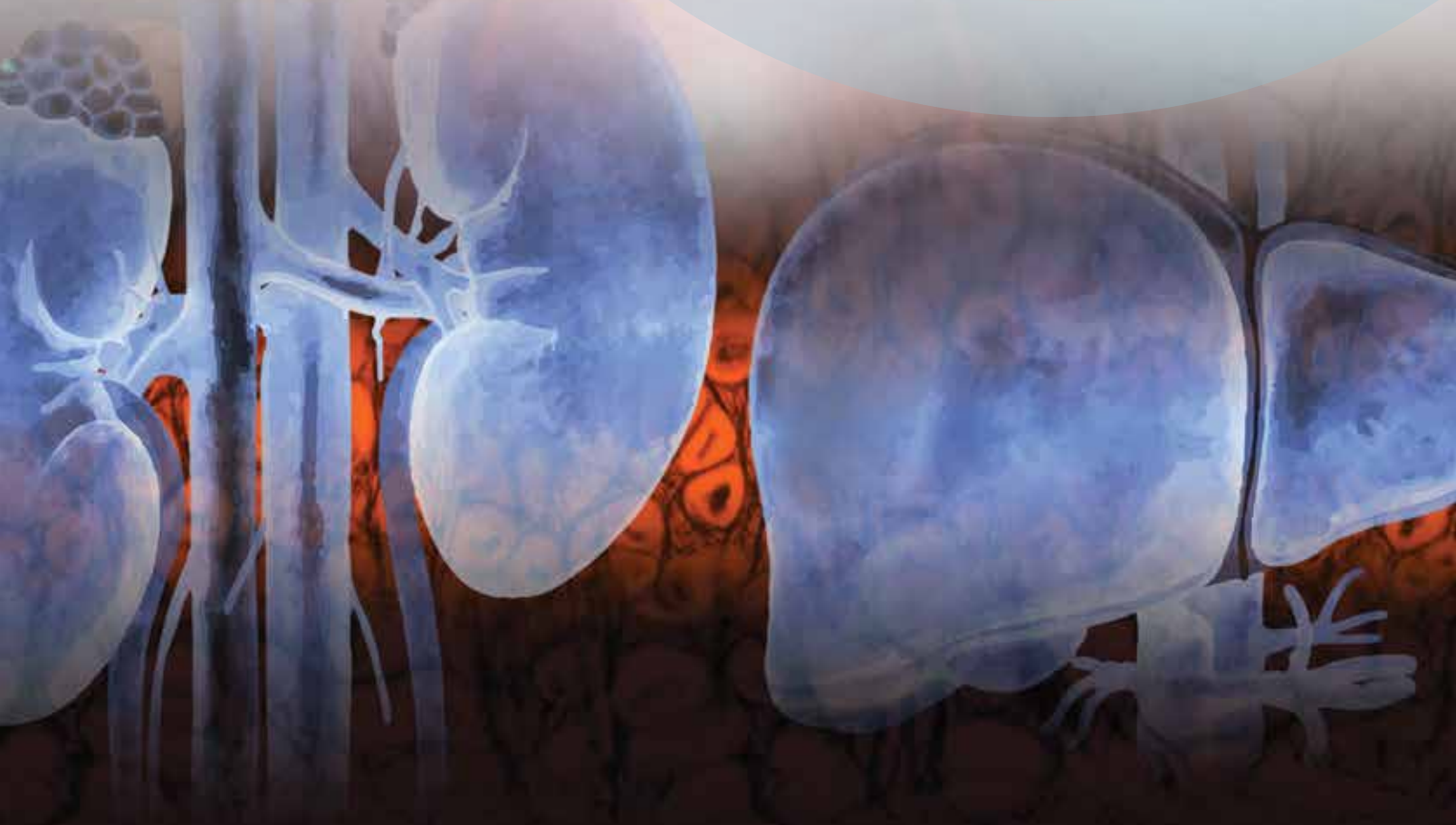
HUGO SACHS ELEKTRONIK | Harvard Apparatus

The Physiology Specialists

Abdominal Organ

PERFUSION SYSTEMS

Liver • Kidney • Mesenteric Bed
Intraluminal Vessel Perfusion



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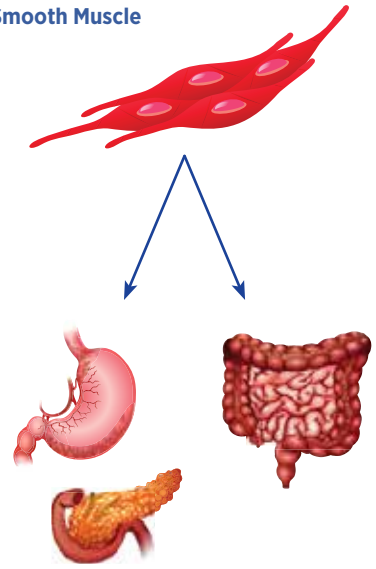
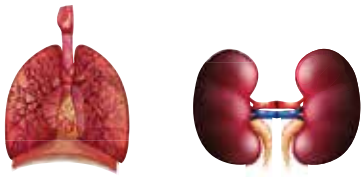
PERFUSION & TISSUE BATH SYSTEMS OVERVIEW

Solutions for All Aspects of Animal Physiology Research

	Organs	Systems for Organs/Applications
Smooth Muscle 	**GASTROINTESTINAL TRACT** • Esophagus • Stomach • Liver/Pancreas • Intestine	• **Moist Chamber**—perfusion of liver, pancreas • **UP-100**—perfusion of liver ex vivo or in situ • **PBTO**—intraluminal intestine perfusion • **SCP**—perfusion of GI organs and tissues using peristaltic pump • **IPR**—perfusion of ileum peristaltic reflexes
	UROGENITAL TRACT • Kidney • Placenta	• **Moist Chamber**—perfusion of kidney, uterus • **UP-100**—perfusion of kidney ex vivo or in situ • **PBTO**—intraluminal vas deferens perfusion
	VASCULAR MUSCULATURE • Hind Quarter • Mesenteric Bed • Coronary Vasculature	• **Moist Chamber with Edema Balance**—simultaneous vascular and intraluminal perfusion • **UP-100**—perfusion of mesenteric bed, hindquarter, hind quarter ex vivo or in situ • **IH-SR, IH-5, IH-9**—isolated heart perfusion of small rodent, rabbit, small pig • **PBTO**—blood vessel perfusion
	**BRONCHIAL MUSCULATURE** • Lung	• **IPL-1, IPL-2, IPL-4, IPL-16**—isolated lung perfusion of mouse, rat, guinea pig, rabbit, pig • **PBTO**—intraluminal trachea perfusion • **PCLS**—precision cut lung slice chamber See our *Isolated Lung Brochure* for more information.
Cardiac 	**HEART** • Langendorff • Working Heart • Heart-Lung Preparation	• **UP-100, IH-SR, IH-5, IH-9**— isolated heart perfusion of small rodent, rabbit, small pig See our *Isolated Heart Brochure* for more information.
Skeletal Muscle 	**SKELETAL MUSCULATURE** • Intact Limb • Hindquarter	• **UP-100**—perfusion of intact limb, hindquarter ex vivo or in situ
Nerve Bundle 	**NERVOUS SYSTEM** • Brain • Spinal Cord • Ganglion	See our *Tissue Baths & Perfusion Systems Selection Guide* for more information.
Tissue	**TISSUES**	See our *Tissue Baths & Perfusion Systems Selection Guide* for more information.

Abdominal
ORGAN PERFUSION
SYSTEMS

Hugo Sachs Elektronik (HSE), part of the Harvard Bioscience family of companies, provides top-notch, fully integrated physiology research systems, including perfusion and tissue bath systems for many organ and tissue types.

This catalog contains all the information you need to choose an optimal isolated abdominal organ system for your research. These comprehensive and complete systems are modular in design, providing the flexibility to tailor a system to fit your specific needs.

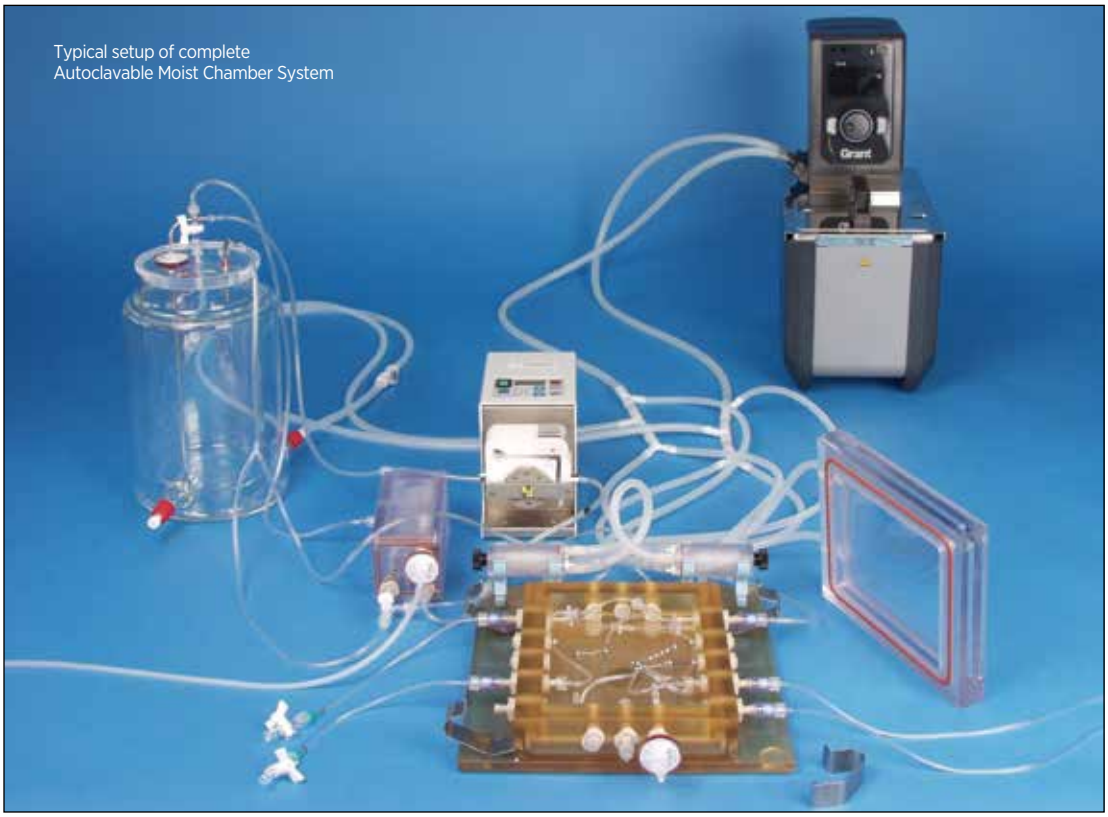
Whether you need a complete isolated organ system or an addition to a system you already have, Hugo Sach Elektronik has a solution.

HUGO SACHS ELEKTRONIK | Harvard Apparatus

The Physiology Specialists

What's Inside:

CONFIGURING AN ISOLATED PERFUSED ORGAN SYSTEM



Organs within the body are designed to perform different, specialized functions that work in unison to maintain homeostasis in a living organism. Despite their differences, similar conditions are required to study organs in isolation.

These requirements include controlled temperature, a nutrient or buffer at physiological pH, aeration for the buffer, a perfusion pump to move the buffer and a system with a chamber to hold the isolated organ. Some organs may require additional equipment related to their specialized functions, such as a ventilator for isolated perfused lungs.

Additionally, in order to ensure the health of the isolated organ, experimental conditions and various physiological parameters are monitored. These include perfusate flow and pressure, pH, pO_2, pCO_2, and biopotentials.

Hugo Sachs Elektronik (HSE) and Harvard Apparatus offer a complete line of equipment and accessories to conduct isolated organ experiments and monitor associated physiological parameters. Our products and systems are backed by expert technical support to assist you with any questions.

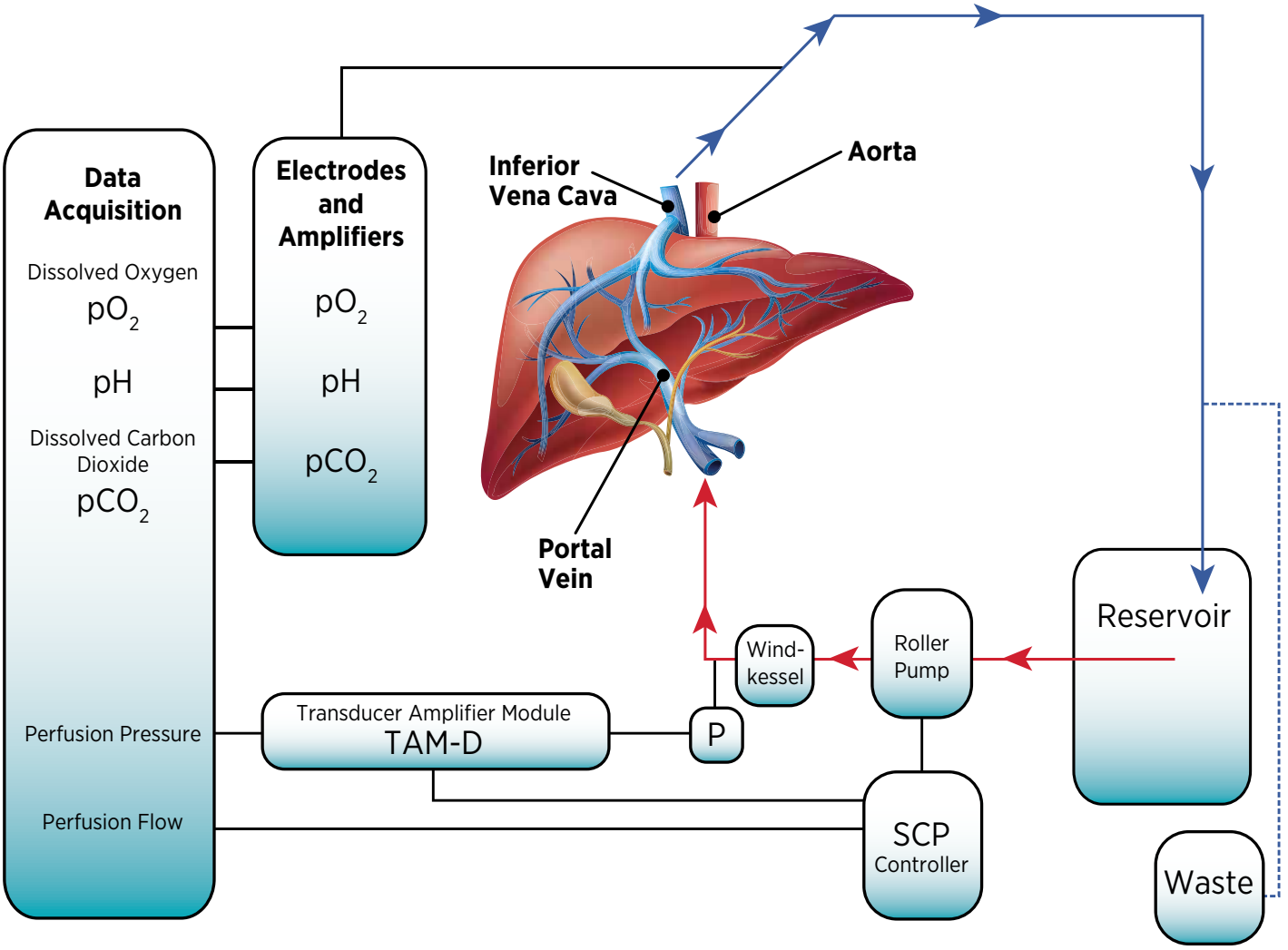
System Components

All functional isolated organ systems require:

- Base system
- Pump for perfusate (buffer) movement and control
- Thermocirculator to control the system temperature
- Buffer reservoirs to maintain temperature and aeration of the perfusate
- Species and organ specific cannulae
- Transducers and amplifiers for physiological measurements
- Data acquisition and analysis method

