Isolated Lung Systems Overview

**Isolated Lung Systems Overview**

<table>
<thead>
<tr>
<th><strong>Typical Applications</strong></th>
<th><strong>Advantages</strong></th>
<th><strong>Disadvantages</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Studies on primarily respiratory effects or combined respiratory and vascular effects</strong></td>
<td>• Advanced physiological mode</td>
<td>• Higher cost</td>
</tr>
<tr>
<td>• Physiology:</td>
<td>• No risk for barotraumatic ventilation</td>
<td>• Since flow is not constant effective dose is difficult to calculate</td>
</tr>
<tr>
<td>– Hypoxic vasoconstriction</td>
<td>• Lower cost</td>
<td></td>
</tr>
<tr>
<td>– Edema formation</td>
<td>• No risk of damaging the vascular system by overpressure</td>
<td></td>
</tr>
<tr>
<td>• Pharmacology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Action of histamine, arachidonic acid metabolites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Immunopharmacology (cytokines...)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Inhalation toxicology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Environmental toxins (ozone, sulphur dioxide...)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Biochemistry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Metabolic activity (biogenic amines, prostacyclin, angiotensin...)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Surfactant biochemistry</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Examples of typical applications:**

- Studies on primarily respiratory effects or combined respiratory and vascular effects
- Physiology:
  - Hypoxic vasoconstriction
  - Edema formation
- Pharmacology:
  - Action of histamine, arachidonic acid metabolites
  - Immunopharmacology (cytokines...)
- Inhalation toxicology:
  - Environmental toxins (ozone, sulphur dioxide...)
- Biochemistry:
  - Metabolic activity (biogenic amines, prostacyclin, angiotensin...)
  - Surfactant biochemistry
- Non physiologic ventilation
- Risk for barotraumatic ventilation
- Risk of damaging the vascular system by overpressure
- Higher cost
- Since flow is not constant effective dose is difficult to calculate
NEW IL-16 Isolated Perfused Lung for Pigs and Large Animals

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

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

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

Extensions
Aerosol nebulizer for inhaled compound challenge Controller for constant pressure perfusion

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

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

Order #  Product
PY2 73-4109  Basic Unit for Isolated Perfused Pig Lung Size 16 Type 869/3 (IL-16)
Benefits and Features

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

Applications

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

Additional Options Include:

- Dedicated PLUGSYS ventilator module for negative or positive pressure ventilation VCM (see page I53)
- Dedicated PLUGSYS module for regular induction of hyperinflation of the lung TCM (sigh, augmented breath) (see page I53)
- Transducers and amplifiers for respiratory mechanics measurement: airflow, tracheal pressure, thoracic chamber pressure
- Transducers and amplifiers for perfusion measurement: realtime flow, perfusion pressure, venous pressure, temperature etc... (see section I)
- Dedicated software PULMODYN for data acquisition and analysis of respiratory mechanics and perfusion (see pages I82 to I83)
- Optional connection for external ventilator (e.g. MINIVENT see page F10) for testing barotraumatic ventilation
- Optional connection for supplying alternative gas mixtures and/or aerosols during negative pressure ventilation
- Sensor and amplifier for continuous perfusate analysis (pO\textsubscript{2}, pCO\textsubscript{2}, pH)
- Deoxygenation using membrane oxygenator of blood or erythrocyte containing perfusion
- Large choice of accessories: thermocirculator, jacketed reservoir, holders etc... (see pages K62 to K73)
The Following Signals Can be Measured:

| FL  | Respiratory Airflow |
| TCP | Thoracic Chamber Pressure (intrapleural pressure) |
| TP  | Tracheal Pressure |
| PP  | Perfusion Pressure |
| VP  | Venous Outflow Pressure |
| pO_2/a/e | Oxygen Partial Pressure in the Affluent/Effluent |
| pCO_2/a/e | CO_2 Partial Pressure in the Affluent/Effluent |
| pH a/e | pH in the Affluent/Effluent |
| T   | Temperature |

The Following Parameters Can be Evaluated Using PULMODYN:

- Peak Inspiratory and Expiratory Airflow
- Tidal Volume, Minute Volume
- Dynamic Lung Resistance, Dynamic Compliance
- Vascular Resistance
- O_2, CO_2 Exchange

Description

Ventilation of the lung is possible under negative pressure as well as under positive pressure (the latter is essential during the preparation phase). The ventilation parameters are controlled with a special PLUGSYS Ventilator, the “Ventilation Control Module” (VCM, Type 681). The apparatus consists essentially of a flat jacketed Plexiglas thoracic chamber and a jacketed cover. The size has been chosen so that a complete mouse can be mounted inside it. The walls of the Plexiglass dish carry all the auxiliary devices, connections and ports for perfusion and ventilation. This arrangement offers the advantage that connecting tubing and cannulae can be kept short, resulting in a very small dead volume and ensuring optimum thermal stability.

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

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

Extensions

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

Order #     Product
PY2 73-2329 Basic Unit for Isolated Perfused Mouse Lung
Size 1 Type 839 (IL-1)
PY2 73-1741 VCM-P PLUGSYS Ventilation Control Module
VCM is a PLUGSYS module and requires a system maincase see page 153.

For a system description according your requirements please use:
www.hugo-sachs.de/ilmail.html or contact our technical experts at:
physiology@harvardapparatus.com
For a custom configuration and full system quotation.
Benefits and Features
- Optimized temperature conditions for the isolated lung, unique jacketed thoracic chamber
- Optional operating table for non-damaging in-situ preparation
- Negative-pressure ventilation similar to in-vivo condition or positive pressure ventilation available
- Low flow resistance and dead space volume, minimize perfusion artifacts
- Unique built-in pneumotachometer and air humidifier with small dead volume
- Drug injection pathway built directly into pulmonary perfusate stream
- Unique compensation system for vascular transmural pressure changes
- Dedicated option for continuous measurement of lung weight (Edema)
- More measurement parameters than any other system

Applications
- Studies on combined respiratory and vascular effects
- Physiology:
  - Hypoxic vasoconstriction
  - Edema formation
- Pharmacology
  - Action of histamine, arachinodic acid metabolites
- Inhalation toxicology
  - Environmental toxins (ozone, sulphur dioxide)

- Biochemistry
  - Metabolic activity (biogenic amines, prostacyclin, angiotensin..)
  - Surfactant biochemistry

Additional Options Include:
- Dedicated PLUGSYS ventilator module for negative or positive pressure ventilation VCM (see page I53)
- Dedicated PLUGSYS module for regular induction of hyperinflation of the lung TCM (sigh, augmented breath) (see page I53)
- Transducers and amplifiers for respiratory mechanics measurement: airflow, tracheal pressure, thoracic chamber pressure
- Transducers and amplifiers for perfusion measurement: realtime flow, perfusion pressure, venous pressure, temperature etc... (see section I)
- Dedicated software PULMODYN for data acquisition and analysis of respiratory mechanics and perfusion (see pages I82 to I83)
- Optional connection for external ventilator (see section F) for testing barotraumatic ventilation
- Optional connection for supplying alternative gas mixtures and/or aerosols
- Sensor and amplifier for continuous perfusate analysis (pO2, pCO2, pH)
- Deoxygenation using membrane oxygenator of blood or erythrocyte containing perfusion
- Large choice of accessories: thermocirculator, jacketed reservoir, holders etc... (see pages K62 to K72)
### The Following Signals Can Be Measured:

- FL: Respiratory Airflow
- TCP: Thoracic Chamber Pressure (intrapleural pressure)
- TP: Tracheal Pressure
- PP: Perfusion Pressure
- VP: Venous Outflow Pressure
- W: Lung Weight Changes
- \( pO_2 \) a/e: Oxygen Partial Pressure in the Affluent/Effluent
- \( pCO_2 \) a/e: \( CO_2 \) Partial Pressure in the Affluent/Effluent
- \( pH \) a/e: \( pH \) in the Affluent/Effluent
- T: Temperature

### The Following Parameters Can be Evaluated Using PULMODYN:

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

### Basic System

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

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

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

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

### Perfusion

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

Can be configured in one of three different perfusion modes:

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

### Lung Weight Changes

Continuous measurement of weight changes of the lung is required for monitoring edema formation. This is possible during negative pressure ventilation inside the thoracic chamber by using the HSE-Edema balance LS 30 (weight transducer) (PY2 73-0593). Weight changes induced by raising or lowering the perfusion pressure can be used to assess vascular permeability by determining the filtration coefficient.

### Extensions

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

### Order # Product

- **PY2 73-2266** Basic Unit for Isolated Perfused Rat and Guinea Pig Lung Size 2 Type 829 (IL-2)
- **PY2 73-1741** VCM-P PLUGSYS Ventilation Control Module

VCM is a PLUGSYS module and requires a system maincase see page I53

### Application Note:

**IL-2 option for modification**

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

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

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

Additional Options Include:
- Dedicated PLUGSYS ventilator module for negative or positive pressure ventilation VCM (see page I53)
- Dedicated PLUGSYS module for regular induction of hyperinflation of the lung TCM (sigh, augmented breath) (see page I53)
- Transducers and amplifiers for respiratory mechanics measurement: airflow, tracheal pressure, thoracic chamber pressure
- Transducers and amplifiers for perfusion measurement: realtime flow, perfusion pressure, venous pressure, temperature etc... (see section I)
- Dedicated software PULMODYN for data acquisition and analysis of respiratory mechanics and perfusion (see pages I82 to I83)
- Optional connection for external ventilator (see page section F) for testing barotraumatic ventilation
- Optional connection for supplying alternative gas mixtures and/or aerosols
- Sensor and amplifier for continuous perfusate analysis (pO₂, pCO₂, pH)
- Deoxygenation using membrane oxygenator of blood or erythrocyte containing perfusion
- Large choice of accessories: thermocirculator, jacketed reservoir, holders etc... (see pages K62 to K72)

The Following Signals Can be Measured:
- FL Respiratory Airflow
- TCP Thoracic Chamber Pressure (intrapleural pressure)
- TP Tracheal Pressure
- PP Perfusion Pressure
- VP Venous Outflow Pressure
- W Lung Weight Changes
- pO₂a/e Oxygen Partial Pressure in the Affluent/Effluent
- pCO₂a/e CO₂ Partial Pressure in the Affluent/Effluent
- pH a/e pH in the Affluent/Effluent
- T Temperature

The Following Parameters Can be Evaluated Using PULMODYN:
- Peak Inspiratory and Expiratory Airflow
- Tidal Volume, Minute Volume
- Lung Resistance, Dynamic Compliance
- Vascular Resistance
- Precapillary and Postcapillary Resistance
- Filtration Coefficient
- O₂, CO₂ Exchange
IL-4 Isolated Perfused Lung for Rabbit

(continued)

**MRI-Cover for IL-4**

There is an increasing interest in studying isolated lungs by using MRI. A special metal free cover for the IPL4 lung thoracic chamber has been designed. The regular cover is replaced by the MRI cover, and the complete lung chamber can be removed from the stand after surgery. The lung chamber with cover is mounted on the MRI e.g. in a head holder. All parts are non-metalic and made of plexiglas, Teflon and carbon fiber. In the NMR version only positive pressure ventilation can be used.

**Basic System**

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

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

Ventilation of the lung is possible under negative pressure as well as under positive pressure (the latter is essential during the preparation phase). The ventilation parameters are controlled with a special PLUGSYS Ventilator, the "Ventilation Control Module" (VCM, Type 881). The ventilation medium (air or gas mixture) is constantly humidified by the built-in humidifier.

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

**Constant Flow Perfusion**

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

**Lung Weight Changes**

Continuous measurement of weight changes of the lung is possible during negative pressure ventilation inside the thoracic chamber by using the HSE-Edema balance LS 30 (weight transducer) (PY2 73-3468).

