Uro-Genital Tract • ***Kidney*** • ***Placenta***	> PS-1, Moist Chamber, Perfusion System for Kidney, etc. > PBTO, Intraluminal Vas Deferens Perfusion	• ***Bladder*** • ***Ureter*** • ***Vas-deferens*** • ***Uterus*** • ***Placenta***	> Schuler Vertical Tissue Bath > Graz Vertical Tissue Bath > Mayflower Horizontal Tissue Bath > Coleman Superfusion Bath > Superfusion Cascade Bath > M Series Myograph	
Cardiac 				
Heart • ***Langendorff*** • ***Working heart*** • ***Heart-Lung Preparation***	> IH-SR, BL-IH, HA-PL, BL-UP, UP-100, IH-5, IH-9 Isolated Heart System for Small Rodents, Rabbit, Small Pig	• ***S-A node*** • ***Purkinjie Fiber*** • ***A-V node*** • ***Atrium*** • ***Cardiac Muscle*** • ***Trabecula*** • ***Papillary Muscle***	> Schuler Vertical Tissue Bath > Graz Vertical Tissue Bath > Mayflower Horizontal Tissue Bath > Steiert Tissue Bath for Cardiac AP and Force Measurement	**Frequently Used for Studying:** • ***Inotropism*** • ***Chronotropism*** • ***Dromotropism*** • ***Refractory State***
Skeletal Muscle 				
• ***Intact Limb/Hindquarter***	> UP-100	• ***Sartorious*** • ***Gastrocnemius*** • ***Nerve-muscle Preparations***	> Schuler Vertical Tissue Bath for Strips or Rings > Graz Vertical Tissue Bath for Strips or Rings > Mayflower Horizontal Tissue Bath for Strips or Rings	**Frequently Used for Studying:** • ***Metabolism*** • ***Neromuscular Transmission***
Nerve Bundle 				
• ***Brain*** • ***Spinal Cord*** • ***Ganglion***		• ***Nerve*** • ***Ganglion***	> Marsh Ganglion Bath for Whole Nerve and Ganglion > Schuler Vertical Tissue Bath for Nerve-Muscle Preparation	**Frequently Used for Studying:** • ***Neuro-Neuronal Transmission*** • ***Neuromuscular Transmission***

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The Harvard Apparatus 3 Tier Approach to Research

Our 3 Tier System is Organized in the Following Manner:

advanced research

Harvard Apparatus HSE Advanced Research

This tier offers cutting edge research systems with advanced features for ultimate physiological stability and experimental flexibility. Guided by decades of in-the-field research and development, Harvard Apparatus HSE Advanced Research solutions are the engines of breakthrough research.

With more capability packages and measurement possibilities than any comparable system, Harvard Apparatus HSE Advanced Research systems allow physiological recording to be more integrated than ever before. In addition, modular engineering and construction allows options and capabilities to be added at any time as the goals and demands of your research change.

Isolated Heart for Small Rodents

We recommend that researchers contact us directly to discuss specific applications so that we may custom configure a system tailored to your research goals. This proven approach allows us to construct a system with the tools to achieve immediate research goals and the upgradeability to achieve those which are not yet apparent. **These systems will grow with your research needs.**

research

Harvard Apparatus Research

This tier is designed for functionality and ease of use, Harvard Apparatus Research systems are fully configured with necessary components and accessories already included.

It offers precision systems for the routine or standard measurements in any lab. Harvard Apparatus Research systems are also perfect for compound screening or rapid-throughput experimentation.

To make these systems easy to order, each complete system is represented by a single Ordering # and option packages are clearly marked.

teaching

Harvard Apparatus Teaching

This third tier of equipment was designed for the teaching labs needs. The products are constructed to meet a special set of demands, especially where usage is high and regular maintenance is a challenge. Harvard Apparatus Teaching systems are exceptionally rugged, reliable and accurate, while representing an excellent value.

Graz Tissue Bath System

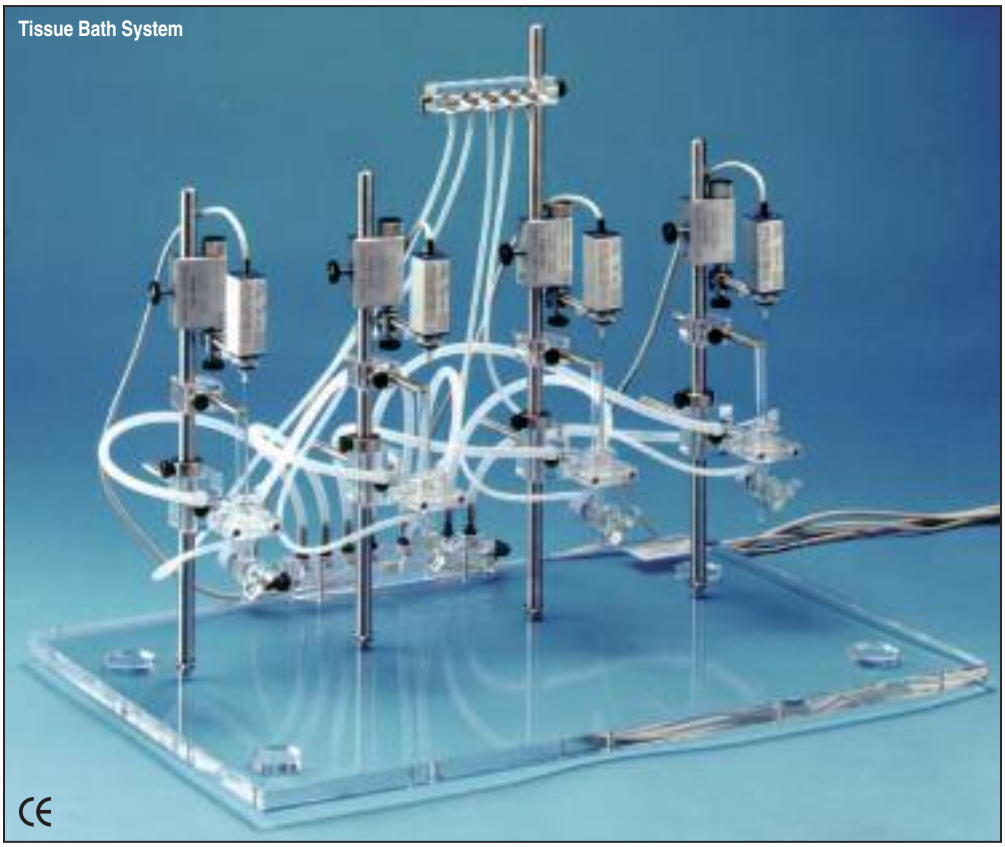


Figure 1: Tissue Support for Strips

Figure 2: Tissue Support for Rings

Figure 3: Core Holder with Field Stimulation Electrodes

- Suitable for most standard pharmacological experiments
- Permits experiments on smooth muscle preparations as well as on cardiac (atria) or skeletal muscle preparations, vascular rings etc
- Clear, 4-channel arrangement or single bath unit
- Rigid construction
- Contractions can be measured isometrically or isotonically
- Interchangeable tissue vessels: 2, 5, 10 or 20 ml
- Experiments with minimum test substance quantities are possible using small tissue vessels
- Adaptable to different tissue preparations with appropriate tissue supports
- Tissue supports with integral field stimulating electrode available
- Simple to operate, easy to clean

Graz Tissue Bath System (continued)

Graz Tissue Bath System

The Graz Organ Bath can be used for many standard pharmacological experiments. This apparatus was originally developed for experiments on small isolated vascular rings (1 to 2 mm dia.) with special attention to a low incubation volume of the medium. The smallest tissue vessel available has a volume of 2 ml. The muscle contractions produced in these experiments can be measured either as forces (isometrically) or as displacements (isotonically).

The organ bath is also available in variable versions. Larger tissue vessels of 5, 10 or 20 ml are available for larger vessels and other muscle preparations. These baths can also be used for experiments on papillary muscle or isolated atria (e.g. guinea-pig), with provision for electrical stimulation.

The recommended F30 isometric transducer can easily be replaced by other types of transducers without any modification of the apparatus.

The main consideration in designing the bath has been a simple and clear arrangement, without neglecting the necessary stability. A rigid construction is an essential requirement for measuring small contraction forces. A rigid Plexiglas baseplate carriers 4 vertical rods on which the individual components are mounted. Tissue vessels and suitable holders are available in 4 different sizes. The perfusion solution is aerated by glass frits fused into the vessel bottom. A needle valve is provided for each tissue vessel to permit accurate adjustment of the gas flow.

The tissue supports consist of a core holder and support sets.

Two types of core holder are available with or without field stimulation electrodes. The field stimulation electrodes are two parallel Platinum plates of 15 x 5 mm separated by 11 mm for the 10 or 20 ml tissue vessels or 12 x 5 mm and separated by 6 mm for the 2 and 5 ml glassware.

Four types of support sets are available. A support set consists of the anchor for the tissue, mounted on the core holder and the connecting wire to the transducer. The anchors can be easily interchanged to adapt to the current experiment.

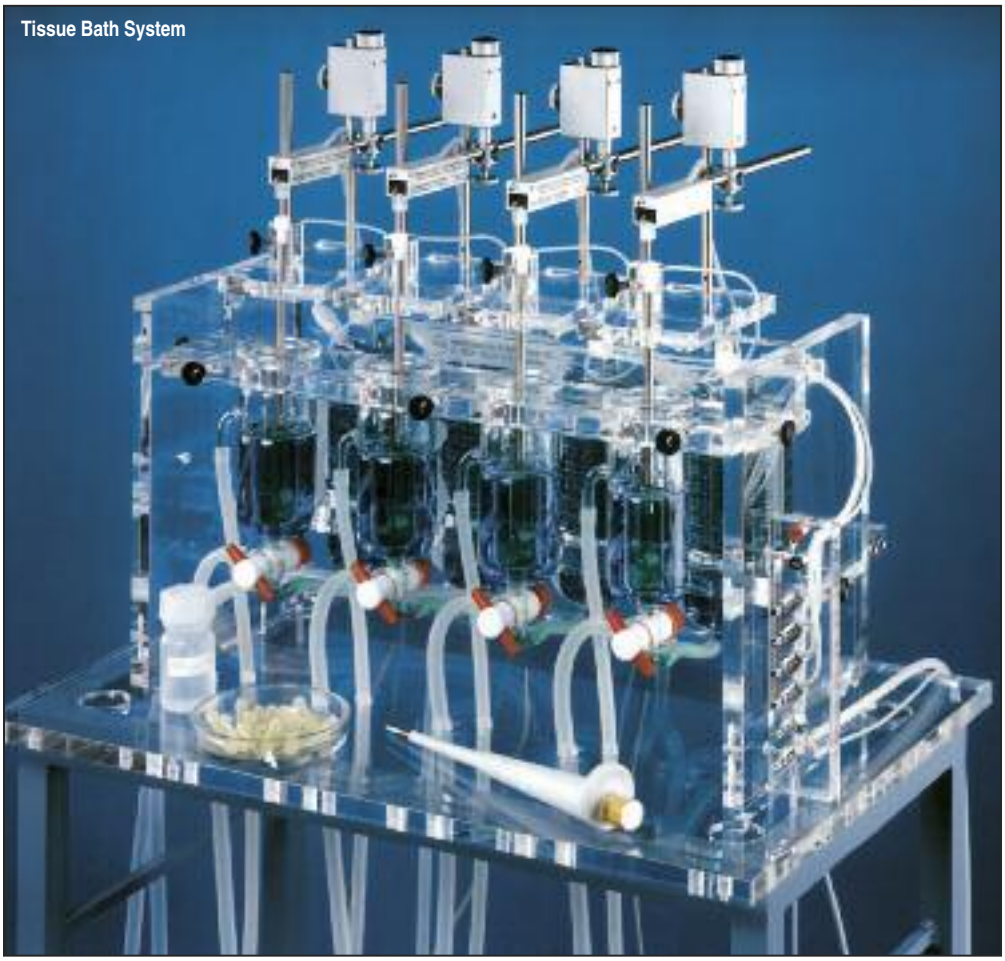
- Support set for muscle strips (see Fig. 1) wire diameter 0.5 mm
- Support set for rings (see Fig 2) exist in two versions wire diameter 0.5 mm fixed pin lenght 6 mm and wire diameter 0.3 mm fixed pin length 6 mm for very small vessels.
- Support set for rings with 0.5 mm diameter fixed pin length 11 mm can only be used with 10 or 20 ml vessels.

Additional items required are a thermociculator, a reservoir for the solution, transducers, monitoring system setup using the PLUGSYS Amplifier System. Recording and Evaluation of the signals using ACAD software, in case of electrical stimulation a multiple output stimulator is required.

Order #	Product
73-2369	Basic Unit for 4-Position Tissue Bath, Model GRAZ
73-0559	Mounting Material for Tissue Vessel and Holder
73-0560	Holder for 10 or 20ml GRAZ Glass Tissue Bath
73-2271	Glass Tissue Bath, 10ml for GRAZ Tissue Bath
73-2276	Glass Tissue Bath, 20ml for GRAZ Tissue Bath
73-0561	Holder for 2 or 5ml GRAZ Glass Tissue Bath
73-2273	Glass Tissue Bath, 2ml for GRAZ Tissue Bath
73-2275	Glass Tissue Bath, 5ml for GRAZ Tissue Bath
73-3531	Core Tissue Holder Without Electrical Stimulation
73-3533	Core Tissue Holder With Field Stimulation Electrodes for 10 or 20 ml GRAZ Tissue Vessel
73-3532	Core Tissue Holder With Field Stimulation Electrodes for 2 or 5 ml GRAZ Tissue Vessel
73-3535	Support Set for Rings 0.5mm Wire (Large Version only 10 and 20 ml Vessels)
73-3537	Support Set for Rings 0.3 mm Wire
73-3534	Support Set for Strips 0.5 mm Wire
73-2117	Gas Distribution Block for Aerating

For a system description according your requirements please use:
www.hugo-sachs.de/timail.html
or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.

Schuler Tissue Bath System



- 4-Channel tissue bath
- 5, 10, 20 and 50 ml tissue vessels available
- Choice of tissue holders to adapt to any application
- Two flush modes:
  - Overflow
  - Drain/Refill
- Software for data acquisition
- Wide range of Force or Displacement Transducers Available

The Schuler tissue bath system is our most advanced and feature rich tissue bath system used for the study of force or displacement from a wide variety of tissue preparations such as: cardiac (atria, papillary muscle), skeletal and smooth muscle (intestine, bladder, uterus). Isolated intact blood vessels and nerve-muscle preparation experiments are also possible with our specially designed tissue holders.

The rigid construction and ergonomic design of the Schuler Bath allows for rapid tissue mounting and adjustment to minimize tissue drying and hypoxia. Tissue bath volumes of 5, 10, 20 and 50 ml are available along with bath and tissue specific holders. Tissue supports are available for rings, strips and specialty applications, with or without platinum plate field stimulation electrodes. All tissue holders include an integrated oxygenating frit at the back of the holder to minimize disruption of force and displacement due to bath oxygenation.

Positioning of the tissue is greatly simplified by the integrated platform carrying the tissue holder, the micropositioner and the transducer; the platform can be raised so that the tissue holder comes out of the glass vessel to provide ready access to the tissue. The flushing solution is warmed by flow-through heat exchangers mounted on the Plexiglass Base. A central connection for gas addition is provided. Six needle valves provide individual adjustment of the gas flow to the four tissue vessels as well as the handy preparation dish and the solution reservoir.

A selection of force (F30, F10, K30) and displacement (B40) transducers is available which are mounted to Vernier positioners. The Vernier micropositioner permits precise adjustment of the preload (pre-stretch) on force transducers, or setting a suitable zero within the range of the displacement transducer.

Electrical Stimulation of isolated tissue requires the use of tissue holders with stimulation electrodes of the appropriate volume and a suitable stimulator which has a separate output for each tissue and also produces stimulus trains for stimulating smooth muscle. The amplitude on each stimulus output should be individually adjustable for each tissue.

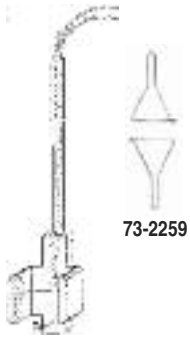
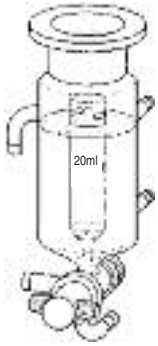
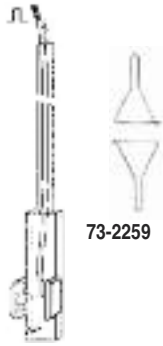
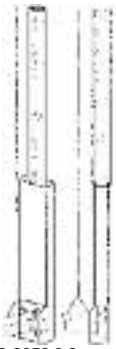
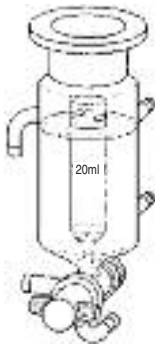
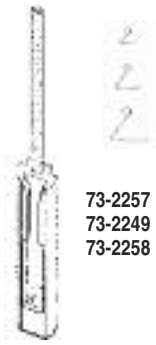
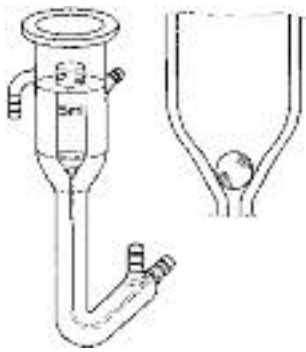
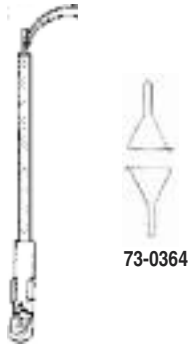
Components are available individually or as complete solutions.

Additional items required: thermociculator, a reservoir for the solution, transducers, monitoring system setup using the PLUGSYS Amplifier System. Recording and Evaluation of the signals using ACAD software, Optional software and hardware modules are available for computer controlled field stimulation, tissue pretension using electronically controlled Vernier positioners and tissue bath flushing. In case of electrical stimulation a multiple output stimulator is required.

Order #	Product
73-2001	Plexiglass Stand for 4-Position Schuler Organ Bath
73-2193	Heat Exchanger

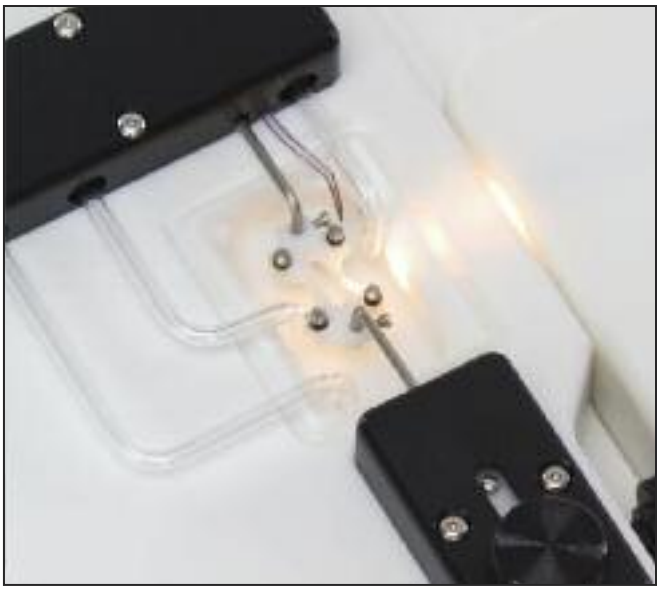
Schuler Tissue Bath System

Tissue Vessels and Holders

Volume	Tissue Vessel	Muscle strips		Tissue Rings	
		With Stimulation	Without Stimulation	With Stimulation	Without Stimulation
50 ml	 73-2201	 73-0400		 73-2259 73-0400	 73-2277
20 ml	 73-2200	 73-0397	 73-2203	 73-2259 73-0397	 73-2256 0.3mm wire 73-3102 0.2mm wire
10 ml	 73-2200	 PY2 73-0404 PY2 73-0364	 73-2206	 73-0404	 73-2257 73-2249 73-2258 73-2207
5 ml	 73-2202	 73-2206	 73-0364	 73-0364 73-0393	 73-2259 73-0364

M Series Myograph System

For Force Measurements in Very Small Tissues



Features and Benefits:

- Precision Fabrication permits use of tissue samples with lumen diameters down to 60µm and segment lengths up to 3 mm
- True Isometric Measurement: rigidly mounted transducer exhibits less than 12.5 µm deflection at 0.5gm force
- Transducer Safety Lock to protect the integrated force transducer during the preparation phase
- Lighted Chamber to assist in tissue mounting
- Sliding Wrist Rest for easy manipulation of the chambers during use
- Ideal 5ml working volume sample chamber
- Integrated Temperature Controller for optimal physiological maintenance
- Available as the M4 four channel and M1 single channel Myograph system configurations.
- Complete Myography workstation ready for interface to any Harvard Apparatus Data Acquisition System

The New M Series Myograph is designed for researchers performing contractile force studies on small ring samples with sizes ranging from 60µm to over 1 mm diameter. That includes mouse aortic rings and small intestinal ring samples down to micro-vessel preparations, such as mesenteric arteries.