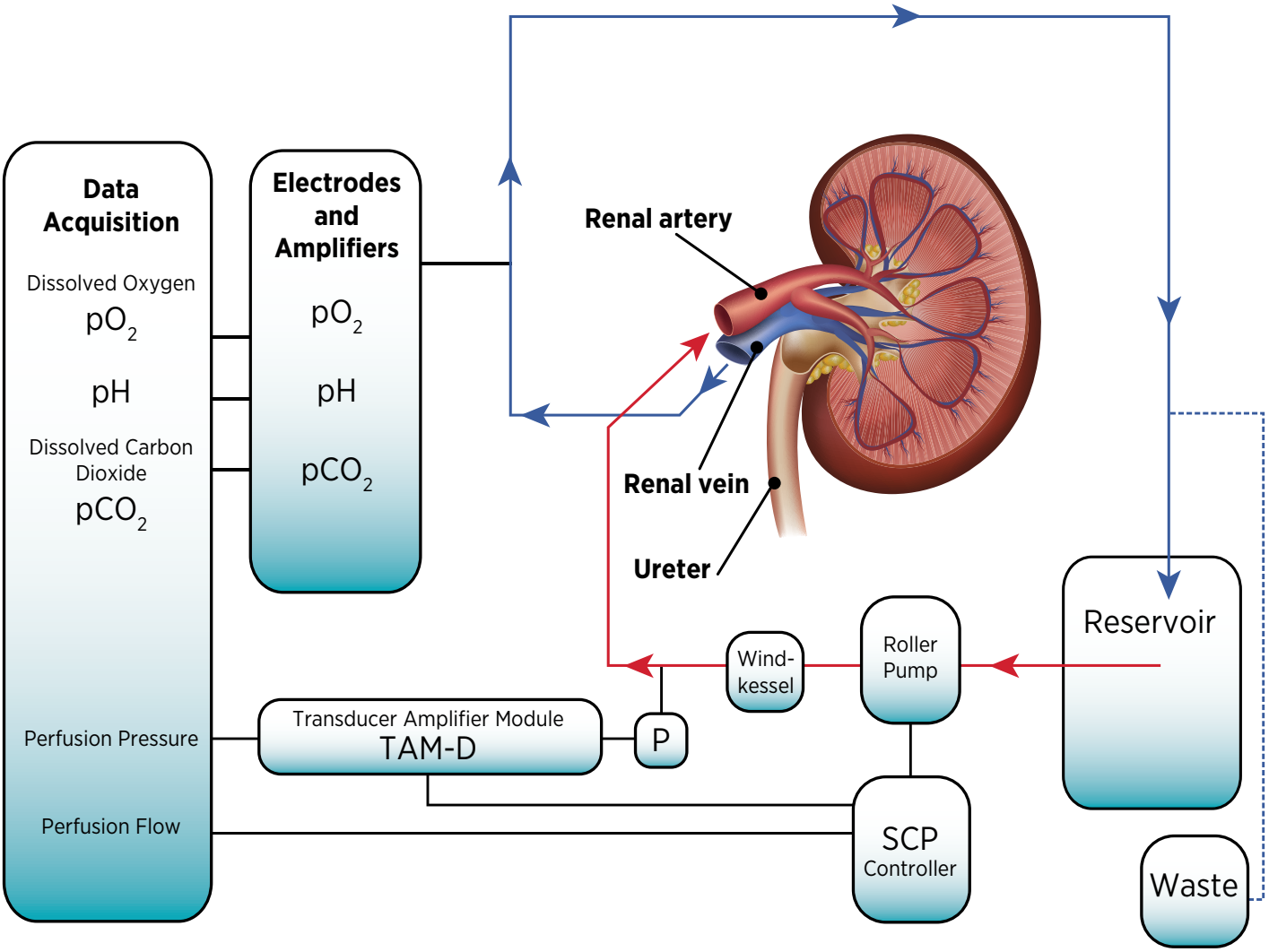
Configure your ideal isolated organ system using the Checklist at the end of this catalog or on the website.

LIVER PERFUSION VIA PORTAL VEIN

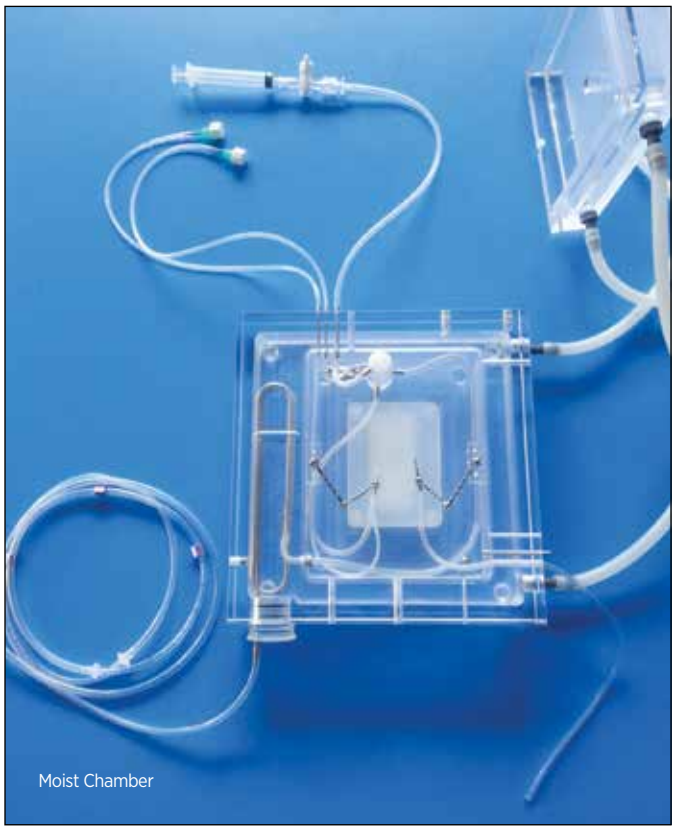


Perfusate is pumped from the reservoir into the portal vein or hepatic artery (not shown) using an analog peristaltic (roller) pump. A windkessel is installed in order to dampen the roller pump's pulsations. Perfusion pressure and perfusion flow can be adjusted and are measured. Constant flow and constant pressure perfusion can be performed by the Servo Controller (SCP). A pressure transducer (P) together with the TAM-D constantly monitors the perfusion pressure. The perfusion flow is calculated from the pump speed by the SCP. The Transducer Amplifier Module (TAM-D) obtains the pressure from the transducer (P) and sends this value to the SCP.The measured perfusion pressure and the calculated flow are displayed on digital displays and can be monitored and recorded with any data acquisition software. Flow through electrodes and their appropriate amplifiers measure pO_2, pH, pCO_2 values in the perfusate exiting the liver. Also these devices directly interface with the data acquisition software so that all acquired signals are measured with one data aquisition (DAQ) system to deliver accurate data for analysis.

KIDNEY PERFUSION VIA RENAL ARTERY



Perfusate is pumped from the reservoir into the renal artery using an analog peristaltic (roller) pump. A windkessel is installed in order to dampen the roller pump's pulsations. Perfusion pressure and perfusion flow are kept constant by the Servo Controller (SCP). A pressure transducer (P) together with the TAM-D constantly monitors the perfusion pressure. The perfusion flow is calculated from the pump speed by the SCP. The Transducer Amplifier Module (TAM-D) obtains the pressure from the transducer (P) and sends this value to the SCP. The measured perfusion pressure and the calculated flow are displayed on digital displays and can be monitored and recorded with any data acquisition software. Flow through electrodes and their appropriate amplifiers measure pO_2, pH, pCO_2 values in the perfusate exiting the kidney via the renal vein. Also these devices directly interface with the data acquisition software so that all acquired signals are measured with one data aquisition (DAQ) system to deliver accurate data for analysis.


Moist Chamber

Moist Chamber

Features & Benefits

- Superior temperature control of perfusate and organ
- Precise positioning of cannulae and measurement probes
- Compact and easy to use
- Compatible with a variety of accessories, making it suitable for a wide range of applications
- Provides a complete perfusion system when combined with the UP-100 or a perfusion control system

Applications

- Rodent isolated organ perfusion—liver, kidney, pancreas, mesenteric bed
- Investigation of the tone of small blood vessels under the effect of vasoactive substances
- Biochemistry—studying metabolic processes
- Drug studies—testing of vasodilative drugs, testing of side effects of any drug
- Transplantation studies and studies on preservation solutions

The standard Moist Chamber is an exceptionally flexible and useful tool for perfusion of most abdominal organs from typical rodent models. In its most basic configuration, the Moist Chamber consists of a suitably deep (110 x 40 x 35 mm) organ chamber and cover. Both components are double-walled and water-jacketed to provide a stable temperature controlled environment within the organ chamber. The perfusate is warmed by passage through a built-in heat exchanger. A bubble trap should be used in the perfusate path immediately before contact with the organ.

Inside the chamber, a flexible silicone platform acts as a rest for fixation (aided by the use of fixing pins when necessary) 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.

This Moist Chamber 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 can also be used in conjunction with the UP-100 or a perfusion control system to allow for constant pressure perfusion.

Included items: Jacketed moist chamber with metal tube heat exchanger, jacketed cover and silicone plate

Additional equipment required: Thermocirculator, bubble trap, cannulae, holders, peristaltic pump, transducers, monitoring system setup. Recording and evaluation of the signals uses BDAS or LabChart software. For constant pressure perfusion the SCP and TAM-D modules, along with PLUGSYS housing, are needed in addition to the peristaltic pump.

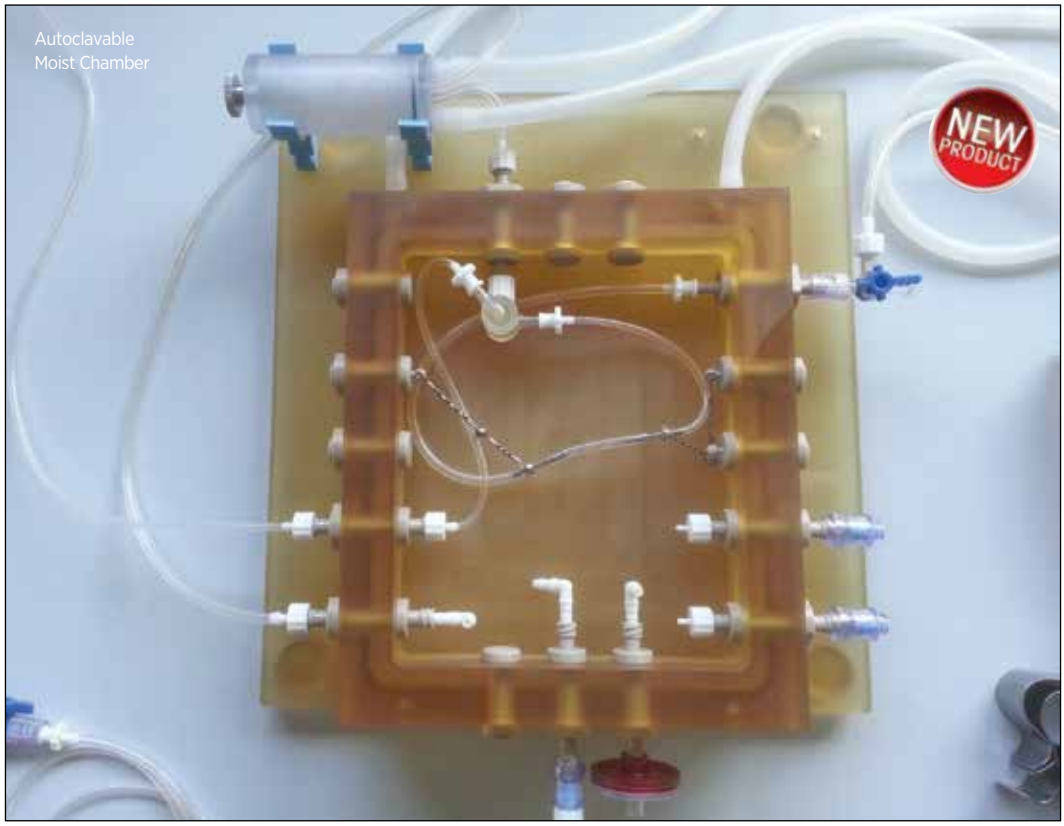
Special Application: The Rat Mesenteric Bed

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.

Specifications	
Inside Dimensions (L x W x H)	110 x 140 x 35 mm
Outer Dimensions (L x W x H)	200 x 200 x 75 mm with cover
Priming Volume	18–20 ml (dependent on length of tubing used)

Order #	Product
73-2901	Moist Chamber with Metal Tube Heat Exchanger
73-3692	Bubble Trap for use with 1.5 PRB Flow Probe
73-2780	Bubble Trap for Flow Rates up to 50 ml/min
73-3094	Stainless Steel Mesh Electrode

The Moist Chamber can be paired with a multitude of additional equipment to suit a wide range of applications. Please contact us with information on your application and needs and we can provide you with a customized set up.



Autoclavable Moist Chamber

Features & Benefits

- Interchangeable connecting parts for the 16 openings around the chamber allows you to customize the chamber to suit your needs
- Built-in bubble trap
- Optional perfusate reservoir and oxygenator
- Multiple cannulae sizes available to suit a variety of applications
- Each perfusion line is equipped with an independent heat exchanger

Applications

- Long term drug studies on ex vivo liver, kidney, and other abdominal organs
- Regenerative tissue engineering studies involving decellularization and recellularization with stem cells lasting up to weeks
- Organ transplantation studies
- Sheep ovary and uterus transplantation studies

Like the standard Moist Chamber, the Autoclavable Moist Chamber is intended for perfusion of isolated organs of small animals such as kidney, liver or mesenteric bed of mice, rats or guinea pigs. It has been designed to perfuse such isolated organs under optimized sterile and physiological conditions, making this chamber suitable for long term perfusion studies.

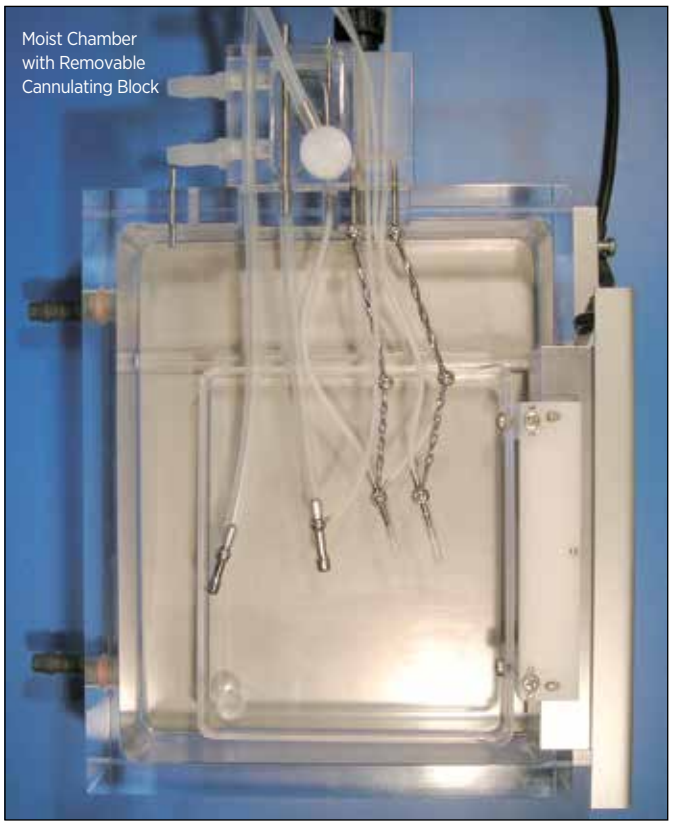
While utilizing the optimized design of the standard Moist Chamber, the Autoclavable Moist Chamber has additional features to help ensure sterility. The chamber is completely sealed. All accesses are made over swabable Luer female connections or tuohy adapters. Sterile air filters allow gas exchange with the environment for pressure compensation inside to outside. Sterile low flow gas exchange inside is the chamber possible. The system is made entirely of autoclavable materials. In addition, the cover is mounted on the chamber and secured with four metal clamps to avoid unexpected opening and contamination of the chamber.