**Order #** | **Product** |
---|---|
PY2 73-2366 | Basic Unit for Isolated Perfused Rabbit Lung Size 4 Type 841 (IL-4) |
PY2 73-1755 | VCM4-R Ventilation Control Module for IL-4 |
VCM is a PLUGSYS module and requires a system maincase, see page 153. |
PY2 73-3376 | NMR Cover for IL-4 |
PY2 73-3377 | Pulmonary Artery Cannula for IL-4, NMR |
PY2 73-3378 | Left Atrium Cannula for IL-4, NMR |
PY2 73-3379 | Jacketed Tubing for IL-4 NMR |
PY2 73-3469 | Pressure Equilibration System for IL-4 NMR |

For a system description according your requirements please use:  
[www.hugo-sachs.de/ilmail.html](http://www.hugo-sachs.de/ilmail.html)  
or contact our technical experts at:  
[physiology@harvardapparatus.com](mailto:physiology@harvardapparatus.com)  
For a custom configuration and full system quotation.
Lung Functions Under the Microscope

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

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

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

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

Example of an Application

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

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

Order #   Product
PY2 73-2370   Precision Cut Lung Slice Chamber

Accessories

PY2 73-0125   Thermostatic Circulator E 103, 230 VAC, see page K72
PY2 73-2802   Thermostatic Circulator E 103, 115 VAC, see page K72
PY2 73-0113   Roller Pump Reglo Analogue ISM 827, 4 Channels, 0.002 to 30 ml/min
Moist Chamber Type 834/8

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

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

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

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

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

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

For cannulae see page K66, for ball joint holders see page K71.

Additional equipment required: thermocirculator, bubble trap, cannulae, holders, peristaltic pump, transducers, monitoring system setup using the PLUGSYS Amplifier System, see pages I31 to I34. Recording and Evaluation of the signals using BDAS software.

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

Order # Product
- PY2 73-2901 Moist Chamber Type 834/8 with Metal Tube Heat Exchanger
- PY2 73-3692 Bubble Trap for Flow Rate up to 50 ml/min
- PY2 73-3094 Stainless Steel Mesh Electrode

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

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

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

Moist Chamber for Microvascular Permeability Studies

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

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

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

Additional equipment required: thermocirculator, peristaltic pump, syringe pump, transducer for perfusion pressure, servocontroller (SCP), monitoring system setup using the PLUGSYS Amplifier System, see pages I31 and I34. Recording and Evaluation of the signals using BDAS software.

The chamber can be used for any other organ that requires continuous weighing during perfusion. The interchangeable adapter block holding the perfusion lines and cannulae can be customized for other types of organ to be perfused.

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

Order #    Product
PY2 73-3685  Moist Chamber with Edema Balance Type 802 (MCWEB)

Citations
A Model of the Isolated Perfused Rat Small Intestine

Ingmar Lautenschläger,1 Heike Dombrowsky,2 Ines Freirichs,3 Solveig-Carolin Kuchenbecker,3 Steffen Bade,2 Holger Schulz,2 Peter Zabel,2 Norbert Wieland,3,* and Stefan Uhlig2
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Submitted 31 July 2009; revision received 8 October 2009; accepted in final form 8 November 2009

ABSTRACT

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

Features and Benefits:

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

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

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

Order #  Product
---  ----------------------------------
PY2 72-9434  Radnoti M4 4-Channel Myograph System, 115VAC
PY2 72-9435  Radnoti M1 1-Channel Myograph System, 115VAC
PY2 72-9436  Radnoti M4 4-Channel Myograph System, 220VAC
PY2 72-9437  Radnoti M1 1-Channel Myograph System, 220VAC
PY2 72-9438  Peristaltic Pump Quad Bank
PY2 72-9430  Replacement Wire for Myograph, 25 micron, pack of 10
PY2 72-9431  Replacement Wire for Myograph, 50 micron, pack of 10
PY2 72-9432  Replacement Wire for Myograph, 75 micron, pack of 10
PY2 72-9433  Replacement Wire for Myograph, 125 micron, pack of 10
The Schuler tissue bath system is our most advanced and feature rich tissue bath system used for the study of force or displacement from a wide variety of tissue preparations such as: cardiac (atria, papillary muscle), skeletal and smooth muscle (intestine, bladder, uterus). Isolated intact blood vessels and nerve-muscle preparation experiments are also possible with our specially designed tissue holders.

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

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

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

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

Components are available individually or as complete solutions. Additional items required: thermocirculator, a reservoir for the solution, transducers, monitoring system setup using the PLUGSYS Amplifier System, see pages I31 to I34. Recording and Evaluation of the signals using ACAD software, Optional software and hardware modules are available for computer controlled field stimulation, tissue pretension using electronically controlled Vernier positioners and tissue bath flushing. In case of electrical stimulation a multiple output stimulator is required.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 73-2001</td>
<td>Plexiglass Stand for 4-Position Schuler Organ Bath</td>
</tr>
<tr>
<td>PY2 73-2193</td>
<td>Heat Exchanger</td>
</tr>
</tbody>
</table>
## Schuler Tissue Bath System

### Tissue Vessels and Holders

<table>
<thead>
<tr>
<th>Volume</th>
<th>Tissue Vessel</th>
<th>Muscle strips</th>
<th>Tissue Rings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>With Stimulation</td>
<td>Without Stimulation</td>
</tr>
<tr>
<td>50 ml</td>
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<td><img src="50ml_muscle_strip.png" alt="Image" /></td>
<td><img src="50ml_tissue_ring.png" alt="Image" /></td>
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<tr>
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<td><img src="20ml_muscle_strip.png" alt="Image" /></td>
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<td><img src="10ml_muscle_strip.png" alt="Image" /></td>
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<tr>
<td>5 ml</td>
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<td><img src="5ml_muscle_strip.png" alt="Image" /></td>
<td><img src="5ml_tissue_ring.png" alt="Image" /></td>
</tr>
</tbody>
</table>

### Part Numbers

<table>
<thead>
<tr>
<th>Volume</th>
<th>Tissue Vessel</th>
<th>Muscle strips</th>
<th>Tissue Rings</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 ml</td>
<td>PY2 73-2201</td>
<td>PY2 73-0400</td>
<td>PY2 73-0400</td>
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<tr>
<td>20 ml</td>
<td>PY2 73-2200</td>
<td>PY2 73-0397</td>
<td>PY2 73-2203</td>
</tr>
<tr>
<td>10 ml</td>
<td>PY2 73-2200</td>
<td>PY2 73-0404</td>
<td>PY2 73-2206</td>
</tr>
<tr>
<td>5 ml</td>
<td>PY2 73-2202</td>
<td>PY2 73-2206</td>
<td>PY2 73-0364</td>
</tr>
</tbody>
</table>
Graz Tissue Bath System

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

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

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

The recommended F30 isometric transducer (see page 14) can easily be replaced by other types of transducers without any modification of the apparatus.

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

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

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

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

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

Additional items required are a thermociculator, a reservoir for the solution, transducers, monitoring system setup using the PLUGSYS Amplifier System, see pages 131 to 134. Recording and Evaluation of the signals using ACAD software, in case of electrical stimulation a multiple output stimulator is required.

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

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

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

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

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

**Flow Through System (PY2 73-2155)**
The tissue chamber is carved out of an acrylate block and placed on the support stand. This chamber includes the tissue holder, the connections for electrical stimulation electrodes, a frit for aeration and a draw-off tube with height adjustment to set the bath volume. As it is not jacketed, continuous flow through the chamber is required.

**Incubation System (PY2 73-3600)**
The tissue chamber is jacketed. The bottom of the chamber is made of a teflon coated stainless steel plate to optimize the temperature stability of the solution. A additional small stainless steel heat exchanger is also built in to avoid temperature fluctuation.

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

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

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

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

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

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

Order #   Product
PY2 73-2155 Small Volume Horizontal Tissue Bath, System MAYFLOWER
PY2 73-3600 Small Volume Horizontal Tissue Bath, System MAYFLOWER “Fully Thermostated Bath Top”

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

For a system description according your requirements please use: www.hugo-sachs.de/ihmail.html
or contact our technical experts at: physiology@harvardapparatus.com
For a custom configuration and full system quotation.
TIOX Tissue Bath for $O_2$ Consumption & Contraction Force Measurement

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

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

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

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

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

The following items and equipment are required for work with the tissue bath:
- Thermocirculator with approx. 3 liter capacity, see page K72 to K73.
- Magnetic stirrer
- Reservoir for perfusion solution with frit for equilibrating the solution supply, see page K62.
- Transducer to measure the muscle contractions (isometric or isotonic as required) with vernier control for fine adjustment of the pretensioning, see pages I4 to I8.
- A bridge amplifier for the transducer, for signal conditioning, see page I34.
- OPPM amplifier for the Clark $pO_2$ electrode, for signal conditioning and adaptation to a data acquisition system, see page I48.
- Data acquisition system, see page I74 for a summary.

**Order #    Product**

PY2 73-3794  TIOX Tissue Bath
PY2 69-3006  Microcathode Oxygen Electrode
PY2 72-1975  Magnetic Mini Stirrer
PY2 72-1977  Micro Stirring Bar
PY2 73-0831  HSE Isometric Force Transducer F30
Benefits and Features

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

Applications

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

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

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

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

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

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

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

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

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

Order # Product
PY2 73-2221 Basic Unit for Superfusion Bath according to COLEMAN (stand for 4-Baths) Type 840
PY2 73-2222 Superfusion Bath according to COLEMAN
PY2 73-2917 Heat Exchanger to Superfusion Bath COLEMAN

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

For a custom configuration and full system quotation.
Steiert Tissue Bath System
For Simultaneous Action Potential & Contraction Force Measurements on Cardiac Tissue

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

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

The tissue bath has ports for fluid inlet and outlet. The port outlet is a sipper pipe connected to the peristaltic pump. The sipper pipe is adjustable in height to adjust the bath volume (1-2 ml). The tissue under investigation is secured with needles to a Silicone pad fitted in the bath bottom, the other end is secured, either with a thread or directly, to the hook of the force transducer. Only transducers F10 or F30 can be used, see page 14.

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

The Temperature Controller DC has been specially developed for thermostating the perfusion solution supply on the organ bath after Steiert. Special attention has been paid during the development of this controller to a very low radiated interference level. The heating circuit (temperature controller and heating element) has excellent decoupling from the perfusion solution circuit. The heating element is a long life halogen bulb. It is therefore excellently suitable for the interference-free measurement of intracellular action potentials. Additional equipment required: force transducer, bridge amplifier for the force transducer and microelectrode amplifier with headstage, Data acquisition, recording microelectrodes, electrical stimulator with isolation unit, tissue preparation dish, anti-vibration table, microscopes, illumination, micromanipulators and many other options.

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

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

Order #   Product
PY2 73-2152 Basic Unit, Organ Bath According to STEIERT Type 813, 230 VAC 50 HZ
PY2 73-2892 Basic Unit, Organ Bath According to STEIERT Type 813, 115 VAC 60 HZ

For a system description according your requirements please use: www.hugo-sachs.de/timail.html
or contact our technical experts at: physiology@harvardapparatus.com
For a custom configuration and full system quotation.
The MARSH Ganglion Bath is intended to test the action of drugs on the synaptic transmission or nerve conduction in the vagus nerve or the cervical ganglion.