Using precision fabricated micro vessel support brackets, the system accommodates lumen diameters down to 60µm and segment lengths up to 3mm. To mount the vessel segment, two individual parallel wires are passed through the sample lumen and attached to the micro vessel support brackets. Each vessel support bracket incorporates a micro groove on the face to aid in maintaining the wire position when mounting. One bracket is connected to a precision 0-0.5 gm capacitance type isometric force transducer (switchable to 0-5 gm and also available in 0-2 gm/0-20 gm configurations) that provides a true isometric measurement, i.e. less than 12.5 µm deflection at 0.5 gm force, which is critical when working with small vessel samples. The opposing support bracket is connected to a precision micrometer controlling the X axis movement, with Y and minor Z axis positioning controls conveniently positioned on the Myograph chamber, allowing for precise alignment of the micro vessel support brackets. The wires are then anchored via a locking screw on each of the brackets. The locking screws feature a small bushing that is incorporated under the screw head greatly improving capture of the support wire. A pre-load tension is then applied via adjustment of the X axis micrometer.

Order #	Product
72-9434	Radnoti M4 4-Channel Myograph System, 115VAC
72-9435	Radnoti M1 1-Channel Myograph System, 115VAC
72-9436	Radnoti M4 4-Channel Myograph System, 220VAC
72-9437	Radnoti M1 1-Channel Myograph System, 220VAC
72-9438	Peristaltic Pump Quad Bank
72-9430	Replacement Wire for Myograph, 25 micron, pack of 10
72-9431	Replacement Wire for Myograph, 50 micron, pack of 10
72-9432	Replacement Wire for Myograph, 75 micron, pack of 10
72-9433	Replacement Wire for Myograph, 125 micron, pack of 10

Compact Organ Baths for Isolated Tissues

8-Channel Compact Organ Bath

Key Features

- Compact design reduces space requirements
- Complete accessibility to all components facilitates maintenance
- Independent perfusate inputs allow use of different physiological solutions in the same chamber
- All the input-output connections are accessible on the rear panel of the device
- Two modes for solution replacement: overflow/emptying and filling
- Turbulence-free water circulation
- Use of safety sensors for both water level and water temperature (cut-off at 50°C)
- Electronic heating resistance control system prevents thermal shock
- Available accessories for continuous perfusion
- Ensures optimal heat stability

Parameters Measured

- Parameters given by the associated software (see PROTOWIN)

Use of totally inert materials, Viton, Teflon, Delrin, Silicone and other materials that are not degraded by acids or salt

Components Included

- Compact organ bath unit
- Micropositioners (one per chamber)
- Thermo regulation unit
- Tissue holder
- Oxygen outlet for petri chambers
- Set of spare fuses
- Instruction manual
- Calibration certificate
- 2 year warranty

Options

- Tissue chambers
- Stimulation electrodes
- Stimulators
- Isometric or isotonic transducers
- Signal amplifiers
- PROTOWIN Software

Compact Organ Baths for Isolated Tissues (continued)

Accessories to Use Continuous Perfusion

The Compact Organ Baths have been designed and developed to satisfy the requirements of investigators by offering advanced characteristics that render them suitable for the in-vitro study of tissue behavior. Due to their compact design minimum bench space is required.

The modular design allows up to eight individually mounted tissues to be studied simultaneously and independently per system. Several models are available, from one up to eight chambers. All of them are supplied with an external heating control unit, transducer' stands & micropositioners and tissue holders. The main perspex reservoir houses the heater system, the chambers and coils, all submerged in thermostatetically controlled water. Each vessel is filled and emptied by means of a three-way tap (Manual Series) or by electrically-operated valves (Automatic Series) which, besides the possibility of manual activation by means of frontal pushbuttons, can also be remotely controlled by a Timer or Programmer (Software).

Tissue chambers come in 5, 10, 25 or 50 mL capacity. A range of isometric or isotonic force transducers are available.

The Compact Organ Baths are associated with the PROTOWIN software for data storage and analysis.

Specifications

Chamber Capacites	5, 10, 25 or 50 ml
Coil Capacity	180 ml
Temperature Range	+3°C to 50°C (Protection); Resolution 0.1°C Room Temperature
Temperature Stability	± 0.1°C in the Whole Water Heat Tank
Power Supply	115-220 V, 50-60 Hz; Consumption 1000 W

Order #	Model	Product
76-0030	LE01002	2 Chambers Manual Compact Organ Bath, Chambers not Included
76-0031	LE01026	2 Chambers Automated Compact Organ Bath, Chambers not Included
76-0032	LE01004	4 Chambers Manual Compact Organ Bath, Chambers not Included
76-0033	LE01046	4 Chambers Automated Compact Organ Bath, Chambers not Included
76-0034	LE01006	6 Chambers Manual Compact Organ Bath, Chambers not Included
76-0035	LE01066	6 Chambers Automated Compact Organ Bath, Chambers not Included
76-0036	LE01008	8 Chambers Manual Compact Organ Bath, Chambers not Included
76-0037	LE01086	8 Chambers Automated Compact Organ Bath, Chambers not Included

Order #	Model	Product
Options		
76-0038	PROTOWIN	Software for Organ Bath, Up to 8 Channels, Dose/Response
76-0039	ISO510	Amplifier for Isometric and Isotonic Transducer
76-0323	LE0140	10 Tissue Clamps Set
76-0324	LE0145	10 Tissue Hooks Set
76-0044	LE0105	5 ml Chamber for Compact Organ Bath
76-0045	LE0110	10 ml Chamber for Compact Organ Bath
76-0046	LE0125	25 ml Chamber for Compact Organ Bath
76-0047	LE0150	50 ml Chamber for Compact Organ Bath
76-0048	LE01030A	Stainless Steel Electrode
76-0049	LE01030B	Stainless Steel Electrode, Two Rings, 20 mm Apart
76-0050	LE01030C	Stainless Steel Electrode, Two Rings, 15 mm Apart
76-0051	LE01030D	Stainless Steel Electrode, Surface Contact
76-0052	LE01035A	Platinum Electrode, Single Ring
76-0053	LE01035B	Platinum Electrode, Two Rings, 20 mm Apart
76-0054	LE01035C	Platinum Electrode, Two Rings, 15 mm Apart

* Visit our STIMULATORS section for more details.

* Visit our transducers section for more details.

Citations

Rodriguez A et al. (2007) Induced vasoconstriction in vascular smooth muscle cells is mediated via a nitric oxide-dependent mechanism. Endocrinology 148(1): 324-331. (aorta vascular smooth muscle, Spain)

Kim EJ et al. (2005) Safety pharmacology of sibutramine mesylate, an anti-obesity drug. Hum. Exp. Toxicol. 24(3): 109-119 (rat smooth muscle, Korea

Shpak B et al. (2004) Inotropic and lusitropic effects induced by the inhibitory factor of the Na/Ca exchanger are not mediated by the (beta)-adrenergic activation. J. Cardiovasc. Pharm. 44(4): 466-472. (guinea and rat ventricle strips, Israel)

Hisbrunner G et al. (2003) An in vitro study on spontaneous cervical contractility in the cow during oestrus and diestrus. J. Vet. Med. Series A, 50(9): 442-446 (cervical smooth muscle, Switzerland).

Tissue Bath Sets

Basic Double Tissue Bath Set with 50-0652 Complete Simple Lever Assembly*

Basic Single Tissue Bath Set with 50-0652 Complete Simple Lever Assembly*

Student Single Tissue Bath Set with 50-0652 Complete Simple Lever Assembly

Research Double Tissue Bath Set

- Temp. automatically held within 0.5°C
- Dial graduated from 15° to 45°C in 5° increments
- Large 11.2 L water bath capacity for stable temp. in coils and tissue vessels
- Magnetic stirrer ensures uniform temp.
- 250 watts of heating power for fast heat-up time
- Warming coils lie flat against sides of tank, leaving center free for procedures
- 400 ml capacity flat perfusate warming coils ensure sufficient supply of temp. controlled perfusate for lengthy assays
- Detachable stem tissue vessel, for increased convenience when changing tissue vessels (tissue chamber can be removed without disturbing stem or disconnecting tubing for warmed perfusate and drainage

Basic Double/Basic Single Tissue Bath Sets

- Temperature automatically held within 0.5°C
- Dial graduated from 15° to 45°C in 5° increments
- Fixed stem tissue vessels supplied as standard

Student Single Tissue Bath Set

- Manual temperature control
- Offers superior visibility and access for student
- Side limb of the special fixed stem student tissue vessel is curved upward making it easy to connect to the spiral perfusate warming coil

Specifications and Ordering Information for Harvard Apparatus Tissue Bath Sets

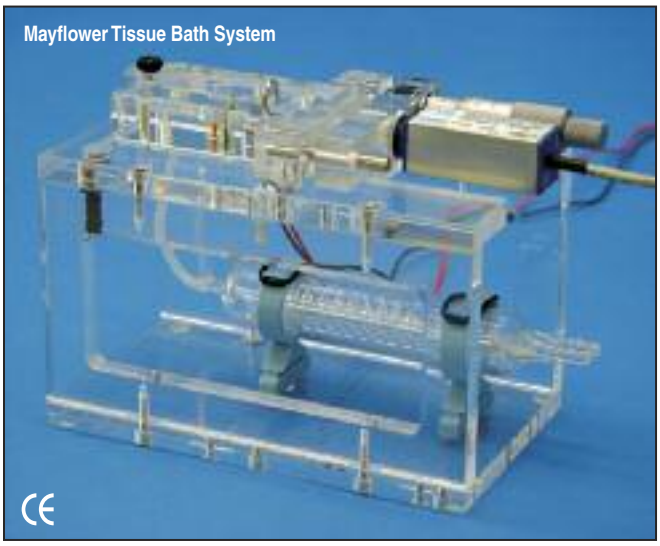
	Research Double Tissue Bath Set 115 VAC, 60 Hz/230 VAC, 50 Hz	Basic Double Tissue Bath Set 115 VAC, 60 Hz/230 VAC, 50 Hz	Basic Single Tissue Bath Set 115 VAC, 60 Hz/230 VAC, 50 Hz	Student Single Tissue Bath Set 115 VAC, 60 Hz/230 VAC, 50 Hz
Heated Water Bath				
Heater Power	250 W	80 W	80 W	50 W
Temperature Control	Automatic within 0.5°C	Automatic within 0.5°C	Automatic within 0.5°C	Manual
Magnetic Stirrer	Yes	No	No	No
Capacity	11.2 L	4.7 L	3.6 L	0.8 L
Dimensions, H x W x D	18 x 29 x 21.5 cm (7.25 x 11.5 x 8.5 in)	15.5 x 21.5 x14 cm (6.25 x 8.5 x 5.5 in)	15.5 x 16.5 x 14 cm (6.25 x 6.5 x 5.5 in)	12.5 x 10 cm (H x D) (5 x 4 in)
Tissue Vessel(s)				
Quantity per Set	2	2	1	1
Type Supplied	Detachable Stem	Fixed Stem	Fixed Stem	Student Fixed Stem
Perfusate Warming Coils				
Type	Flat Coil	Spiral Coil	Spiral Coil	Spiral Coil
Capacity per Vessel	200 ml	35 ml	35 ml	35 ml
Thermometer Length	15 cm	10 cm	10 cm	10 cm
Order #	**50-2146 / 50-2153**	**50-2120 / 50-2138**	**50-2104 / 50-2112**	**50-0306 / 50-0314**

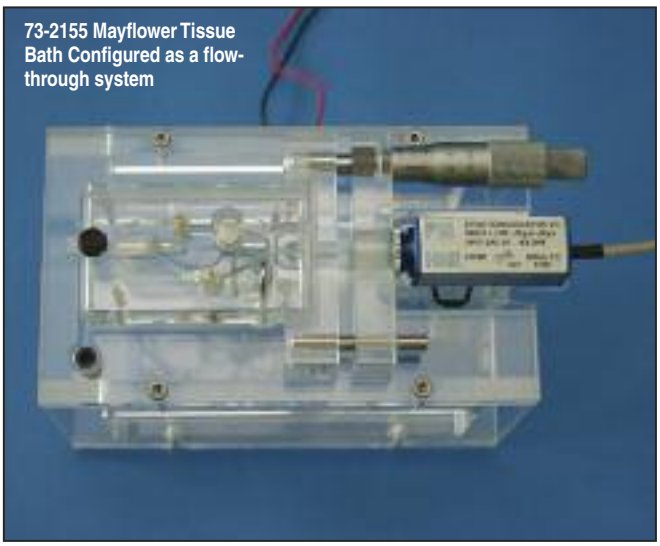
teaching

Tissue Bath Set Components

Order #	Description	Research TissueBath Set		Double Tissue Bath Set		Single Tissue Bath Set		Student Tissue Bath Set	
		50-2146	50-2153	50-2120	50-2138	50-2104	50-2112	50-0306	50-0314
50-2328	Research Heated Water Bath, 115 VAC, 60 Hz	1	-	-	-	-	-	-	-
50-2336	Research Heated Water Bath, 230 VAC, 50 Hz	-	1	-	-	-	-	-	-
50-2302	Double Heated Water Bath, 115 VAC, 60 Hz	-	-	1	-	-	-	-	-
50-2310	Double Heated Water Bath, 230 VAC, 50 Hz	-	-	-	1	-	-	-	-
50-2286	Single Heated Water Bath, 115 VAC, 60 Hz	-	-	-	-	1	-	-	-
50-2294	Single Heated Water Bath, 230 VAC, 50 Hz	-	-	-	-	-	1	-	-
50-2260	Student Heated Water Bath, 115 VAC, 60 Hz	-	-	-	-	-	-	1	-
50-2278	Student Heated Water Bath, 230 VAC, 50 Hz	-	-	-	-	-	-	-	1
50-0322	Rod for Student Tissue Bath Set	-	-	-	-	-	-	1	1
50-0330	Student Tissue Vessel	-	-	-	-	-	-	1	1
50-0348	Spiral Perfusate Warming Coil	-	-	2	2	1	1	1	1
50-0355	Thermometer, 0-50°C, 100 mm	-	-	-	-	-	-	1	1
50-0363	Oxygenation Tubes	2	2	2	2	1	1	1	1
50-2203	Fixed Stem Tissue Vessel, 50 ml	-	-	2	2	1	1	-	-
50-2237	Detachable Stem Tissue Vessel Only, 50 ml	2	2	-	-	-	-	-	-
50-2245	Detachable Stem Tissue Vessel Stem, 50 ml	2	2	-	-	-	-	-	-
50-2369	Rubber Bung	2	2	2	2	1	1	1	1
50-2385	Flat Perfusate Warming Coil	1	1	-	-	-	-	-	-
50-2419	Thermometer Holder	-	-	-	-	-	-	1	1
50-2427	Upright Rod for Water Baths	4	4	4	4	2	2	-	-
50-2575	Rod Clamp	4	4	4	4	2	2	2	2
50-6485	Frontal Writing Point	2	2	2	2	1	1	1	1
50-6519	Simple Lever	2	2	2	2	1	1	1	1

Mayflower Tissue Bath System





- Horizontal tissue bath for isometric contraction measurements using a F10 or F30 force transducer
- Two versions are available:
  - Flow-through superfusion system
  - Incubation system
- Possibility of electrical stimulation
- Exchangeable holders depending on tissue used (for vascular or tracheal rings, for strips)

The Mayflower tissue bath is a horizontal tissue chamber with an integral contraction force measurement. It is completely open at the top and has a small bath volume of 3 - 5 ml. The compact and modular construction provides ideal conditions for investigations on small muscle preparations (urethra, papillary muscle, cavernous body), vascular rings, or tracheal rings.

Basic Equipment:

- Acrylate support with a movable mounting platform for preload adjustment through a micrometer screw. This platform receive the tissue chamber and acts as holder for the force transducer. The acrylate support also includes a glass heat exchanger for the pre-heating of the perfusate solution.
- The tissue chamber differentiates the two versions.

Flow Through System (73-2155)

The tissue chamber is carved out of an acrylate block and placed on the support stand. This chamber includes the tissue holder, the connections for electrical stimulation electrodes, a frit for aeration and a draw-off tube with height adjustment to set the bath volume. As it is not jacketed, continuous flow through the chamber is required.

Incubation System (73-3600)

The tissue chamber is jacketed. The bottom of the chamber is made of a teflon coated stainless steel plate to optimize the temperature stability of the solution. A additional small stainless steel heat exchanger is also built in to avoid temperature fluctuation.

The incubation chamber can also be used as a flow-through superfusion chamber. The superfusion chamber cannot be used for incubation.

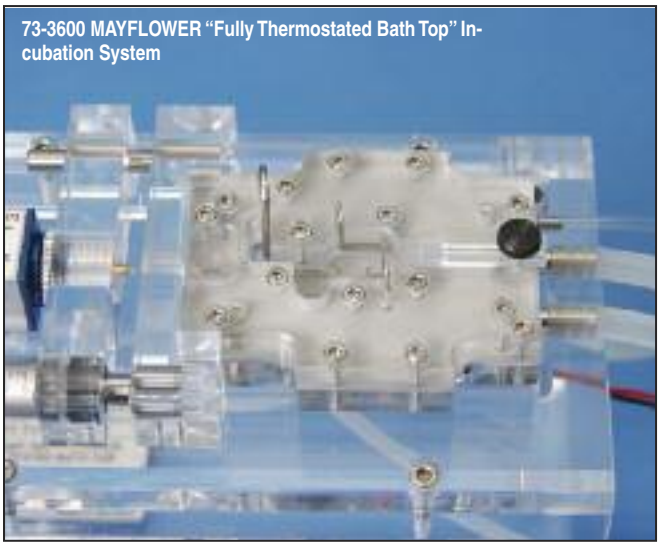
Additional Equipment:

- A multi-channel roller pump for the perfusate circuit
- A thermocirculator for keeping the perfusate solution at constant temperature

The modular concept of this apparatus offers a wide range of different arrangements to meet individual requirements regarding bath geometry, tissue holders and stimulation electrodes. The horizontal arrangement of the tissue and the open top provide ideal conditions during preparation and experiment.

The various parts of the apparatus are made mainly from Plexiglas or stainless steel and are therefore inert and corrosion-resistant. The solution flows in from a roller pump and passes through a heat exchanger, the outflow is under suction through a suction tube with height adjustment by the same pump. A frit for aeration is located in the tissue chamber. Two connection sockets for the stimulation electrodes are located on either side of the tissue chamber.

Mayflower Tissue Bath System (continued)


73-3600 MAYFLOWER "Fully Thermostated Bath Top" Incubation System


MAYFLOWER Chamber with direct Stimulation Electrode


MAYFLOWER Chamber with Field Electrodes

Electrical Stimulation Electrodes

The stimulation electrodes can be of different types:

- Coaxial electrode for contact stimulation (stainless steel).

  If point stimulation is required, a Miniature Coaxial Stimulation Electrode is installed using our Mini Ball Joint Postioning System. The electrode can therefore precisely and easily be placed.
- Two plate electrodes for field stimulation (platinum or AgAgCl)
- Flexible platinum wires for direct contact with the tissue

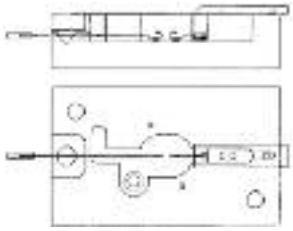
Tissue Holders

Three different tissue holders are available. Tissue holders can be exchanged. The holders consist of two parts, a fixed part positioning the tissue inside the bath and the part transmitting the contractile force to the transducer.