Included items: Jacketed moist chamber, jacketed lid, tubing heat exchanger and bubble trap for a single perfusion

Additional equipment required: Thermocirculator, cannulae, holders, peristaltic pump, transducers, monitoring system setup. Recording and evaluation of the signals uses BDAS or LabChart software. For constant pressure perfusion, the SCP and TAM-D modules, along with PLUGSYS housing, are needed in addition to the peristaltic pump.

Specifications	
Inside Dimensions (L x W x H)	110 x 140 x 35 mm
Outer Box Dimensions (L x W x H)	200 x 250 x 75 mm
Base Plate	260 x 245 x 16 mm
Overall Height without Lid	55 mm
Overall Height with Lid	85 mm

Order #	Product
73-4733	Autoclavable Moist Chamber
73-4734	Jacketed Reservoir with Oxygen tube, 2 L
73-4808	Jacketed Reservoir with Oxygen tube, 220 mL


Moist Chamber with Removable Cannulating Block


Cannulation Block Removed from Chamber for Surgeery

Moist Chamber with Edema Balance

Features & Benefits

- Dual perfusion system—vascular and intraluminal intestinal
- Built-in balance for edema evaluation and organ weight measurement

Applications

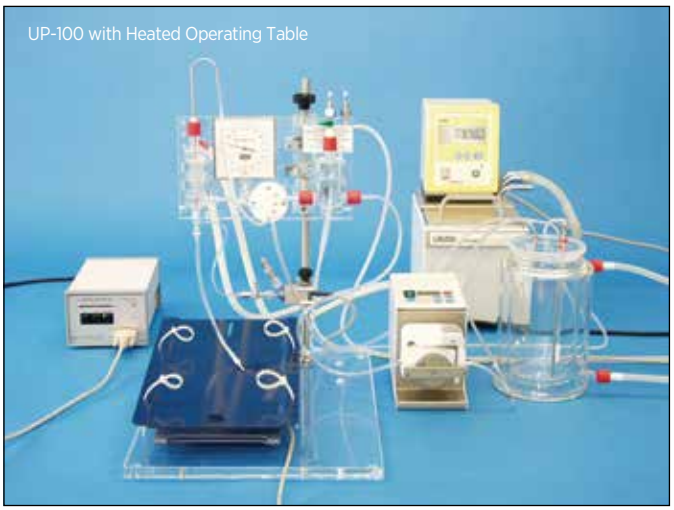
- Rodent isolated intestine perfusion
- Microvascular permeability studies
- Simultaneous study of vascular, luminal and lymphatic flows
- Arterial, venous and intraluminal pressures and bowel weight
- Septic multi-organ failure studies in gastrointestinal area

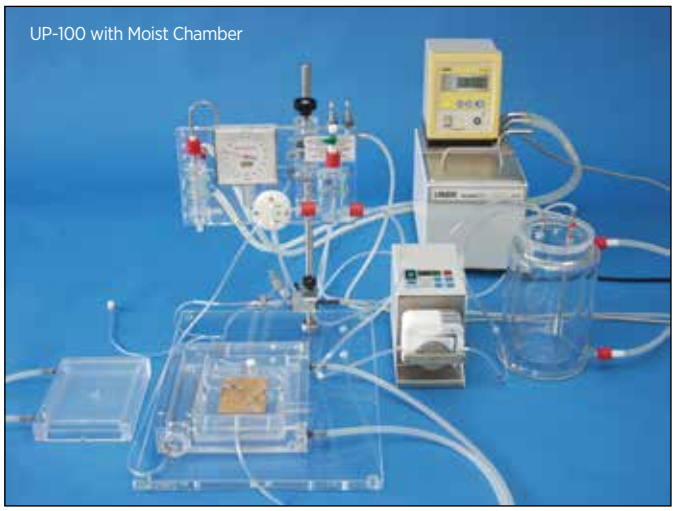
This system is comprised of a moist chamber with a built-in organ weighing system. The jacketed chamber maintains a warm and moist environment for the organ. The chamber has been configured for studying the edema evolution in a perfused intestine with attached mesenteric bed using two separate perfusion 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.

Included items: Moist chamber with cannulae and mini holders for mesenteric artery, portal vein, ileum inflow and ileum outflow, balance (requires TAM-D amplifier), cannulating block (can be removed from chamber for surgery)

Additional equipment required: TAM-D and housing (for inflow/outflow balance), thermocirculator, peristaltic pump, transducers, monitoring system setup. Recording and evaluation of the signals uses BDAS or LabChart software. For constant pressure perfusion, the SCP and TAM-D modules, along with PLUGSYS housing, are needed in addition to the peristaltic pump.

Order #	Product
73-3685	Moist Chamber with Edema Balance (MCWEB), Rat
73-4528	Moist Chamber with Edema Balance (MCWEB), Mouse


UP-100 with Heated Operating Table


UP-100 with Moist Chamber

Universal Perfusion System (UP-100)

Features & Benefits

- Multipurpose system for perfusing isolated organs ex vivo or in situ
- Ideal for perfusing isolated organs such as: liver, rabbit ear, heart, kidney, rat hind limb, mesenteric bed
- Allows for constant flow or constant pressure perfusion

Applications

- Ex vivo perfusion of liver, kidney, mesenteric bed (requires the addition of a moist chamber)
  - Test of vasodilative drugs
  - Studying metabolic processes
  - Neural vascular tone
  - Organ preservation for transplant
- In situ perfusion of liver, kidney, mesenteric bed, hind limb, hindquarter (requires the addition of an operating table):
  - 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)

The UP-100 is a multi-purpose perfusion system best utilized when different types of organs must be perfused either ex vivo or in situ. 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 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.

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. Please see next page for information on the operating table.

Included items: Plexiglass stand, heat exchanger with built-in bubble trap, holder for APT300 pressure transducer, membrane system, pressure gauge and special spindle pump for perfusion pressure adjustment, membrane resistor (73-2316 only)

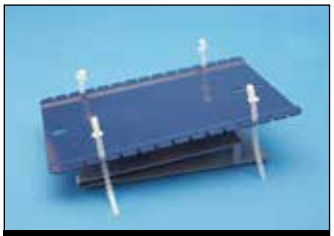
Additional equipment required: Moist Chamber or operating table, thermocirculator, peristaltic pump, transducer for perfusion pressure, monitoring system setup using the PLUGSYS Amplifier System. Recording and evaluation of the signals uses BDAS or LabChart software.

Specifications	
System Volume	30 ml

Order #	Product
73-4228	Universal Perfusion System, configured for use with SCP
73-2316	Universal Perfusion System, with Membrane Resistor

See our Isolated Heart Brochure for information on the UP-100 specialized for Langendorff heart perfusion.

Operating Table
with Homeothermic Controller



Operating Table
with Flat Angled Base

Operating Tables for In Situ Perfusion Studies

Features & Benefits

- Heated and homeothermic versions available
- Includes paw holders
- Capable of receiving thorax retractors and mounting ball joint holders

Applications

- For in situ perfusion studies, when paired with the UP-100 Universal Perfusion System
- For general surgical work on small animals

There are three heated options available for this operating table:

- **Basic Fixed Temperature:** includes an adapter box and power supply. The temperature is fixed at 38°C.
- **Advanced Fixed Temperature:** includes heating controller. Allows the user to adjust the power to the heating element from 20 to 100% of the maximum power, allowing for more flexibility in the target temperature. It does not include feedback control.
- **Homeothermic-Controlled:** provides feedback-controlled heating. This option consists of a temperature probe, a control until and an adapter box. The power to the heating element is adjusted according to the temperature reading from the probe.

The core component for the operating tables is a plastic-coated aluminum plate measuring 300 x 195 mm. Both sides of the plate have multiple slots for fixing the paw holders and optional thorax retractors. Numerous slots and dedicated paw holders allow both large and small animals to be held firmly in position for optimal surgical access. A block clamp with ball joint holder can be fixed onto the plate for holding various probes, electrodes, or cannulae. A 4 mm banana plug outlet is available when grounding of the table is required (e.g. for ECG recordings).

Holder for Two Cannulae
with Bubble Trap

Thorax Retractor with Ball Chain

HINT! For in situ perfusion studies using the Homeothermic Controlled Operating Table, we suggest you position the temperature probe under the target organ.

Specifications	
Operating Table	
Table Plate	300 x 195 mm Aluminum, plastic coated
Height with Angled Base	30 mm (low side) 62 mm (high side) 6° (angle of slope)
Heating Element	Printed circuit base
Heater Resistance	1.5 Ω
Weight Plate (with Heating)	0.45 kg
Power Supply for Basic Fixed Temperature Model	
Power Output	12 V DC / 60 VA
Mains Voltage	115-230 VAC, 50/60 Hz
Dimensions (W x H x D), Adapter Box	105 x 55 x 30 mm
Dimensions (W x H x D), Power Supply	140 x 60 x 30 mm
Weight	0.6 kg
Heating Controller for Advanced Fixed Temperature Model	
Power Output	DC 9 Volt, 40 VA adjustable in the range 20–100%
Mains Voltage	115 VAC, 60 Hz or 230 VAC, 50 Hz
Dimensions (W x H x D)	125 x 95 x 210 mm
Weight	2 kg
Control Unit for Homeothermic-Controlled Model	
Power Output	Maximum 40 VA. Supplied continuously (not switched), the level is dependent on the temperature monitored
Ripple Output	Less than 10 mV RMS
Temperature Accuracy	±1% of actual temperature (35° to 40°C)
Temperature Range	35° to 40°C monitored on the front panel LCD
Temperature Safety Limit	40°C
Analogue Output	50 mV at 35°C to 150 mV at 40°C (20 mv/°C)
Mains Voltage	115 VAC, 60 Hz or 230 VAC, 50 Hz
Dimensions (W x H x D)	274 x 320 x 94 mm
Weight	3 kg

Order #		Product
Operating Tables (Size 5)		
115V	**230V**	
73-3777		Flat Angled Base Operating Table, heated with power supply 115/230 VAC, 50/60 Hz
73-3586	**73-3585**	Flat Angled Base Operating Table, heated with heating controller
73-3976	**73-3980**	Flat Angled Base Operating Table, heated with homeothermic controller
Accessories		
73-3512		Replacement Paw Holders, pkg. of 5
73-3855		Replacement Holder for clamping probes, electrodes and cannulae
73-3822		Thorax Retractor with ball chain, 1 pair
73-3945		Small Holder Link for higher loading
73-3857		Holders for two cannulae with bubble trap
73-3857		Holders for two in situ cannulae
73-3856		Holder with ball joint
73-3748		Holder for anesthetic mask
73-7217		Flexible Probe for all systems, 1.3 mm OD

Smaller operating tables for mice and non-heated versions are also available. Visit **www.harvardapparatus.com** or contact Technical Services for more information.

Moist Chamber for Isolated Pig Liver and Kidney

Moist Chamber for Isolated Pig Liver and Kidney

Features & Benefits

- Jacketed heated chamber maintains physiological temperature conditions
- Allows for constant flow or pressure perfusion in a single system
- Ability to expand set up to monitor and record pressure, flow, pH, pO_2, pCO_2 and temperature

Applications

- 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

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 used to reduce hemolysis. Since 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.

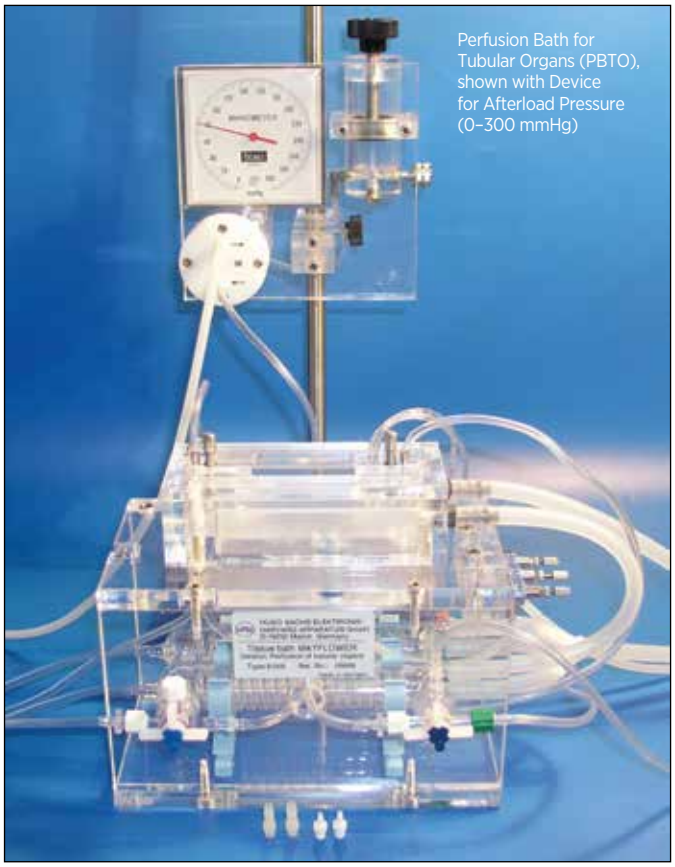
Included items: Jacketed plexiglass chamber with connections for perfusion tubes, jacketed cover

Additional equipment required: Thermocirculator, pump with analog control*, Servo Controlled Perfusion System (SCP), measurement system for flow and pressure, oxygenator with heat exchanger, e.g. Terumo, Capiox SX10® or Medtronic Minimax Plus PRF®, monitoring system setup using the PLUGSYS Amplifier System. Recording and evaluation of the signals uses BDAS or LabChart software.

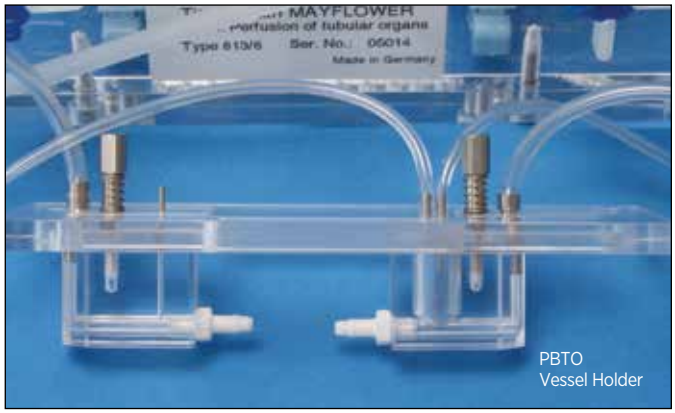
**For blood we recommend a Pump Drive BVP-ZX with centrifugal pump head*

Specifications	
Inside Dimensions (L x W x H)	Liver: 346 x 300 x 210 mm Kidney: 260 x 200 x 210 mm
Outer Box Dimensions (L x W x H)	Liver: 480 x 380 x 210 mm Kidney: 340 x 270 x 250 mm
Lower Compartment (L x W x H) (Reservoir for blood)	Liver: 346 x 300 x 80 mm (Volume 9.6 L) Kidney: 260 x 200 x 60 mm (Volume 3.12 L)
Upper Compartment (Receives the organ)	Liver: 346 x 300 x 210 mm Kidney:260 x 200 x 120 mm

Order #	Product
73-2804	Moist Chamber for Isolated Pig Liver
73-2994	Moist Chamber for Isolated Pig Kidney



Perfusion Bath for Tubular Organs (PBTO), shown with Device for Afterload Pressure (0–300 mmHg)



PBTO Vessel Holder

Cannula options for PBTO

Perfusion Bath for Tubular Organs (PBTO)

Features & Benefits

- Accommodates 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

The Perfusion Bath for Tubular Organs (PBTO) has been designed for studying 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 50 mm. 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).