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

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

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

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

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

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

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

For a system description according your requirements please use: www.hugo-sachs.de/timail.html

or contact our technical experts at: physiology@harvardapparatus.com

For a custom configuration and full system quotation.
Marsh Ganglion Bath

Key Features
• Optimal modularity
• 5, 10, 25 and 50 ml chambers available
• Chambers fully and easily interchangeable
• Micropositioner for high precision adjustment of the Transducer and tissue-holder support
• Complete accessibility to all components to facilitate maintenance or replacement
• Extremely easy to place the stimulation electrodes
• Independent valves per chamber for the fine adjustment of bubbling
• Minimum drift of the nutrient liquid
• Use of totally inert materials, Viton, Teflon, Delrin, Silicone and other materials that are not degraded by acids or salts

Parameters Measured
• Parameters given by the associated software (see PROTOWIN) see page K79

Components Included
• Modular organ bath units
• Chambers included (25ml by default)
• Micropositioner (one per chamber)
• Thermoregulator water pump (except LE11100)
• Set of two spare fuses (except LE11100)
• Tissue holder
• Instruction manual
• 2 year warranty

Options
• Thermoregulated water pump (for Modular Single Chamber)
• Stimulation electrodes, see pages I13 to I14
• Stimulators, see pages I15 to I30
• Isometric or isotonic transducers, see pages I4 to I8
• Signal amplifiers, see page I34
• PROTOWIN software, see page K79
Modular Organ Baths

The Modular Single Chamber Organ Bath was developed to provide a practical and functional design. They are used basically in teaching, where their low demanding maintenance, ruggedness and ease of use guarantee excellent didactic performance.

The system consists of a Perspex organ bath with a tissue chamber, three-way stopcock for physiological solution exchange and a fine needle valve for gas regulation.

To maintain a constant temperature in the tissue chamber, the LE13000 Thermo Regulated Pump is available which can be used with up to four Single Chamber Organ Baths at once.

All organ baths include tissue holders, transducer holders, microprobes and tissue chambers (25 ml volume is supplied standard; 5, 10, or 50 ml volumes are available on request). A range of Isometric or Isotonic Force Transducers and amplifiers are available.

Optionally, the Modular Organ Baths can be associated with PROTOWIN software for data storage and analysis, including Dose/Response.

LE13000 Thermo Regulated Pump

The LE13000 is used to heat and recirculate the water that maintains the nutrient liquid of the chamber and coils at a constant selected temperature. It may be used to heat-adjust up to 6 individual Baths, provided that they are close enough to avert drastic temperature drops. The LE13000 Thermo Regulated Pump is included with the Double and Quadruple Modular Organ Baths.

Characteristics

Temperature Range: From Ambient +5° to 80°C
Resolution: 0.2°C
Flow: 12 l/min
Pressure: 150 mbar
Total Height: 53 cm
Power Supply: 125 V or 220 V 1.000W
Tank: Plexiglas (60° Max.) Volume: 8 liters
Measurements: 32 x 19 x 16 cm

Order # Model Product

PY2 76-0165 LE1100 Modular Individual Organ Bath, Chamber Included (25ml by default)
PY2 76-0166 LE11200 Modular Double Organ Bath, Includes Thermo Regulated Pump LE13000 (25ml by default)
PY2 76-0167 LE11400 Modular Quadruple Organ Bath, Includes Thermo Regulated Pump LE13000 and Chambers (25ml by default)

Order # Model Product

PY2 76-0323 LE0140 10 Tissue Clamps Set
PY2 76-0324 LE0145 10 Tissue Hooks Set
PY2 76-0169 LE11005 5 ml Chamber for Modular Organ Baths
PY2 76-0170 LE11010 10 ml Chamber for Modular Organ Baths
PY2 76-0171 LE11025 25 ml Chamber for Modular Organ Baths
PY2 76-0172 LE11050 50 ml Chamber for Modular Organ Baths
PY2 76-0048 LE01030A Stainless Steel Electrode
PY2 76-0049 LE01030B Stainless Steel Electrode, Two Rings, 20 mm Apartment
PY2 76-0050 LE01030C Stainless Steel Electrode, Two Rings, 15 mm Apartment
PY2 76-0051 LE01030D Stainless Steel Electrode, Surface Contact
PY2 76-0052 LE01035A Platinum Electrode, Single Ring
PY2 76-0053 LE01035B Platinum Electrode, Two rings, 20 mm Apartment
PY2 76-0054 LE01035C Platinum Electrode, Two Rings, 15 mm Apartment

Citations

Shpak B et al. (2004) Inotropic and lusitropic effects induced by the inhibitory factor of the Na/Ca exchanger are not mediated by the (beta)-adrenergic activation. J. Cardiovasc. Pharm. 44(4): 466-472. (guinea and rat ventricle strips, Israel)
Fortunato A et al. (1998) Torasemide inhibits angiotensin II-induced vasoconstriction and intracellular calcium increase in the aorta of spontaneously hypertensive rats. Hypertension 34: 138-143. (rat aortic rings, Spain)
Compact Organ Baths for Isolated Tissues

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

Parameters Measured
- Parameters given by the associated software (see PROTOWIN)
- Use of totally inert materials, Viton, Teflon, Delrin, Silicone and other materials that are not degraded by acids or salt

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

Options
- Tissue chambers
- Stimulation electrodes, see pages I13 to I14
- Stimulators, see pages I15 to I30
- Isometric or isotonic transducers, see pages I4 to I8
- Signal amplifiers, see page I34
- PROTOWIN Software, see page K79
Compact Organ Baths for Isolated Tissues (continued)

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

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

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

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

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

Order #   Model   Product
PY2 76-0038 LE01002 2 Chambers Manual Compact Organ Bath, Chambers not Included
PY2 76-0039 LE01026 2 Chambers Automated Compact Organ Bath, Chambers not Included
PY2 76-0040 LE01004 4 Chambers Manual Compact Organ Bath, Chambers not Included
PY2 76-0041 LE01046 4 Chambers Automated Compact Organ Bath, Chambers not Included
PY2 76-0042 LE01066 6 Chambers Manual Compact Organ Bath, Chambers not Included
PY2 76-0043 LE01066 6 Chambers Automated Compact Organ Bath, Chambers not Included
PY2 76-0044 LE01086 8 Chambers Manual Compact Organ Bath, Chambers not Included
PY2 76-0045 LE01086 8 Chambers Automated Compact Organ Bath, Chambers not Included

Options
- PY2 76-0038 PROTOWIN Software for Organ Bath, Up to 8 Channels, Dose/Response
- PY2 76-0039 ISO510 Amplifier for Isometric and Isotonic Transducer
- PY2 76-0040 LE01040 10 Tissue Clamps Set
- PY2 76-0041 LE01045 10 Tissue Hooks Set
- PY2 76-0042 LE0105 5 ml Chamber for Compact Organ Bath
- PY2 76-0043 LE0110 10 ml Chamber for Compact Organ Bath
- PY2 76-0044 LE01125 25 ml Chamber for Compact Organ Bath
- PY2 76-0045 LE01150 50 ml Chamber for Compact Organ Bath
- PY2 76-0046 LE01030A Stainless Steel Electrode
- PY2 76-0047 LE01030B Stainless Steel Electrode, Two Rings, 20 mm Apart
- PY2 76-0048 LE01030C Stainless Steel Electrode, Two Rings, 15 mm Apart
- PY2 76-0049 LE01030D Stainless Steel Electrode, Surface Contact
- PY2 76-0050 LE01030E Stainless Steel Electrode, Single Ring
- PY2 76-0051 LE01035A Platinum Electrode, Single Ring
- PY2 76-0052 LE01035B Platinum Electrode, Two Rings, 20 mm Apart
- PY2 76-0053 LE01035C Platinum Electrode, Two Rings, 15 mm Apart

* Visit our STIMULATORS section for more details, see pages I12 to I30
* Visit our transducers section for more details, see pages I4 to I8

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

This unique assembly of tissue bath components provides the utmost convenience and flexibility in either the research or student laboratory. Four sets are offered. Three of the sets provide the basic components for specific experiments with smooth muscles, rat diaphragms and mammalian hearts with Langendorff preparations. A universal set provides enough components to make any of the other three sets diagrammed. All of the components are interchangeable, permitting additional components to be added later. All glassware is jacketed so that the warming water is pumped through a closed circuit only; there are no open baths that can become contaminated. The tissue vessels and the heart chamber all have the same outside circumference so that they can be easily interchanged in the same spring clip holder.

Since apparatus is mounted on a heavy pharmacology stand, minimum bench space is occupied. The experimental areas are clearly visible and easy to get to. The open assembly makes taking samples and adding wash or test fluids an easy task. The sensibility of the design is evident by examining the reservoir. When the cap is fitted, the reservoir becomes a marriotte flask. Fluid can leave the reservoir only as air enters it via the small bore tube which runs from the cap to the bottom of the flask maintaining a constant pressure. This is ideal for heart perfusion. When the cap is removed, the flow is slightly greater and can be controlled by a tube clamp on the outlet pipe (or on the outlet of the aeration reservoir if used). This mode is ideal for rapid filling/flushing of tissue vessels. In both cases the pressure can be varied by changing the height of the reservoir above the preparation.

Order #   Product
PY2 50-0413  Set for Smooth Muscle
Includes all items listed to left plus:
PY2 50-0538  20 ml Jacketed General Tissue Vessel
PY2 50-0553  Detachable Stem for Jacketed General Tissue Vessel

Order #   Product
PY2 50-0421  Set for Rat Diaphragm
Includes all items listed to above left plus:
PY2 50-0546  100 ml Jacketed General Tissue Vessel
PY2 50-0553  Detachable Stem for Jacketed General Tissue Vessel
PY2 50-0561  Phrenic Nerve Electrode with Oxygen Bubbler

Order #   Product
PY2 50-0439  Set for Mammalian Heart Perfusion (Langendorff)
Includes all items listed to above left plus:
PY2 50-0579  Jacketed Heart Chamber
PY2 50-0587  Aeration Reservoir
PY2 50-0595  Aeration Stone with Tubing
PY2 50-0603  Heart Mounting Junction Block
PY2 50-0611  Manometer
PY2 50-0629  Horizontal Thermometer with Rubber Bung
PY2 50-0637  Heart Cannula
PY2 50-0702  Double Pulley Holder
PY2 50-0710  Fixed Mount Pulley, 25 mm, pkg. of 2
Constant Head 1 Liter Reservoir

This 1 liter polyethylene reservoir supplies a constant head of wash or test fluid by a simple mechanism. The tight fitting cap is pierced by a length of small bore stainless steel tubing. Cemented to the stainless steel tubing is a length of flexible tubing that reaches the bottom of the reservoir. The fluid can flow from the bottom outlet and into the warming system only as an air bubble goes down through the tubing in the cap to the bottom of the reservoir and bubbles up to the top of the reservoir. This air inlet can be adjusted to any desired feed rate. Conversely, the cap can be removed and the quantity of the fluid leaving the reservoir can be controlled by the pinch clamp provided on the outlet tubing. It comes supplied with 25 cm (10 in) length of 7 mm ID x 10.5 mm OD outlet tubing with plastic male connectors, a precision threaded pinch clamp, and a tapered plastic connector.

Order # Product
PY2 50-0496 Constant Head Reservoir, 1 L

Aeration Reservoir

This glass Aeration Reservoir attaches by means of spring clips to the main Reservoir Holder, see above. The fluid flows from the main Reservoir to the side limb of the Aeration Reservoir through flexible tubing and a plastic connector (supplied). The PY2 50-0595 Aeration Stone with Tubing described below is placed in the Aeration Reservoir. The bottom has a piece of flexible tubing and a tapered plastic connector for attachment to the Jacketed Warming Coil. The Aeration Reservoir has an inside diameter of 2 cm (3/4 in) and is 20 cm (8 in) long. It comes supplied with two 5 cm (2 in) lengths of 7 mm ID x 10.5 mm OD tubing.