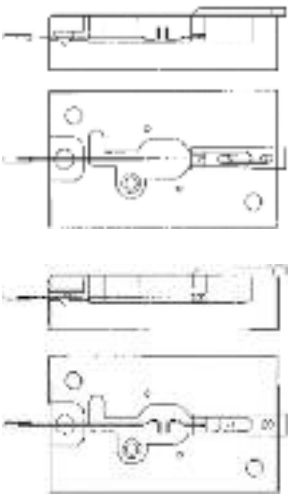
Order #	Product
73-2155	Small Volume Horizontal Tissue Bath, System MAYFLOWER
73-3600	Small Volume Horizontal Tissue Bath, System MAYFLOWER "Fully Thermostated Bath Top"

IMPORTANT NOTE: *Mayflower Tissue Bath is especially designed for HSE-HA F30 or F10 Force Transducers and it is not possible to modify Transducer Holder to suit other transducer models.*

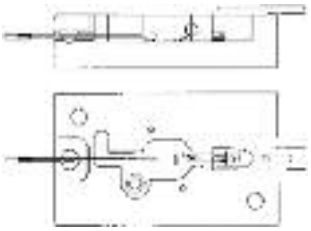
For a system description according your requirements please use:
www.hugo-sachs.de/ihmail.html
or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.



A standard tissue holder is used for small muscle preparations. The tissue is attached to both hooks by threads.

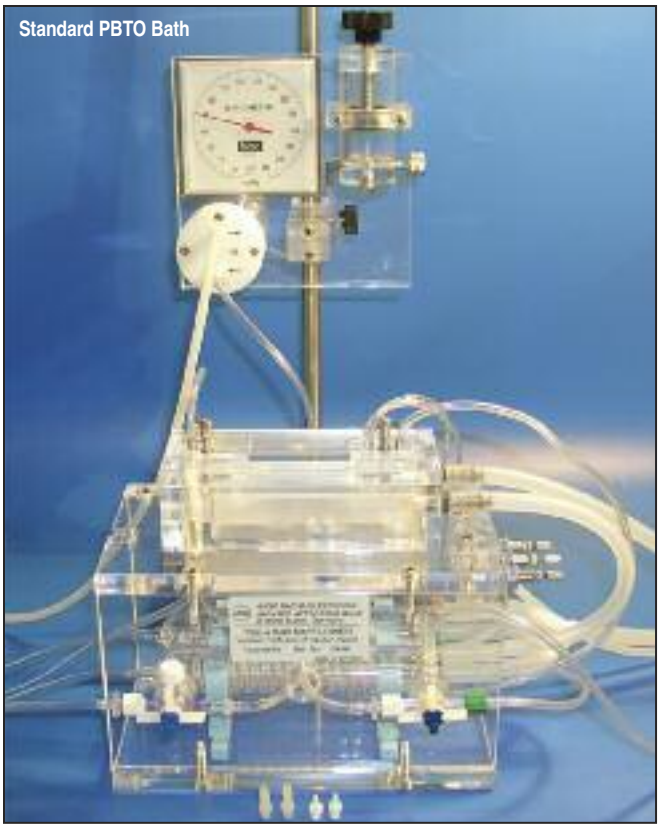


Special holder for vascular or tracheal rings. The rings are slid over the holder jaws.



Special holder for small muscle preparation. The tissue is clamped on the right-hand side by a spring clip against the bottom of the chamber and attached to the transducer hook using a thread. A tool for lifting the clamping system is supplied.

Perfusion Bath for Tubular Organs (PBTO) & IPR Bath for Ileum Peristalic Reflex



Benefits and Features

- Perfusion of tubular organs (trachea, blood vessels, intestines)
- Individual solutions for intraluminal perfusions and extraluminal superfusion
- Controlled perfusion pressure

Applications

- Intraluminal perfusion of tubular organs (trachea, blood vessels, intestines)
- Testing circular-action musculature, vascular tone and stents in isolated vessels

PBTO

The PBTO has been designed for the studying of perfused tubular organs such as trachea, blood vessels, intestines and vas deferens. Individual solutions can be used for intraluminal perfusion and extraluminal superfusion. Two peristaltic pumps are required, one for intraluminal constant flow perfusion and the second for extraluminal superfusion. The intraluminal perfusion pressure is generated by an adjustable afterload control system. A differential pressure transducer is used to measure the intraluminal pressure difference at the proximal and distal end of the organ.

The tissue bath is a jacketed Plexiglas bath. The holder for the cannulae can be removed from the main bath for the cannulation of the segment of tubular organs. The cannulae are fixed on sliding holders to adjust to organs of different length, up to 50mm. The intraluminal pressure is controlled by one of two afterload systems available. One for low pressure applications (0 to 30 mmHg) and the second for high pressure applications (0 to 300 mmHg).

The unit comes with four different interchangeable cannulae with the following diameters: 1.5, 2.5, 3 and 4 mm. For smaller vessels customized stainless steel cannulae can be made on request. For micro-vessels, glass capillary pipettes pulled to the required diameter can be connected to the adapter cannulae using a silicone tube collar.

A special sliding block for testing stent (e.g. drug diluting stent) has been developed. An additional port allows insertion of a stent into a cannulated isolated vessel.

Additional equipment required: thermocirculator, reservoir, peristaltic pump, transducer, monitoring system setup using the PLUGSYS Amplifier System. Recording and Evaluation of the signals using BDAS software.

Order #	Product
73-2158	Horizontal Tissue Bath PBTO, Type 813/6
73-2044	Device for Afterload Pressure of 0-30 cmH20
73-2333	Device for Afterload Pressure of 0-300 mmHg

Applications

- Basic test in gastro-intestinal research
- Peristaltic reflex in guinea pig ileum
- For studying emptying phase of peristaltic reflex

IPR

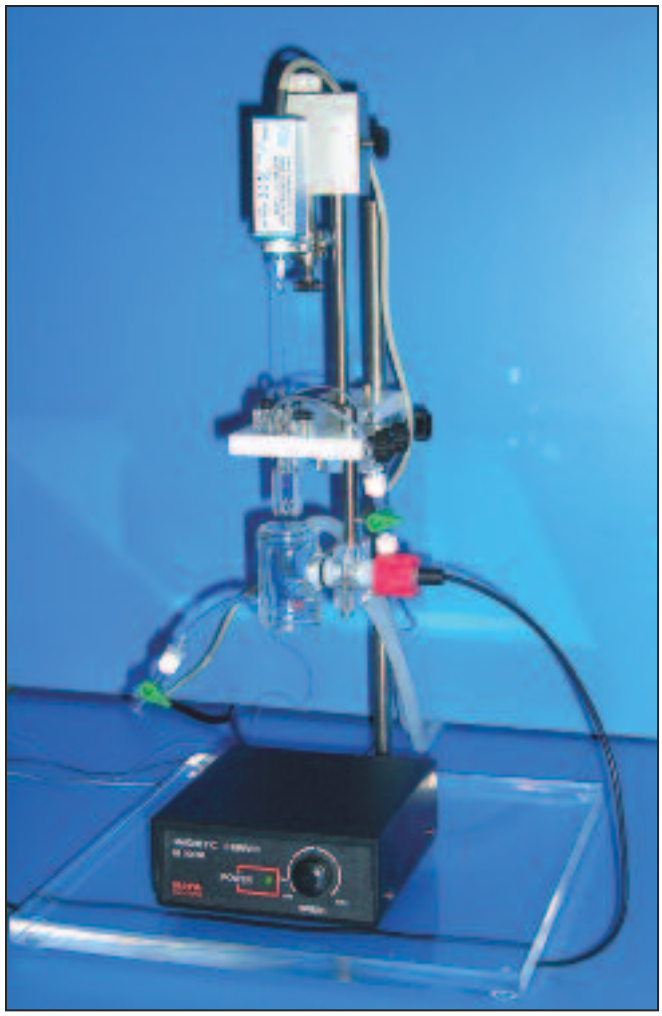
The IPR (Ileum Peristaltic Reflex) is a version of the PBTO that has been designed for studying the peristaltic reflex in the guinea-pig ileum. The circular muscle contraction which propels the contents of the ileum from aboral to anal direction is induced by the increase of the intraluminal pressure up to a threshold point.

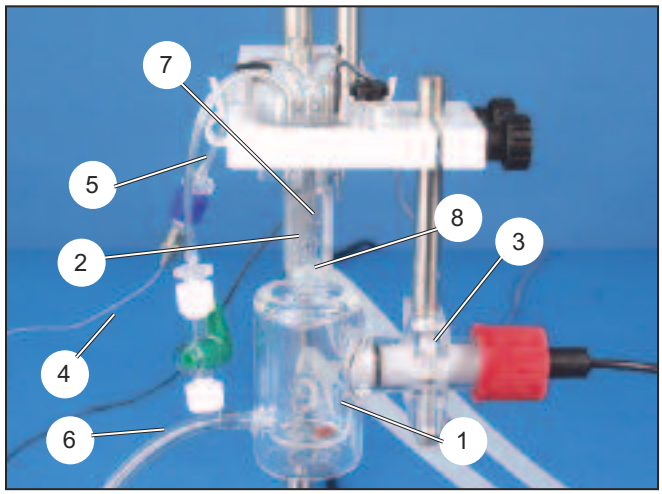
The tissue bath is a jacketed Plexiglas bath. The holder for the cannulae can be removed from the main bath during the preparation. The oral and aboral ends of a 4 to 5 cm long segment of guinea pig ileum is cannulated. Three different sizes of cannulae are available. The cannulae are fixed on sliding holders to adapt the distance between the cannulae to the individual length of the ileum. The inflow is controlled by means of a peristaltic pump with a flowrate of about 0.5 ml/min. The direction of the perfusion flow must meet the physiological way. The outflow can be switched using a stopcock from a level equivalent to the level of the bath to a level of about 3 cm above the level of the fluid in the bath. The peristaltic reflex is induced by this procedure. In the 'peristalsis' position, the pressure increases slowly resulting in a distention of the ileum until the pressure threshold level is reached. At this time the emptying phase is started as a visible contraction of the circular muscle moving from the oral to the aboral side.The intraluminal pressure is then recorded from the oral side.

Additional equipment required: thermocirculator, reservoir, peristaltic pump, transducer, monitoring system setup using the PLUGSYS Amplifier System. Recording and Evaluation of the signals using BDAS software.

Order #	Product
73-3013	Horizontal Tissue Bath IPR, Type 813/2

TIOX Tissue Bath for O_2 Consumption & Contraction Force Measurement





1. Tissue Vessel
2. Tissue Holder
3. Clark Type pO_2 Electrode
4. Temperature Probe
5. Drug Injection Line
6. Draining and Refilling Line
7. Tissue Hook with Transmission Wire to the Force Transducer
8. Fixing Hook for Mounting the Tissue

Benefits and Features

- Unique sealed system to measure muscle contraction and oxygen consumption.
- Oxygen electrode with very low rate of oxygen consumption
- Small volume

Applications

- Bioenergetics studies
- Sarcopenia in senescence studies
- Evaluation of metabolic - contractile caracteristics
- Fatigue and muscle weakness studies
- Sports physiology and biochemistry

The TIOX tissue bath is intended for experiments on isolated tissue preparations by measuring simulanously the tissue contraction and the oxygen consumption. It is used in fundamental research in physiological and pharmacological laboratories. It is particularly suitable for experiments in sport physiology.

The TIOX tissue bath consists of a Plexiglass baseplate with a vertical column. It carries a movable platform holding the tissue support and the transducer for measuring the contractile force. The tissue vessel is also mounted on the platform and is movable, it includes the Clark pO_2 electrode for measurement of oxygen consumption. Fresh solution which must be pre-warmed and aerated is introduced into the vessel with a syringe from the bottom of the vessel.

The tissue support is suitable for mounting muscle strips of a maximum length of 20mm (0.75 inch) and is equiped with two parrallel plate electrodes made of platinum for electrical field stimulation.

The following items and equipment are required for work with the tissue bath:

- Thermocirculator with approx. 3 liter capacity
- Magnetic stirrer
- Reservoir for perfusion solution with frit for equilibrating the solution supply
- Transducer to measure the muscle contractions (isometric or isotonic as required) with vernier control for fine adjustment of the pretentioning
- A bridge amplifier for the transducer, for signal conditioning
- OPPM amplifier for the Clark pO_2 electrode, for signal conditioning and adaptation to a data acquisition system
- Data acquisition system

Order #	Product
73-3794	TIOX Tissue Bath
69-3006	Microcathode Oxygen Electrode
72-1975	Magnetic Mini Stirrer
72-1977	Micro Stirring Bar
73-0831	HSE Isometric Force Transducer F30

Coleman Superfusion Bath

Benefits and Features

- Suitable for virtually any tissue sample
- Compact, allows the study of up to four tissue preparations in parallel
- Rapid removal of potentially toxic metabolites
- Obviates the necessity of repeated washing procedures
- Simple reclaimation of perfusate for recirculation or collection

Applications

- Evaluation of the potency of labile substances
- Determining the rates of onset and offset of drug action
- Evaluation of spasmogenic and spasmolitic agents

The Coleman superfusion system is suitable for a variety of applications involving the study of contraction and relaxation of smooth muscle preparations, the effect of drugs that interfere with these actions, as well as those that interfere with autonomic neurotransmission. The system consists of a main stand that can receive up to eight single superfusion chambers. Each chamber is equipped with electrical stimulation capability, a rod for fixing the force transducer and an optional two channel heat exchanger. The lower end of the tissue is held by a stainless steel hook. The thread attached to the top of the tissue passes through the opening directly to the force transducer. The superfusion solution is fed by a peristaltic pump through a stainless steel cannula to the thread; it runs down the thread and superfuses the tissue. Two separate solution paths are available for superfusion with and without test substance. Two platinum wires are placed parallel to the tissue to form stimulation electrodes. The solution running down provides electrical contact between the electrodes and the tissue.

The superfusion chambers are made of Plexiglas and do not require thermostating owing to the low thermal conductivity of the material. The chamber is fixed on the frame in the horizontal position. All additional parts (tissue holder, dual heat exchanger, road for mounting the transducer) are fixed on the chamber. The upper part of the chamber receives the tissue holder. The lower part can be swung away to simplify access to the preparation. The lower part is funnel-shaped to allow the collection of the efluate for reperfusing, perfusing the next tissue or bioassay analysis. The isometric force transducer is fixed on the rod using a Vernier control.

The tissue holder is a separate part that is installed in the main superfusion chamber. The holder can easily be removed to simplify the preparation. The holder consists of the body, the hook for fixing the tissue, the stainless steel cannulas for superfusion and the stimulation electrodes. The tissue is attached using a thread to the tissue hook. The thread at the other end of the tissue must be attached to the transducer. A slide in the holder body allows easy positioning of the thread in the central hole. The superfusion cannulae can be rotated in the main body to optimize the superfusion after the holder is in place into the chamber and the thread fixed to the transducer. The stimulation electrodes are made of platinum and must be buckled to be close to the tissue. The electrodes do not touch the tissue but must be parallel and close enough to the tissue so that the superfusing solution makes electrical contact.

The dual heat exchanger consists of Tygon tubing loops inside a jacket tube connected to a thermocirculator.

In the Flow through mode each tissue is superfused individually with fresh solution or solution containing the test compound. The outcoming solution is collected and goes to waste or is stored for later bioassay analysis.

In the Recirculating mode each tissue is superfused individually. The outcoming solution after superfusion is collected and used for superfusing again in the same tissue.

In the Cascade mode the first tissue is superfused with fresh solution and all the subsequent tissues are superfused with the outcoming solution of the preceding chamber.

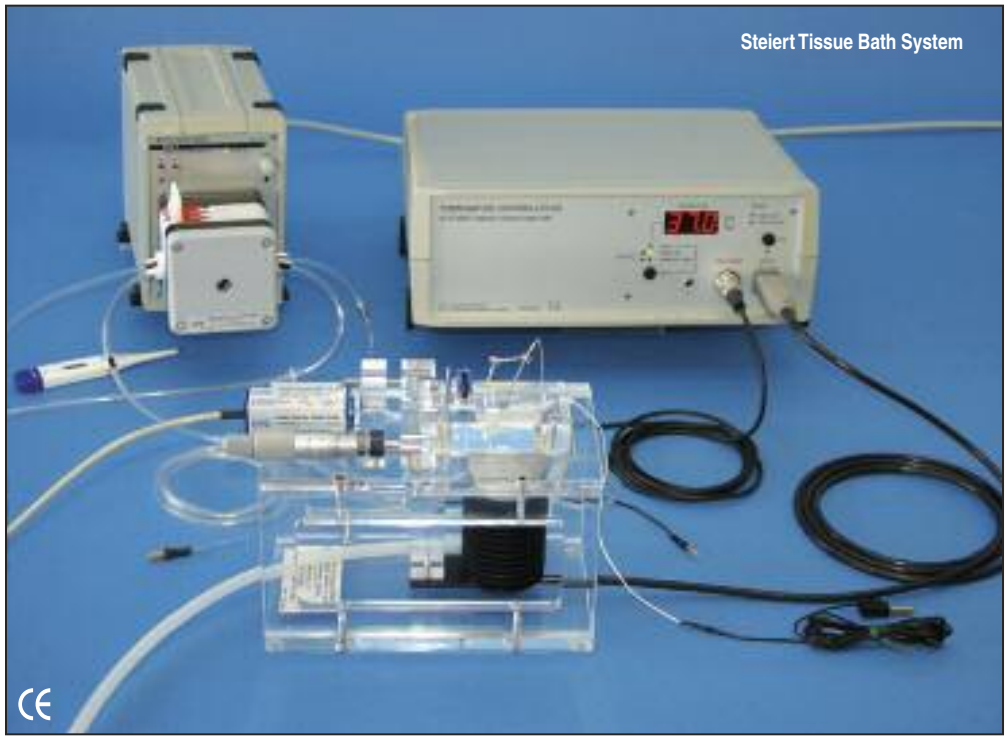
Additional equipement required: peristaltic pump, force transducer with Vernier control, bridge amplifier for the force transducer, Data acquisition ACAD, electrical stimulator, thermocirculator if heat exchangers are used.

Order #	Product
73-2221	Basic Unit for Superfusion Bath according to COLEMAN (stand for 4-Baths) Type 840
73-2222	Superfusion Bath according to COLEMAN
73-2917	Heat Exchanger to Superfusion Bath COLEMAN

For a system description according your requirements please use:
www.hugo-sachs.de/timail.html
or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.

Steiert Tissue Bath System

For Simultaneous Action Potential & Contraction Force Measurements on Cardiac Tissue



Applications and Features

- Compact and easy to use setup for electrophysiology studies on heart muscles
- Suitable for papillary muscle and Purkinje Fibre
- Simultaneous recording of intracellular action potential and force development
- Mini coaxial electrode for electrical stimulation

The Steiert Tissue bath system is a horizontal bath, open at the top, specifically designed for electrophysiological (Intracellular Action Potential) and mecanical (Contractile Force) studies of cardiac tissue preparations such as papillary muscle and purkinje fibers. The unique design allows the user to record both intracellular action potentials and contractile force from the same tissue preparation. The core system includes the tissue bath, a peristaltic pump and the DC-controller for temperature regulation and control of the perfusate, a direct contact coaxial stimulation electrode and the force transducer mounting with micrometer control to maintain tissue tension.

The tissue bath has ports for fluid inlet and outlet. The port outlet is a sipper pipe connected to the peristaltic pump. The sipper pipe is adjustable in height to adjust the bath volume (1-2 ml). The tissue under investigation is secured with needles to a Silicone pad fitted in the bath bottom, the other end is secured, either with a thread or directly, to the hook of the force transducer. Only transducers F10 or F30 can be used.

Stimulation takes place through a miniature coaxial electrode which is mounted flexibly on a triple ball joint to the back of the bath. The stimulation electrode can therefore be positioned to suit individual requirements.

The Temperature Controller DC has been specially developed for thermostating the perfusion solution supply on the organ bath after Steiert. Special attention has been paid during the development of this controller to a very low radiated interference level. The heating circuit (temperature controller and heating element) has excellent decoupling from the perfusion solution circuit. The heating element is a long life halogen bulb. It is therefore excellently suitable for the interference-free measurement of intracellular action potentials.

Additional equipment required: force transducer, bridge amplifier for the force transducer and microelectrode amplifier with headstage, Data acquisition, recording microelectrodes, electrical stimulator with isolation unit, tissue preparation dish, anti-vibration table, microscopes, illumination, micromanipulators and many other options.

If contractile force measurement is not required, special versions are availble on request.

A version with field stimulation is also available on request. Be aware that in this case stimulation artefacts may interfere with the action potential signal.