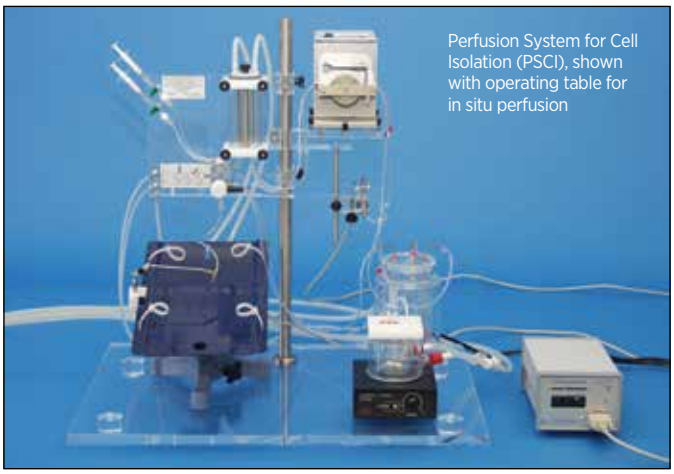
Included items: Plexiglass chassis, organ chamber with adjustable organ holder with connection cannulas, preheating coils for extraluminal and intraluminal perfusates, four different interchangeable cannulae with diameters of 1.5, 2.5, 3 and 4 mm. For smaller vessels customized stainless steel cannulae 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.

Additional equipment required: Thermocirculator, reservoir, peristaltic pumps, transducer, monitoring system setup using the PLUGSYS Amplifier System. Recording and evaluation of the signals uses BDAS or LabChart software.

Specifications	
Bath Volume	30 ml
Maximum Vessel Length	50 mm
Inner Bath Dimensions (L x W x H)	100 x 20 x 20 mm
Outer Bath Dimensions (L x W x H)	200 x 120 x 200 mm

Order #	Product
73-2158	Horizontal Tissue Bath PBTO
73-2044	Device for Afterload Pressure of 0–30 mmHg
73-2333	Device for Afterload Pressure of 0–300 mmHg

Two peristaltic pumps are required for the PBTO, one for intraluminal constant flow perfusion and a second for extraluminal superfusion.



Perfusion System for Cell Isolation (PSCI), shown with operating table for in situ perfusion

Perfusion System for Cell Isolation (PSCI)

Features & Benefits

- Allows cell isolation from mouse, rat and guinea pig organs by enzymatic disintegration
- Specifically engineered dual perfusion system for blood cell flush and enzymatic disintegration
- Dedicated extension for cardiomyocyte isolation

Applications

- Harvesting individual cells from isolated organs such as mouse, rat or guinea pig heart, liver and other organs

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

The system has two separate perfusion circuits and a specialized stopcock which allows the organ to be easily switched between the two circuits. The first circuit is filled with conventional perfusion solution and is used in the initial phase of the isolation process to flush out the blood cells from the organ. For the second phase, the system is switched to the second circuit which is filled with an enzyme solution for disintegration.

In the standard PSCI system, perfusion is performed under constant flow conditions. A peristaltic pump (purchased separately) is used to adjust the flow to a rate appropriate for the organ of interest. The system itself can handle flow rates of up to 50 or 100 m/min, depending on the specific configuration. A pressure transducer and amplifier can easily be added to a set up to monitor perfusion pressure. Furthermore, the system can be upgraded to constant pressure perfusion with the addition of the SCP controller.

The easy to use system is designed to be as compact and user-friendly as possible. Components that come in contact with perfusion solutions are alcohol resistant so that the perfusion circuits can be filled with alcohol to clean and sterilize after use.

The main system includes a dual heat exchanger and a platform for the peristaltic pump, both of which are secured to a vertical stainless steel rod and can be moved to appropriate positions for the process. Additional components are not fixed to the base as the dual heat exchanger and pump platform are. Instead, they are positioned on the PSCI baseplate and are connected to the system by tubing. The protease reservoir and the holder for the perfusion pressure transducer are included in the main system.

Adaptation for Ex Vivo Perfusion

The PSCI can be adapted for ex vivo perfusion by adding jacketed moist chamber and appropriate cannula for the organ of interest.

Included items: Plexiglass stand, double heat exchanger, switching valve, protease reservoir and holder for pressure transducer

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

Adaptation for In Situ Perfusion

The PSCI can be adapted for in situ perfusion by adding an operating table and appropriate cannula for the organ of interest.

Specifications	
Heat Exchanger Inside Diameter	Mouse: 1.5 mm Rat: 2.0 mm
Maximum Flow Rate	Mouse: 50 ml/min Rat: 100 ml/min
Prime Volume	Mouse: <3 ml Rat: <5 ml
System Volume	<3.0 ml
Dimensions, W x D x H	600 x 400 x 570 mm
Weight	8 kg

Order #	Product
73-3659	Perfusion System for Cell Isolation from Mouse Organs (PSCI-M)
73-3639	Perfusion System for Cell Isolation from Rat Organs (RSCI-R)

See our Isolated Heart Brochure for more detailed information on using this system for cardiomyocyte isolation.

Cell Extraction by Organ Disintegration Setup

Features & Benefits

- Simple to set up, operate and maintain
- Compact size minimizes bench space required
- Components of the perfusion circuit that come in contact with the perfusate can be flushed with 70% ethanol or autoclaved to sterilize

Applications

- Cell isolation from mouse, rat or guinea pig organs by disintegration using protease solutions
- Designed for cardiomyocyte isolation
- Can be used with other organs ex vivo or in situ

This perfusion system has been specifically created to meet the needs of researchers who wish to isolate primary cells from organs of species in the size range of mouse to guinea pig. The system can be configured for either in situ or ex vivo organ perfusion.

The system is first used with perfusate for the removal of red blood cells (blanching) and then with the protease solution for tissue disintegration. The perfusate for blanching is warmed and oxygenated in a separate buffer reservoir and supplied via a 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 applications (heart, liver, etc.) the system can be equipped with a jacketed chamber.

We offer a complete line of perfusion cannulae (aortic, ex vivo and in situ) to accommodate vessels from 1.0 to 3.5 mm ID. The ex vivo and in situ cannulae feature our unique tip basket to prevent vessel occlusion.

Included items: Base stand with clamps, bubble trap/Windkessel vessel, heating coil and protease reservoir

Additional equipment required: Thermocirculator, peristaltic pump, magnetic stirrer, reservoir, cannulae, operating table, transducer, monitoring system setup using the PLUGSYS Amplifier System

Easy Organ Distintegration Set-Up for Cell Extraction

Order #	Product
73-3756	Cell Extraction by Organ Disintegration Setup

See our Isolated Heart Brochure for detailed information on using this system for cardiomyocyte isolation.

Harvard Peristaltic Pump
with P-70 motor drive

Harvard Peristaltic Pump

Key Features

- Ability to separate the motor drive from the controller to facilitate use and save space in incubators and fume hoods
- Library of tubing sizes is stored in the pump's memory minimizing set up time
- Custom tubing can be used allowing complete flexibility
- Connectivity to a wide range of external input or output devices is easily accomplished.

The Harvard Peristaltic Pump provides unparalleled accuracy, reproducibility, and ease of use over a broad range of flow rates. It consists of a control unit, a motor drive, a tubing cassette and some sample tubing. The P70 drive allows for flow rates of 1 µm/min to 70 ml/min, depending on tubing size used.

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

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

Specifications	
Type	8 rollers, 5 channels
Accuracy	±1.0%
TTL Connector	15-pin D-sub
Computer Interface	USB Type 'B'
Pump-To-Pump	IEEE 1394
Back Pressure Maximum	15 psi (~1.0 bar)
Tubing ID	0.13 to 2.79 mm
Flow Rate Range	0.001 to 70 ml/min
Dimensions, Control Box	207 x 130 x 96 mm
Dimensions, Pump Head	115 x 254 x 118 mm
Weight	4.7 kg
Pump Voltage	30 VDC, 1.67 A
Power Supply	100–250 VAC, 50/60 Hz

Order #	Product
70-7000	Harvard Peristaltic Pump with P-70 Motor Drive
70-2215	Footswitch
72-0604	Replacement Cartridge/Cassette for P-70

Order #	Product
72-0643	3-stop Collared Silicone Tubing, 1.29 mm ID
72-0649	3-stop Collared Silicone Tubing, 2.05 mm ID
72-0651	3-stop Collared Silicone Tubing, 2.54 mm ID
72-0652	3-stop Collared Silicone Tubing, 2.79 mm ID

Visit the Harvard Apparatus website or contact Technical Services for more information about additional Harvard Peristaltic Pumps and other tubing sizes available.

Reglo Analog Peristaltic Pump

Reglo Digital Peristaltic Pump

REGLO Analog & Digital Peristaltic Pumps

Key Features

- Included snap-on MS/CA Click 'n' Go Cassettes makes these pumps very easy to use

The REGLO peristaltic pump is available in either analog or digital models. The analog pump has a variable speed drive with start/stop, speed, and direction functions. The digital version features a dispense mode with variable flow rates and also dispenses by volume or time intervals. The digital readout facilitates programming.

While the REGLO digital is suitable for constant flow perfusion, the analog is necessary when utilizing the SCP module for constant pressure perfusion.

Order #	Product
73-0113	REGLO Analog Peristaltic Pump, 4-channel MS-4/8, 115 VAC, 60 Hz
73-0114	REGLO Analog Peristaltic Pump, 4-channel MS-4/8, 230 VAC, 50 Hz
73-2915	REGLO Digital Peristaltic Pump, 4-channel MS-4/8, 115 VAC, 60 Hz
73-0100	REGLO Digital Peristaltic Pump, 4-channel MS-4/8, 230 VAC, 50 Hz

3-Stop Collared Tubing		
Order #	**AME#**	**Product**
73-0126	14	3-stop Collared TYGON E-Lab Tubing, 1.22 mm ID
73-1836	21	3-stop Collared TYGON E-Lab Tubing, 2.06 mm ID
73-1838	23	3-stop Collared TYGON E-Lab Tubing, 2.54 mm ID
73-1839	25	3-stop Collared TYGON E-Lab Tubing, 3.1 mm ID

Visit the Harvard Apparatus website or contact Technical Services for information about additional REGLO pump options and other tubing sizes available.

Specifications		
	Analog	**Digital**
Channels*	4	
Pump Rollers*	8	
Minimum Flow Rate (per channel)	2 µl/min	
Maximum Flow Rate (per channel)	35 ml/min	57 ml/min
Speed Range	2–100 rpm	1.6–160 rpm
Main Connection	115 VAC/60 Hz or 230 VAC/50 Hz	
Power Consumption	20 W	
Reversible Flow	Yes	
Speed Setting	3 to 99% resolution, 1% 2-digital potentiometer	N/A
Analog Interface Input	Speed control 0–5 V or 0–10 V and 0–20 mA or 4–20mA respectively	N/A
Set Point	N/A	Digital, 3–4 digits according to function (mode), LED display
RS-232 Interface	N/A	For all functions
Display Input (TTL Level)	Run/Stop AutoStart	
Back Pressure Maximum	14.5 psi (1.0 bar)	
Suction Height	7–8 m	
Protection Rating	IP 30	
Tubing Cassettes	MS/CA Click 'n' Go Cassettes are included	
Dimensions (H x W x D)	143 x 100 x 190 mm	135 x 100 x 178 mm
Weight	2.1 kg	2.0 kg

**Please note: Other channel and roller options are available for both the analog and digital versions of the REGLO peristaltic pump. Please see our website for the full offering.*

Ecoline Roller Pump, VC-MS/CA4-12

Ecoline Microprocessor Controlled Tubing Pumps

Key Features

- Economical and powerful
- Stackable pumps for dosing and filling applications requiring variable flow rates
- MS/CA Click 'n Go Cassettes included
- Uses 3-stop collared tubing
- Differential pressure 1.0 bar
- Analog interface
- Robust stainless steel housing
- Suitable pump for SPC controller

The Ecoline pumps are economical and compact and offer a wider flow rate range than both the Harvard Peristaltic Pump and the REGLO Analog and Digital Pumps. They are ideal for complex pumping applications such as recirculating organ perfusion system.

The Ecoline pumps accept 3-stop collared tubing and utilize the MS/CA Click 'n' Go Cassettes.

Order #	Product
72-6434	Ecoline Roller Pump, VC-MS/CA4-12, 4 Channels, 230 VAC, 50 Hz
72-6435	Ecoline Roller Pump, VC-MS/CA4-12, 4 Channels, 115 VAC, 60 Hz
72-6432	Ecoline Roller Pump, VC-MS/CA8-6, 8 Channels, 230 VAC, 50 Hz
72-6422	Ecoline Roller Pump, VC-MS/CA8-6, 8 Channels, 115 VAC, 60 Hz

3-Stop Collared Tubing		
Order #	AME#	Product
73-0126	14	3-stop Collared TYGON E-Lab Tubing, 1.22 mm ID
73-1836	21	3-stop Collared TYGON E-Lab Tubing, 2.06 mm ID
73-1838	23	3-stop Collared TYGON E-Lab Tubing, 2.54 mm ID
73-1839	25	3-stop Collared TYGON E-Lab Tubing, 3.1 mm ID

Specifications		
	Ecoline 4-Channel	Ecoline 8-Channel
Channels	4	8
Pump Rollers	12	6
Minimum Flow Rate (per channel)	3 µl/min	5 µl/min
Maximum Flow Rate (per channel)	83 ml/min	150 ml/min
Motor Type	DC Motor	
Speed Seating/Control	1 to 99% resolution, 1% 2-digital potentiometer	
Speed	3.5 to 350 rpm	
Power Consumption	100 W	
Mains Connection	115 VAC/60 Hz or 230 VAC/50 Hz, adjustable	
Protection Rating	IP 30	
Remove Control	Analog Interface	
Tubing Cassettes	MS/CA Click 'n Go Cassettes included	
Dimension (H x W x D)	138 x 169 x 281 mm	138 x 169 x 313 mm
Weight	5.4 kg	5.5 kg

Visit the Harvard Apparatus website or contact Technical Services for more information about tubing sizes available.

MCP
Pump Drive

MCP Pump Drive

Key Features

- Stores four programs in memory
- Dispensing volumes in ml and flow rates in ml/min
- Calibrated in ml/min
- Various dispensing modes: MAX key for priming and rapid filling or emptying of the tube system

The MCP programmable pump drive offers various dispensing modes, providing highly reproducible and accurate results. Pump head must be purchased separately.

Specifications	
Model	MCP pump drive only, pump head must be purchased separately
Speed	1 to 240 rpm with 0.1 rpm resolution
Back Pressure Maximum	22 psi (1.5 bar)
Mains Connection	115 VAC (50/60 Hz) or 230 VAC (50/60 Hz)
Power Consumption	100 W maximum
RS-232 Interface 8 Pumps	Baud rate 9600 or 1200 baud, 8 bit, 1 stop bit, no parity for complete computer control for cascade control or up to 8 pumps
Analog Interface	Speed control 0–5 V or 0–10 V, respectively 0–20 mA or 4–20 mA
Digital Input (TTL Level)	Flow direction, start/stop, speed control
Valve Plug	1 for 24 V valve
Protection Rating	IP 30
Electro Magnetic Immunity	EN 50082-1
Electro Magnetic Radiation	55022 Class B
Operating Conditions	0° to 40°C (normal environmental conditions)
Dimensions (H x W x D)	260 x 155 x 220 mm without pump head
Weight	6.4 kg

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

BVD
Pump Drive

BVP Pump Drive

Key Features

- Smooth operation at a low noise level
- Robust drive for long-term operation
- Small footprint
- MAX Switch for priming of tubing system
- Switchable flow direction
- Suitable for SCP controller

The BVP pump drive is very robust and designed for continuous operation. It is equipped with a 3-digital potentiometer speed selector and an analog interface. Pump head must be purchased separately.