Aeration Stone with Tubing

This sintered Aeration Stone is mounted on one end of 2 m (6 ft) long translucent PVC 4 mm ID x 7 mm OD (3/16 x 5/16 in) tubing that connects to the laboratory oxygen supply. The Stone measures, H x W x D, 14 x 14 x 30 mm (1/2 x 1/2 x 1-1/5 in) and fits inside the PY2 50-0587 Aeration Reservoir. It serves as a gas bubbler to provide suitable oxygenation to the perfusate.

Order # Product
PY2 50-0595 Aeration Stone with Tubing

Reservoir Holder

This sturdy, steel Holder is coated with white paint and has a 10.8 cm (4-1/4 in) diameter plate mounted on top of a 13 mm (1/2 in) ID, 19.7 cm (7-3/4 in) long tubular rod. The plate has three pronged spring clips to securely hold the PY2 50-0496 Constant Head 1 Liter Reservoir. Two smaller 2.5 cm (1 in) spring clips attached to one of these prongs hold the PY2 50-0587 Aeration Reservoir. The tube slips over the rod of the PY2 50-0470 Pharmacology Stand and locks in place with a knurled set screw 3.2 cm (1-1/4 in) from the bottom of the tube. A 13 mm (1/2 in) open sided connector, mounted to the base of the plate can also be used to mount the Holder to the Pharmacology Stand. Since the rod of the Pharmacology Stand is 72 cm (28 in) long, the maximum height of the Reservoir is 86 cm (34 in) and the minimum height of the Reservoir is 20 cm (8 in). Thus, the maximum distance between the Holder placed as high as possible using the set screw on the tube and as low as possible using the open sided connector on the top plate is 66 cm (26 in).

Order # Product
PY2 50-0488 Reservoir Holder
**Universal Isolated Tissue Bath Set**

**Components (continued)**

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**Detachable Stem Jacketed General Tissue Vessels**

These glass Jacketed General Tissue Vessels consist of a tissue chamber with a cone joint and a detachable stem. The chamber has an outside diameter of 55 mm (2-1/4 in). The bottom of the tissue chamber is fitted with a 14/23 cone joint to accept the PY2 50-2096 Detachable Stem (not supplied) or PY2 50-0553 Detachable Stem with tubing, springs and pinch clamps. This stem attaches to the tissue chamber with two springs (included). The tissue chamber has three limbs. Two of the limbs serve as the inlet and outlet for the water warming circuit. The third is the level tube which maintains a constant volume of perfusate in the chamber.

Harvard Apparatus offers this Tissue Vessel in two sizes with approximate capacities of 20 and 100 ml. Supplied with flexible tubing with plastic connectors for all three limbs. The 100 ml Tissue Vessel is primarily intended for work with rat diaphragms. Stems and springs must be purchased separately.

**Order #**
**Product**

<table>
<thead>
<tr>
<th>PY2 50-0538</th>
<th>20 ml General Tissue Vessel, Detachable Stem, Inner Chamber 20 x 85 mm (3/4 x 3-1/2 in)</th>
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<tbody>
<tr>
<td>PY2 50-0546</td>
<td>100 ml General Tissue Vessel, Detachable Stem, Inner Chamber 45 x 100 mm (1-3/4 x 4 in)</td>
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<tr>
<td>PY2 50-0520</td>
<td>Spring Clip Clamp with Support Rod</td>
</tr>
<tr>
<td>PY2 50-0504</td>
<td>Spring Clip Clamp without Support Rod</td>
</tr>
<tr>
<td>PY2 50-2450</td>
<td>Tissue Chamber Only without Tubing, 20 ml without Tubing</td>
</tr>
<tr>
<td>PY2 50-2492</td>
<td>Tissue Chamber Only without Tubing, 100 ml without Tubing</td>
</tr>
<tr>
<td>PY2 50-2096</td>
<td>Detachable Stem Only to Fit 14/23 Cone Joint</td>
</tr>
<tr>
<td>PY2 50-2088</td>
<td>Springs, set of 2</td>
</tr>
<tr>
<td>PY2 50-0553</td>
<td>Detachable Stem for Jacketed General Tissue Vessels</td>
</tr>
</tbody>
</table>

---

**Jacketed Warming Coils**

These glass-jacketed warming coils have tight, even spirals and four rifled limbs. Two limbs serve as inlet and outlet for the perfusate. The other two limbs serve as inlet and outlet for the warm water circuit. Harvard Apparatus offers this warming coil in two sizes with approximate capacities of 30 and 100 ml. Supplied with four pieces of flexible, translucent PVC tubing permanently attached for both the warm water circuit and the perfusate. The tubing for the warm water circuit is 8 mm ID x 12 mm OD and has large plastic connectors attached. The tubing for the perfusate is 7 mm ID x 10.5 mm OD and has small plastic connectors attached.

**Order #**
**Capacity (approx.)**
**Jacket (ID x L, approx.)**

| PY2 50-1593 | 30 ml | 35 x 280 mm (1.4 x 11 in) |
| PY2 50-0512 | 100 ml | 65 x 250 mm (2-1/2 x 9.8 in) |
| PY2 50-0504 | Spring Clip Clamp without Support Rod for Holding 100 ml Warming Coil |

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**Jacketed Heart Chamber**

This glass Jacketed Heart Chamber has an outside diameter of 60 mm (2.4 in) and an inner chamber measuring 40 x 75 mm (1-1/2 x 3 in). The bottom has an opening of 20 mm (3/4 in) in diameter for passing the measuring line to a lever or transducer. Supplied with tapered plastic connectors and 8 mm ID x 12 mm OD flexible translucent PVC tubing for the inlet and outlet limbs. One piece of tubing has a female connector; the other has a male connector.

**Order #**
**Product**

| PY2 50-0579 | Jacketed Heart Chamber |
| PY2 50-0520 | Spring Clip Clamp with Support Rod |
| PY2 50-0504 | Spring Clip Clamp without Support Rod |
### Specifications and Ordering Information for Harvard Apparatus Tissue Bath Sets

<table>
<thead>
<tr>
<th></th>
<th>Research Double Tissue Bath Set</th>
<th>Basic Double Tissue Bath Set</th>
<th>Basic Single Tissue Bath Set</th>
<th>Student Single Tissue Bath Set</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>115 VAC, 60 Hz/230 VAC, 50 Hz</td>
<td>115 VAC, 60 Hz/230 VAC, 50 Hz</td>
<td>115 VAC, 60 Hz/230 VAC, 50 Hz</td>
<td>115 VAC, 60 Hz/230 VAC, 50 Hz</td>
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<tr>
<td>Heated Water Bath</td>
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<tr>
<td>Heater Power</td>
<td>250 W</td>
<td>80 W</td>
<td>80 W</td>
<td>50 W</td>
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<tr>
<td>Temperature Control</td>
<td>Automatic within 0.5°C</td>
<td>Automatic within 0.5°C</td>
<td>Automatic within 0.5°C</td>
<td>Manual</td>
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<tr>
<td>Magnetic Stirrer</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Capacity</td>
<td>11.2 L</td>
<td>4.7 L</td>
<td>3.6 L</td>
<td>0.8 L</td>
</tr>
<tr>
<td>Dimensions, H x W x D</td>
<td>18 x 29 x 21.5 cm (7.25 x 11.5 x 8.5 in)</td>
<td>15.5 x 21.5 x 14 cm (6.25 x 8.5 x 5.5 in)</td>
<td>15.5 x 16.5 x 14 cm (6.25 x 6.5 x 5.5 in)</td>
<td>12.5 x 10 cm (H x D) (5 x 4 in)</td>
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<tr>
<td>Tissue Vessel(s)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Quantity per Set</td>
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<td>2</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Type Supplied</td>
<td>Detachable Stem</td>
<td>Fixed Stem</td>
<td>Fixed Stem</td>
<td>Student Fixed Stem</td>
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<tr>
<td>Perfusate Warming Coils</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Type</td>
<td>Flat Coil</td>
<td>Spiral Coil</td>
<td>Spiral Coil</td>
<td>Spiral Coil</td>
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<td>Capacity per Vessel</td>
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<td>35 ml</td>
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<td>Thermometer Length</td>
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<td>10 cm</td>
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<td>Order #</td>
<td>PY2 50-2146 / PY2 50-2153</td>
<td>PY2 50-2120 / PY2 50-2138</td>
<td>PY2 50-2104 / PY2 50-2112</td>
<td>PY2 50-0306 / PY2 50-0314</td>
</tr>
</tbody>
</table>

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

**Basic Double/Basic Single Tissue Bath Sets**
- Temperature automatically held within 0.5°C
- Dial graduated from 15° to 45°C in 5° increments
- Fixed stem tissue vessels supplied as standard

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

<table>
<thead>
<tr>
<th>Order #</th>
<th>Description</th>
<th>Research Tissue Bath Set</th>
<th>Double Tissue Bath Set</th>
<th>Single Tissue Bath Set</th>
<th>Student Tissue Bath Set</th>
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<tbody>
<tr>
<td>PY2 50-2228</td>
<td>Research Heated Water Bath, 115 VAC, 60 Hz</td>
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<td>PY2 50-2236</td>
<td>Research Heated Water Bath, 230 VAC, 50 Hz</td>
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<td>PY2 50-2302</td>
<td>Double Heated Water Bath, 115 VAC, 60 Hz</td>
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<td>PY2 50-2310</td>
<td>Double Heated Water Bath, 230 VAC, 50 Hz</td>
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<td>PY2 50-2286</td>
<td>Single Heated Water Bath, 115 VAC, 60 Hz</td>
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<td>PY2 50-2294</td>
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<td>PY2 50-2260</td>
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<td>PY2 50-2278</td>
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<td>PY2 50-0322</td>
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<td>PY2 50-0330</td>
<td>Student Tissue Vessel</td>
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<td>PY2 50-0348</td>
<td>Spiral Perfusate Warming Coil</td>
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<td>PY2 50-0355</td>
<td>Thermometer, 0-50°C, 100 mm</td>
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<td>PY2 50-0363</td>
<td>Oxygenation Tubes</td>
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<td>PY2 50-2203</td>
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<td>PY2 50-2237</td>
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<td>PY2 50-2245</td>
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<td>PY2 50-2369</td>
<td>Rubber Bung</td>
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<td>PY2 50-2419</td>
<td>Thermometer Holder</td>
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<td>PY2 50-2427</td>
<td>Upright Rod for Water Baths</td>
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<td>PY2 50-2575</td>
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<td>PY2 50-6519</td>
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</table>
Fixed and Detachable Stem Tissue Vessels

- Available in three sizes: 10, 25 and 50 ml (nominal capacity)
- For use with Research Double, Basic Double and Basic Single Tissue Bath Sets

The glass Fixed Stem Tissue Vessels consist of a single piece with the inlet and drainage stems fixed to the tissue vessel. The inlet stem connects with the 6 mm ID x 9 mm OD tubing of the Flat Perfusate Warming Coil, or Spiral Perfusate Warming Coil, see following page.

The Detachable Stem Glass Tissue Vessel consists of two pieces: the tissue chamber and stem. The tissue chamber and stem must be ordered separately. The chamber is joined to the stem by a 10/19 ground glass conical joint. The Detachable Stem Tissue Vessel is more convenient to use since the stem with its attached inlet and outlet drainage tubes (not supplied) can be left undisturbed while the tissue chamber is changed.