Order #	Product
73-2152	Basic Unit, Organ Bath According to STEIERT Type 813, 230 VAC 50 HZ
73-2892	Basic Unit, Organ Bath According to STEIERT Type 813, 115 VAC 60 HZ

For a system description according your requirements please use:
www.hugo-sachs.de/timail.html
or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.

PCLS Precision Cut Lung Slice Chamber

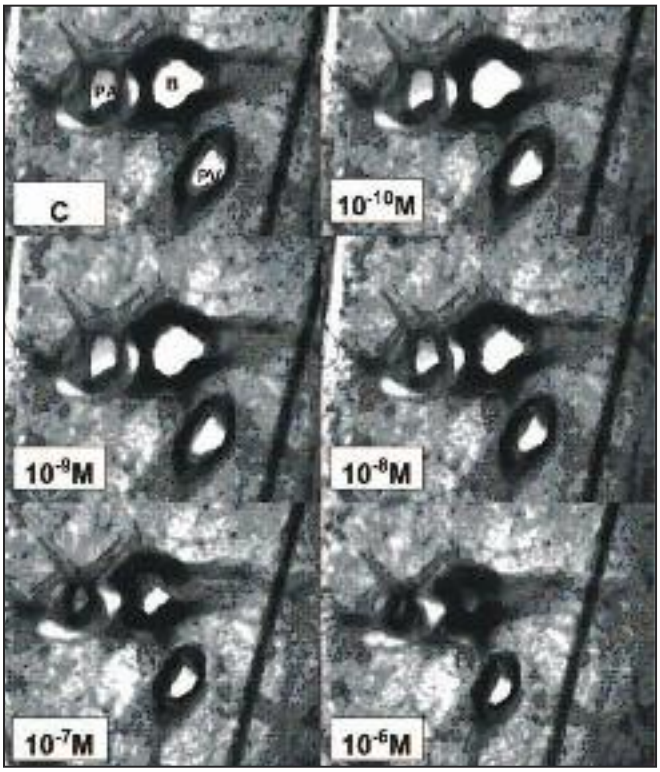
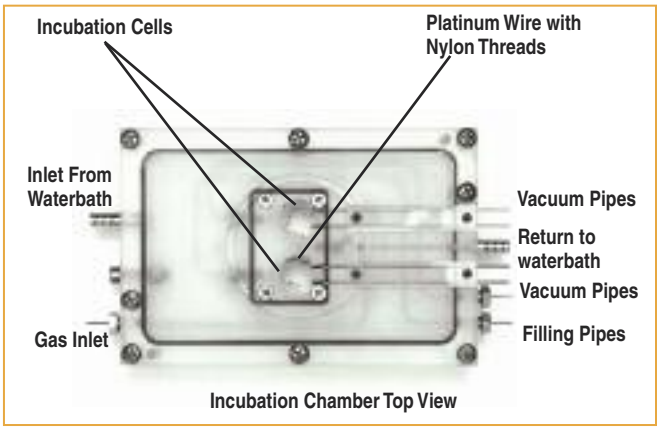


Figure 1. Exposure of a PCLS to increasing concentrations of endothelin-1. Shown is one lung slice containing a small airway (B), a pulmonary artery (PA) and a pulmonary vein (PV). The slice was imaged before (C) and after exposure to increasing concentrations of endothelin-1, ranging from 10-10 M to 10-6 M.

- Assessment of lung functions under cell culture conditions
- From any species (murine, rat, human)
- Study of airways of different sizes
- Allows quantification of the responsiveness of simple airway passages and simple vessels
- Analyzing ciliary beating frequency

Lung Functions Under the Microscope

Precision-cut lung slices (PCLS) offer a novel and unique way to assess lung functions under cell culture conditions. They can be prepared from nearly any species including mouse, rat and human lungs. The method allows the study of the response of airways of different size (down to the terminal bronchioles) and to relate these changes in lung functions to gene expression and mediator release. Slices are viable for at least three days. They can be placed under an inverted microscope, where digital image techniques allow quantification not only of the responsiveness of single airways, but also of single vessels. In addition, it is possible to analyze the ciliary beating frequency. More than 20 slices can be obtained from one lung, thus this method is very economical in terms of experimental costs and animal use. Tissue cores are prepared from the lungs filled with agarose solution, after cooling to 4°C. From the cores, slices (220 ± 20µm) are cut using a tissue slicer



The incubation chamber was developed to allow incubation and observation of slices by an inverted microscope. The chamber is made of Polycarbonate. It is connected to a water bath to maintain constant temperature conditions. Two incubation cells are positioned in the center of the chamber. The bottom of the cells is sealed by glass, the cover is made of acrylic glass. The slices are fixed in the incubation cells by positioning them under nylon strings fixed to a bent platinum wire. The incubation cells can be filled with buffer, medium or drug solutions through the filling pipe. Buffer solution can be removed from the cells over a vacuum pipe. In addition, it is possible to gas the incubation cells in order to use bicarbonate buffered media.

The incubation chamber is placed on the stage of an inverted microscope and warmed to 37°C. The slices are screened for airways and transferred to the incubation chamber. Lung slices are selected for study using predefined criteria (Martin et al. 1996). Airways and vessels are focused, and finally the images are analyzed by image analysis software (e.g., Optimas or Metamorph).

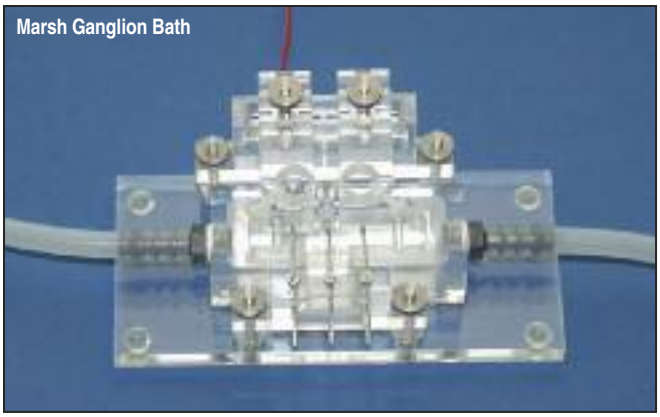
Example of an Application

As an example Figure 1 shows exposure of a slice to increasing concentrations of endothelin-1. Shown is a lung slice containing an airway (B), a pulmonary artery (PA) and a pulmonary vein (PV). The pulmonary artery and the airway contracted almost completely, while the pulmonary vein area decreased to only 50% of its initial area. These responses are now easily quantified by digital imaging technique.

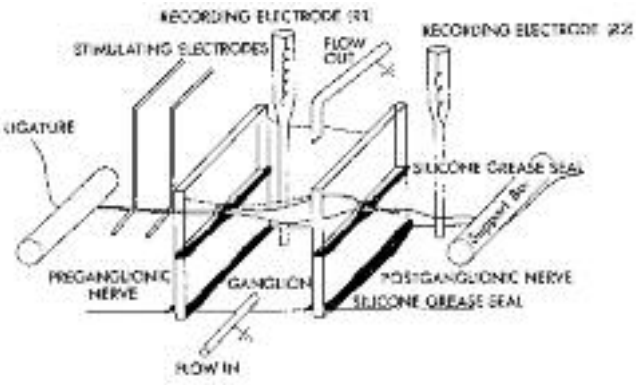
It is a distinct advantage of this technique that in many ways precision-cut slices can be treated like a cell culture. Thus, the slices can be incubated under various conditions and gene as well as protein expression or mediator release be determined. In contrast to cell culture models, in slices the anatomical structure of the lung is largely maintained, so that the functional consequences of gene expression and mediator release can be evaluated.

Order #	Product
73-2370	Precision Cut Lung Slice Chamber
Accessories	
73-0125	Thermostatic Circulator E 103, 230 VAC,
73-2802	Thermostatic Circulator E 103, 115 VAC
73-0113	Roller Pump Reglo Analogue ISM 827, I 4 Channels, 0.002 to 30 ml/min

Marsh Ganglion Bath



Marsh Bath set up for recording from rat superior cervical ganglia



For Studying

- Synaptic transmission
- Nerve conduction

Applications Include

- Vagus nerve
- Cervical ganglion

The MARSH Ganglion Bath is intended to test the action of drugs on the synaptic transmission or nerve conduction in the vagus nerve or the cervical ganglion.

The bath is an open-top Perspex bath which is divided into three compartments by two separators. Each of these separators consists of a removable upper section and a lower section with a cutout to allow the nerve to pass between chambers without crushing and also support the tissue in position.

The first chamber contains two platinum electrodes for axonal stimulation of the nerve bundle or preganglionic nerve trunk. Recordings are made from the central chamber with the third chamber acting as reference chamber using non-polarizing silver/silver chloride electrodes. Drugs are applid via the continously perfused central chamber.

The electrode set to the Marsh Ganglion Bath includes the necessary components to produce two recording electrodes to interconnect the recording chamber with the PHDA headstage amplifier.

Additional equipement required: amplifier with high-impedance input and a peak height detector (PLUGSYS module PHDA), Data acquisition, electrical stimulator with isolation unit, thermocirculator, solution reservoir, illumination, oscilloscope.

The elctrode set contains two 1ml syringes, 2 lengths of PE tubing with luer tip, 2 Ag/AgCl pellets with taper plastic body and connecting socket at the back suitable for 2 mm plug pin and Agar powder.

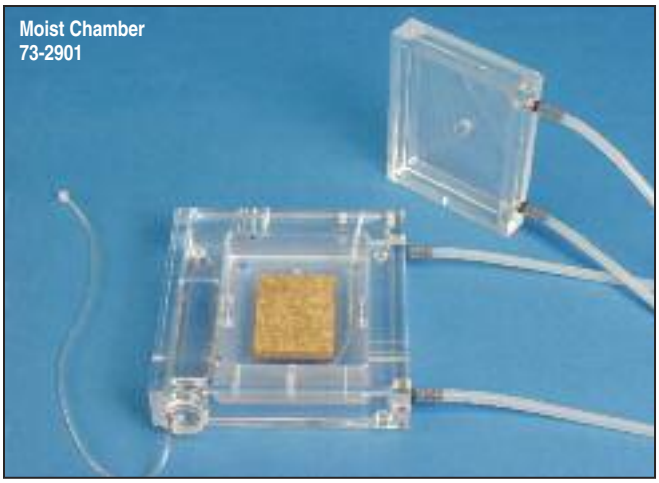
If stored properly (protected from light sources) electrodes can be used for about 2 weeks, the Agar solution must then be replaced.

The electrodes are connected by short wires with 2mm pins to the headstage of the amplifier. These cables are supplied with the PHDA amplifier.

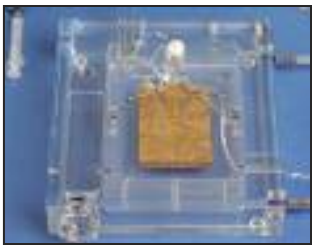
For a system description according your requirements please use:
www.hugo-sachs.de/timail.html
or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.

Order #	Product
73-2414	MARSH Ganglion Bath Type 858
73-0387	Set Electrode Components to MARSH Ganglion Bath (for 2 electrodes)

Moist Chamber Type 834/8



Mini ball joint holders support arterial and venous cannulae for rat liver perfusion



Moist chamber equiped for isolated rat liver perfusion under constant flow conditions

Benefits and Features

- Excellent temperature control for perfusate and organ
- Precise positioning of cannulae and measurement probes
- Straight forward operation and compact dimensions
- A large choice of cannulae, bubble traps and other acessories makes the moist chamber suitable for a huge range of perfusion applications
- Provides a complete perfusion system in combination with the UP-100 or Perfusion Control System

Applications

- For perfusion of organs from rodents like liver, kidney, pancreas and mesenteric bed
- For investigating the tone of small blood vessels under the effect of vasoactive substances
- Biochemistry, studying metabolic processes

The popular Moist Chamber Type 834/8 is an exceptionally flexible and useful tool for perfusion of most "simple" organs from typical rodent models. In its most basic configuration, the Moist Chamber consists of a suitably deep (110x40x35mm) organ chamber and tight-fitting cover. Both components are double-walled and water-jacketed to provide a stable temperature controlled environment within the organ chamber. Perfusate is warmed by passage through a built-in heat exchanger and bubble trap immediately before contact with the organ.

Inside the chamber, a flexible silicon platform acts as a rest for fixation (usually with standard fixing pins) of the organ. Anchors for our Mini Ball Joint positioning system and precision arterial and venous cannulae are pre-drilled on both sides of the organ. In addition, several measurement and sample ports are provided for easy access to the inner chamber, even with the cover in place, making the chamber suitable for collecting a wide range of physiological data.

The Moist Chamber Type 834/8 can be part of a simple constant flow perfusion system. Used as such, a water-jacketed buffer reservoir, peristaltic pump and appropriate cannulae are used to complete the perfusion circuit, while a thermocirculator feeds the water-jacketed components to maintain the thermostating circuit. The Moist Chamber Type 834/8 can also be used to form the core of our UP-100 or Perfusion Control system to permit perfusion at constant pressure as well as constant flow.

The basic Moist Chamber Type 834/8 is configured as shown above and consists of the chamber, cover and silicon plate only. Contact Harvard Apparatus for configuration of a complete perfusion system for specific applications.

Additional equipment required: thermocirculator, bubble trap, cannulae, holders, peristaltic pump, transducers, monitoring system setup using the PLUGSYS Amplifier System. Recording and Evaluation of the signals using BDAS software.

Special Application: The Rat Mesenteric Bed

The key part of the perfusion system for the rat mesenteric bed is the moist chamber. The mesenteric tissue is placed into the moist chamber on a stainless steel mesh (replaces the silicone plate) which also acts as anode during electrical stimulation.

Order #	Product
73-2901	Moist Chamber Type 834/8 with Metal Tube Heat Exchanger
73-3692	Bubble Trap for Flow Rate up to 50 ml/min
73-3094	Stainless Steel Mesh Electrode

For a system description according your requirements please use:
www.hugo-sachs.de/orgmail.html
or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.

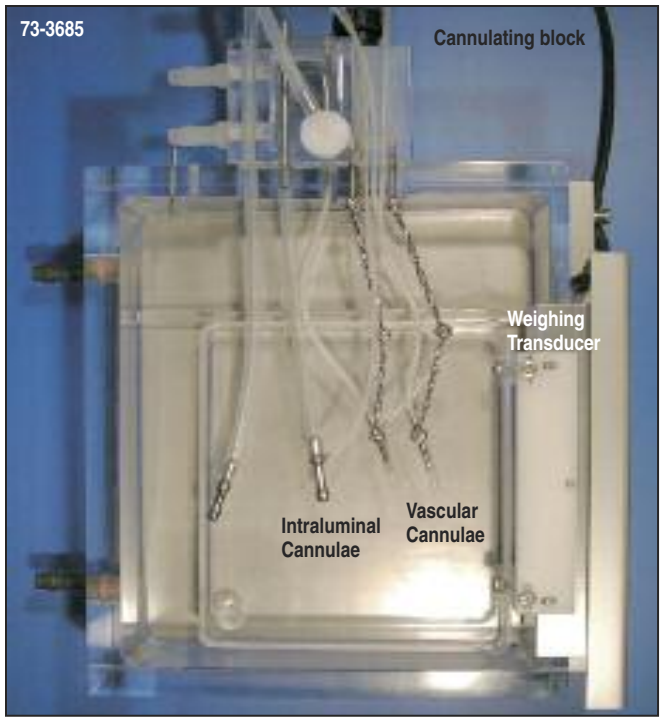
Moist Chamber Applications

Moist chamber with peristaltic pump, perfusate reservoir and thermocirculator. Used for constant flow perfusion for organs such as Liver.

Moist chamber with peristaltic pump, SCP perfusion control system, perfusate reservoir and thermocirculator. Used for constant pressure perfusion for organs such as kidney and pancreas. The SCP perfusion control system includes flow measurement capability. By disabling the pressure control, the system can also work as constant flow perfusion system with pressure measurement.

Moist Chamber with Edema Balance

Moist Chamber for Microvascular Permeability Studies



Cannulation block removed from chamber for surgery

- Compact arrangement
- Dual Perfusion System, vascular & intraluminal intestinal
- Built-in balance for edema evaluation/organ weight measurement
- Vascular bed is in warm and moist environment during perfusion
- Optimized temperature control of perfusate and organ
- Controlled perfusion conditions
- Cannulation block simplifies surgery

Applications

- To study simultanuously vascular, luminal and lymphatic flows, arterial, venous and intraluminal pressures and bowel weight.
- Septic multi-organ failure study in gastro intestinal area

The system is based on a moist chamber with a built-in organ weighing system. The jacketed chamber maintains a warm and moist environment for the organ. The chamber has been configured for studying the edema evolution in a perfused intestine with attached mesenteric bed with two separate perfusion lines for simultaneous vascular and intraluminal perfusion.

The chamber is supplied with a movable cannulation block including all the required heating coils and bubble traps. This block acts also as holder for the tubing and cannulae, it can be placed near the animal for easy in-situ preparation. After surgery, the block with the preparation is moved and fixed on the chamber. This ensures continuous perfusion during the entire duration of surgery and reduced risk of embolism or ischemia.

The chamber provides a number of ports for connecting the measurement system and perfusate collection. Measurement of perfusion pressures and flows are also available. A peristaltic pump is used for vascular perfusion. A constant pressure is maintained by controlling the pump speed with an electronic controller (SCP) via pressure measurement. For the intraluminal Ileum perfusion, a syringe pump is used.

Additional equipment required: thermocirculator, peristaltic pump, syringe pump, transducer for perfusion pressure, servo controller (SCP), monitoring system setup using the PLUGSYS Amplifier System. Recording and Evaluation of the signals using BDAS software.

The chamber can be used for any other organ that requires continuous weighing during perfusion.

The interchangeable adapter block holding the perfusion lines and cannulae can be customized for other types of organ to be perfused.

Developed in cooperation with the Forschungszentrum Borstel, 23845, Borstel and Universitätsklinikum, Chirurgie, 24105 Kiel.

Order #	Product
73-3685	Moist Chamber with Edema Balance Type 802 (MCWEB)

Citations

A Model of the Isolated Perfused Rat Small Intestine

Ingmar Lautenschläger,1 Heike Dombrowsky,2 Inez Frerichs,3 Solveig-Carolin Kuchenbecker,3 Steffen Bade,2 Holger Schultz,2 Peter Zabel,2 Jens Scholz,3 Norbert Weiler,3, and Stefan Uhlig2*

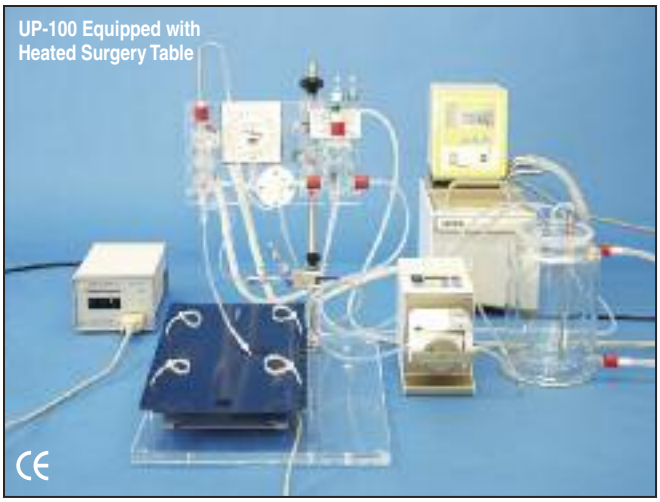
1University Medical Centre Schleswig-Holstein, Campus Kiel 2Research Center Borstel 3University Hospital Schleswig-Holstein, Campus Kiel

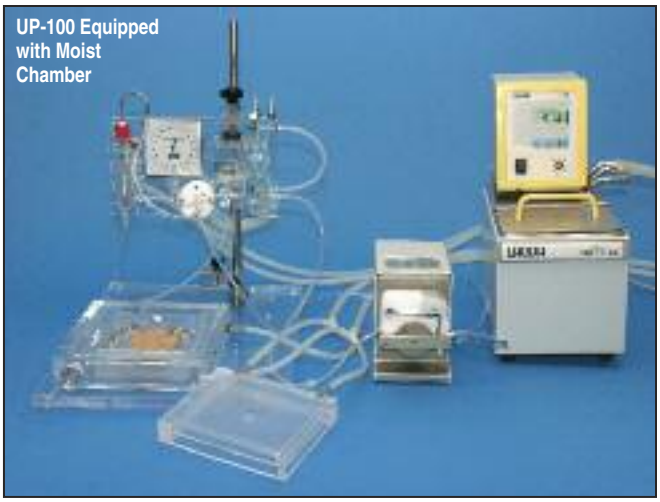
Submitted 31 July 2009 ; revision received 8 October 2009 ; accepted in final form 8 November 2009

ABSTRACT

Intestinal edema remains a serious clinical problem and novel approaches to study its pathophysiology are needed. It was our aim to develop a long term stable isolated perfused rat small bowel preparation permitting analysis of vascular, luminal, interstitial and lymphatic compartments and to demonstrate the utility of this model by studying the effects of the pro-inflammatory mediator platelet-activating factor (PAF). A temperature-controlled chamber with an integrated balance was designed to perfuse isolated intestines through the mesenteric artery and the gut lumen. Steroids or oxygen carriers were not needed. Functional and morphological integrity of the tissue was preserved for several hours as confirmed by oxygen consumption, venous lactate-to-pyruvate ratio, arterial and venous pH, lactose digestion and galactose uptake, intravascular and luminal pressures, maintained fluid homeostasis, gut motility, and by quantitative light microscopic analysis. Administration of PAF caused typical effects such as vasoconstriction, gut atony, and loss of galactose uptake. PAF also elicited a transient loss of 20% of the perfusate liquid from the mesenteric vascular bed, two thirds of which were transferred to the lumen. All these responses were entirely reversible. This new model provides detailed insights into the physiology of the small intestine, and will allow to study fundamental processes such as fluid homeostasis, barrier functions, transport mechanisms and immune responses in this organ. Using this model, here we show a dramatic and yet reversible response of the rat small bowel to PAF suggesting luminal water clearance as a novel safety factor in the intestine that may be of clinical relevance. Intestine physiology; fluid balance; platelet activating factor.