Specifications	
Model	BVP pump drive only, pump head must be purchased separately
Speed	2.4 to 240 rpm, adjustable in 0.1% steps
Back Pressure Maximum	22 psi (1.5 bar)
Mains Connection	115 VAC (50/60 Hz) or 230 VAC (50/60 Hz)
Power Consumption	100 W maximum
Analog Interface	Speed control 0–5 V or 0–10 V, respectively 0–20 mA or 4–20 mA
Digital Input (TTL Level)	Flow direction, start/stop, speed control
Digital Input	Flow direction, start/stop
Protection Rating	IP 30
Electro Magnetic Immunity	EN 50082-1
Electro Magnetic Radiation	55022 Class B
Operating Conditions	0° to 40°C (normal environmental conditions)
Dimensions (H x W x D)	260 x 155 x 220 mm without pump head
Weight	5.7 kg

Order #	Product
73-3028	BVP Pump Drive, 230 VAC, 50/60 Hz
73-3027	BVP Pump Drive, 115 VAC, 50/60 Hz
73-3049	Foot Switch for BVP Pump

SB Pump Head

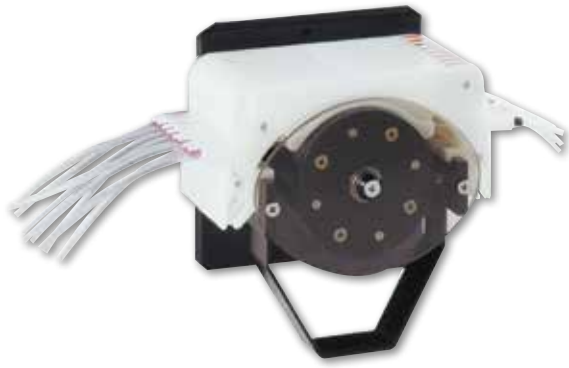
SB Pump Head with Tube Bed Sets

Specifications		
	With 2 V Tube Bed Set	With 3 V Tube Bed Set
Tube Bed Set	2 V	3 V
Channels	2	3
Pump Rollers	6	
Minimum Flow Rate (per channel)	1.1 ml/min	0.9 ml/min
Maximum Flow Rate (per channel)	1100 ml/min	870 ml/min
Back Pressure Maximum	22 psi (1.5 bar)	
Tubing Type	Standard tubing	
Tube ID	3.2 to 8.0 mm	0.8 to 6.4 mm
Tubing Wall Thickness	1.6 mm	

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

**Note: Requires selection of Tube Bed Set*

CA 8 Pump Head



CA Pump Heads

Specifications	
Channels	4, 8, or 12
Pump Rollers	8
Minimum Flow Rate (per channel)	2 µl/min
Maximum Flow Rate (per channel)	230 ml/min
Back Pressure Maximum	14.5 psi (1.0 bar)
Tubing Type	2-stop collared tubing
Tube ID	0.13 to 3.17 mm

Order #	Product
73-3035	CA-4 Pump Head, 4-Channel, for BVP/MCP Pump Drives
73-3036	CA-8 Pump Head, 8-Channel, for BVP/MCP Pump Drives
73-3037	CA-12 Pump Head, 12-Channel, for BVP/MCP Pump Drives
73-3052	Replacement CA Click 'n' Go Cassette

2-Stop Collared Tubing		
Order #	ENE#	Product
73-1853	14	2-stop Collared TYGON E-Lab Tubing, 1.22 mm ID
73-1860	21	2-stop Collared TYGON E-Lab Tubing, 2.06 mm ID
73-1862	23	2-stop Collared TYGON E-Lab Tubing, 2.54 mm ID
73-1863	24	2-stop Collared TYGON E-Lab Tubing, 2.79 mm ID
73-1844	25	2-stop Collared TYGON E-Lab Tubing, 3.17 mm ID

Centrifugal Blood Pump

Centrifugal Pump for Blood

Key Features

- Low hemolysis
- Flow rates up to 16 L/min
- Little to no pulsation, with only low noise
- Robust construction for long life

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

Specifications	
Pump Drive	
Type	BVP-ZX
Speed	3–3000 rpm, adjustable in 0.1% steps
Mains Connection	230 V (50/60 Hz) 115 V (50/60 Hz)
Power Consumption	120 W maximum
Analog Interface	Speed control 0–5 V or 0–10 V or 0–20 mA or 4–20 mA, start/stop (TTL contacts)
Protection Rating	IP 30
Operation Conditions	0° to 40°C (normal environmental conditions)
Dimensions (H x W x D)	260 x 155 x 260 mm without pump-head
Weight	7 kg without pump head

Centrifugal Pump Heads	
Type	**BP-80**
Manufacturer	Medtronic
Pump Technologies	Centrifugal
Maximum Flow Rate	10 L/min at 50 mmHg–16 L/min at 50 mmHg 3 L/min at 300 mmHg–13 L/min at 300 mmHg
Pulsation	No
Priming Volume	80 ml
Inlet/Outlet ID	9.5 mm
Fitting to BVP-ZX	Direct

Order #	Product
73-2963	BVP-ZX Centrifugal Pump Drive, 115 VAC, 50/60 Hz
73-2470	BVP-ZX Centrifugal Pump Drive, 230 VAC, 50/60 Hz
73-2807	BP-80 Centrifugal Pump Head

Pulsatile Blood Pump

Pulsatile Blood Pump

Key Features

- Minimal hemolysis
- Models for mouse to large animals
- Ideal for moving emulsions, suspensions and non-Newtonian fluids such as blood

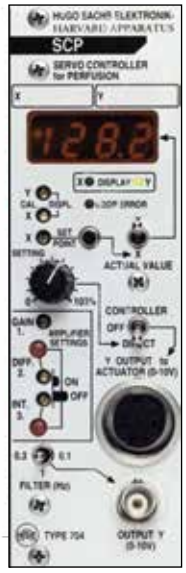
The pulsatile output of the Harvard Apparatus Pulsatile Blood Pump closely simulates the ventricular action of the heart. This action provides physiological advantages in blood flow for perfusion in cardiovascular and hemodynamic studies. It is ideal for isolated organ perfusion as well as whole body perfusion, blood transducers, hydrations/dehydration procedures and blood cellular profile studies.

Specifications	Model 1407	Model 1405	Model 1421	Model 1423
Species	Mouse/Rat	Rabbit	Dog/ Monkey	Large Animal
Stroke Volume, Adjustable	0.05 to 1.0 ml	0.5 to 10 ml	4 to 30 ml	15 to 100 ml
Rate (Strokes/Minute)	20 to 200	20 to 200	20 to 200	10 to 100
Minute Volume (Volume x Rate)	1 to 200 ml	10 ml to 2 L	80 ml to 6 L	150 ml to 10 L
Phasing	Fixed		Adjustable	
Systole/Diastole Ratio	35% Systole		35–50%	
Tube ID	8 mm		11 mm	14 mm
Dimensions (H x W x D)	312 x 156 x 250 mm		500 x 212 x 337 mm	
Weight	7.3 kg		13.6 kg	14.5 kg
Voltage	115 VAC, 50/60 Hz or 230 VAC, 50/60 Hz UK and EU Models			

Order #	Product
Blood Pumps	
52-9552	Pulsatile Blood Pump Model 1407, for Mouse/Rat
55-1838	Pulsatile Blood Pump Model 1405, for Rabbit
55-3321	Pulsatile Blood Pump Model 1405, for Dog/Monkey
55-3305	Pulsatile Blood Pump Model 1421, for Large Animal, Hemodynamic Studies
Tubing	
72-1028	Tygon E-3603 Tubing, 7.9 x 14.3 mm ID x OD, 15.2 m
72-1032	Tygon E-3603 Tubing, 11.1 x 17.5 mm ID x OD, 15.2 m
72-1036	Tygon E-3603 Tubing, 14.3 x 20.6 mm ID x OD, 15.2 m

Note: Please add EU for Europe or UK for United Kingdom to end of part numbers when applicable

SCP Module shown in PLUGSYS Housing with TAM-D amplifier. APT300 pressure transducer and peristaltic pump also shown.



PLUGSYS SCP Module

Servo Controller for Perfusion Control (SCP)

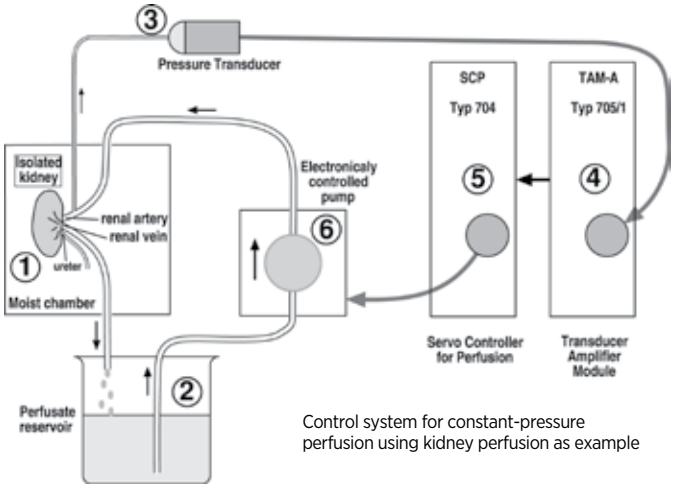
Features & Benefits

- Accurate control of perfusion pressure or flow, even with very small perfusate quantity
- Calculates flow rate from pump speed, eliminating the need for an expensive flowmeter
- Analog output (0–10 V)
- Provides a flexible, yet compact, perfusion circuit setup that adjusts to suit individual perfusion conditions

Applications

- Constant pressure perfusion, when paired with a peristaltic or centrifugal pump

PLUGSYS Servo Controlled Perfusion System (SCP) is used for the perfusion of organs and tissues using a peristaltic pump. It is a conventional closed loop controller which operates to maintain either a constant perfusion pressure or a constant perfusion flow by controlling the peristaltic pump.



Control system for constant-pressure perfusion using kidney perfusion as example

The pressure or flow measure (actual value) is fed in to the SCP PLUGSYS module. The SCP has a provision for setting the required perfusion pressure or perfusion flow which represents the “Set Value”. From the actual value and the set point value, the SCP module produces a control voltage for the pump so that the measured “actual value” matches the desired “Set value”.

In the case of a constant pressure controlled system, the control voltage for the peristaltic pump is proportional to the pump speed and therefore to the perfusion flow. The system provides for a low cost flow measurement.

Required items: Measuring system, either for perfusion pressure or for perfusion flow and analog pump capable of external control and providing the appropriate pumping rate

Order #	Product
73-2806	PLUGSYS Servo Controller Module for Perfusion (SCP)*

**Module requires 2 PLUGSYS slots. See* PLUGSYS Modules & Cases *for PLUGSYS housing options.*

TXF200 Thermocirculator, shown with 5 L Stainless Steel Bath

Thermocirculators

Features & Benefits

- Accurate and safe temperature control
- Easy to use design
- Robust
- Cost effective
- Available in general purpose and advanced options

The easily-programmable TC120, TX150 and TXF200 thermocirculators allow for high precision temperature control. The powerful pump makes these circulators ideal for both routine and sensitive procedures.

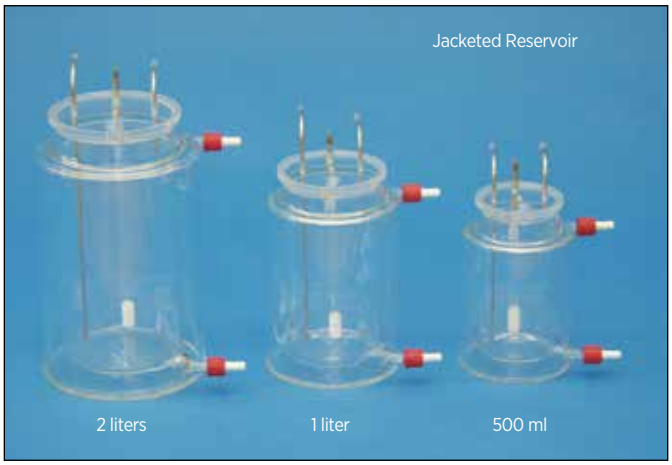
The LT ecocool thermocirculators are energy-efficient, eco-friendly refrigerated/heated circulating baths. They offer significant running cost savings while delivering powerful cooling. They are supplied assembled and complete with accessory hosing, clips and connectors.

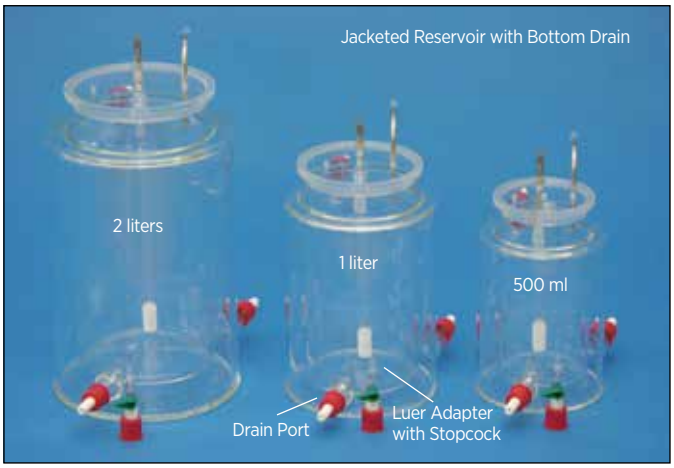
Specifications					
	TC120	**TX150**	**TXF200**	**LT ecocool 100**	**LT ecocool 150**
Temperature Range	+15–120°C	0–150°C	0–200°C	-20–100°C	-25–150°C
Temperature Stability	0.05°C	0.01°C	0.01°C	0.05°C	0.02°C
Flow Rate Maximum	16 L/min	18 L/min	22 L/min (adjustable)	17 L/min	14–22 L/min (adjustable)
Pump Pressure Maximum	210 mbar	310 mbar	530 mbar	250 mbar	530 mbar
Tank Volume	User defined, see below			5 L	6 L
Socket for External Temperature Probe	-	Yes	Yes	-	6 pin mini DIN
Programmable	-	Remote via PC/laptop 1 x 30 segments	Direct via USB interface or Remote via PC/laptop 10 x 100 segments	-	1 x 30 segments Labwise™ required
Temperature Presets	3	3	3	3	3
Display	4-digit LED	Full-color QVGA TFT		4-digit LED	Full-color QVGA TFT
Timer	1 min to 99 hrs 59 min				
Communication Interface	-	USB, RS232		USB	
Alarms	High	High and low	High and low	High	High and low
Safety	Fixed overtemperature	Adjustable cut-out overtemperature			

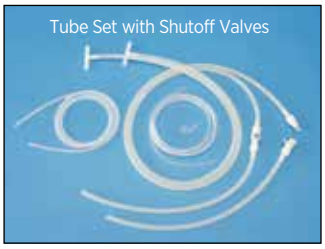
Ordering Information					
	TC120	**TX150**	**TXF200**	**LT ecocool 100**	**LT ecocool 150**
5L Stainless Steel Bath, 120 V	73-4545	73-4547	75-1614	-	-
5L Stainless Steel Bath, 220 V	73-4544	73-4546	75-1615	-	-
12L Stainless Steel Bath, 120 V	75-1601	75-1612	75-1616	-	-
12L Stainless Steel Bath, 220 V	75-1603	75-1613	75-1617	-	-
120 V	-	-	-	75-0310	75-0312
230 V	-	-	-	75-0311	75-0313

Note: Order Numbers listed above reflect a complete system: pump, water bath and lid

Visit the Harvard Apparatus website or contact Technical Services for additional thermocirculator and water bath options.