Specifications

<table>
<thead>
<tr>
<th>Capacity (nominal)</th>
<th>Inside Dimensions, D x L</th>
<th>Fixed Stem Tissue Vessel</th>
<th>Detachable Stem Tissue Vessel*</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 ml</td>
<td>16 x 60 mm (0.62 x 2.4 in)</td>
<td>PY2 50-2187</td>
<td>PY2 50-2211 PY2 50-2245</td>
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<tr>
<td>25 ml</td>
<td>22 x 75 mm (0.86 x 2.95 in)</td>
<td>PY2 50-2195</td>
<td>PY2 50-2229 PY2 50-2245</td>
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<tr>
<td>50 ml</td>
<td>30 x 100 mm (1 x 4 in)</td>
<td>PY2 50-2203</td>
<td>PY2 50-2237 PY2 50-2245</td>
</tr>
</tbody>
</table>

Order # Product

PY2 50-2369 Rubber Bung

*Note: For the Detachable Stem Glass Tissue Vessels, the Tissue Chamber and Stem must be ordered separately.

Student Tissue Vessel

This glass Tissue Vessel has a 50 ml capacity. It is a single piece with a drainage stem and an inlet stem fixed directly to the vessel. The side limb is curved upwards for easier connection to the Warming Coil. The Vessel chamber is 25 mm diameter x 100 mm long (1 x 4 in).

Order # Product

PY2 50-0330 Student Tissue Vessel

Rubber Bung

Made of tapered, soft rubber, these Bungs have a hole through the center that accepts the stem of the glass Tissue Vessel. The Bung fits into the tapered plastic cone in the bottom of the Heated Water Bath to make a leak proof joint.

Order # Product

PY2 50-2369 Rubber Bung
Flatt Perfusate Warming Coil Set for Research Double Water Bath

This set is supplied complete with four flat 14 cm (5-1/2 in) square glass coils with tapered ends, eight 14 cm (5-1/2 in) lengths of 6 mm ID x 9 mm OD tubing with a plastic male or female connector at one end, a plastic “T” connector with tubing and two spring clips required to join the coils together. Each coil has a 100 ml capacity, resulting in a 400 ml total capacity.

Two pieces of tubing join two glass coils together as follows: The plastic female and male connectors are joined together and the tubing ends connect to the inner spirals of each of the two coils. The remaining two coils are joined in the same way.

The two sets of coils are then joined together using the two 5.1 cm (2 in) lengths of 7 mm ID x 10.5 mm OD tubing attached to the plastic “T” connector. The remaining part of the 6 mm ID x 7 mm OD plastic “T” connector connects to the Reservoir, with 7 mm ID x 10.5 mm OD tubing (not supplied).

The four remaining 14 cm (5-1/2 in) lengths of tubing with either a male or female connector at one end join together and attach to the outer spiral of the two end coils and the two Tissue Vessels.

The double-ended spring clips have two 13 mm (1/2 in) diameter white nylon-coated spring clips separated by a 19 mm (3/4 in) rod which attach to the outer spirals of two coils to hold the coils at right angles to each other so that they fit in the corners of the Bath.

Order # Product
PY2 50-2385 Flat Perfusate Warming Coil Set for Research Double Water Bath

Spiral Perfusate Warming Coil

This glass Warming Coil has a capacity of 35 ml. It has a 4 cm (1-1/2 in) ID and is 10 cm (4 in) high. Supplied with 7.5 cm (3 in) length of 7 mm ID x 10.5 mm OD tubing to connect to Tissue Vessel.

Order # Product
PY2 50-0348 Spiral Perfusate Warming Coil

Rod for Single, Double and Research Tissue Bath Set

This Rod is a standard 9.5 mm (3/8 in) diameter by 12.5 cm (5 in) long rod with a slotted 9 cm (3-1/2 in) long ‘L’ base. A wing nut secures the slotted ‘L’ based to a metal clamp. The clamp has a groove that fits over the top edge of the water bath tank. Two screws lock the clamp with rod in position along the top edge of the tank.

Order # Product
PY2 50-2427 Rod for Single, Double and Research Tissue Bath Sets

Oxygenation Tubes

These stainless steel Oxygenation Tubes are available in two sizes. The end of the Tube is clinched closed and precisely ground until only fine bubbles of gas can escape from it. A wire hook at the end of the Tube anchors specimens over the Oxygenation Tube outlet.

Order # Product
PY2 50-0363 Oxygenation Tubes, Holding Stem length 9 cm (3-1/2 in), Main Stem length 12.5 cm (5 in)
PY2 50-0371 Oxygenation Tubes, Holding Stem length 5 cm (2 in), Main Stem length 11 cm (4-1/4 in)

Rod for Student Tissue Bath Set

This Rod mounts in any of the three holes in the base of the Student Water Bath. It is standard 9.5 mm (3/8 in) diameter, 20 cm (8 in) long rod with a slotted long ‘L’ base. A screw and wing nut supplied are used to secure the Rod to the Water Bath Base.

Order # Product
PY2 50-0322 Rod for Student Tissue Bath Set
The walls of these Baths are heavy, 6 mm (1/4 in) thick, transparent plastic so that the specimen can be constantly and easily observed. The two sides of the Baths are extended to form a stand. The heating control housing is made of white plastic that is corrosion proof and serves as an excellent electrical insulator from the heaters. A drain hole with tubing and a plug are located in the tank.

All of the baths, with the exception of the student water bath feature a sophisticated digital temperature control system. The control system provides an LED display of the current water temperature, accurate to within half a degree and temperature stabilization. The user may select a water temperature anywhere between 15 and 45 degrees using front panel mounted keys. A float switch provides a safety cut off should the water level fall below the minimum permitted level, thus preventing any damage occurring to the structure of the unit from excessive heat build up.

The model shown is the Single Tissue bath, however the Double and Research Baths are very similar in appearance with just their overall dimensions differing.

### Basic Double and Basic Single Heated Water Baths

Two 40-watt heaters that are mounted through the front of the tank near the bottom and extend 5 cm (2 in) into these Water Baths. These Baths are identical except that the Basic Double Water Bath has a larger tank to accommodate two Tissue Vessels.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 50-2302</td>
<td>Basic Double Heated Water Bath, 115 VAC, 60 Hz</td>
</tr>
<tr>
<td>PY2 50-2310</td>
<td>Basic Double Heated Water Bath, 230 VAC, 50 Hz</td>
</tr>
<tr>
<td>PY2 50-2286</td>
<td>Basic Single Heated Water Bath, 115 VAC, 60 Hz</td>
</tr>
<tr>
<td>PY2 50-2294</td>
<td>Basic Single Heated Water Bath, 230 VAC, 50 Hz</td>
</tr>
</tbody>
</table>

### Student Heated Water Bath

A 50-watt heater is mounted off center through the bottom of the tank. An energy regulator mounted on the front of the Bath manually controls the temperature. The dial has a position for ‘full energy’ while the bath is being brought up to its desired temperature and ten graduations so that the working temperature can be easily maintained.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 50-2260</td>
<td>Student Heated Water Bath, 115 VAC, 60 Hz</td>
</tr>
<tr>
<td>PY2 50-2278</td>
<td>Student Heated Water Bath, 230 VAC, 50 Hz</td>
</tr>
</tbody>
</table>
Glass Perfusate Reservoirs

Glass Reservoirs
These Glass Reservoirs are for use with a pump. They are heated by a water thermocirculator. To connect to the thermocirculator 5mm ID tubing is necessary. For aeration of perfusate a large gas frit is included. The pump is connected to the longer stainless steel suction tube via a Luer connector and tubing. A return flow can be connected to the short stainless steel tube with the included Luer Slip connector. Pictured tubing connections are included with each reservoir. Tubing sets must be purchased separately. See below.

Reservoirs with Bottom Drain
These Glass Reservoirs have a bottom drain. They are for gravity supply systems or for use with a pump. The Reservoirs are heated by a water thermocirculator. For aeration of perfusate they are supplied with a large gas frit. The outlet is the drain port at the bottom. It can be directly connected to a 5mm ID tubing or via a Luer adapter to the stopcock. A return flow can be connected to the short stainless steel tube via a Luer connector. Pictured tubing connections are included with each reservoir. Tubing sets must be purchased separately.

Order #   Product
PY2 73-3440  2 Liter Reservoir Jacketed for Buffer Solution
PY2 73-3438  1 Liter Reservoir Jacketed for Buffer Solution
PY2 73-3436  0.5 Liter Reservoir Jacketed for Buffer Solution
PY2 73-0322  6 Liter Reservoir Jacketed for Buffer Solution with tube set for thermostating circuit and fluid line shutoff valves
PY2 73-3455  2 Liter Reservoir Jacketed for Buffer Solution with Bottom
PY2 73-3439  1 Liter Reservoir Jacketed for Buffer Solution with Bottom
PY2 73-3437  0.5 Liter Reservoir Jacketed for Buffer Solution with Bottom
PY2 73-3566  Repl. Frit for 2.0 Liter Glass Reservoirs
PY2 73-3565  Repl. Frit for 1.0 Liter Glass Reservoirs
PY2 73-3564  Repl. Frit for 0.5 Liter Glass
PY2 73-3562  Fluid Outlet with Stopcock for Jacket Reservoir with Bottom Drain

Tubing Sets
Order #   Product
PY2 73-3455  Tube Set for Jacketed Buffer Reservoir
PY2 73-3456  Tube Set for Jacketed Buffer Reservoir with Fluid Line Shutoff Valves

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**Perfusate Oxygenation**

- **Hollow Fiber Oxygenator** in two sizes D150 or D200
- **MediSulfone® Membrane Material**
- **19/54 ml Total Priming Volume**
- **0.25/0.6 m² Active Oxygenating Surface Area**
- **Can Be Used 3 to 10 Times**
- **Available in individual units or in packages of 5**
- **Selection of different Holders**

**Fiber (Membrane) Oxygenator**

Alternative oxygenator to glass frit oxygenating bubblers or glass bulb oxygenators. The membrane oxygenator is used for blood, blood doped perfusate, or when using perfusate that contains protein to prevent foaming.

**Specifications**

<table>
<thead>
<tr>
<th></th>
<th>D150</th>
<th>D200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Membrane:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>MediSulfone®</td>
<td>MediSulfone®</td>
</tr>
<tr>
<td>Effective Surface Area</td>
<td>0.25 m²</td>
<td>0.6 m²</td>
</tr>
<tr>
<td>Wall thickness</td>
<td>50 µm</td>
<td>50 µm</td>
</tr>
<tr>
<td>ID</td>
<td>250 µm</td>
<td>250 µm</td>
</tr>
<tr>
<td>Effective Fiber Length</td>
<td>140 mm</td>
<td>140 mm</td>
</tr>
<tr>
<td>Sterilization</td>
<td>ETO</td>
<td>ETO</td>
</tr>
<tr>
<td>Priming Volume</td>
<td>19 ml</td>
<td>54 ml</td>
</tr>
</tbody>
</table>

**Oxygenator Materials:**

- Housing: Polycarbonate
- Bloodports: Polycarbonate
- Potting: Polyurethane

**Oxygenator:**

- Maximum Recommended TMP: 500 mmHg
- Dimensions: 180 x 40 mm
- Weight (grams): 66

**Order #  Product**

- PY2 73-3757  Fiber (Membrane) Oxygenator D150, pkg. of 1
- PY2 73-3762  Fiber (Membrane) Oxygenator D150, pkg. of 5
- PY2 73-3758  Fiber (Membrane) Oxygenator D200, pkg. of 1
- PY2 73-3763  Fiber (Membrane) Oxygenator D200, pkg. of 5
- PY2 73-3759  Mounting Kit for D150 Fiber Oxygenator on Holder1
- PY2 73-3760  Mounting Kit for D200 Fiber Oxygenator on Holder1
- PY2 73-3765  Gas & Perfusate Connector (5 Sets)

1 - Oxygenator mounting kits also require a system specific Oxygenator Holder except when used with the PS-1 system. The different holders available are listed in Table listed below.