Universal Perfusion System UP-100





- Multi-purpose system for perfusing isolated organs in-situ or ex-vivo
- Ideal for perfusing isolated organs such as:
  - Liver – Rabbit Ear – Heart
  - Kidney – Rat hind limb – Mesenteric bed
- Perfusion can be performed at constant pressure or constant flow without involving any modification of apparatus
- Ideal replacement for perfusion system with hydrostatic pressure generation, low perfusate volume in use, perfusion pressure up to 300 mmHg possible
- Can be equipped with an oxygenator for optimal aeration of perfusate containing albumin or erythrocytes

Applications

- In situ perfusion of hind limb, hindquarter mesenteric bed, liver, kidney:
  - Blood vessel tone in peripheral vascular bed
  - Balance tests by muscle work (glucose/lactate/pyruvate, high energy phosphates/orthophosphate, etc.)
  - Test of vasodilative drugs in occlusive diseases of legs
  - Test of muscle relaxants (end-plate pharmacology)
- Ex-vivo perfusion of liver, kidney, mesenteric bed, by using the additional Moist Chamber Type 834/8
  - Test of vasodilative drugs
  - Studying metabolic processes
  - Neural vascular tone
  - Organ preservation for transplant
- Special version for Langendorff heart perfusion
  - Optimized for LVP measurement
  - Ideal for compound screening

The UP-100 is a multi-purpose perfusion system best utilized when different types of organs must be perfused either in situ or ex vivo. The modular design of this system allows easy adaptation to different applications using additions or extensions to the base unit.

System Extensions for Perfusion Ex-Vivo

Internal organs (kidney, liver, mesenteric bed) must obviously be kept under optimal physiological conditions; moist and at defined temperature during perfusion. For these applications the UP-100 is combined with the Moist Chamber Type 834/8.

System Extensions for Perfusion in Situ

For in situ perfusion of organs such as liver and kidney, or for perfusion of regional vascular systems like hindquarter, an operating table can be placed on the main Plexiglas plate below the UP-100 mounting platform. The compact arrangement allows the connection line between organ and heat exchanger to remain short to ensure consistent perfusate temperature.

System Extensions for Perfusion of Mouse, Rat, Guinea-pig or Small Rabbit Heart

For perfusion of the isolated heart according to Langendorff, the UP-100 can be equipped with a jacketed heart chamber and additional measurement system for isovolumetric LVP.

Additional equipment required: thermocirculator, electrical stimulator, peristaltic pump, transducer for perfusion pressure, monitoring system setup using the PLUGSYS Amplifier System. Recording and Evaluation of the signals using BDAS software.

Order #	Product
73-2316	Universal Perfusion System Basic Unit UP-100, Type 834

The UP-100 is a universal system. It needs to be adapted to the specific application by adding other equipment.

For a system description according your requirements please use:
www.hugo-sachs.de/orgmail.html
or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.

Perfusion System for Isolated Pig Liver or Pig Kidney


HSE Perfusion System for Isolated Pig Liver or Pig Kidney

- For use in physiological or pharmacological research for the perfusion of a pig liver or kidney with blood or erythrocyte containing perfusate
- For liver or kidney transplantation studies
- For liver or kidney xenotransplantation studies

Basic System

The pig liver to be perfused is placed in a moist, thermostated chamber (inside dimensions: 400 x 300 x 180 mm) and perfused with blood or erythrocyte containing perfusate under constant-flow conditions via the portal vein. A centrifugal pump with a gentle action on blood is employed to reduce hemolysis. As this type of pump does not supply a constant flow or pressure, the constant flow is maintained by an electronic controller (SCP). For the kidney instead of the liver chamber, a smaller chamber (inside dimensions 260 x 200 x 210 mm) is used. The kidney is mainly perfused at constant pressure, which is also controlled by the SCP.

For a system description according your requirements please use:
www.hugo-sachs.de/orgmail.html
or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.

Components for a complete system:

- **Thermostated moist chamber for pig liver or pig kidney**

The following additional items are required for operating the apparatus:

- **Thermocirculator**
- **Pump with electrical control. For blood we recommend a Pump Drive BVP-ZX with centrifugal pump head, see the Pump Section A**
- **SCP, Servo Controlled Perfusion System**
- **Measurement system for Flow and Pressure**
- **Oxygenator with heat exchanger, e.g. Terumo Capiox SX10® or Medtronic Minimax Plus PRF®**

Additional monitoring equipment can be added to the system as required to create a custom, application specific, system for your unique research needs.

Monitoring System is set up using the PLUGSYS Amplifier System. Recording and Evaluation of the signals using BDAS software.

Order #	Product
73-2804	Moist Chamber for Isolated Pig Liver Type 69/2
73-2994	Moist Chamber for Isolated Pig Kidney

Isolated Heart System Overview

Use the chart below to find the system(s) that match your specific research requirements. Then, contact our technical experts with any questions or for a custom configuration to your requirements.

Mouse
Rat/Guinea Pig
Rabbit
Minipig/Small Pig

• Included in Basic Unit
+ Available Option

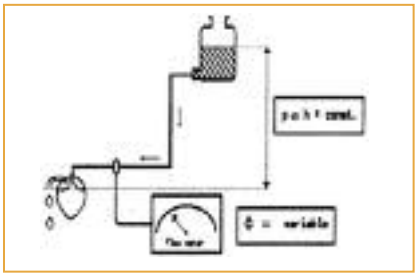
Langendorff Perfusion Systems	Your Requirments	IH-SR	IH5	IH-9	UP-100 Langendorff	HA-PL	Student IH
		advanced research			research		teaching
Heart							
Constant Flow		• •	• •	•	• •	• •	• •
Constant Pressure		• •	• •	•	• •	• •	• •
Working Heart Capability		+ +	+ +	+			
General Features							
Optimal Temperature Conditions		• •	• •	•			
Solid State Perfusion Circuit		• •	• •	•			
High Perfusion Pressure Possible		• •	• •	•			
Adjustable Flow Resistance		• •	• •	•	• •		
Features in WH Mode							
True Cardiac Afterload System		• •	• •	•			
Measurements in LD Mode							
Coronary Flow (Direct Measurement)		+ +	+ +	+	+ +		
Coronary Flow (Indirect Measurement)		• •	+ +	+	+ + +	•	
Perfusion Pressure		• •	• •	•	• • •	• •	• •
Isovolumetric LVP Contraction		• •	+ +	+	+ + +	• •	+ +
Contractile Force						•	•
Measurements in WH Mode							
Preload Pressure		+ +	+ +	+			
Afterload Pressure		+ +	+ +	+			
Flow into Atrium		+ +	+ +	+			
Aortic Flow		+ +	+ +	+			
LVP Pressure		+ +	+ +	+			
Pressure-Volume Loop		+ +	+ +	+			
Measurements in All Modes							
Single ECG		+ +	+ +	+	+ + +		+ +
Multi-lead ECG			+ +				
Single MAP		+ +	+ +	+	+ + +		+ +
Multiple MAP		+ +	+ +	+	+ + +		
Heart Dimensions		+	+ +	+	+ +		
Blood Gasses (pH, pO_2, pCO_2)		+	+ +	+	+ +		
Data Acquisition and Analysis Software		+ +	+ +	+	+ + +	• •	+ +

Isolated Heart Systems Overview

Perfusion Modes

Langendorff Perfusion Mode

Constant Pressure Perfusion



ADVANTAGES

- Physiological mode
- No risk of damaging heart by unintentionally high pressure
- Most commonly use method, facilitates comparison w/large body of literature

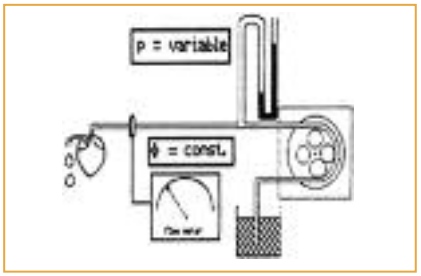
DISADVANTAGES

- Heart does only Isovolumetric work
- Can involve higher cost
- Since flow is not constant effective dose is difficult to calculate

TYPICAL APPLICATIONS

- Cardiology
- Physiology
- Pharmacology
- Biochemistery
- Testing vasoactive substances
- Ischemia / Reperfusion studies
- Testing cardiac rhythm
- Dispersion of ventricular repolarization
- Cardiovascular screening
- Hypoxic studies

Constant Flow Perfusion



ADVANTAGES

- Lower cost
- Simple methodology usually employed in compound screening

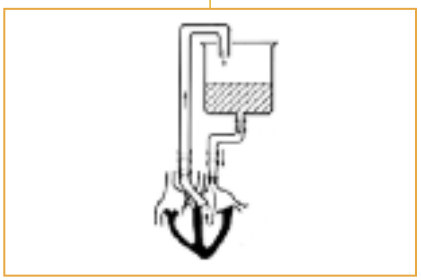
DISADVANTAGES

- Non physiological mode
- Heart does only Isovolumetric work
- Risk of massive pressure may cause heart damage

TYPICAL APPLICATIONS

- Cardiology
- Physiology
- Pharmacology
- Biochemistery
- Testing vasoactive substances
- Testing cardiac rhythm
- Ischemia/Reperfusion studies
- Dispersion of ventricular repolarization
- Cardiovascular screening
- Hypoxic studies

Ejecting Working Heart



ADVANTAGES

- Heart produces pressure volume work
- Ultimate physiological mode
- No risk of isolated heart damaging by unintentionally high pressure
- Allows study of cardiac function and metabolism

DISADVANTAGES

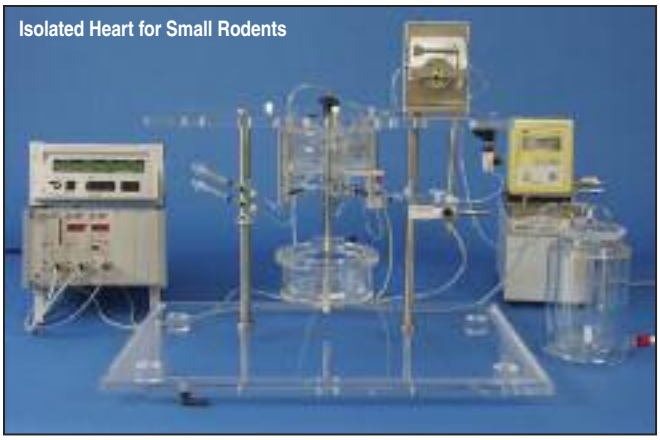
- Usually higher cost
- Since flow is not constant, effective dose is difficult to calculate

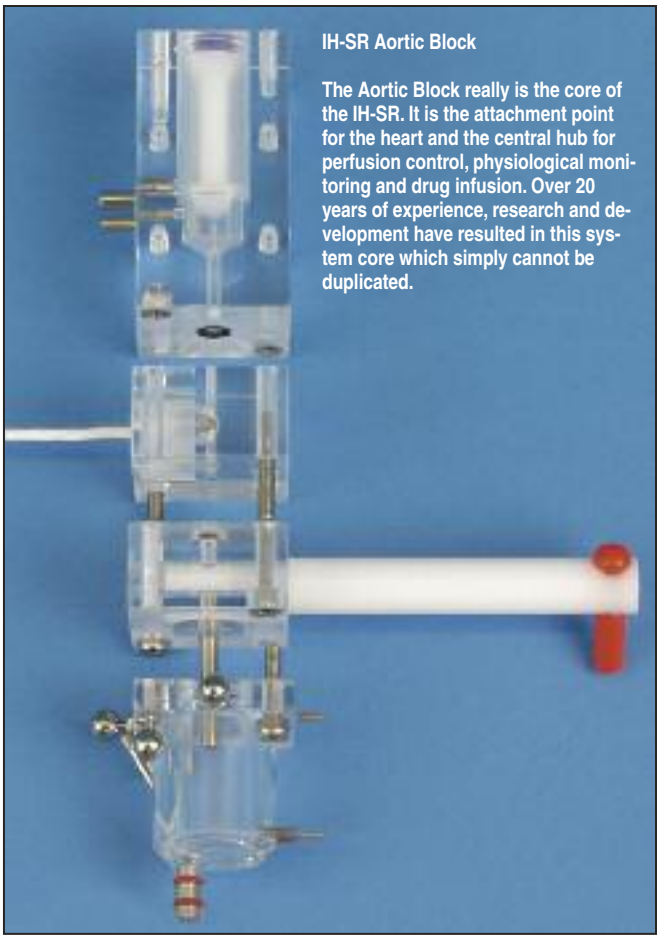
TYPICAL APPLICATIONS

- Cardiology
- Physiology
- Pharmacology
- Biochemistery
- Cardiac preload and afterload dependent studies
- Low-flow/ischemia studies
- Metabolic studies
- Cardiolplegia recovery
- Hypoxic studies

IH-SR Isolated Heart for Small Rodents

Mouse, Rat and Guinea Pig





Features and Benefits

- Langendorff and Optional Working Heart Perfusion in a Single System
- Compact Design, Optimized Individually for: Mouse, Rat or Guinea Pig
- Constant Pressure or Constant Flow Perfusion in one unit, easily switch between the two modes
- Compact, doesn't require wall-installed high water columns, suitable for hearts from hypertensive rats (perfusion pressures up to 300 mmHg are possible)
- Unique integrated small volume Aortic Block with built-in Bubble Trap and Windkessel
- Large Fully-Heated Heart Chamber
  - Natural physiological environment for the isolated heart
  - Hearts are kept alive for hours in a very stable physiologic environment
  - Easy-to-use with smooth open and closed operation
  - All electrodes, catheters and probes are fully enclosed for easy access and to maintain physiological conditions while performing the experiments
- Unique cannula design
  - Cannula resistance is optimized according to Hagen-Poiseuilles physical law
  - Different cannula sizes available, all metal, no fragile glass cannulae
- Proprietary Mini Holders allow easy and stress-free positioning of electrodes, catheters and probes

Applications

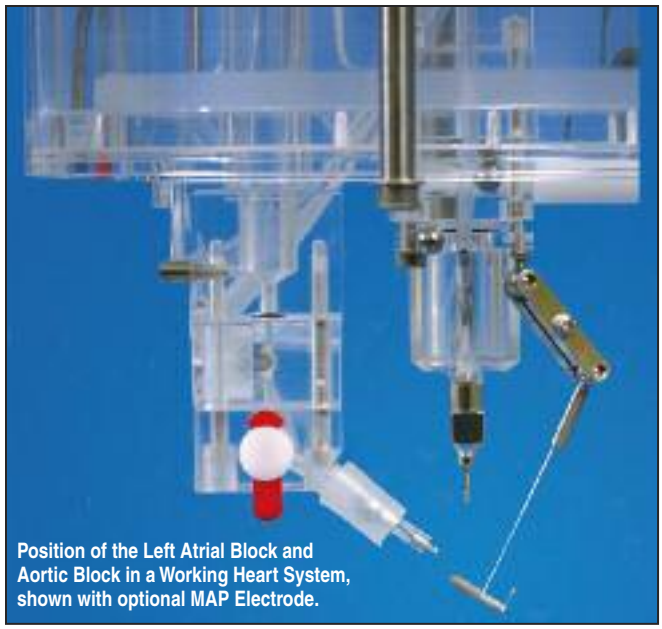
- Treatment with Inotropic Substances
- Cardiac Rhythm
- Ischemia and Reperfusion
- Cardiac Preconditioning
- Cardiovascular Screening Performance
- Phenotyping of Transgenic Animals
- Compound Screening

In either Langendorff or Working Heart configuration, the IH-SR can be outfitted as a complete Cardiac Physiology Workstation with a range of measurement devices, signal conditioning equipment and acquisition & analysis software to provide a superior solution for virtually any study.

What makes the IH-SR unique is the revolutionary Perspex construction which simply cannot be matched. The use of Perspex instead of traditional glass allows our engineers to mill the perfusion pathway directly into the solid Perspex blocks. The result is what we call a Solid State Physiological Perfusion Circuit (S2P2C). This patented perfusion technology ensures a precisely repeatable non-turbulent perfusion pathway for the highest fidelity pressure and flow measurement. This combined with the naturally excellent thermal properties of Perspex, creates a system that allows control, maintenance and monitoring of circulatory parameters in a way that is more physiologically relevant than any conventional perfusion system.

IH-SR Isolated Heart for Small Rodents

Mouse, Rat and Guinea Pig (continued)



Position of the Left Atrial Block and Aortic Block in a Working Heart System, shown with optional MAP Electrode.

Working Heart Extension

Benefits

- Assessment of External Heart Work Under Adjustable Load (Preload and Afterload)
- Optional Continuous Measurement of Metabolic Parameters, i.e. pH, pO_2, pCO_2
- Compact Design, Optimized for Each Species: Mouse, Hamster, Rat, Guinea Pig
- Modular Design to Integrate More Applications in the Future
- Unsurpassed Physiological Environment
- Unique Aortic Block for Precision Preload and Afterload Control
- Small Flow Resistance and Low Dead Space Volume for Highly Reproducible and Accurate Results
- Low Volume Drug Injection Pathway
- Solid State Physiological Circuit Mimics In-vivo Perfusion and Prevents Measurement Artifact
- Provides a valuable tool for the researcher who wants to study cardiac function and metabolism
- Combines the advantages of an isolated organ preparation with in situ-like perfusion features
- Allows a more comprehensive monitoring of functional parameters, the calculation of the external heart work and mechanical efficiency, and a considerably higher sensitivity for various experimental manipulations

The Working Heart model is the ultimate Ex-Vivo physiological model. The IH-SR Working Heart allows the researcher to take full advantage of this model with physiological simulation that cannot be matched.

The modular nature of the IH-SR allows for initial integration or later upgrade with the Working Heart perfusion pathway. This enables orthograde perfusion: entering the left atrium, flowing through the left ventricle and exiting the aorta. In this way, more physiological assay of ventricular contractility is possible as the left ventricle is now fully-ejecting and performing pressure volume work. In order to fully exploit this advantage, the IH-SR includes a specialized pathway which easily allows introduction of a Pressure or Pressure Volume catheter directly into the left ventricle via the aorta.