Jacketed Reservoirs

Features & Benefits

- Available standard, sealing or with drain
- Replacement frits and tubing sets available separately

Applications

- Used with a peristaltic pump or centrifugal pump to deliver warmed perfusate to target organ

These jacketed glass reservoirs are used in conjunction with a peristaltic pump to deliver warmed perfusate to the target organ. They interface with a thermocirculator to stabilize the temperature of the reservoir through ports that accept 5 mm ID tubing. Each reservoir is supplied with a frit to aerate the perfusate. These reservoirs are available in multiple sizes and in three different styles. In the standard and sealing options, the peristaltic pump is connected to the longer stainless steel tube via a Luer connector and tubing. In the option with a bottom drain, the perfusate outlet is the drain port, which can be connected to 5 mm ID tubing or via a Luer adapter to the stopcock (included with the reservoirs with bottom drain). For all styles, a return flow can be connected to the short stainless steel tube with the included Luer to barded tubing connector.

Required Items: Tubing sets for interfacing with a thermocirculator must be purchased separately.

Order #	Product
Reservoirs	
73-3436	0.5 L Standard Jacketed Reservoir
73-3438	1.0 L Standard Jacketed Reservoir
73-2440	2.0 L Standard Jacketed Reservoir
73-0322	6.0 L Standard Jacketed Reservoir with Tube Set for Thermostating Circuit and Fluid Line Shutoff Valves
73-3437	0.5 L Jacketed Reservoir with Drain
73-3439	1.0 L Jacketed Reservoir with Drain
73-3441	2.0 L Jacketed Reservoir with Drain
73-4952	220 ml Sealing Jacketed Reservoir
73-4954	2.0 L Sealing Jacketed Reservoir
Replacement Parts	
73-3564	Replacement Frit for 0.5 L Jacketed Reservoir
73-3565	Replacement Frit for 1.0 L Jacketed Reservoir
73-3566	Replacement Frit for 2.0 L and 6.0 L Jacketed Reservoirs
73-3562	Fluid Outlet with Stopcock for Jacket Reservoir with Bottom Drain
73-3455	Tube Set for Jacketed Buffer Reservoir
73-3456	Tube Set for Jacketed Buffer Reservoir with Fluid Line Shutoff Valves

Fiber Oxygenator


Stand Alone Oxygenator Holder, shown with Needle Valve


Universal Mounting Kit

Fiber (Membrane) Oxygenators & Holders

Features & Benefits

- Hollow fiber oxygenator in two sizes D150 or D200
- MediSulfone® membrane material
- 19/54 ml total priming volume
- 0.25/0.6 m^2 active oxygenating surface area
- Can be used 3 to 10 times
- Available in individual units or in packages of five
- Selection of different holders available

The fiber (or membrane) oxygenator is an alternative to glass frit or bulb oxygenators. This oxygenator is used for blood, blood/perfusate mix, or perfusate that contains protein (to prevent foaming).

Oxygenator holders are available separately. Mounting rods are not included. Mounting kits are specific for either the D150 or D200 oxygenator. They include two ring clamps to hold the oxygenator, tubing adapters, and silicone and Tygon® tubing.

Specifications		
	D150	**D200**
Membrane:		
Material	MediSulfone	
Effective Surface Area	0.25 m^2	0.6 m^2
Wall Thickness	50 µm	
ID	250 µm	
Effective Fiber Length	140 µm	
Sterilization	ETO	
Priming Volume	19 ml	54 ml
Oxygenator Materials:		
Housing	Polycarbonate	
Bloodports	Polycarbonate	
Potting	Polycarbonate	
Oxygenator:		
Maximum Recommended TMP	500 mmHg	
Dimensions	180 x 44 mm	180 x 55 mm
Weight (grams)	66	124

Order #	Product
73-3757	Fiber (Membrane) Oxygenator D150, pkg. of 1
73-3762	Fiber (Membrane) Oxygenator D150, pkg. of 5
73-3758	Fiber (Membrane) Oxygenator D200, pkg. of 1
73-3763	Fiber (Membrane) Oxygenator D200, pkg. of 5
73-3061	Oxygenator Holder for UP–100 or IH–SR System, 13 mm max. diameter for rod mount, no needle valves included
73-3057	Oxygenator Holder for PSCI System, 20 mm max. diameter for rod mount, no needle valves included
73-3058	Stand Alone Oxygenator Holder, 13 mm max. diameter for rod mount, 1 needle valve included
73-3759	Mounting Kit for D150 Fiber Oxygenator on Holder
73-3760	Mounting Kit for D200 Fiber Oxygenator on Holder
73-3765	Gas & Perfusate Connector (5 Sets)

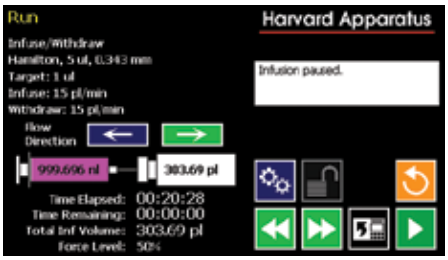
Small Animal Cannulae

These specialized cannulae were designed for atraumatic cannulation of isolated organs. The cannulae are equipped with a basket-like tip to avoid any occlusion of the vessel during preparation and throughout the experiment. Multiple sizes are available depending on the species and the need for a side port for pressure measurement during drug delivery.

When choosing cannulae, it is important to ensure that outflow cannulae are always larger than inflow cannuale. Doing so will reduce flow resistance and help to avoid back pressure in the organ.

Ordering Information						
Target Organ	**Species**	**Vasculature**	**Order#**	**OD (mm)**	**ID (mm)**	**Features**
Liver	**Mouse**	Portal vein	**73-3309**	1.0	0.7	Basket and side port
		Inferior vena cava	**73-3310**	1.3	1.0	Basket
	Rat, guinea pig	Portal vein	**73-3315**	2.3	1.9	Basket and side port
			73-3313	2.0	1.5	Basket and side port
		Inferior vena cava	**73-3314**	2.3	1.9	Basket
			73-3312	2.0	1.5	Basket
Kidney	**Mouse**	Abdominal artery	**73-3309**	1	0.7	Basket and side port
			73-3311	1.3	1.0	Basket and side port
		Abdominal vein	**73-3308**	1.0	0.7	Basket
			73-3310	1.3	1	Basket
	Rat, guinea pig	Renal artery	**73-3309**	1	0.7	Basket and side port
			73-3311	1.3	1.0	Basket and side port
		Renal vein	**73-3308**	1.0	0.7	Basket
			73-3310	1.3	1	Basket
Mesenteric bed	**Mouse**	Mesenteric artery	**73-3309**	1	0.7	Basket and side port
	Rat, guinea pig		**73-3311**	1.3	1.0	Basket

Pump 11 Elite Syringe Pump



Pump 11 Elite Syringe Pumps

Features & Benefits

- Smooth, accurate flow down to the pl/min range
- Easy to use LCD color touchscreen
- Available in infuse only and infuse/withdrawal programmable configurations
- Single or dual syringe options available

Applications

- Drug addition
- Dose response studies
- Toxicology studies
- Diabetes studies
- Animal infusions and injections

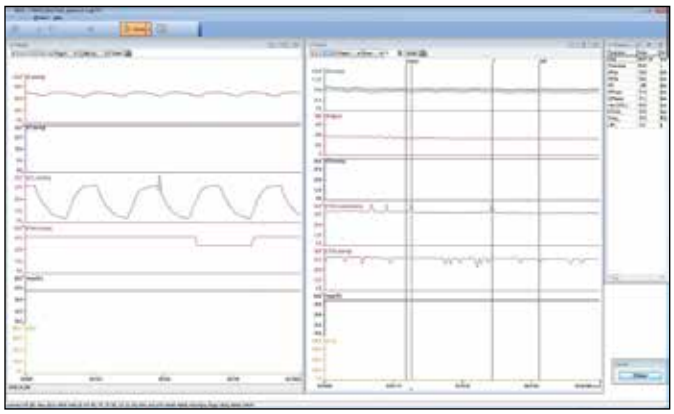
The Pump 11 Elite series is the research community's syringe pump of choice. These compact, accurate, low flow syringe pumps offer unparalleled ease of use with a high resolution color touch screen display and intuitive icon interface.

The ease of use, accuracy, and reproducibility make the Pump 11 Elite the perfect pump for drug additions in isolated organ studies.

Order #	Product
70-4500	Pump 11 Elite Infuse Only Single Syringe
70-4501	Pump 11 Elite Infuse Only Dual Syringe
70-4504	Pump 11 Elite Infuse/Withdraw Programmable Single Syringe
70-4505	Pump 11 Elite Infuse/Withdraw Programmable Dual Syringe

Specifications	
Type	Microprocessor Dual Syringe, Infusion Only or Infusion/Withdrawal, Programmable
Accuracy	±0.5%
Reproducibility	±0.05%
Syringe:	
Type	Plastic or glass
Size (Single Syringe)	0.5 µl to 50/60 ml
Size (Dual Syringe)	0.5 µl to 10 ml
Flow Rate:	
Single Syringe	1.26 pl/min to 88.4 ml/min
Dual Syringe	1.26 pl/min to 26.03 ml/min
Display	4.3" WQVGA TFT Color Display with Touchscreen
Connectors:	
RS-485	IEEE-1394, 6-position
USB	Type B
I/O & TTL	15-Pin D-Sub Connector
Footswitch	Mini Phono Jack
Average Linear Force	16 kg at 100% Force Selection
Step Resolution	0.031 µm/µstep
Input Power	12–30 VDC
Input Power Connection	2.5 mm ID x 5.5 mm OD male plug
Power Supply	100–240 VAC, 50/60 HZ, 8-watt universal power supply; use only a Harvard Apparatus approved power supply and line cord
Dimensions (H x W x D)	226 x 178 x 150 mm
Weight	2.1 kg
Regulatory Certifications	CE, ETL (UL, CSA), WEEE, EU RoHS & CB

Visit the Harvard Apparatus website to browse our complete pump offering.



BDAS Software Screenshot

PowerLab System

Basic Data Acquisition Software (BDAS)

BDAS software is a basic data acquisition software for measuring relatively slow moving signals where only a mean value is of interest such as temperature, pH, pO_2, pCO_2, pK^+, mean flow, mean pressure, and smooth muscle contraction. It can also be used as ECG /EMG/ EEG monitoring software or to monitor vital signals from different instruments such as capnographs, and other amplifiers.

The data acquisition hardware collects measured signals and sends them to the software. The USB version can read output signals from any instrument that has analog output via a USB port. The PLUGSYS version can read output signals only from PLUGSYS modules.

BDAS software can acquire a maximum of 8 or 16 channels, depending on which hardware is used. The assignment of the signals to the individual channels is determined in the menu by the user. The sample rate, the type of signals and the algorithm used for analysis are also user-defined. The display of the graphic detail (raw signals) and trend (calculated parameters) is defined in the menu. User-defined parameters can be created by formulas.

Easy to use (predefined settings for known applications)

- Choose available signals to acquire and display
- Choose from possible parameters to evaluate and display
- Enter experimental protocol
- Calibrate
- Start data acquisition

During data acquisition, all acquired signals and derived parameters are displayed on screen. All raw data and trend data are stored. Data reduction tools are included. Export of data to any statistical package are possible.

Order #	Product
Software	
73-4796	Basic Data Acquisition Software (BDAS)
Hardware	
73-3330	Data Acquisition Hardware, USB Universal Stand Alone Version, 16 channels
73-4817	Data Acquisition Hardware for Modular PLUGSYS Measuring System, 8 channels
73-4818	Data Acquisition Hardware for Modular PLUGSYS Measuring System, 16 channels

PowerLab® Data Acquisition System with LabChart™ Software

PowerLab® is a complete data analysis and data acquisition system used with LabChart™ software offering comprehensive data recording, display and analysis features for a wide variety of research applications.

LabChart™ is a suitable for research on any species—from primates to mice to flies. The software provides the capability to continuously record and display up to 16 channels of data, perform online or offline calculations, display numerous analysis windows, and automatically extract data. Quick and easy setup of experimental parameters, powerful computation and analysis features are just the beginning.

Configuring and recording parameters, such as range and filters, take seconds, with all of the information, including settings, calibration and computed values, saved in a single file. Parameters of interest are easily extracted to an internal spreadsheet and can be exported for further analysis or graphing.

Multiple modules are available to expand on the capability of the standard LabChart™ software. All modules are available for individual purchase (for use with the latest LabChart™ software) or as part of LabChart™ Pro. Modules includes ECG, blood pressure, cardiac output, dose response and more.

Order #	Product
PowerLab® with LabChart	
77-0239	PowerLab® 4/35, 4 Channels with LabChart™ Software
77-0241	PowerLab® 8/35, 8 Channels with LabChart™ Software
77-0243	PowerLab® 16/35, 16 Channels with LabChart™ Software
PowerLab® with LabChart Pro	
77-0240	PowerLab® 4/35, 4 Channels with LabChart™ Pro Software
77-0242	PowerLab® 8/35, 8 Channels with LabChart™ Pro Software
77-0244	PowerLab® 16/35, 16 Channels with LabChart™ Pro Software

OVERVIEW

Experimental conditions and various physiological parameters are followed throughout the course of an isolated perfused organ experiment to monitor the health of the organ. Perfusate flow, pressure and temperature are measured and controlled. Physiological parameters such as pH, pO_2, pCO_2, and organ temperature are monitored.

To monitor key experimental conditions or physiological parameters, the information (e.g., signal, current, etc.) must be captured, amplified, acquired and recorded. Typical equipment might include:

- Transducer, electrode, probe or sensor captures the signal
- Amplifier, such as a PLUGSYS amplifier module, amplifies the signal
- Analog to digital converter converts signal to a format that can be processed
- Data acquisition method (software) acquires and analyzes the converted signal

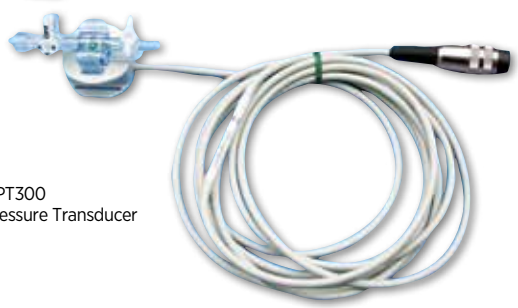
Hugo Sachs Elektronik (HSE) and Harvard Apparatus offer a full complement of instruments, devices and software to conduct physiological measurements essential for the success of your isolated perfused organ experiment. Our products are backed by expert technical support to assist you with any questions.

P75 Pressure Transducer

PLUGSYS 601 Case with Modules

PLUGSYS TTFM-2 Transit Time Flowmeter Module

Portable Thermocouple Thermometer



APT300
Pressure Transducer

PLUGSYS TAM-A and TAM-D Modules

PLUGSYS Minicase Type 609 and TAM-A Module

PLUGSYS Housing Type 603

PLUGSYS Housing Type 601 with Five PLUGSYS Modules

PLUGSYS Modules & Cases

Features & Benefits

- Universal modular measuring and controlling system for recording and data acquisition
- Wide range of modules available to cover a multitude of physiological measurements
- Modules can be interconnected internally, eliminating the need for bulky cabling

PLUGSYS is a flexible measuring and control system for amplifying, capturing, monitoring and recording physiological data. Developed for use in physiological and pharmacological research, its modular structure permits multi-application platform use in areas such as hemodynamics, pulmonary studies, isolated organ studies, biopotentials, and combination studies.

A wide range of available modules can easily be interconnected and interfaced to bridge amplifiers, differentiators, integrators, heart rate meters, ECG amplifiers and other recording devices. All PLUGSYS modules fit directly into the PLUGSYS main frame. In addition to being a conventional modular analog measuring system, the PLUGYSYS includes specific interface modules and application software for data acquisition and analysis.

Visit the Harvard Apparatus Website or contact Technical Services for more information on PLUGSYS modules and cases.