**Stand Alone Oxygenator Holder**

- Holds Fiber Oxygenator (PY2 73-3757 / PY2 73-3758)
- Includes 1 Needle Valve for gas regulation
- 13 mm OD Maximum for Mounting Rod (rod not included)

**Universal Mounting Kit** *(Depending on Type D150 or D200)*

- 2 Ring Clamps to Hold Oxygenator
- Tubing Adapters for Oxygenator
- Silicone & Tygon Tubing

**Specifications**

<table>
<thead>
<tr>
<th>Holder for:</th>
<th>Order #</th>
<th># of Needle Valves Included</th>
<th>Maximum Diameter for Rod Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>UP100 &amp; IH-SR</td>
<td>PY2 73-3061</td>
<td>0</td>
<td>13 mm</td>
</tr>
<tr>
<td>UP100D &amp; PSCI</td>
<td>PY2 73-3057</td>
<td>0</td>
<td>20 mm</td>
</tr>
<tr>
<td>Stand Alone</td>
<td>PY2 73-3058</td>
<td>1</td>
<td>13 mm</td>
</tr>
</tbody>
</table>

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Balloon Kits for LVP Measurement

Latex Balloons for Isovolumetric Contractile Force
Latex Balloons are used for measuring isovolumetric contractile forces in the left ventricle of isolated perfused hearts. These latex balloons are available in several different sizes to be used with hearts from rats up to pigs. Review the table to select the right size balloon for your application. These latex balloons are not suitable for mice hearts due to the rigidity of the latex material. A technique using cling-film allows you to create small balloons which can be used for such small hearts. If you are working with mice, please order the Mouse Ventricular Balloon Kit PY2 73-2787. These Latex Balloons are sold in packages of 10 balloons. There are also convenient sample kits available that contain a selection of various sized balloons. Stainless steel catheters and Syringes are also available, see right.

Table for Selecting Balloon Size*

<table>
<thead>
<tr>
<th>Species</th>
<th>Weight (kg)</th>
<th>Size No.</th>
<th>Volume** (mm)</th>
<th>Order #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mouse and Small Rat</td>
<td>0.02 to 0.1</td>
<td>Mouse Ventricular Balloons</td>
<td>No Balloon</td>
<td></td>
</tr>
<tr>
<td>Rat</td>
<td>0.1 to 0.2</td>
<td>3</td>
<td>0.03 ml</td>
<td>3 x 7 PY2 73-3478</td>
</tr>
<tr>
<td>Guinea Pig</td>
<td>0.3 to 0.4</td>
<td>4</td>
<td>0.06 ml</td>
<td>4 x 8 PY2 73-3479</td>
</tr>
<tr>
<td>Rat</td>
<td>0.5</td>
<td>5</td>
<td>0.1 ml</td>
<td>5 x 9 PY2 73-3480</td>
</tr>
<tr>
<td>Rat</td>
<td>0.7</td>
<td>6</td>
<td>0.2 ml</td>
<td>6 x 10 PY2 73-3481</td>
</tr>
<tr>
<td>Rabbit</td>
<td>1.0</td>
<td>7</td>
<td>0.3 ml</td>
<td>7 x 11 PY2 73-3482</td>
</tr>
<tr>
<td>Rabbit</td>
<td>1.2</td>
<td>8</td>
<td>0.4 ml</td>
<td>8 x 12 PY2 73-3483</td>
</tr>
<tr>
<td>Rabbit</td>
<td>1.5</td>
<td>9</td>
<td>0.5 ml</td>
<td>9 x 13 PY2 73-3484</td>
</tr>
<tr>
<td>Cat</td>
<td>1.7</td>
<td>10</td>
<td>0.7 ml</td>
<td>10 x 14 PY2 73-3485</td>
</tr>
<tr>
<td>Cat</td>
<td>2.2</td>
<td>12</td>
<td>1.3 ml</td>
<td>12 x 17 PY2 73-3486</td>
</tr>
<tr>
<td>Cat</td>
<td>2.7</td>
<td>13</td>
<td>1.6 ml</td>
<td>13 x 18 PY2 73-3487</td>
</tr>
<tr>
<td>Cat</td>
<td>3.0</td>
<td>14</td>
<td>1.9 ml</td>
<td>14 x 19 PY2 73-3488</td>
</tr>
<tr>
<td>Cat</td>
<td>3.5</td>
<td>15</td>
<td>2.4 ml</td>
<td>15 x 20 PY2 73-3489</td>
</tr>
<tr>
<td>Cat</td>
<td>3.5 to 4.0</td>
<td>16</td>
<td>3.0 ml</td>
<td>16 x 22 PY2 73-3490</td>
</tr>
<tr>
<td>Dog</td>
<td>3.5 to 4.0</td>
<td>17</td>
<td>3.5 ml</td>
<td>17.2 x 23 PY2 73-3491</td>
</tr>
<tr>
<td>Dog</td>
<td>3.5 to 4.0</td>
<td>18</td>
<td>4.0 ml</td>
<td>18 x 24 PY2 73-3492</td>
</tr>
<tr>
<td>Dog</td>
<td>4</td>
<td>19</td>
<td>5.0 ml</td>
<td>19 x 25 PY2 73-3493</td>
</tr>
<tr>
<td>Dog</td>
<td>4 to 5</td>
<td>20</td>
<td>10 ml</td>
<td>20 x 26 PY2 73-3494</td>
</tr>
<tr>
<td>Dog</td>
<td>Up to 5</td>
<td>24</td>
<td>10 ml</td>
<td>24 x 32 PY2 73-3495</td>
</tr>
<tr>
<td>Dog</td>
<td>Up to 40</td>
<td>30</td>
<td>20 ml</td>
<td>30 x 40 PY2 73-3496</td>
</tr>
</tbody>
</table>

* Balloon Sample Kits are available, see below.
** Volume unloaded.

Mouse Ventricular Balloon Kit
• Simple Means to produce balloons for LVP measurement in isolated mice heart
• Easy to use

Latex Balloons are traditionally used for measuring isovolumetric contractile forces in the left ventricle of isolated perfused hearts. Latex balloons are not suitable for mice hearts due to the rigidity of the latex material. A technique using cling-film allows you to create small balloons which can be used for such small hearts. All the components to make these balloons are included in a convenient kit.

This kit for Mouse Ventricular Balloons includes the tools and procedure to assemble balloons for isovolumetric left ventricular pressure measurement in the isolated perfused mouse heart. The kit consists of a stand with two holders and crocodile clamps, hex screwdriver modified for balloon forming, syringe, scissor, cling wrap and PE tubing.

Order # Product
PY2 73-2787 Mouse Ventricular Balloon Assembly Kit
PY2 73-0183 Stainless Steel Catheter 1464 LL2 (0.01 kg) for Balloon Size 3 or 4
PY2 73-0184 Stainless Steel Catheter 1464 LL3 (0.01 kg) for Balloon Size 5 to 10
PY2 73-2897 Stainless Steel Catheter 1464 LL4 (0.01 kg) for Balloon Size 12 to 18
PY2 73-2898 Stainless Steel Catheter 1464 LL5 (0.01 kg) for Balloon Size 19 to 30
PY2 73-0320 Spindle Syringe, 2 ml
PY2 73-3341 Balloon Sample Kit, 2 each of Sizes 3 through 10, pkg. 16 Balloons
PY2 73-3342 Rat/Guinea Pig Balloon Sample Kit, 5 each of Sizes 3 through 6, pkg. 20 Balloons
PY2 73-3343 Rabbit Balloon Sample Kit, 5 each of Sizes 7 through 10, pkg. 20 Balloons

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### IH-SR Mini Balloon Kit for Mice Hearts
This kit includes 10 PE catheters for connecting the balloon to the pressure transducer, Luer stub cannula OD 0.6mm, holder with ball joints for fixation of the balloon in the left ventricle, spindle syringe for sensitive filling of balloons.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 73-0143</td>
<td>IH-SR Mini Balloon Kit for Mice Heart</td>
</tr>
</tbody>
</table>

### IH-SR Balloon Kit for Rat/Guinea Pig Hearts
This kit includes ball-joint holder, steel catheter 1464 LL2-IHSR, 10 balloons No. 5 (0.1 ml), spindle syringe for sensitive filling of balloons to adjust preload (balloon pressure), blunt Luer cannula, holder with ball joints for spindle syringe.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 73-2813</td>
<td>Balloon Kit for Rat / Guinea Pig Hearts to IH-SR</td>
</tr>
</tbody>
</table>

### J-Holder LVP Kit for IH-SR in Working Heart Mode
This special holder was designed to maintain the small PE-catheter forced through the left ventricle apex for LVP measurement in the isolated working mouse heart. In combination with the mini ball joint holders a precise fixation without stress load from the PE-catheter on the heart is possible. This kit includes a J-holder for PE-catheters, Luer adapter, 2 mini ball joints, 1 ball with thread and 10 PE-catheters l = 15 cm.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 73-0179</td>
<td>J-Holder for LVP Catheter for Isolated Working Mouse Heart, Including Cannula</td>
</tr>
<tr>
<td>PY2 73-0167</td>
<td>LVP Kit for IH-SR WH</td>
</tr>
</tbody>
</table>

### Universal Balloon Kit V.1 for Rat/Guinea Pig Hearts
This kit includes a steel catheter 1464 LL2, 10 balloons No. 4 (0.06 ml), spindle syringe for sensitive filling of balloons to adjust preload (balloon pressure), including holder with ball joints for spindle syringe.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 73-0197</td>
<td>Universal Balloon Kit V.1 for Rat/Guinea Pig Hearts</td>
</tr>
</tbody>
</table>

### Universal Balloon Kit V.2 for Rat/Guinea Pig Hearts
This kit includes a ball-joint holder, LL2-IHSR, 10 balloons No. 5 (0.1 ml), blunt Luer cannula, plexiglass block clamp and bar with ball, spindle syringe with LECTROCATH catheter for sensitive filling of balloons to adjust end diastolic preload (balloon pressure), including holder with ball joints for spindle syringe.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 73-3560</td>
<td>Universal Balloon Kit V.2 for Rat/Guinea Pig Hearts</td>
</tr>
</tbody>
</table>

### Universal Mini Balloon Kit for LVP on Isolated Mice Hearts
This kit includes a PE catheter for connecting the balloon to the pressure transducer, cannula, T-piece, holder for balloon catheter with 2 mini ball joint holders, plexiglass block clamp and bar with ball, and spindle syringe.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 73-0331</td>
<td>Universal Mini Balloon Kit for LVP on Isolated Mice Hearts</td>
</tr>
</tbody>
</table>

### Balloon Kit for Pig Hearts
This kit includes a steel catheter 1464 LL5, 10 No. 24 (9.6 ml) (PY2 73-0327), spindle syringe for sensitive filling of the balloon to adjust preload (balloon pressure), including holder with ball joints.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 73-0329</td>
<td>Balloon Kit for Small Pig Hearts</td>
</tr>
<tr>
<td>PY2 73-0327</td>
<td>Balloon Kit for Pig Hearts</td>
</tr>
</tbody>
</table>

### Balloon Kit for Rabbit Hearts
This kit includes a steel catheter 1464 LL4, 5 balloons No. 12 and 5 balloons No. 13, spindle syringe for sensitive filling of balloons to adjust preload (balloon pressure), including holder with ball joints.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 73-0323</td>
<td>Balloon Kit for Rabbit Hearts</td>
</tr>
</tbody>
</table>

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**Isolated Organ & Tissue accessories**

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**Balloon Kits for LVP Measurement**
Ball Joint Holder and Cannulating System for Pulmonary Artery

This special holder was designed to cannulate the pulmonary artery on isolated perfused heart. In combination with the mini ball joint holders a precise fixation without stress load from the cannula on the heart and vessel is possible. It is used for collecting the effluate of the heart for measuring gas concentrations or metabolism analysis. It allows also to measure coronary flow on a working heart by connecting the appropriate flow sensor.