Specifications

Operating Modes:	
Version LH	Only Langendorff Mode at constant pressure or constant flow
Version WH	Working Heart Mode (after Neely)
Limiting Data:	
Aorta, ID	0.8 to 2.5 mm
Pulmonary Artery, ID	0.8 to 2.5 mm
Aortic Flow (WH)	Up to 100 ml/min
Aortic Pressure	Up to 300 mmHg
Atrial Pressure	Up to 10 mmHg approx. with special option up to 30 mmHg

On the Langendorff Preparation Following Signals Can Be Measured:

LVP	Isovolumetric LVP or Contraction Force
PP	Perfusion Pressure (Aortic Pressure)
CF	Coronary Flow
ECG	Electrocardiogram
MAP	Monophasic Action Potential
pO_2a / e	Oxygen Partial Pressure in the Affluent /Effluent
pH	pH in the Effluent
T	Temperature

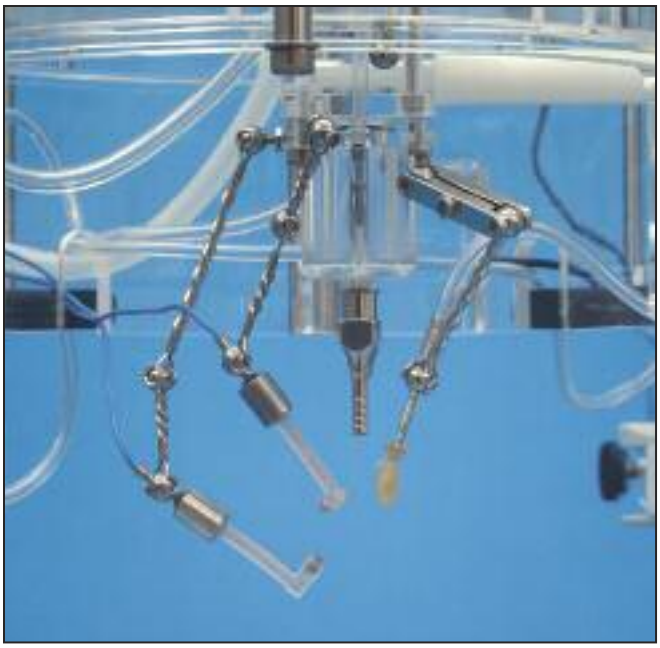
On the Working Heart Preparation Following Signals Can Be Measured:

PrP	Preload Pressure
AoP	Aortic Pressure (Afterload)
LVP	Left Ventricular Pressure
PV Loops	LV Pressure-Volume Loops
AF	Aortic Flow
CO	Cardiac Output (Flow into Left Atrium)
ECG	Electrocardiogram
MAP	Monophasic Action Potential
pO_2a / e	Oxygen Partial Pressure in the Affluent/Effluent
pH	pH in the Effluent
T	Temperature

For a system description according your requirements please use:
www.hugo-sachs.de/ihmail.html
or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.

IH-SR Isolated Heart for Small Rodents

Mouse, Rat and Guinea Pig (continued)



System Description

The apparatus by design is constructed to be very compact, improved for low volume and high temperature stability.

All of the components are mounted on a basic Plexiglas stand except for the thermostatic circulator and the measuring instruments. Special attention has been made to ensure constant and defined temperature conditions in the heart. All critical parts in this respect are arranged inside the unique temperature stable heart chamber, thus avoiding any cooling through a temperature gradient to ambient temperature.

The key part of the system is the unique aortic block. A clever arrangement of balls around the aortic cannula allows to mount easily by means of the miniature ball joint holders all the available measurement electrodes (ECG, MAP, electrical stimulation...) and collecting cannulae. This system can be upgraded from a simple Langendorff system to Working Heart and for many specific applications. The modular setup allows a continuously evoluting system. Many customized version are also available.

The connection to the heart is made through interchangeable aortic cannulae and atrial cannulae in working heart extension. The perfusate is aerated by bubbling in the reservoir. When the perfusate contains erhytrocytes or albumine, a special membrane oxygenator to prevent foaming can equip the unit.

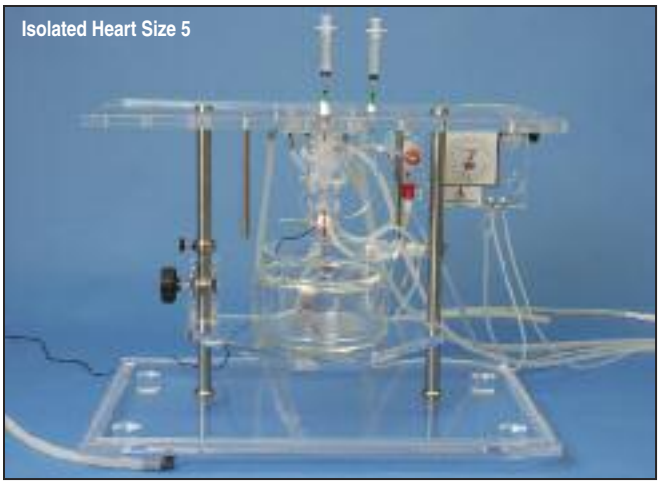
To get started, select the basic system then add specific options to suit the particular needs of your study. If any questions arise, our expert technical team of scientists and engineers is always ready to assist with system configuration, application support or custom design requests.

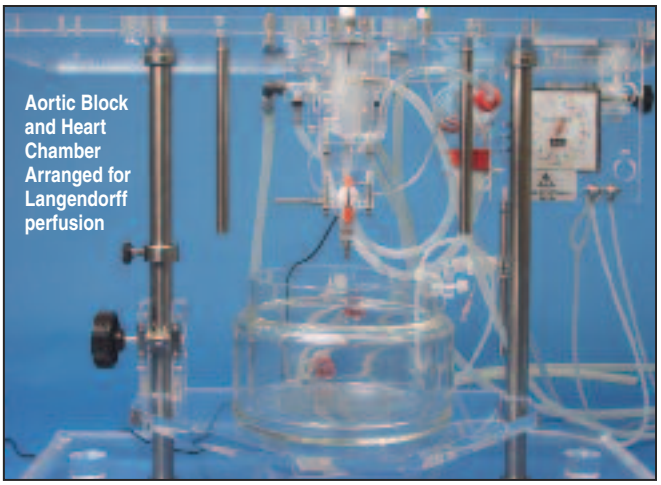
Contact us to receive the **NEW** detailed IH-SR Isolated Heart System brochure. Please visit our website or call us to request your ***FREE*** copy today!

Order #	Product
Langendorff System & Options	
73-4018	Basic IH-SR (Core System requires option 73-4019 or 73-4020)
73-4019	Additions to IH-SR core system for Mouse hearts
73-4020	Additions to IH-SR core system for Rat hearts
73-4021	Direct Flow Measurement for Mouse Hearts
73-4022	Direct Flow Measurement for Rat Hearts
73-4023	Measurement of ECG Lead II
73-4024	Pacing
73-4025	Measurement of One Epicardial Monophasic Action Potential on Mouse Hearts
73-4026	Measurement of One Epicardial Monophasic Action Potential on Rat Hearts
73-4027	Measurement of Endocardial Monophasic Action Potential on Rat Hearts
73-4028	Cannulating System for Pulmonary Artery on Rat Hearts for Metabolic Studies
73-4029	pO_2 Measurement
73-4030	pH Measurement
73-4031	pCO_2 Measurement
Additions to the Core System for a Working Heart	
73-4032	Working Heart Option (requires 73-4033 or 73-4034)
73-4033	Addition to WH-Option for Mouse Hearts
73-4034	Addition to WH-Option for Rat Hearts
73-4035	Measurement of Cardiac Output for Mouse Hearts
73-4036	Measurement of Cardiac Output for Rat Hearts
73-4037	LVP Measurement in Mouse Hearts
73-4038	LVP Measurement in Rat Hearts
73-4043	Pressure-Volume Loop Measurement in Mouse Hearts
73-4044	Pressure-Volume Loop Measurement in Rat Hearts
Data Acquisition Options	
73-4039	Data Acquisition and Evaluation System ISOHEART
73-4040	Data Acquisition and Evaluation System PowerLab
Drug Application Options	
73-4041	Drug Application
73-4042	Drug Application Flow Controlled in Constant Pressure Mode
Other Additions or Options	
73-4045	Additions for Cardioplegia Solution Application
73-2481	Low-Temperature Thermociculator, 230V
73-2981	Low-Temperature Thermociculator, 115VAC
73-4046	Cell Isolation with IH-SR Basic System
73-4047	Temperature Measurement
73-4048	Oxygenating System for Foaming Solutions Containing Albumin or Fatty Acids
73-3329	Effluate Fraction Collection
73-4049	Multi-Mapping ECG, 32 Microelectrodes
73-4050	Multi-Mapping ECG, 64 Microelectrodes

IH-5 Isolated Heart Size 5

Rat, Guinea Pig and Rabbit


Isolated Heart Size 5


Aortic Block and Heart Chamber Arranged for Langendorff perfusion

Features and Benefits

- Langendorff and Optional Working Heart Perfusion in a Single System
- Compact Design, Optimized Individually for: Rabbit, Rat or Guinea Pig
- Constant Pressure or Constant Flow Perfusion in One Unit, Easily Switch Between the Two Modes
- Compact, Doesn't Require Wall Installed High Water Columns, Suitable for Hearts from Hypertensive animals (Perfusion Pressures up to 300 mmHg are Possible)
- Unique Integrated Small Volume Aortic Block with Built-in Bubble Trap and Windkessel
- Unique Cannulae Design
  - Cannula Resistance is Optimized According to Hagen-Poiseuilles Physical Law
  - Different Cannulae Sizes Available, All Metal, No Weak Glass Cannulae
- Proprietary Mini Holders Allow Easy and Stress Free Access to Hold Electrodes and Catheters in Position
- Drug injection pathway built directly into aortic perfusate stream
- Can easily be upgraded to a working heart system

Applications

- Electrophysiology studies Monophasic Action Potential (MAP) single and multiple ECG measurements
- Dispersion of ventricular repolarization
- In-depth hemodynamic applications including study of cardiac flow, LVP and pressure-volume relationships
- Treatment with Inotropic and Vasoactive Substances
- Cardiac Rhythm

Applications (continued)

- Ischemia and Reperfusion
- Cardiac Preconditioning
- Cardiovascular Screening Performance
- Phenotyping of Transgenic Animals
- Compound Screening

In either Langendorrf or Working Heart configuration, the IH-5 can be outfitted as a complete Cardiac Physiology Workstation with a range of measurement devices, signal conditioning equipment and acquisition & analysis software to provide a superior solution for virtually any study.

To get started, select the basic system then add specific options to suit the particular needs of your study. If any questions arise, our expert technical team of scientists and engineers is always ready to assist with system configuration, application support or custom design requests.

Langendorff Heart System (Retrograde Perfusion)

The IH-5 utilizes the proven architecture of our ground-breaking IH-SR to set the standard for isolated heart perfusion in rabbits, adult guinea pigs and adult rats. Engineered for the increased flow produced by these species, the IH-5 offers ultimate perfusion stability and real physiological conditions for longer, more relevant recordings with fewer artifacts.

Both Langendorff and Working Heart versions allow a choice of measurement capabilities unmatched by any existing system, with dedicated capability packages available for specialized applications.

Perfusion of larger hearts creates the opportunity for detailed study of cardiac electrophysiology. With dedicated electrodes, positioners, amplifiers and software for a complete cardiac electrophysiology workstation, the IH-5 is the only choice for measurement and analysis of multiple ECG and MAP signals.

IH-5 Isolated Heart Size 5

Rat, Guinea Pig and Rabbit (contined)

Left Atrial Block, Aortic Block and Heart Chamber Arranged for Working Heart Perfusion

Benefits and Features – Working Heart Option

- Provides a Valuable Tool for the Researcher Who Wants to Study Cardiac Function and Metabolism
- Combines the Advantages of an Isolated Organ Preparation with In situ-like Perfusion Features
- It Allows a More Comprehensive Monitoring of Functional Parameters, the Calculation of the External Heart Work and Mechanical Efficiency, and a Considerably Higher Sensitivity for Various Experimental Manipulation
- Compact Design, Optimized for Each Species: Rabbit, Rat, Guinea Pig
- Allows Rapid and Easy Switching Between Working Heart and Langendorff Modes
- Patented Physiological Afterload System (Starling Resistor) Eliminates the Conventional Water Column to Create an Afterload. The Result is Vastly Improved Arterial Pressure Evaluation Without the Risk of Damage to Heart Valves.
- Compact, Less Space in Lab is Necessary, No High Water Column Afterload (Afterload Pressures Up to 300 mm Hg are Possible)
- Reduced Line Resistance, Optimized to Exceed Species Flow Producing Optimal Atrial Filling
- Proprietary Patented Afterload System to Eliminate Water Column Bouncing
- Laminar Flow Lines to Improve Accuracy of Flow Measurement
- Assessment of External Heart Work Under Adjustable Load
- Modular Design to Integrate More Applications in the Future
- Small Flow Resistance and Low Dead Space Volume for Highly Reproducible and Accurate Results
- Low Volume Drug Injection Pathway
- Solid State Perfusion Technology Mimics In-vivo Perfusion and Prevents Measurement Artifact

On the Langendorff Preparation Following Signals Can be Measured:

LVP	Isovolumetric LVP or Contraction Force
PP	Perfusion Pressure (aortic pressure)
CF	Coronary Flow
ECG	Single Lead Electrocardiogram
MAP	Single Monophasic Action Potential
Multiple ECG	Lead I, II, III, aVr, aVf, aVl, V1-V6
Multiple MAP	Up to 8
pO_2a / e	Oxygen Partial Pressure in the Affluent/Effluent
pH	pH in the Effluent
T	Temperature

On the Working Heart Preparation Following Signals Can be Measured:

PrP	Preload Pressure
AoP	Aortic Pressure (afterload)
LVP	Left Ventricular Pressure
PV Loops	LV Pressure-Volume Loops
AF	Aortic Flow
CO	Cardiac Output (Flow into Left Atrium)
CF	Coronary Flow
ECG	Single Lead Electrocardiogram
MAP	Single Monophasic Action Potential
Multiple ECG	Lead I, II, III, aVr, aVf, aVl, V1-V6
Multiple MAP	Up to 8
pO_2a / e	Oxygen Partial Pressure in the Affluent/Effluent
pH	pH in the Effluent
T	Temperature

IH-5 Isolated Heart Size 5

Rat, Guinea Pig and Rabbit (contined)

Circular Holder for Placement of MAP Electrodes and Multi Lead ECG

System Description

The IH-5 is very compact, improved for low volume and high environment stability.

All of the components are mounted on a basic Plexiglas stand except for the thermocirculator, and the PLUGSYS amplifier system. Special attention has been made to ensure that all critical connecting tubing are maintained short, thus avoiding any cooling through a temperature gradient to ambient temperature.

The key part of the system is the unique aortic block which is the interface between the heart and the IH-5. The bubble trap, compliance chamber, patented flow resistance membrane, infusion and measurement ports are all integrated into this single specialized component. In addition, the aortic block features adjustable attachment points for our proprietary Mini Ball Joint Holder positioning system. This permits precise placement of measurement probes for ultra-stable recordings.

The modular nature of the IH-5 allows the system to evolve along with your research. A Langendorff system can easily be upgraded to full Working Heart; and any IH-5 can be upgraded with special purpose capabilies like multi-channel ECG and MAP for a complete cardiac electrophysiology workstation.

The connection to the heart is made through interchangeable aortic cannulae and atrial cannulae in working heart extension. The perfusate is aerated by bubbling in the reservoir. When the perfusate contains erythrocytes or albumine, a special membrane oxygenator to prevent foaming can equip the unit. In the Langendorff mode, heart contractility is measured using a balloon inserted into the left ventricle and connected to a pressure transducer.

Additional equipment required: thermocirculator, peristaltic pumps, transducers, monitoring system setup using the PLUGSYS Amplifier System. Data acquisition and Evaluation using ISOHEART software.

Multi-Lead ECG Recording

The heart is immersed in the heart chamber. The ECG-electrodes are mounted on an insert placed into the heart chamber. The ECG-signals are picked up from the heart surface using the conductivity of the perfusate. The three electrodes are arranged on the insert to mimic an 'Einthoven' derivation with the reference electrode located beneath the heart. The additional six electrodes are mounted around the heart on a special ring to record unipolar Wilson leads V1 to V6. The electrodes are connected to the input box located on top of the unit (on the same box as the MAP electrodes). The box is connected to the PLUGSYS EGM (Einthoven Goldberger Module) and the PLUGSYS WLA (Wilson Lead Amplifier). The twelve leads recorded are I, II, III, aVL, aVR, aVF, V1 to V6.

If only a single ECG derivation (II) is required two single elctrodes are simply mounted with ball joint holders on the aortic block. In this case the insert is not required.

Multiple MAP Recording

A special holder for up to 8 MAP-electrodes has been designed. On this holder are located eight evenly spaced cantilever arms holding spring-loaded monophasic action potential electrodes. The spring-force (pressure of the electrodes against the epicardium) can be adjusted individually for each electrode. Even the position of the electrode on the heart can be adjusted individually. The electrodes are connected to the main input box type 701/1 fixed on the top of the unit. This input box is connected to the MAPM (Monophasic action potential module) type 703 an especially designed PLUGSYS module. One MAPM can handle six electrodes, two modules are requested.

A special electrode for endocardial MAP is also available. This electrode is mounted with ball joint holders on the aortic block

Specifications

Perfusion Kit	
Body Weight	Up to 2.5 kg
Heart Diameter	25 mm
Heart Length (Base - Apex)	30 mm
Aorta, ID	Up to 5 mm
Aortic Flow (in WH Mode)	Up to 500 ml/min
Perfusion Pressure (Afterload)	Up to 300 mmHg

Order #	Product
73-3604	Basic Unit for Isolated Heart Size 5 Type 843/1
73-2916	Heart Chamber for IH5 D=135/100 mm H=115 mm
73-3072	Aortic Cannulae Set to IH-5 for Rat/Guinea Pig Hearts
73-0719	Aortic Cannulae Set to IH-5 for Rabbit Hearts
73-3064	Working Heart Option to IH-5 Basic Unit
73-3066	Left Atrium Cannula for IH-5 for Rat/Guinea Pig Heart, OD=2.3 mm
73-2880	Left Atrium Cannula for IH-5 for Rabbit Heart, OD=6.0 mm

UP-100 Basic Langendorff Heart System

For Isovolumetric LVP Measurement


UP-100 Basic Set-up for Langendorff Heart Perfusion


UP-100 Basic Set-up for Langendorff Heart Perfusion

- For isolated mouse, rat, guinea pig or small rabbit heart perfusion according to Langendorff
- Constant flow or constant pressure perfusion using the same equipment
- Easy and compact

Applications

- Simple Langendorff heart preparation optimized for LVP measurement using the balloon method
- Ideal for compound screening in multi-channel configuration
- In-line flow and ECG measurement available

For the perfusion of the isolated heart according to Langendorff, the universal perfusion system UP-100 can be equipped with a jacketed heart chamber and additional measurement system for isovolumetric LVP, using a latex balloon with spindle syringe for diastolic pressure adjustment. The setup represents a compact unit. It can be used for constant pressure or constant flow perfusion of isolated hearts of mice, guinea pigs, rats and small rabbits as long as the coronary flow is below 100 ml/min. The heart is connected via the aortic cannula to the heat exchanger which acts also as bubble trap. Provides an accurate, low-cost way to indirectly measure coronary flow. The system can be adapted for direct, real-time coronary flow measurement allowing the study of myogene autoregulation (reactive hyperemia) and/or for electrogram recording.

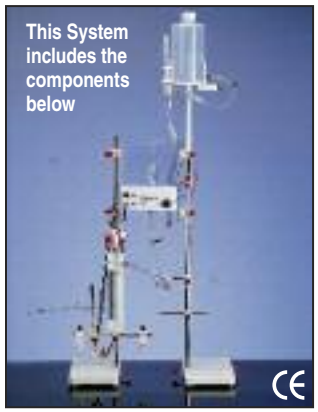
If perfusate containing albumin or erythrocytes is used, the oxygenation can be optimized with the additional fiber oxygenator.

The complete system includes the perfusion apparatus, the transducers and amplifiers for perfusion pressure, the servo controller and integrated peristaltic pump, the isovolumetric left ventricular pressure measurement (isovolumetric balloon method) using a second pressure transducer and amplifier.