PLUGSYS Modules		
Order #	**Product**	**PLUGSY Width (Slots)**
73-0065	Transducer Amplifier Module, Analog (TAM-A)	2
73-1793	Transducer Amplifier Module, Digital (TAM-D)	2
73-2806	Servo Controller for Perfusion (SCP)	2
73-0210	Oxygen Partial Pressure Module (OPPM)	2
73-0215	pH Measurement Module (pHMM)	2
73-0212	Electrometer Module (EMM)	2
73-1792	Thermocouple Amplifier Module (TCAM)	2
73-4617	Transit Time Flowmeter Module (TTFM-2)	5

PLUGSYS Housings			
Order #	**PLUGSYS Case Type**	**Slots**	**Dimensions (H x W x D)**
73-0045	603	20	132 x 483 x 435 mm
73-1521	601	10	150 x 235 x 420 mm
73-1523	609	4*	160 x 160 x 250 mm

**Type 609 Minicase is not modular. Amplifier units are factory installed and hard wired.*

APT300 Pressure Transducer

P75 Venous Pressure Transducer

Pressure Transducers

Features & Benefits

- Holds both the perfusion pressure and venous pressure constant throughout an experiment

Applications

- Pressure monitoring within an isolated organ setup

Monitoring pressure within an isolated organ setup allows the user to hold both the perfusion pressure and venous pressure constant throughout the experiment. This is important to ensure the health of the sample organ. A perfusion pressure that is too high will lead to fluid buildup and edema. Likewise, a venous pressure that is too high will lead to a backpressure to the organ and ultimately to edema as well. To prevent this from happening pressure transducers are integrated into the system to monitor arterial and venous pressure.

There are several different types of pressure transducers that can be utilized. Typically when using these transducers, a fluid-filled catheter is introduced into the area of interest. The transducer senses changes to the pressure against the catheter and sends a signal to the amplifier.

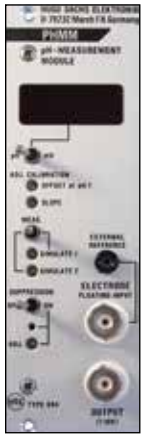
The three transducers detailed here are amongst our most popular for isolated organ studies. The APT300 measures arterial pressures up to 300 mmHg, while the P75 is best suited for venous pressure. Both the APT300 and the P75 pressure transducers have excellent frequency response. The Research Grade Blood Pressure Transducer (RGBP) is ideal for monitoring blood pressure during surgery, but also produces a signal suitable for direct connection to recorders, oscillographs and computers. The RGBP includes an integrated amplifier, and therefore, unlike the APT300 and P75 pressure transducers, does not require the purchase of an additional external amplifier.

Visit the Harvard Apparatus Website or contact Technical Services for more infomration on our pressure transducers offering.

Specifications			
	APT300	**P75**	**RGBP**
Ideal for:	Arterial Pressure	Venous Pressure	Arterial Pressure (rat and larger)
Pressure Range	±300 mmHg	±75 mmHg	-10 to +300 mmHg
	~-40 kPa to ~40 kPa	~-10 kPa to 10 kPa	~-1.3 kPa to ~40 kPa
Overload	4000 mmHg	-760 (vacuum) to 4000 mmHg	3000 mmHg
Sensitivity	5 µV/V/mmHg (±1%)	1 mV/mmHg	10 mV/mmHg
Volume Displacement	<0.04 mm^3/100 mmHg	0.06 mm^3/10 mmHg	
Analog Output Range	0–10 V	0–10 V	0–5 V
Amplifier	External Amplifier Required	External Amplifier Required	Includes Integrated Amplifier
Mounting Rod	8 mm OD x 75 or 160 mm length	8 mm OD x 70 mm length	9.7 mm OD x 76.2 mm length

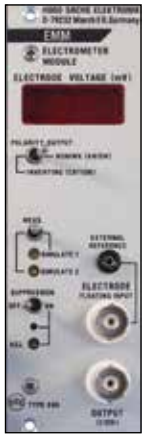
Order #	Product
Transducers	
73-3862	APT300 Pressure Transducer for PLUGSYS TAM Module
73-3866	APT300 Pressure Transducer for ADInstruments Bridge Amp
73-0020	P75 Pressure Transducer for PLUGSYS TAM Module
73-3738	P75 Pressure Transducer for ADInstruments Bridge Amp
72-4496	Research Grade Blood Pressure Transducer, 115 V, 60 Hz
72-4497	Research Grade Blood Pressure Transducer, 230 V, 50 Hz
Amplifiers	
73-0665	PLUGSYS Transducer Amplifier Module (TAM-A)*
73-1793	PLUGSYS Transducer Amplifier Module (TAM-D)*
73-1582	PLUGSYS DC Bridge Amplifier Module (DBA)
77-0254	ADInstruments Bridge Amplifier (FE221)
Accessories	
73-3869	Holder for APT300, 75 mm
73-3868	Holder for APT300, 160 mm
73-0500	Stand with Block Clamp
73-4479	Manual Pressure Calibrator Kit

**Each module requires 2 PLUGSYS slots.*



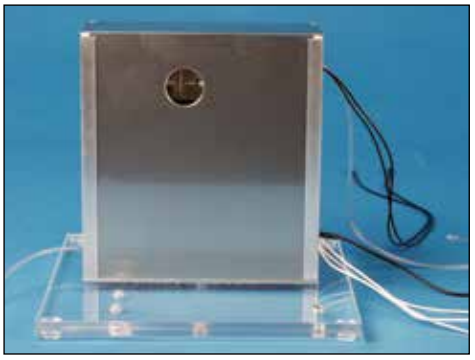
PLUGSYS PHMM Module

PLUGSYS OPMM Module



PLUGSYS EMM Module

Universal Perfusion Solution Monitor, shown with cover removed



Universal Perfusion Solution Monitor, shown with cover in place

Perfusion Solution Monitor for pH, pO_2 and pCO_2

Features & Benefits

- Continuous measurement of pH, pO_2, and pCO_2 in perfusate
- Smooth side stream flow through electrodes with use of 8-channel peristaltic pump
- Noise-free design (when used with the Shielding Case)
- For measurements both pre- and post-isolated organ in the perfusate stream

Applications

- Perfusion solution monitoring of amperometric and potentiometric parameters (pH, pO_2 and pCO_2)
- Measurement of O_2 consumption

Continuous measuring pH, pO_2 and pCO_2 of the perfusion solution in an isolated organ system allows the user to control these parameters over the course of the experiment. It is especially important to monitor these parameters throughout the course of drug studies as any change in these values indicates a significant effect of the drug being tested

It is also possible to measure these parameters in the reservoir (pre-organ) and in the effluent (post-organ). Doing this allows measurement of O_2 exchange, CO_2 production and pH change.

The pH Measurement Module (pHMM) is used to measure pH with pH glass electrodes. The main application is continuously recording pH in biological fluids such as perfusate for isolated perfused organs.

The Electrometer Module (EMM) is a high-impedance electrometer plug-in amplifier for the PLUGSYS measuring system. It is used to measure continuously concentrations with potentiometric electrochemical sensing electrodes.

The main application is recording of pCO_2 (or Na^+, K^+, and Ca^{++}) concentrations in biological fluids such as perfusate for isolated perfused organs, using the corresponding electrodes. The input circuit of the module includes an isolation amplifier (potential separation between sensing electrode and circuit ground of the PLUGSYS measuring system) to avoid measurement errors due to ground loops and leakage currents.

The Oxygen Partial Pressure Module (OPPM) is a polarographic amplifier for the PLUGSYS system. It is used to measure continuously oxygen concentrations with CLARK-style flow through or dip electrodes. The main application is recording of pO_2 concentrations in biological fluids, e.g., perfusate or effluate of isolated perfused organs, using the corresponding electrodes. The digital display indicates either electrode polarization voltage, O_2 concentration as percent or mmHg or the electrode current. The input circuit of the module includes an isolation amplifier (potential separation between sensing electrode and circuit ground of the PLUGSYS measuring system) to avoid measurement problems due to ground loops.

Required items: Peristaltic pump to provide constant flow through electrodes

Order #	Product
Electrodes	
73-4189	O_2 Flow Through Electrode, 1/16" fitting, for use with OPPM
66-0100	O_2 Flow Through Electrode, 1/16" fitting
73-4191	CO_2 Flow Through Electrode, 1/16" fitting
73-4190	pH Flow Through Electrode, 1/16" fitting
73-4197	pH Mini Flow Through Electrode Set, 1/16" fittings. Includes: flow through electrode, solid state reference system and cable
Shielding Case	
73-4195	Shielding Case for 3 electrodes
73-0207	Mounting plate for shielding case
Amplifiers	
73-0210	Oxygen Partial Pressure Module (OPPM)*
77-0299	O_2 Adapter (100%), for use with PowerLab
73-4829	O_2 Adapter (100%), universal
73-0215	pH Measurement Module (pHMM)*
73-0212	Electrometer Module (EMM)*
73-4828	Millivolt Adapter
Accessories and Replacement Parts	
73-3812	pO_2 Zero Solution for Zero Calibration
73-4770	Replacement pO_2 membrane, flow through, 1/16" fittings
73-4771	Replacement pCO_2 membrane, flow through, 1/16" fittings

**Each module requires 2 PLUGSYS slots. See PLUGSYS* Modules & Cases *for PLUGSYS housing options*

PLUGSYS TTFM-2 Module

PLUGSYS Transit Time Flowmeter Module (TTFM-2) & Flow Probes

Features & Benefits

- Accurate, real-time pulsatile flow measurement in blood or perfusates
- Ultrasonic transit time flowmeter
- Digital display for direct reading of mean flow
- Wide range of available flow probes
  - Inline flow probes to monitor perfusion flow on isolated organs
  - Perivascular flowprobes to measure blood flow in arteries, veins and ducts
- BNC analog output to maximize compatibility with data acquisition systems

Applications

- Flowmeter for fluids used to measure blood flow in vivo or flow rates of any perfusion solution in isolated organ systems

The Transit Time Flowmeter Module (TTFM-2) is an ultrasonic transit time flowmeter for animal research. It incorporates a complete 1-channel Transonic® ultrasonic transit time flowmeter, and can be used either with in-line flow probes or perivascular probes from Transonic®.

The module features a built-in digital display for direct reading of the mean flow and an analog instrument to show flow, signal quality and scale factors.

The extracorporeal in-line probes are ideal for isolated organ perfusions and are available in sizes from 1.0 to 8.0 mm. All in-line flow probes are cannulated, with the inner diameter (ID) listed in the specification chart.

Specifications					
Flow Probe Type	**1N**	**2N**	**4N**	**6N**	**8N**
ID	1 mm	2 mm	4 mm	6 mm	8 mm
Nominal Range, up to:	20 ml/min	100 ml/min	400 ml/min	1 L/min	2 L/min
For Tubing ID Size	1–1.5 mm	2 mm	4–5 mm	6–7 mm	8–9 mm
Suggested Species	Mouse, Rat	Rabbit	Rabbit	Pig	Pig

Order #	Product
Flowmeter	
73-4617	Transit Time Flowmeter Module TTFM-2*
Flow Probes	
73-4753	Inline Flow Probe, Type 1N for TTFM-2
73-4754	Inline Flow Probe, Type 2N for TTFM-2
73-4755	Inline Flow Probe, Type 4N for TTFM-2
73-4946	Inline Flow Probe, Type 6N for TTFM-2
73-4947	Inline Flow Probe, Type 8N for TTFM-2

**Module requires 5 PLUGSYS slots. See* PLUGSYS Modules & Cases *for PLUGSYS housing options.*

Visit the Harvard Apparatus website or contact Technical Services for information on perivascular flow probes to measure blood flow in arteries, veins and ducts.

Portable Thermocouple Thermometer

Portable Thermocouple Thermometer

Features & Benefits

- Superior accuracy: 0.1°C ± 1 digit in physiological range
- Fast reading to 0.1°C
- Auto-correction feature compensates for ambient temperature from 0° to 50°C
- Analog output (10 mV/°C) allows for interface for interface with data acquisition software
- Accepts a wide range of thermocouple probes
- Waterproof, dustproof and fume-proof
- Supplied with heavy-duty carrying case

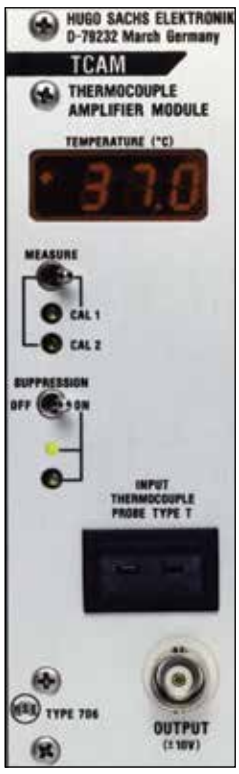
Applications

- Monitoring temperature of perfusate or isolated organ

This accurate digital thermocouple thermometer can measure surface temperatures, liquids, solids, and any biological temperature. It is available for use with either a 9-volt transistor battery (120 hours of operation), or for AC power with battery operation using rechargeable NiCad batteries and an integral battery charger. Automatic warnings indicate low battery or faulty probe.

A wide range of thermocouple probes are available (visit our website to see the complete offering). The IT-18 is recommended for isolated organ applications.

Order #	Product
Thermometer	
52-1302	Portable Thermocouple Thermometer with 9-V Disposable Batteries
59-7567	Portable Thermocouple Thermometer for AC or Rechargeable Batteries, 115 VAC, 60 Hz
59-7568	Portable Thermocouple Thermometer for AC or Rechargeable Batteries, 230 VAC, 50 Hz
Accessories	
52-1732	IT-18 Thermocouple microprobe, 0.635 mm OD
72-7564	Extension cable for miniature thermocouples
75-0501	Adapter, 3.5 mm mono phono to BNC
73-4193	3 Fr Tuohoy Adapter



PLUGSYS TCAM Module

PLUGSYS Thermocouple Amplifier Module (TCAM)

Features & Benefits

- Accuracy of 0.1°C in physiological range (30° to 45°C)
- Digital display with resolution of 0.1°C
- Analog Output (100 mV/°C)

Applications

- Monitoring temperature of perfusate or isolated organ

The PLUGSYS Thermocouple Amplifier Module (TCAM) is used to accurately measure temperature with thermocouple probes. The range of the TCAM module covers 0°C to 100°C. In the physiological temperature range (30 to 45°C) the basic accuracy is 0.1°C; outside this range the accuracy is 0.2°C. The built-in digital display has a resolution of 0.1°C.

The TCAM module has an analog output (100 mV/°C) for connection to a recorder or data acquisition system. The recorder or acquisition system can easily be calibrated through a built-in simulation device with two adjustable temperature values. In addition, there is a zero suppression facility for recorders which permits recording temperatures within a limited range (e.g., 36 to 38°C) at a high resolution.

A wide range of thermocouple probes are available (visit our website to see the complete offering). The IT-18 is recommended for isolated organ applications.

Order #	Product
Thermometer	
73-1792	Thermocouple Amplifier Module (TCAM)*
52-1732	IT-18 Thermocouple microprobe, 0.635 mm OD
73-7564	Extension cable EXT-6 for thermocouples
73-4193	Touhoy Adapter for inserting small temperature probe

**Module requires 2 PLUGSYS slots. See* PLUGSYS Modules & Cases *for PLUGSYS housing options.*

Mini Ball Joint Holders

These mini ball joint holders consist of arms of different lengths which carry a ball or a wire clip (eye) on the ends. Several arms can be clipped together and the ball joint allows the holder to be moved into any configuration. Arms with special terminations are available to carry electrodes, mount flow probes or support intracardial balloons. A high-flexibility mount for crystal pickups maintains contact with the surface of the organ during its intrinsic movement.

All holder elements are made from stainless steel. The special design of the ball joint ensures minimum size and permits perfectly smooth operation without any trace of spring-back. Mini holders remain rigid while carrying weights up to a few grams and are suitable for supporting tubing and small components.