Order #  Product
PY2 73-2934  Ball Joints and Cannulating System for Pulmonary Artery on Rat / Guinea Pig Hearts to IH-SR
PY2 73-0206  Ball Joints and Cannulating System for Pulmonary Artery on Rat / Guinea Pig Hearts for any system

Cannulae for Isolated Liver or Kidney Perfusion

These special cannulae were designed for non traumatic cannulation of an isolated perfused liver or kidney. The cannulae are equipped with a basket like tip to avoid any occlusion of the vessel during preparation and experiment. The cannulae are available at different sizes depending on the species and with or without side port for pressure measurement drug application.

The cannulae are also available as cannulating system to the moist chamber, see pages K31 and K33.

These cannulae can also be combined with Mini Ball Joint Holders to build universal perfusion cannulating systems.

Order #  Product
PY2 73-3308  In Situ Cannula with Basket OD 1.0 mm
PY2 73-3310  In Situ Cannula with Basket OD 1.3 mm
PY2 73-3312  In Situ Cannula with Basket OD 2.0 mm
PY2 73-3314  In Situ Cannula with Basket OD 2.3 mm
PY2 73-3309  In Situ Cannula with Basket and Side Port OD 1.0 mm
PY2 73-3311  In Situ Cannula with Basket and Side Port OD 1.3 mm
PY2 73-3313  In Situ Cannula with Basket and Side Port OD 2.0 mm
PY2 73-3315  In Situ Cannula with Basket and Side Port OD 2.3 mm
PY2 73-2946  Ex Vivo Cannula with Basket OD 1.0 mm and Holder to Moi st Chamber
PY2 73-0729  Ex Vivo Cannula with Basket OD 1.3 mm and Holder to Moi st Chamber
PY2 73-2947  Ex Vivo Cannula with Basket and Side Port OD 1.0 mm and Holder to Moi st Chamber
PY2 73-2777  Ex Vivo Cannula with Basket and Side Port OD 1.3 mm and Holder to Moi st Chamber
PY2 73-2778  Ex Vivo Cannula with Basket and Side Port OD 2.3 mm and Holder to Moi st Chamber

Aortic Cannulae to IH-SR System

These special cannulae were designed for cannulating isolated heart to mount specifically on the IH-SR System, see page K8.

Order #  Product
PY2 73-2816  Aortic Cannula to IH-SR, OD 1.0 mm
PY2 73-2857  Aortic Cannula to IH-SR, OD 1.3 mm
PY2 73-2858  Aortic Cannula to IH-SR, OD 1.5 mm
PY2 73-2859  Aortic Cannula to IH-SR, OD 1.8 mm
PY2 73-2860  Aortic Cannula to IH-SR, OD 2.0 mm
PY2 73-2861  Aortic Cannula to IH-SR, OD 2.3 mm
PY2 73-2862  Aortic Cannula to IH-SR, OD 3.0 mm

Aortic Cannulae to IH-5 System

These special cannulae were designed for cannulating isolated heart to mount specifically on the IH-5 System, see page K11.

Order #  Product
PY2 73-3065  Aortic Cannula to IH-5, OD 2.0 mm
PY2 73-2875  Aortic Cannula to IH-5, OD 2.5 mm
PY2 73-2876  Aortic Cannula to IH-5, OD 3.0 mm
PY2 73-2877  Aortic Cannula to IH-5, OD 3.5 mm
PY2 73-2878  Aortic Cannula to IH-5, OD 4.0 mm
PY2 73-2879  Aortic Cannula to IH-5, OD 5.0 mm
PY2 73-2880  Aortic Cannula to IH-5, OD 6.0 mm

Note: IH-SR Cannulae are not compatible with Luer fittings.

Aortic Cannulae with Luer Fitting

Order #  Product
PY2 73-0112  Set of 4 Aortic Metal Cannula with Luer Taper, 2.0, 2.5, 3.0, and 4.0 mm OD
PY2 73-2798  1.0 mm OD Aortic Metal Cannula with Luer Taper
PY2 73-2800  1.3 mm OD Aortic Metal Cannula with Luer Taper
PY2 73-2867  1.5 mm OD Aortic Metal Cannula with Luer Taper
PY2 73-3337  1.8 mm OD Aortic Metal Cannula with Luer Taper
PY2 73-2868  2.0 mm OD Aortic Metal Cannula with Luer Taper
PY2 73-2869  2.3 mm OD Aortic Metal Cannula with Luer Taper
PY2 73-2870  2.5 mm OD Aortic Metal Cannula with Luer Taper
PY2 73-2871  3.0 mm OD Aortic Metal Cannula with Luer Taper
PY2 73-2872  4.0 mm OD Aortic Metal Cannula with Luer Taper

Note: IH-SR Cannulae are not compatible with Luer fittings.
Mini Coaxial Stimulation Electrode

- For electrical stimulation of the isolated perfused heart
- Reduced stray fields for more accurate recordings

These stimulation electrodes are used for electrical stimulation of small heart or tissues. Through the coaxial construction the outer electrode at zero potential acts as a screen so that stray fields are reduced and interference to recordings is limited (ECG, MAP). In combination with the special holder for the PY2 73-0219 electrode and mini ball joint holders for the PY2 73-0181 electrode a precise fixation on the myocard is possible.

Specifications

| Coaxial Stimulation Electrode PY2 73-0219: |   |
| Outside Diameter | 4.3 mm |
| Electrode Length | 75 mm |
| Cable Length | 120 mm Ending on 4 mm Banana Plugs 2-Core Shielded Cable |

| Mini Stimulation Electrode PY2 73-0181: |   |
| Outside Diameter | 1.3 mm |
| Length of Electrode | 20 mm |
| Cable Length | 35 mm Ending on Modified Lemosa Connector 2-Core Shielded Cable |

Order#   Model

| PY2 73-0160 | Small Stimulation Electrode Set, Includes PY2 73-0181 & PY2 73-0182 and 2 Mini Holders |
| PY2 73-0181 | Mini Coaxial Stimulation Electrode |
| PY2 73-0182 | Adapter Cable for Mini Coaxial Stimulation Electrode to 4 mm Banana Plugs |
| PY2 73-0219 | Coaxial Stimulation Electrode |
| PY2 73-0220 | Holder with Ball Joint for Coaxial Stimulation Electrode |

Mini ECG Electrode for Isolated Hearts

This special Monopolar ECG electrode was designed to get the ECG from the surface of isolated hearts. The electrode can be used from the isolated mouse heart up to the pig heart. In combination with the mini ball joint holders a precise fixation on the myocard is possible. Due to the flexible end these electrodes follow the beating heart. Connection: 4 mm banana connector, cable length 1 m.

Note: Two electrodes are necessary for measuring ECG.

Order#   Model

| PY2 73-0200 | Monopolar ECG Electrode for Isolated Heart |
| PY2 73-0148 | Cable with Banana Plugs for ECGA or BPA |
| PY2 73-0562 | Bar with Ball for Mounting on a Stand |
| PY2 73-0174 | Mini Ball Joint Holder, Eye-Eye, L=23 mm |
| PY2 73-0177 | Mini Ball Joint Holder, Eye-Ball, L=23 mm |
Monophasic Action Potential Electrodes

Micro MAP Electrode for Small Isolated Hearts

This special electrode was designed to get the MAP from the surface of isolated hearts. The technique used is described by Prof. Franz (Washington DC). The electrode can be used from the isolated mice heart and rat heart. This electrode has a recording electrode at its tip (diameter 0.8mm) and an integral reference electrode which is side mounted. In combination with the mini ball joint holders a precise fixation on the myocardium is possible. The electrode comes with male 2mm connectors, and requires a link for higher load (PY2 73-0564) to fix on 5mm balls.

Order # Model
PY2 73-3840 Micro MAP-Tip Electrode
PY2 73-0564 Link for Higher Loading Capacity
PY2 73-0152 Connecting Cable for MAP Electrode on BPA
PY2 73-0499 Stand with Rightangular Base
PY2 73-0562 Bar with Ball

Endocardial Action Potential Tip Electrode

- For Isolated Heart Studies
- Integrated reference electrode
- Easy to position using Ball Joint Holders

PY2 73-3715

MAP Electrode for larger isolated hearts

The electrode is used for the larger isolated heart like rabbit or pig. This electrode has a recording electrode at its tip (diameter 0.8mm) and an integral reference electrode which is side mounted. The contact of the reference electrode to the myocard is realized with a sponge. In combination with the mini ball joint holders a precise fixation on the myocardium is possible. The electrode comes with male 2mm connectors and requires a link for higher load (PY2 73-0564) to fix on 5mm balls.

Order # Product
PY2 73-0150 MAP-Tip Electrode
PY2 73-2910 Sponges for MAP-Electrode (pack of 12)
PY2 73-0151 Holder for MAP Electrode for IH-SR System
PY2 73-0152 Connecting Cable for MAP Electrode on BPA
PY2 73-0562 Bar with Ball
PY2 73-0499 Stand with Rightangular Base
**Harvard Apparatus Tissue Clips**

- For suspending biological preparations in tissue vessels
- Rapid sample attachment
- Even clamping pressure
- Lightweight; small size
- Extrem ely low drug absorption
- Easily cleaned

A pair of these tissue clips provides a quick and simple means of attaching small pieces of biological tissue for suspension in isolated tissue vessels. Preparations such as vascular smooth muscle, papillary muscle, skeletal muscle and intestinal sections are particularly well suited for this type of clip. The clip provides firm uniform pressure across the clamping region by means of a stainless steel spring.

**Specifications**

| Overall Size | 3.8 x 11.4 mm (0.150 x 0.450 in) |
| Clamping Pressure | No Slip at 40 g min |
| Clip | Barex 210, Vistron Corp. |
| Axle/Spring | Stainless Steel Tube |
| Weight | 250 mg |

**Order #** | Product
--- | ---
PY2 56-5119 | Harvard Tissue Clips, pkg. of 2

---

**Thread Connection Clip**

This clip permits simple attachment of the tension thread to the transducers. The special feature of the thread clip is that the length of the thread can easily be adjusted without having to undo or make a knot. This clip provides reliable and secure clamping even with fine threads. The Thread Connection Clip is constructed from stainless steel wire which is 0.5 mm in diameter. The overall length of the clip is 45 mm.

**Order #** | Product
--- | ---
PY2 73-0572 | Thread Connection Clip, pkg. of 1

---

**Flat Serrated Hook Clip**

This clip has flat serrated stainless steel hook jaws and side loops. The Flat Serrated Hook Clip is constructed from stainless steel wire which is 0.5 mm in diameter. The overall length of the clip is 17 mm.

**Order #** | Product
--- | ---
PY2 73-0573 | Flat Serrated Hook Clip, pkg. of 1

---

**Pointed Jaw Clip**

This clip features pointed jaws and side loops for simple operation. The Pointed Jaw Clip is constructed from stainless steel wire which is 0.5 mm in diameter. The overall length of the clip is 14 mm.

An Extra Fine Pointed Jaw Clip is also available. It is constructed from stainless steel wire which is 0.4 mm in diameter. The overall length of the clip is 10 mm.

**Order #** | Product
--- | ---
PY2 73-0574 | Pointed Jaw Clip, pkg. of 1
PY2 73-3563 | Extra Fine Pointed Jaw Clip, pkg. of 1

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**Long Flat Jaw Clip**

This clip features long flat jaws and side loops for simple operation. The Long Flat Jaw Clip is constructed from stainless steel wire which is 0.5 mm in diameter. The overall length of the clip is 18 mm. The jaw size is 0.5 x 5 mm.