Order #	Product
Langendorff System	
73-4128	Basic System UP-100H (Core System requires at least option 73-4129 or 73-4130)
73-4129	Additions to UP-100H core system for Mouse hearts
73-4130	Additions to UP-100H core system for Rat hearts
Options	
73-4131	Direct Flow Measurement
73-4132	Measurement of ECG Lead II
73-4134	Pacing
73-4133	Oxygenating System for Foaming Solutions Containing Albumin or Fatty Acids
73-4047	Temperature Measurement
Data Acquisition	
73-4039	Data Acquisition and Evaluation System ISOHEART
73-4040	Data Acquisition and Evaluation System POWERLAB
Drug Application	
73-4041	Drug Application
73-4042	Drug Application Flow Controlled in Constant Pressure Mode

teaching

Student Isolated Heart Perfusion Apparatus



- For the perfusion of the excised mammalian heart
- Large capacity warming bath with temperature controlled to 0.5°C
- Free-standing apparatus uses minimal bench space

The 'Langendorff' preparation offers extreme flexibility for handling the perfusing fluids:

- **The perfusing fluid reservoir serves as a Mariotte flask that maintains a constant perfusion pressure as the reservoir empties**
- **The perfusion pressure can be varied easily and rapidly by varying the height of the reservoir above the perfused heart. The height of the reservoir can be varied through 62.5 cm (24 in)**
- **To rapidly change perfusing fluids a second reservoir (offered as an accessory) can be added to the second frame upright and a 'Y' connector can connect it to the glass warming coil**

The 1 liter reservoir supplies a constant head of perfusate. The perfusate flow rate is controlled by one of two methods. If the Reservoir cap is off, the flow rate is controlled directly by a pinch clamp on the outlet tubing. If the reservoir cap is tightly sealed, a Mariotte flask is created and the flow rate is set by the perfusion pressure. The height of the reservoir determines this pressure which in turn sets the rate of air allowed to enter the reservoir. As air enters, the perfusate flows out. This reservoir is placed in the three-prong, spring clip reservoir holder that has a 20 cm (8 in) long tube that slips on the top of a rod and locks in place by a knurled set screw. Using this set screw the height of the Reservoir can be varied from 15 cm (6 in) above the top of the rod down to the top of the rod. If it is necessary to lower the reservoir even more, the holder has a clamp mounted on one side that can locate the holder at any point on the rod. The total vertical movement of the reservoir is 62.5 cm (24 in) above the top of the fluid warming coil. The aeration reservoir is mounted to the side of the reservoir holder. The perfusing fluid is led from the main reservoir to the aeration reservoir by tubing provided. The aeration stone is mounted on the end of 2 m (6.6 ft) tubing. This aeration stone fits inside the aeration reservoir and provides a high level of oxygenation to the perfusant.

The transparent, heavy plastic water bath which warms the perfusant measures, H x W x D, 15.5 x 16.5 x 14 cm (6-1/4 x 6-1/2 x 5-1/2 in) and has a capacity of 3.6 liters. The bath is heated by two simple sturdy cartridge elements that are mounted through the front of the tank near the bottom and extend 5 cm (2 in) into it. These heating elements have a combined rating of 80 watts. The temperature of the water is controlled by a front panel dial graduated from 15° to 45°C by 5°C graduations. A metal tube mounted inside the bath carries a sensitive thermistor sensing bead. Once stabilized, this system maintains the water temperature within 0.5°C of the desired temperature. The front panel of the water bath has two indicator lights. One illuminates when the bath is plugged into the AC line. The second illuminates whenever the heating circuit is energized. A screw-in fuse holder is also mounted on the front panel for easy access. A drain hole with tubing, a plug and a tapered plastic cone are located in the bottom of the water tank. The soft rubber bung that carries the stem of the warming coil fits into the cone making a leakproof joint. The glass warming coil for the perfusing fluid is 5 cm (2 in) diameter by 9 cm (3-1/2 in) long. It has a capacity of approximately 35 ml. The stem of the warming coil connects to the heart cannula with tubing and a pinch clamp controls the flow of the warmed perfusate. A clamp and grooved rod are supplied for securing the bottom of the excised mammalian heart.

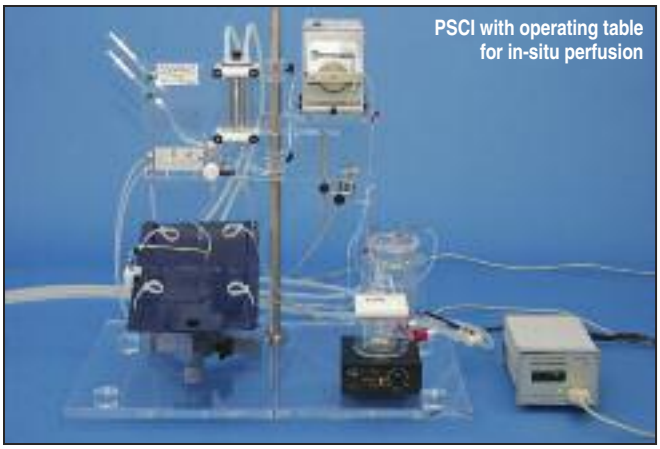
The heart cannula has openings to accommodate both a manometer and thermometer. The manometer has a fixed clamp for mounting directly to a crossbar and is connected to the cannula by tubing. The scale reads 0 to 250 mmHg and is free to move up and down behind the tubing to facilitate zero adjustment. The glass thermometer is straight, 10 cm (4 in) long and graduated from 0° to 50°C by 0.1°C increments. It is mounted in a rubber bung and fits into the side arm of the heart cannula. All of the clamps, stands and rods supplied with this apparatus are from our Stronghold™ line. Two light pulleys are supplied and carry a thread from the heart to a transducer (not supplied) or writing point.

Order #	Product
System Components	
50-0496	Constant Head 1 L Reservoir
50-0488	Reservoir Holder
50-0587	Aeration Reservoir
50-0595	Aeration Stone with Tubing
50-0537	Bath Assembly
50-2898	Tubing 1 m (3-1/4 ft)
50-0554	Warming Coil
50-2369	Rubber Bung
50-2914	Screwclips, 2
50-0562	Red Rubber Bung
50-0563	Cannula
50-6287	Thermometer
50-0588	Manometer
50-7624	Plug
50-0596	Tying Rod
53-2262	Pulleys, qty. of 2
53-2512	Rod, 150 mm (6 in)

Order #	Product
System Components	
53-2522	Rod, 250 mm (10 in)
53-2530	Rod, 500 mm (20 in)
53-2550	Rods, 750 mm (29 in), qty. of 3
53-2336	Extra Weight Rectangular Laboratory Stand Base, qty. of 2
53-2102	Small Clamp with Extension Stem
53-2012	Closed Connectors, qty. of 5
53-2032	'T' Connectors, qty. of 3
53-2062	Large 360° Rotation Connector
53-2244	Male-Female Hinged Adapter
50-0686	Ink Pen with Lever
50-7681	Replacement Ink Pen
50-0678	Brodie Lever

Order #	Product
50-2864	Student Isolated Heart Perfusion Apparatus, 115 VAC, 60 Hz
50-2872	Student Isolated Heart Perfusion Apparatus, 230 VAC, 50 Hz
50-2880	Second Reservoir Set Includes Reservoir Holder, 1 L Reservoir, glass Aeration Reservoir and Aeration Stone. Set comes complete with tubing and connectors for mounting on second rod of Perfusion Apparatus

PSCI Perfusion System for Cell Isolation


PSCI with operating table for in-situ perfusion

- For cell isolation from mouse, rat and guinea pig organs by enzymatic disintegration
- Specifically engineered dual perfusion system for blood cell flushand enzymatic disintegration
- Dedicated extension for cardiomyocite isolation

The PSCI is specially designed for harvesting individual cells from isolated organs like mouse, rat or guinea-pig hearts, liver and other organs. Individual cells are released from the cell structure of the tissue through perfusion with enzyme solution and are then flushed out.

The apparatus has two separate perfusion circuits. The organ can be switched between the two circuits by means of a specifically designed changeover stopcock. One circuit is filled with conventional perfusion solution and is used in the initial phase to flush out all blood cells from the organ. During the second phase the apparatus is switched to the second circuit which operates with enzyme solution and where disintegration takes place.

In case of using a heart, atmospheric bacteria are kept away from the heart through suitable construction of the apparatus and by creating a small positive pressure in the heart chamber. Throughout the entire perfusion process, the heart is contained within a system closed to the outside atmosphere. It is only opened after the termination of perfusion in order to remove the heart.

Perfusion takes place under constant-flow conditions. The suitable constant flow is adjusted on the peristaltic pump. The limits of the apparatus are a flow rate of about 50 or 100 ml/min depending on the configuration.

Perfusion pressure measurement can easily be added. By using our SCP controller constant pressure perfusion is possible.

The apparatus is so designed that the individual steps required for preparing the cells can proceed as simply and clearly as possible. The components wetted by the perfusion solutions are made from materials resistant to alcohol so that the apparatus can be filled with alcohol
for sterilisation.

The dual heat exchanger is mounted on a vertical panel which in turn is secured to a rigid main vertical stainless steel column. A platform for the roller pump is also secured to the vertical column. The remaining components are not fixed to the basic setup but are positioned on the baseplate and are suitably connected by tubing. All components secured to the vertical steel column can be moved to suitable operating positions after releasing clamping screws. The protease reservoir and the holder for the perfusion pressure transducer are also part of the main system.

The main system is universal and must be adapted to the organ used by adding options.

The following options are available:

The dual heat exchanger:

- **Stainless steel tube ID = 1.5 mm,Volume approx. 1ml for the PSCI-M**
- **Stainless steel tube ID = 2 mm ,Volume approx. 1.5 ml for the PSCI-R**

The heat exchanger steel tubing can be interchanged.

Adaptation for Heart perfusion (not shown)

In case of using the heart version, a jacketed heart chamber is mounted on a slide which is clamped to the vertical column. A slow gas flow into this chamber does ensure a positive pressure inside the heart chamber at all times, thus preventing ingress of bacteria from the surroundings during operation.

Adaptation for in-situ perfusion (shown above)

By adding an operating table and relevant cannulae depending on the organ.

Adaptation for in-vitro perfusion

By adding a jacketed moist chamber and the relevant cannulae depending on the organ.

Additional equipment required: thermocirculator, peristaltic pumps, reservoir, magnetic stirrer, cannulae, operating table and others depending on version selected, eventualy transducers, monitoring system setup using the PLUGSYS Amplifier System.

Specifications

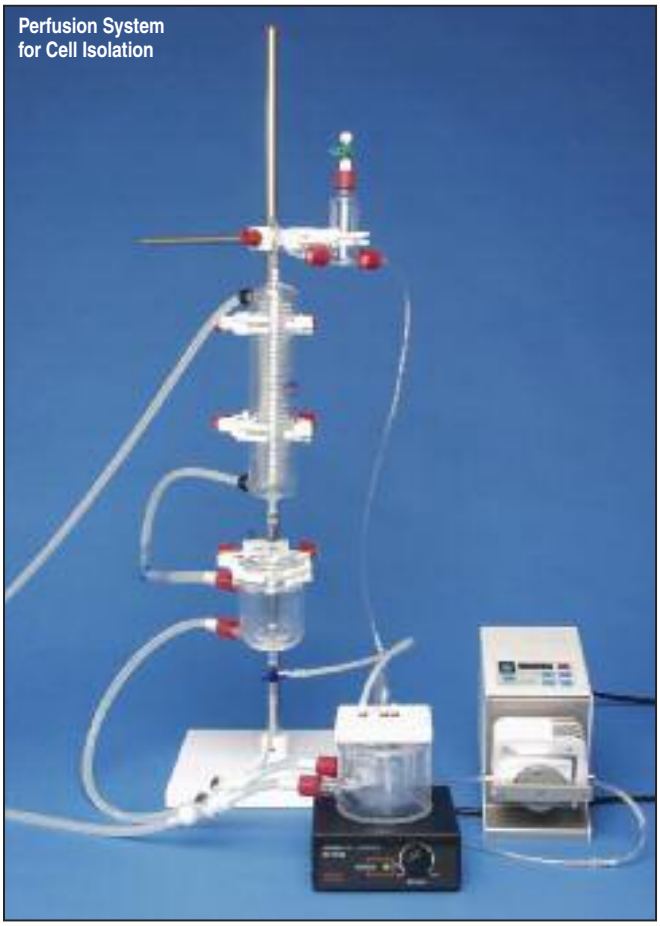
Heat Exchanger Inside Diameter	1.5 mm (0.06 in) for M Version 2.0 mm (0.08 in) for R Version
Maximum Flowrate	50 ml/min for the M Version 100 ml/min for the R Version
Prime Volume	< 3ml for the M Version < 5ml for the R Version
Dimensions, W x D x H	600 x 400 x 570 mm (23.6 x 15.8 x 22.5 in)
Weight	8 kg (17.6 lbs)

Order #	Product
73-3659	PSCI-M Perfusion System for Cell Isolation from Mice Organs
73-3639	PSCI-R Perfusion System for Cell Isolation from Rat Organs
73-3638	PSCI-MH Perfusion System for Cell Isolation from Mice Hearts
73-3672	PSCI-RH Perfusion System for Cell Isolation from Rat or Guinea Pig Hearts

For a system description according your requirements please use:
www.hugo-sachs.de/ihmail.html
or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.

research

Easy Set-up for Cell Extraction



This system is simple to setup, operate and maintain. Its compact design minimizes the bench space required for the system. The wetted components of the perfusion circuit can be flushed with a 70% ethanol solution or autoclaved for sterilization purposes.

Additional equipment required: thermocirculator, peristaltic pumps, magnetic stirrer, reservoir, cannulae, operating table and others depending on verison selected, eventualy transducers, monitoring system setup using the PLUGSYS Amplifier System.

Order #	Product
73-3756	Easy Setup for Cell Extraction by Organ Disintegration Type 803
73-3761	Heart Chamber to Easy Cell Extraction System

For a system description according your requirements please use:
www.hugo-sachs.de/ihmail.html
or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.

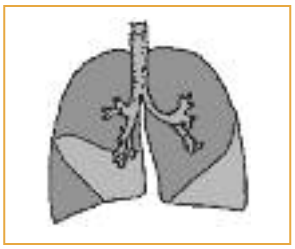
Easy Setup for Cell Extraction by Constant Flow Perfusion

- Cell isolation from mouse, rat, guinea pig organs by disintegration using protease solution
- Designed for cardiomyocyte isolation
- Can be used for other organs In Situ or Ex Vivo

This perfusion system has been specifically created to meet the needs of individuals who wish to isolate primary cells from organs of species in the size range of mouse to guinea pigs. The system can be configured for either In Situ or Ex Vivo organ perfusion.

The system is first used with perfusate for the blanching and than with the protease solution for tissue disintegration. The perfusate for blanching is warmed and oxygenated in separate buffer reservoir and supplied via the peristaltic pump and warming coil. The protease solution is in a separate reservoir oxygenated and stirred. For In Situ perfusion an operating table can be placed just below the warming coil, for Ex Vivo application (heart, liver...) the system can be equipped with a jacketed chamber. We offer a complete line of custom perfusion cannula (Aortic, In Situ and Ex Vivo) to accommodate vessels from 1.0 to 3.5 mm ID. The In Situ and Ex Vivo cannulae feature our unique tip basket to prevent vessel occlusion.

Isolated Lung Systems Overview



Negative Pressure Ventilation

Constant Flow Perfusion

ADVANTAGES

- Advanced physiolgical mode
- No risk for barotraumatic ventilation
- Lower cost
- Easy quantification of drug dose application

DISADVANTAGES

- Higher cost

Constant Pressure Perfusion

ADVANTAGES

- Physiological mode
- No risk for baro traumatic ventilation
- No risk of damaging the vascular system by overpressure

DISADVANTAGES

- Higher cost
- Since flow is not constant effective dose is difficult to calculate

TYPICAL APPLICATIONS

- Studies on primarily respiratory effects or combined respiratory and vascular effects
- Physiology:
  - Hypoxic vasoconstriction
  - Edema formation
- Pharmacology
  - Action of histamine, arachidonic acid metabolites
  - Immunopharmacology (cytokines...)
- Inhalation toxicology
  - Environmental toxins (ozone, sulphur dioxide...)
- Biochemistery
  - Metabolic activity (biogenic amines, prostacyclin, angiotensin..)
  - Surfactant biochemistry

Positive Pressure Ventilation

Constant Flow Perfusion

ADVANTAGES

- Lower cost
- Easy quantification of drug dose application

DISADVANTAGES

- Non physiologic ventilation
- Risk for barotraumatic ventilation
- Risk of damaging the vascular system by overpressure

Constant Pressure Perfusion

ADVANTAGES

- No risk of damaging the vascular system by overpressure

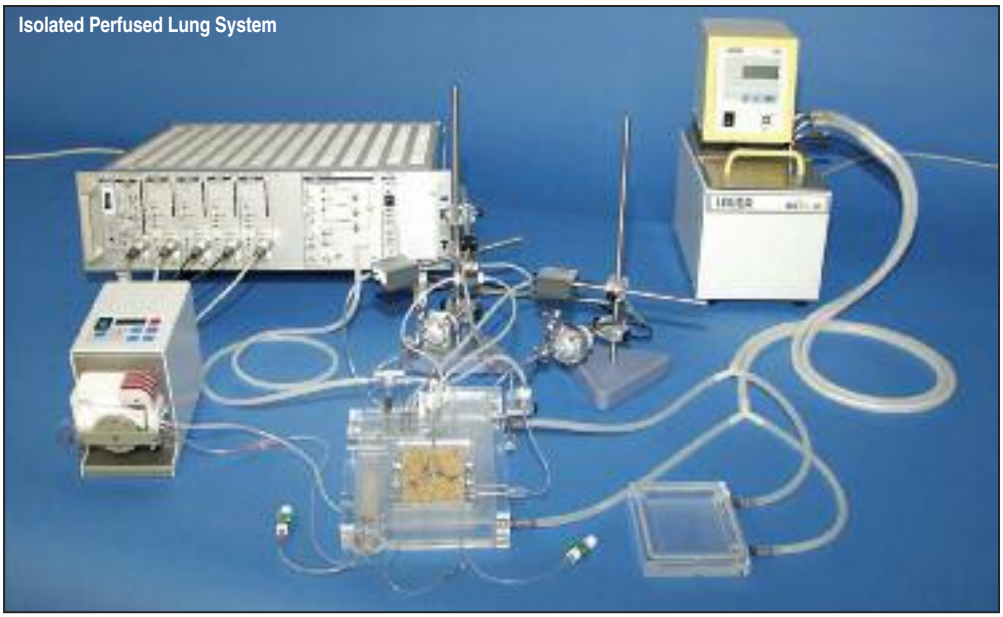
DISADVANTAGES

- Risk for barotraumatic ventilation
- Higher cost
- Since flow is not constant effective dose is difficult to calculate

TYPICAL APPLICATIONS

- Studies on primarily vascular effects
- Physiology:
  - Hypoxic vasoconstriction
  - Edema formation
- Pharmacology
  - Action of histamine, arachidonic acid metabolites
  - Immunopharmacology (cytokines...)
- Biochemistery
  - Metabolic activity (biogenic amines, prostacyclin, angiotensin..)
  - Surfactant biochemistry

IPL-1 Isolated Perfused Lung for Mouse



Benefits and Features

- Exclusive artifical thorax chamber for isolated lung
  - Integrated surgery table to reduce damage during preparation phase
  - Integrated changeover system for switch between physiological negative-pressure ventilation and simple positive-pressure ventilation
- Low flow resistance and dead space volume, minimize perfusion artifacts
- Unique built-in pneumotachometer and air humidifier with small dead volume
- Drug injection pathway built directly into pulmonary perfusate stream
- Unique compensation system for vascular transmural pressure changes and simulation of hypertensive cardiac afterload

Applications

- Studies on combined respiratory and vascular effects
- Physiology:
  - Hypoxic vasoconstriction
- Pharmacology
  - Action of histamine, arachidonic acid metabolites
  - Immunopharmacology (cytokines...)
- Inhalation toxicology
  - Environmental toxins (ozone, sulphur dioxine...)
- Biochemistery
  - Metabolic activity (biogenic amines, prostacyclin, angiotensin..)
  - Surfactant biochemistry

Additional Options Include:

- Dedicated PLUGSYS ventilator module for negative or positive pressure ventilation VCM
- Dedicated PLUGSYS module for regular induction of hyperinflation of the lung TCM (sigh, augmented breath)
- Transducers and amplifiers for respiratory mechanics measurement: airflow, tracheal pressure, thoracic chamber pressure
- Transducers and amplifiers for perfusion measurement: realtime flow, perfusion pressure, venous pressure, temperature etc
- Dedicated software PULMODYN for data acquisition and analysis of respiratory mechanics and perfusion
- Optional connection for external ventilator (e.g. MINIVENT for testing barotraumatic ventilation
- Optional connection for supplying alternative gas mixtures and/or aerosols during negativ pressure ventilation
- Sensor and amplifier for continuous perfusate analysis (pO_2, pCO_2, pH)
- Deoxygenation using membrane oxygenator of blood or erythrocyte containing perfusion
- Large choice of accessories: thermocirculator, jacketed reservoir, holders etc

IPL-1 Isolated Perfused Lung for Mouse (continued)

The Following Signals Can be Measured:

FL	Respiratory Airflow
TCP	Thoracal Chamber Pressure (intrapleural pressure)
TP	Tracheal Pressure
PP	Perfusion Pressure
VP	Venous Outflow Pressure
pO_2a/e	Oxygen Partial Pressure in the Affluent/Effluent
pCO_2a/e	CO_2 Partial Pressure in the Affluent/Effluent
pH a/e	pH in the Affluent/Effluent
T	Temperature

The Following Parameters Can be Evaluated Using PULMODYN:

-Peak Inspiratory and Expiratory Airflow

-Tidal Volume, Minute Volume

-Dynamic Lung Resistance, Dynamic Compliance

-Vascular Resistance

-O_2, CO_2 Exchange

Description

Ventilation of the lung is possible under negative pressure as well as under positive pressure (the latter is essential during the preparation phase). The ventilation parameters are controlled with a special PLUGSYS Ventilator, the "Ventilation Control Module" (VCM, Type 681).