Order #	Product
73-0174	Mini Ball Joint Holder, Eye-Eye, L = 23 mm
73-0175	Mini Ball Joint Holder, Eye-Eye, L = 42 mm
73-0176	Mini Ball Joint Holder, Eye-Ball, L = 18 mm
73-0177	Mini Ball Joint Holder, Eye-Ball, L = 23 mm
73-3321	Mini Ball Joint Holder, Eye-Ball, L = 35 mm
73-0563	Mini Ball Joint Holder, Ball-Ball, L = 18 mm
73-0564	Mini Ball Joint Holder, Link for higher capacity, for two arms with balls, L = 23 mm
73-0566	Plexiglass Block Clamp for mounting 73-0562 Bar onto Stand
73-0562	Bar with Ball for Mounting on a Stand, D = 8 mm, L = 140 mm, Ball Size = 5 mm

Specifications		
	Stand with Triangular Base	**Stand with Rectangular Base**
Rod Mounting	Center	End
Base Plat Dimensions	130 x 130 x 130 mm	150 x 150 x 50 mm
Rod Diameter	8 mm	12 mm
Rod Length	300 or 160 mm	510 mm
Weight	1.6 kg	6.75 kg

Lab Stands

These rugged laboratory stands are useful for many applications. They have a stainless steel upright rod and heavy base plate. The stainless steel rod is threaded and may be removed if desired. The stand with triangular base is supplied with an acrylate block clamp.

Order #	Product
73-0499	Lab Stand with Rectangular Base Plate
73-0500	Lab Stand with Triangular Base Plate with 300 mm Rod
73-4140	Lab Stand with Triangular Base Plate with 160 mm Rod
73-0566	Plexiglass Block Clamp for mounting 73-0562 Bar onto Stand
53-2012W	Closed Connector, White*

**Closed Connector also available in Red. For ordering, use "R" in place of "W"*

Magnetic Stirrers

Features & Benefits

- Compact and lightweight
- Internal speed safe mechanism
- Electronic controls allow regulation of speed with greater precision
- Supplied with a magnetic stir bar 25 mm in length and 7 mm in diameter

Order #	Product
72-1972	Magnetic Stirrer, 115 VAC
72-1973	Magnetic Stirrer, 230 VAC

Rat/Guinea Pig
Isolated Organs Surgical Kit

Deluxe Major Surgical Kit

Surgical Instruments

Features & Benefits

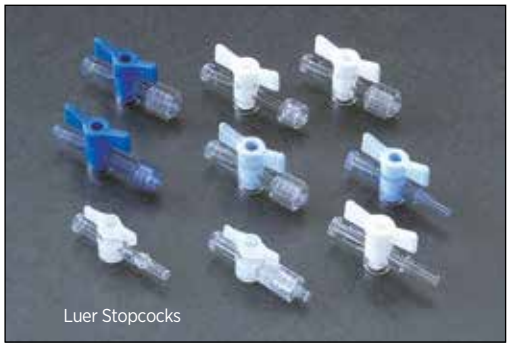
- Full line of precise, high quality surgical tools available
- Made from certified surgical grade German steel
- Forged and finished in a German ISO 9001 facility
- Preconfigured kits to suit a variety of applications

Order #	Product
72-8997	Mouse Isolated Organ Surgical kit
72-8996	Rat/Guinea Pig Isolated Organ Surgical kit
72-9042	Rodent Microsurgical Kit
72-8941	Deluxe Major Surgical Kit

Visit the Harvard Apparatus website to see our complete surgical instrument offering.


Barbed Connectors (Small Kit)


Luer Connector Kit, White Nylon


Luer Stopcocks

Barbed Connector, Luer, and Stopcock Kits

A staple for all labs, these kits allow you to customize or expand the functionality and species range of your perfusion system. Many researchers add a compound of interest to a second or even a third reservoir rather than use a syringe pump for drug addition. Also common is the use of the system for multiple species, which requires that different tube sets be adapted to the existing tubing. The connectors and stopcocks required to accomplish this expansion are not included with base systems.

The Luer Stopcock Kit includes a collection of 1-, 3- and 4-way stopcocks. Fittings include MLL (male Luer lock), FLL (female Luer lock) and Male Luer slip. Some stopcocks have high pressure capabilities. These kits are supplied in a convenient box. All kit components are also sold separately.

Order #	Product
72-1410	Small Polypropylene Barbed Connector Kit
72-1413	Medium Polypropylene Barbed Connector Kit
72-1416	Large Polypropylene Barbed Connector Kit
72-1664	Luer Stopcock Kit
72-1406	White Nylon Luer Connector Kit
72-2739	Polypropylene Male Luer Taper Kit

Visit the Harvard Apparatus website for a detailed list of components and to see our full connector offering.

Replacement parts

Cleaners

Order #	Product
73-4246	ThermoClean DC (Blue), 10 ml
73-4261	ThermoClean DC (Blue), 100 ml, Dosing Bottle
73-2642	Mucasol Cleaning and Disinfecting Fluid, 2 L
73-2643	Mucasol Cleaning and Disinfecting Fluid, 5 L

Pressure Transducers

Order #	Product
73-3861	Replacement Transducer Head for APT300 Pressure Transducer
73-3860	Replacement Cable with Contact Plate for APT300 Pressure Transducer for PLUGSYS Amplifiers
73-3869	Holder APT300 Pressure Transducer, 8 mm rod, 75 mm long
73-0025	Replacement Dome for APT300 Pressure Transducer
73-4479	Manual Pressure Calibrator, Range 0–300 mmHg

Jacketed Reservoirs

Order #	Product
73-3566	Frit for 2.0 L Jacketed Buffer Reservoir
73-3565	Frit for 1.0 L Jacketed Buffer Reservoir
73-3564	Frit for 0.5 L Jacketed Buffer Reservoir
73T17140	Return Tube for Glass Reservoir, stainless steel, D = 4 x 0.25 mm, L = 70 mm
73T17141	Suction Tube for 0.5 L Glass Reservoir, stainless steel, D = 4 x 0.25 mm, L = 190 mm
73T17142	Suction Tube for 1.0 L Glass Reservoir, stainless steel, D = 4 x 0.25 mm, L = 220 mm
73T17143	Suction Tube for 2.0 L Glass Reservoir, stainless steel, D = 4 x 0.25 mm, L = 275 mm

Configure Your Ideal Isolated Organ System

Please use this checklist as a guide to help you define the specific components of an Organ Perfusion System suitable for your research needs. Please contact Technical Services for assistance with any questions and to obtain a quotation.

Organs and Species

Organs

- ❑ Liver
- ❑ Kidney
- ❑ Mesenteric bed
- ❑ Hindquarter

Hollow Organs

- ❑ Ileum
- ❑ Artery
- ❑ Vein
- ❑ Trachea

From

- ❑ Mice
- ❑ Rats
- ❑ Pig
- ❑ Guinea pig
- ❑ Rabbit

If others/none of the above please **specify tissue** and **species** and **approximate perfusion flow rate range:**

_____

Mode

- ❑ In situ
- ❑ Ex vivo
- ❑ Constant pressure perfusion
- ❑ Constant flow perfusion
- ❑ Cell isolation (hepatocyte, etc)

For hollow organs

- ❑ Intraluminal Perfusion
- ❑ Extraluminal Perfusion

Solution Used:

- ❑ Krebs-Henseleit Solution
- ❑ Ringer Solution
- ❑ Other — If others please specify:

_____

- ❑ Recirculating perfusion?

Oxygenation

- ❑ Bubbling in reservoir
- ❑ Fiber Oxygenator
  (If using foaming perfusate e.g. blood, albumin-containing, etc)

Measurement System:

❑ Contractile Force

Others

- ❑ Venous pressure
- ❑ Perfusion pressure
- ❑ Temperature
- ❑ Perfusion flow

Gas concentrations:

- ❑ pO_2
- ❑ pH
- ❑ pCO_2

If others please specify:

_____

Electrical Stimulation:

If applicable for the tissue being studied

- ❑ Field Stimulation
- ❑ Direct Stimulation

Data Acquisition:

❑ Computer data acquisition

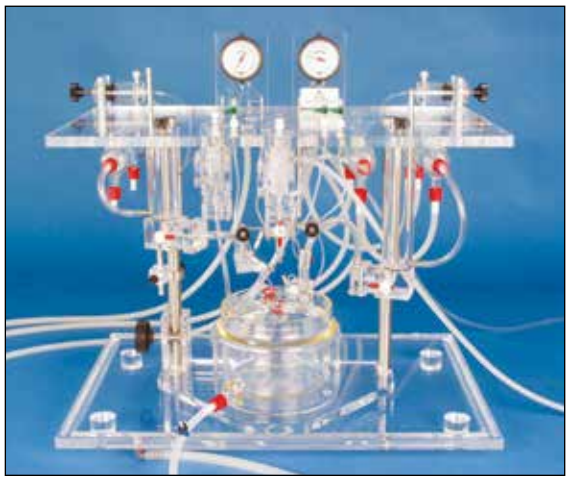
- ❑ Desktop Computer
- ❑ Laptop

For evaluation of typical parameters, such as:

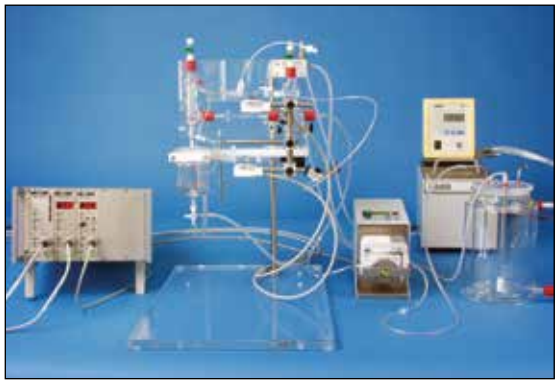
- From All Pressures: **Systolic**, **Diastolic** and **Mean Pressure**
- From All Flows: **Mean**, **Max.** and **Min. Flow**
- **Contractile Force**
- From temperature, pO_2, pH Signals: **Mean Value**
- It is also possible to calculate specific values from these parameters by writing a formula (e.g., Vascular Resistance (P/F) or Flow / organ weight, etc.).

Isolated Perfused Heart (IH) Systems

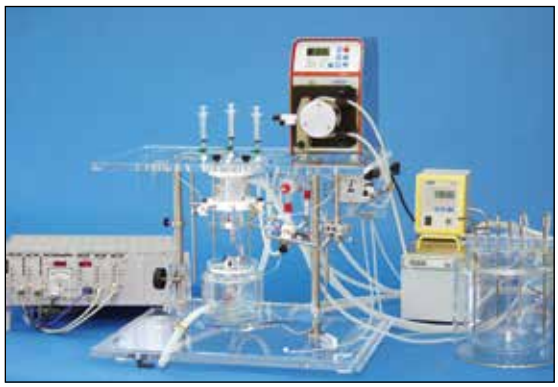
See our Isolated Perfused Heart Brochure, visit our website, or contact Technical Services for detailed information about our specialized isolated heart systems.



IH-5 Biventricular Working Heart
Species: Rat, Rabbit



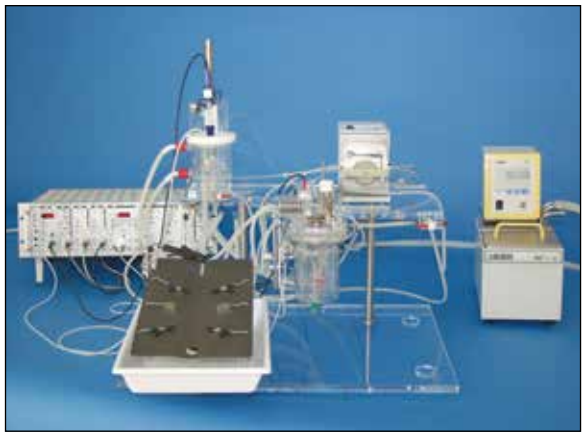
IH-SR Langendorff System
Species: Mouse, Rat, Guinea Pig



IH-5 Langendorff System
Sepcies: Rat, Guinea Pig, Rabbit

Isolated Perfused Lung (IPL) Systems

See our Isolated Perfused Lung Brochure, visit our website, or contact Technical Services for detailed information about our specialized isolated lung systems.



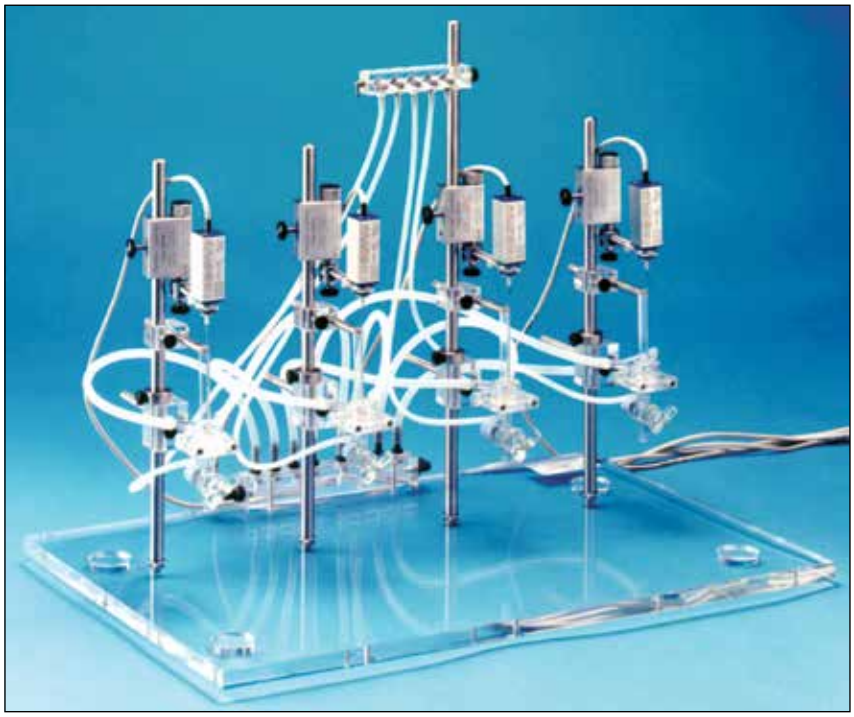
Isolated Perfused Lung for Rat & Guinea Pig (IPL-2)

Isolated Perfused Mouse Lung (IPL-1)

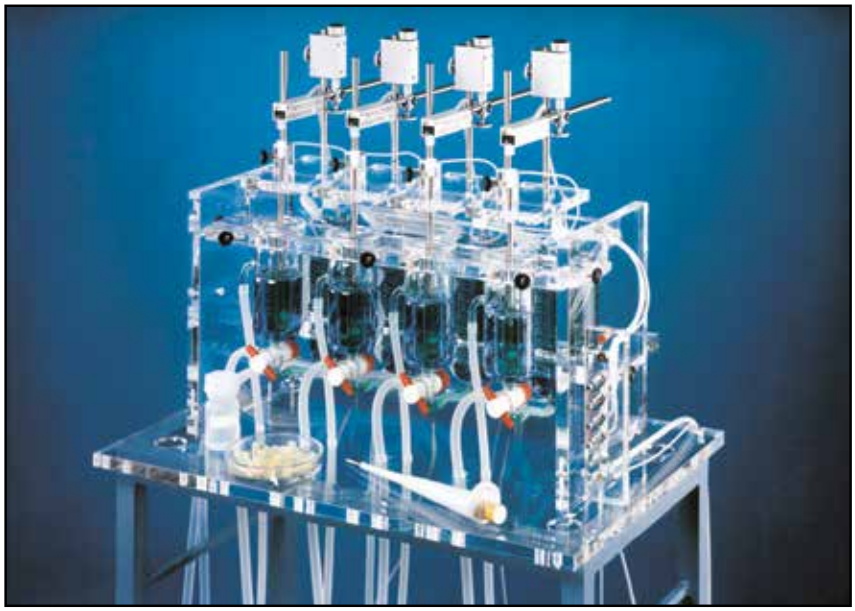
Isolated Perfused Rabbit Lung (IPL-4)

Tissue Bath Systems

Visit our website, or contact Technical Services for detailed information about our specialized tissue bath systems.



Graz Tissue Bath System



Schuler Tissue Bath System

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The Physiology Specialists

Abdominal Organ

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