The apparatus consists essentially of a flat jacketed Plexiglass thoracic chamber and a jacketed cover. The size has been chosen so that a complete mouse can be mounted inside it. The walls of the Plexiglass dish carry all the auxiliary devices, connections and ports for perfusion and ventilation. This arrangement offers the advantage that connecting tubing and cannulae can be kept short, resulting in a very small dead volume and ensuring optimum thermal stability.

Perfusion takes place at constant flow. The perfusate is passed by means of a roller pump at constant flow through the heat exchanger, through a bubble trap to the pulmonary artery and finally into the lung vascular bed. The venous discharge is provided by cannulating the pulmonary vein, the cannula is placed in the left atrium of the heart. The venous discharge passes into the pressure balancing vessel (compensation for the vascular transmural pressure) and is drawn off from there by the second channel of the roller pump.

During the preparation phase the animal is ventilated at positive pressure. After the connections of the trachea and the perfusion supply have been made ventilation can be changed over to negative pressure. The chamber now forms an artificial thorax.

Extensions

Several adapters are available to work with standard ventilators (positive pressure ventilation only), to supply different air mixtures to the lungs or to connect a nebulizer for aerosol challenge.

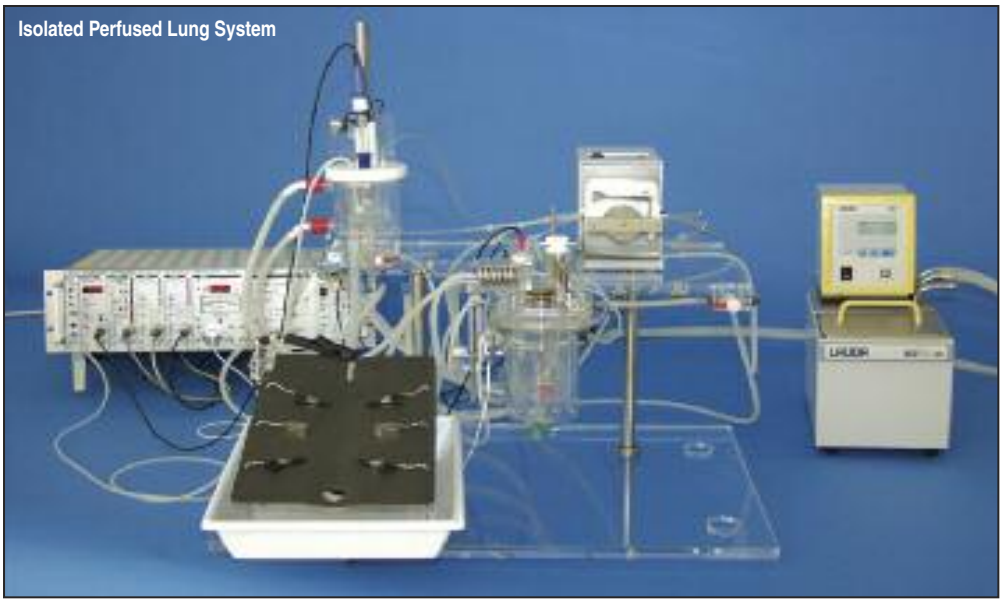
Order #	Product
73-4292	IPL-1 Core System, 115 V
73-4291	IPL-1 Core System, 230 V

VCM is a PLUGSYS module and requires a system maincase.

For a system description according your requirements please use:
www.hugo-sachs.de/ilmail.html
or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.

Need assistance *after hours?*
Email a customer support specialist:
bioscience@harvardapparatus.com
We'll respond to your request asap!

IPL-2 Isolated Perfused Lung for Rat & Guinea Pig



Benefits and Features

- Optimized temperature conditions for the isolated lung, unique jacketed thoracic chamber
- Optional operating table for non-damaging in-situ preparation
- Negative-pressure ventilation similar to in-vivo condition or positive pressure ventilation available
- Low flow resistance and dead space volume, minimize perfusion artifacts
- Unique built-in pneumotachometer and air humidifier with small dead volume
- Drug injection pathway built directly into pulmonary perfusate stream
- Unique compensation system for vascular transmural pressure changes
- Dedicated option for continuous measurement of lung weight (Edema)
- More measurement parameters than any other system

Applications

- Studies on combined respiratory and vascular effects
- Physiology:
  - Hypoxic vasoconstriction
  - Edema formation
- Pharmacology
  - Action of histamine, arachinodic acid metabolites
- Inhalation toxicology
  - Environmental toxins (ozone, sulphur dioxine)
- Biochemistery
  - Metabolic activity (biogenic amines, prostacyclin, angiotensin..)
  - Surfactant biochemistry

Additional Options Include:

- Dedicated PLUGSYS ventilator module for negative or positive pressure ventilation VCM
- Dedicated PLUGSYS module for regular induction of hyperinflation of the lung TCM (sigh, augmented breath)
- Transducers and amplifiers for respiratory mechanics measurement: airflow, tracheal pressure, thoracic chamber pressure
- Transducers and amplifiers for perfusion measurement: realtime flow, perfusion pressure, venous pressure, temperature etc...
- Dedicated software PULMODYN for data acquisition and analysis of respiratory mechanics and perfusion
- Optional connection for external ventilator (see section F) for testing barotraumatic ventilation
- Optional connection for supplying alternative gas mixtures and/or aerosols
- Sensor and amplifier for continuous perfusate analysis (pO_2, pCO_2, pH)
- Deoxygenation using membrane oxygenator of blood or erythrocyte containing perfusion
- Large choice of accessories: thermocirculator, jacketed reservoir, holders etc...

IPL-2 Isolated Perfused Lung for Rat & Guinea Pig (continued)

The Following Signals Can Be Measured:	
FL	Respiratory Airflow
TCP	Thoracal Chamber Pressure (intrapleural pressure)
TP	Tracheal Pressure
PP	Perfusion Pressure
VP	Venous Outflow Pressure
W	Lung Weight Changes
pO_2a/e	Oxygen Partial Pressure in the Affluent/Effluent
pCO_2a/e	CO_2 Partial Pressure in the Affluent/Effluent
pH a/e	pH in the Affluent/Effluent
T	Temperature

The Following Parameters Can be Evaluated Using PULMODYN:
Peak Inspiratory and Expiratory Airflow
Tidal Volume, Minute Volume
Lung Resistance, Dynamic Compliance
Vascular Resistance
Precapillary and Postcapillary Resistance
Filtration Coefficient
O_2, CO_2 Exchange

Basic System

The basic setup consists of a Plexiglass base with two stable vertical steel columns. The main system is mounted on a Plexiglass panel which is fixed on the two steel columns. This allows the system to be modified or extended to suit different versions or for special applications.

The essential part of the system is the artificial thorax. It consists of a water-jacketed glass chamber sealed by a special cover. The cover is mounted on the Plexiglass panel, the glass chamber is fixed underneath it with two metal clips. The inner part of the cover is the organ holder with the connections for cannulating the trachea (ventilation), the pulmonary artery and the left atrium (perfusion).

Ventilation of the lung is possible under negative pressure as well as under positive pressure (the latter is essential during the preparation phase). The ventilation parameters are controlled with a special PLUGSYS Ventilator, the "Ventilation Control Module" (VCM, Type 681).The ventilation medium (air or gas mixture) is constantly humidified by the built-in humidifier.

An optional operating table with trough is mounted on the base plate in front of the artificial thoracic chamber. The organ holder with the connections for the trachea (ventilation) and for the pulmonary artery and pulmonary vein (perfusion) can be removed from the main cover to allow an easier preparation and optimal non traumatic lung transfer from the animal to the system. The lung is continuously ventilated at positive pressure until it is placed into the artificial thorax. Then a simple valve permits instantaneous changeover to negative pressure ventilation.

Perfusion

Lungs can be perfused by either constant flow or constant pressure. Although constant flow perfusion may mimic the in vivo situation more closely, it has the disadvantage that hydrostatic edema becomes inevitable during vasoconstriction. Constant pressure perfusion permits higher perfusate flow rates since vasoconstriction decreases perfusate flow and hydrostatic edema is less likely to occur.

Can be configured in one of three different perfusion modes:

1. **Constant Flow Perfusion**
2. **Constant Pressure Perfusion**
3. **Dual System to Switch from Constant Flow to Constant Pressure and Vice Versa**

Lung Weight Changes

Continuous measurement of weight changes of the lung is required for monitoring edema formation. This is possible during negative pressure ventilation inside the thoracic chamber by using the HSE-Edema balance LS 30 (weight transducer) (73-0593). Weight changes induced by raising or lowering the perfusion pressure can be used to assess vascular permeability by determining the filtration coefficient.

Extensions

Several adapters are available to work with ventilators, to supply different air mixtures to the lungs or to connect aerosol nebulizer for aerosol challenge.

Order #	Product
73-4276	IPL-2 Core System, 115 V
73-4275	IPL-2 Core System, 230 V

VCM is a PLUGSYS module and requires a system maincase.

Application Note:
IPL-2 option for modification

The IPL-2 can also be specially modified to measure lung weight changes in mouse models.

Speak with a technical specialist for details on this option.

For a system description according your requirements please use:
www.hugo-sachs.de/ilmail.html
or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.

IPL-4 Isolated Perfused Lung for Rabbit

Benefits and Features

- Optimized temperature conditions for the isolated lung, unique jacketed thoracic chamber
- Optional operating table for non-damaging in-situ preparation
- Negative-pressure ventilation similar to in-vivo condition or positive pressure ventilation available
- Low flow resistance and dead space volume, minimize perfusion artifacts
- Drug injection pathway built directly into pulmonary perfusate stream
- Unique compensation system for vascular trans-mural pressure changes
- System dedicated option for continuous measurement of lung weight (edema)
- More measurement parameters than any other system

Applications

- Studies on combined respiratory and vascular effects
- Physiology:
  - Hypoxic vasoconstriction
  - Edema formation
- Pharmacology
  - Action of histamine, arachinodic acid metabolites
- Inhalation toxicology
  - Environmental toxins (ozone, sulphur dioxine...)
- Biochemistery
  - Metabolic activity (biogenic amines, prostacyclin, angiotensin..)
  - Surfactant biochemistry

Additional Options Include:

- Dedicated PLUGSYS ventilator module for negative or positive pressure ventilation VCM
- Dedicated PLUGSYS module for regular induction of hyperinflation of the lung TCM (sigh, augmented breath)
- Transducers and amplifiers for respiratory mechanics measurement: airflow, tracheal pressure, thoracic chamber pressure
- Transducers and amplifiers for perfusion measurement: realtime flow, perfusion pressure, venous pressure, temperature etc... (see section I)
- Dedicated software PULMODYN for data acquisition and analysis of respiratory mechanics and perfusion
- Optional connection for external ventilator (see page section F) for testing barotraumatic ventilation
- Optional connection for supplying alternative gas mixtures and/or aerosols
- Sensor and amplifier for continuous perfusate analysis (pO_2, pCO_2, pH)
- Deoxygenation using membrane oxygenator of blood or erythrocyte containing perfusion
- Large choice of accessories: thermocirculator, jacketed reservoir, holders etc

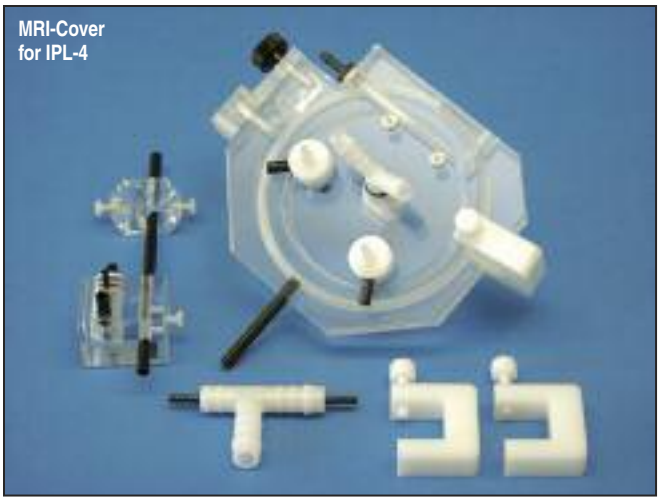
The Following Signals Can be Measured:

FL	Respiratory Airflow
TCP	Thoracal Chamber Pressure (intrapleural pressure)
TP	Tracheal Pressure
PP	Perfusion Pressure
VP	Venous Outflow Pressure
W	Lung Weight Changes
pO_2a/e	Oxygen Partial Pressure in the Affluent/Effluent
pCO_2a/e	CO_2 Partial Pressure in the Affluent/Effluent
pH a/e	pH in the Affluent/Effluent
T	Temperature

The Following Parameters Can be Evaluated Using PULMODYN:

Peak Inspiratory and Expiratory Airflow
Tidal Volume, Minute Volume
Lung Resistance, Dynamic Compliance
Vascular Resistance
Precapillary and Postcapillary Resistance
Filtration Coefficient
O_2, CO_2 Exchange

IPL-4 Isolated Perfused Lung for Rabbit (continued)



MRI-Cover for IPL-4

There is an increasing interest in studying isolated lungs by using MRI. A special metal free cover for the IPL-4 lung thoracic chamber has been designed. The regular cover is replaced by the MRI cover, and the complete lung chamber can be removed from the stand after surgery. The lung chamber with cover is mounted on the MRI e.g. in a head holder. All parts are non-metalic and made of plexiglas, Teflon and carbon fiber. In the NMR version only positive pressure ventilation can be used.

Basic System

The basic setup consists of a Plexiglass base with a stable vertical steel column. The main system is fixed on the steel column. This allows the system to be modified or extended to suit different versions or for special applications.

The essential part of the system is the artificial thoracic chamber. It consists of a water-jacketed glass chamber sealed by a special cover. The cover is mounted on the steel column, the glass chamber is fixed underneath it with two metal clips. The cover is the organ holder with the connections for cannulating the trachea (ventilation), the pulmonary artery perfusion and the pulmonary venous effluent (perfusion).

Ventilation of the lung is possible under negative pressure as well as under positive pressure (the latter is essential during the preparation phase). The ventilation parameters are controlled with a special PLUGSYS Ventilator, the "Ventilation Control Module" (VCM, Type 681). The ventilation medium (air or gas mixture) is constantly humidified by the built-in humidifier.

An optional operating table is mounted on the base plate in front of the artificial thorax cover. The cover with the connections for the trachea (ventilation) and for the pulmonary artery and pulmonary vein (perfusion) can easily be inclined in order to have the tracheal cannula in line with the trachea and allow easier preparation. After cannulation the cover can be gradually rotated and moved up by turning a knob, thus the lung can be removed from the animal with minimal stretch damage. During surgery, the cover is equipped with a special ventilation head, and the lung is continuously ventilated at positive pressure until the artificial thorax is in place. Then a simple valve permits instantaneous changeover to negative pressure ventilation.

Constant Flow Perfusion

The constant flow rate of perfusate into the pulmonary artery is determined by a roller pump. The perfusate is stored in a water-jacketed container to maintain constant temperature. Aeration is provided to keep the pH constant. A heat exchanger and a bubble trap are placed next to the pulmonary artery connection for exact adjustment of the perfusate temperature just before the thorax chamber and to prevent air bubbles entering the lung.

Lung Weight Changes

Continuous measurement of weight changes of the lung is possible during negative pressure ventilation inside the thoracic chamber by using the HSE-Edema balance LS 30 (weight transducer) (73-3468).

Order #	Product
73-4297	IPL-4 Core System, 115 V
73-4296	IPL-4 Core System, 230 V
VCM is a PLUGSYS module and requires a system maincase.	
73-3376	NMR Cover for IPL-4
73-3377	Pulmonary Artery Cannula for IPL-4, NMR
73-3378	Left Atrium Cannula for IPL-4, NMR
73-3379	Jacketed Tubing for IPL-4 NMR
73-3469	Pressure Equilibration System for IPL-4 NMR

For a system description according your requirements please use:
www.hugo-sachs.de/ilmail.html
or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.

IPL-16 Isolated Perfused Lung for Pigs and Large Animals

Benefits and Features

- Optimized temperature and humidity conditions for the isolated lung, unique jacketed thoracic chamber
- Continuous measurement of lung weight to monitor edema formation
- Very low flow resistance and minimal dead space volume virtually eliminate perfusion artifacts
- Drug injection pathway built directly into pulmonary perfusate stream for precision compound dosing and screening
- Removable platform to facilitate surgery
- Standard connection for ventilator
- More measurement parameters with greater precision than any other system

Applications

- Respiratory mechanics
  - Airway Flow, Tidal Volume, dynamic resistance and compliance
- Vascular permeability studies
  - Arterial and venous resistance calculations
  - Inflammation (?) and Tissue Edema monitoring
- Pharmacology
  - Compound screening, e.g. action of histamine, arachinodic acid metabolites
- Inhalation toxicology
  - Environmental toxins, e.g. Ultrafine particles, ozone, sulphur dioxin...
- Biochemistery
  - Metabolic activity, e.g of biogenic amines, prostacyclin, angiotensin..
  - Surfactant bioactivity
- Therapy studies
  - Study of chemotherapy applications using a human lung lobe after lobectomy of the lung is performed in lung cancer patient

Description

The apparatus consists essentially of a jacketed Plexiglass thoracic chamber (inside dimensions 400 x 500 x 300 mm) and a jacketed cover. The size has been chosen so that a complete pig lung (both lobes) can be mounted inside it. The lung is placed on a platform. The platform can be moved out of the chamber to facilitate the surgery. All connections for perfusion and ventilation are mounted on the plattform. This arrangement offers the advantage that connecting tubing and cannulae can be kept short, resulting in a very small dead volume and ensuring optimum thermal stability.

Perfusion

Constant flow perfusion may mimic the in vivo situation more closely, however, it has the disadvantage that hydrostatic edema becomes inevitable during vasoconstriction. Constant pressure perfusion permits higher perfusate flow rates since vasoconstriction decreases perfusate flow and hydrostatic edema is less likely to occur. The chamber is the perfusate reservoir (whole blood or erythrocyte containing perfusate). Perfusion takes place at constant flow. The perfusate is taken from the reservoir and is passed by means of a peristaltic pump at constant flow through the deoxygenator and primary heat exchanger, through a second heat exchanger and a bubble trap to the pulmonary artery and finally into the lung vascular bed. The venous discharge returns to the reservoir. For ventilation, a large animal ventilator Model 665 or 663 or a human ventilator is used.

The chamber also includes our exclusive lung weight measurement system for continuous monitoring of edema formation.

Extensions

Aerosol nebulizer for inhaled compound challenge Controller for constant pressure perfusion

Additional Options Include

- Transducers and amplifiers for respiratory mechanics measurement: airflow, tracheal pressure, thoracic chamber pressure
- Transducers and amplifiers for perfusion measurement: realtime flow, perfusion pressure, venous pressure, temperature etc.
- Dedicated software PULMODYN for data acquisition and analysis of respiratory mechanics and perfusion
- Sensor and amplifier for continuous perfusate analysis (pO_2, pH)
- Deoxygenation using membrane oxygenator of whole blood or erythrocyte containing perfusion
- Large choice of accessories: ventilators, thermocirculator, peristaltic pumps, holders etc...

Order #	Product
73-4302	IPL-16 Core System, 115 V
73-4301	IPL-16 Core System, 230 V