**Order #** | Product
--- | ---
PY2 73-0575 | Long Flat Jaw Clip, pkg. of 1

---

**Long Jaw Clip**

This Long Jaw Clip has longer jaws. The jaw size is 0.7 x 5 mm. The Long Jaw Clip is constructed from stainless steel wire which is 0.5mm in diameter. The overall length of the clip is 18 mm.

**Order #** | Product
--- | ---
PY2 73-3340 | Long Jaw Clip, pkg. of 1

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**Harvard Heart Clips**

These light, spring wire heart clips are used to attach a thread to a frog or mammalian heart. Both clips are made of stainless steel wire and ensure a firm grip.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Description</th>
<th>Clip Length</th>
<th>Clip Spread Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 50-5009</td>
<td>Frog Heart Clips</td>
<td>16 mm (0.6 in)</td>
<td>7 mm (1/4 in)</td>
</tr>
<tr>
<td>PY2 50-5017</td>
<td>Mammalian Heart Clips</td>
<td>32 mm (1-1/4 in)</td>
<td>10 mm (0.4 in)</td>
</tr>
</tbody>
</table>

* Supplied in packages of 5.
Tissue Clips & Hooks (continued)

Triangular Hooks
- Three sizes available for tissue rings
- Ideal for cylindrical vessel segments and tracheal rings
- Holder for vessel segments up to 8 mm (0.3 in) in length

These Triangular Hooks are used to support tissue rings for cylindrical vessel segments and tracheal rings. All 3 sizes are constructed from stainless steel wire which is 0.3 mm in diameter.

Order #  Product
PY2 73-2257  Triangular Hook Size 0, Hook Width 5.0 mm, Height 5.4 mm, Loop Ø 2.0 mm, pkg. of 1
PY2 73-2249  Triangular Hook Size 1, Hook Width 8.0 mm, Height 9.0 mm, Loop Ø 2.5 mm, pkg. of 1
PY2 73-2258  Triangular Hook Size 2, Hook Width 12.0 mm, Height 11.0 mm, Loop Ø 3.0 mm, pkg. of 1

Long Loop Clip
The Long Loop Clip is constructed from stainless steel wire which is 0.3 mm in diameter. It is similar to the PY2 73-3340, but is finer in dimensions. The overall length of the clip is 16 mm. The jaw diameter is 2 mm.

Order #  Product
PY2 73-0577  Long Loop Clip, pkg. of 1

Organ Hook
The Organ Hook Clip has a pointed hook that permits easy mounting of organs. It is constructed from stainless steel wire which is 0.5 mm in diameter. The overall length of the hook is 7.5 mm.

Order #  Product
PY2 73-0578  Organ Hook, pkg. of 1

Serre Fine Tip Closing Clip
This Serre Fine Tip Closing Clip features tip closing jaws for securing tissues. It is constructed from stainless steel wire which is 0.5 mm in diameter. The jaw measures 3 mm. The overall length of the clip is 17 mm.

Order #  Product
PY2 73-3339  Serre Fine Tip Closing Clip, pkg. of 1

Holder for Vessel Segments
This triangular holder is used for holding vessel segments. One pair is required per vessel segment. It is constructed from stainless steel wire which is 0.3 mm in diameter. The maximum vessel segment length is 8 mm (0.3 in).

Order #  Product
PY2 73-2259  Holder for Vessel Segments, 1 pair

Holder for Vessel Segments, Twisted 90°
This triangular holder is used for holding vessel segments. One pair is required per vessel segment. The bottom triangle is twisted to hold the tissue at 90° from top holder. It is constructed from stainless steel wire which is 0.3 mm in diameter. The maximum vessel segment length is 8 mm (0.3 in).

Order #  Product
PY2 73-3096  Holder for Vessel Segments, Lower Triangle Twisted by 90°, 1 pair
Experiments on isolated organs and tissues require the use of clamping devices for locating cannulae, probes and sensors in the correct position relative to the preparation. With the reduced size of modern murine preparations there is now a need for more sensitive devices, light in weight, freely adjustable, and requiring minimal force for adjustment.

HSE-HA mini 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 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.

Mini ball joint holders are ideal for use on small operating tables and especially inside small organ chambers where space is extremely limited. There are complete kits available for measuring isovolumetric LVP balloon pressure in mice hearts, ECG detection from mice hearts and stimulation of mice hearts. Other possibilities are: mounting of small flow probes on open chest experiments in mice or rats, mounting of cannulas on small isolated organs like liver, kidney, lung, hearts. A lot of further applications are possible. For self-created applications the following parts can be used.

### Order | Product
--- | ---
PY2 73-0566 & Plexiglass Block Clamp for Mounting Bar PY2 73-0562 on a Stand
PY2 73-0562 & Bar with Ball for Mounting on a Stand, D=8 mm, L=140 mm, Ball Size=5 mm
PY2 73-0174 & Mini Ball Joint Holder, Eye-Eye, L=23 mm
PY2 73-0175 & Mini Ball Joint Holder, Eye-Eye, L=42 mm
PY2 73-0176 & Mini Ball Joint Holder, Eye-Ball, L=18 mm
PY2 73-0177 & Mini Ball Joint Holder, Eye-Ball, L=23 mm
PY2 73-3321 & Mini Ball Joint Holder, Eye-Ball, L=35 mm
PY2 73-0563 & Mini Ball Joint Holder, Ball-Ball, L=18 mm
PY2 73-0564 & Link for Higher Loading Capacity, for Two Arms with Balls, L=23 mm
PY2 73-0565 & Universal Holder with Eye and Free End for Fixation of Ultrasonic Crystals, ECG Electrodes, etc., L=20 mm
PY2 73-0178 & Mini Ball with 7mm Length Thread M2

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**Application Example:**

Mini Coaxial Stimulation Electrode with Mini Ball Joint Holders, Bar with Ball and Plexiglass Block Clamp

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**Mini Ball Joint Holder (Eye-Ball), 18 or 23 or 35 mm Length**

**Mini Ball Joint Holder (Ball-Ball), 18 mm Length**

**Mini Ball Joint Holder (Eye-Eye), 23 or 42 mm Length**

**Plexiglass Block Clamp for Mounting Bar PY2 73-0562 on Stand**

**Bar with Ball for Mounting on a Stand, D=8 mm, L=140 mm, Ball Size=5 mm**

**Mini Ball with 7 mm Length Thread M2**

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Harvard Apparatus • phone 508.893.8999 • toll free U.S. 800.272.2775 • fax 508.429.5732 • www.harvardapparatus.com K71
**General Use Tissue Vessels**

**Jacketed Tissue Vessels**
- Accommodate all standard isolated pharmacological preparations
- Both ‘fixed’ and ‘detachable’ stem types — each available in three sizes
- Equally suitable for research or student use
- ‘Detachable’ stem types allow researcher to change vessels and leave stem portion connected into circuit for ease of attaching preparation
- Hook in vessels anchors preparations
- Sintered airway tube in each vessel for oxygenation
- Level tube in each vessel maintains level of fluid
- Side limbs are in constant position in all vessels to facilitate interchange or substitution

These glass Harvard Apparatus Jacketed Tissue Vessels accommodate all standard isolated pharmacological preparations and are equally suited for research or student use. The vessels are offered in both ‘fixed’ one piece form or in ‘detachable’ two piece form. The detachable stem jacketed tissue vessels are particularly useful because vessels of the same or different capacities can be interchanged without taking the cone portion out of the external circuit. The cone joints are all 14/23. A hook is provided inside each vessel to anchor the preparation. Each vessel also has an airway tube with a No. 1 porosity, sintered disc for oxygenation. The level tube at the top of each vessel maintains a constant level of fluid in the vessel. It is close to the side wall and clear of the bath. All side limbs are located in a constant position with the same diameter openings for more convenient interchangeability or substitution. The two limbs for connection to the PY2 50-1932 Thermocirculator are purposely made slightly larger than the fluid preparation limbs to increase the flow of warming water and minimize temperature gradients that could occur with multiple set-ups. The detachable jacketed tissue vessels are supplied complete with the tissue chamber, detachable stem and two stainless steel springs to hold the cone in the socket. The springs connect to hooks on each fitting.

**Order #** | **Product**
---|---
PY2 50-1569 | Fixed Stem Jacketed Tissue Vessel, 10 ml capacity, 14 mm ID
PY2 50-1577 | Fixed Stem Jacketed Tissue Vessel, 20 ml capacity, 18 mm ID
PY2 50-1585 | Fixed Stem Jacketed Tissue Vessel, 25 ml capacity, 20 mm ID
PY2 50-1510 | Detachable Stem Jacketed Tissue Vessel, 10 ml capacity, 14 mm ID
PY2 50-1528 | Detachable Stem Jacketed Tissue Vessel, 20 ml capacity, 18 mm ID

**Spares for Detachable Stem Vessels**
- PY2 50-1536 Detachable Stem Jacketed Tissue Vessel, 25 ml capacity, 20 mm ID
- PY2 50-1445 Tissue Chamber, 10 ml
- PY2 50-1478 Tissue Chamber, 20 ml
- PY2 50-1486 Tissue Chamber, 25 ml
- PY2 50-2096 Stem Only to fit 14/23 Cone Joint of Tissue Chamber
- PY2 50-2088 Springs, pkg. of 2

**‘Bennett Type’ Isolated Tissue Vessel**
A distinct advantage of this improved glass Isolated Tissue Vessel is that substances added to the tissue chamber cannot diffuse out. It is similar in construction to other Harvard Apparatus Tissue Vessels in that the chamber containing the tissue chamber and warming coil are kept at a constant temperature by means of the jacketed water assembly. In operation, water of the desired temperature is circulated through the water jacket and physiological solution (perfusate) is passed through the warming coil to fill the tissue chamber. Gas (oxygen, carbon dioxide, etc.) is introduced into the chamber through a 6 mm OD diameter orifice. The action of the gas entering the chamber forms an effective seal that separates the contents of the tissue chamber from the warming coil. This prevents diffusion of the bath contents into the coil. The ‘Bennett Type’ Tissue Vessel has a capacity of 20 ml. The inner chamber diameter is 17.5 mm (2/3 in).

**Order #** | **Product**
---|---
PY2 50-8325 | Bennett Type Isolated Tissue Vessel, 5 ml
PY2 50-8333 | Bennett Type Isolated Tissue Vessel, 10 ml
PY2 50-8341 | Bennett Type Isolated Tissue Vessel, 20 ml
Double ‘Baker’ Heart Perfusion Set

- Maintains constant temperature of the heart regardless of coronary flow
- Eliminates any bubbles that may enter the cannula
- Restricts the drying of the heart tissue

This Set consists of three elements:

- **Double Baker Warming Coil**
- **Baker Heart Cannula**
- **Baker Heart Chamber**

The Double Baker Coil has two separate fluid warming coils heated by the same bath. This allows the heart to be perfused with different solutions. Oxygenated perfusion fluid enters the bottom of each Warming Coil and is warmed by circulating water. Each coil connects to a straight tube that runs axially through the coil.

A piece of pinched silicone rubber at the top of the straight tube acts as a bubble trap and injection site. The changeover stopcock design allows one coil to be used for perfusion while the other is being warmed.

The excised heart is suspended from the Heart Cannula which fits into the bottom straight tube of the Warming Coil. This tube has a rubber tube attached to it to ensure a tight fit. A side arm of the Heart Cannula is used to monitor pressure by means of a manometer or pressure transducer (not included). This Heart Cannula with the excised heart is then enclosed in the Jacketed Heart Chamber.

The Jacketed Heart Chamber is warmed by the same water from the warming coil and encloses the heart suspended from the Heart Cannula. An aperture at the bottom of the chamber allows a thread to pass through for transmitting ventricular contractions and drips from coronary outflow.

Order #  Product
PY2 50-0884  Double Baker Heart Perfusion Set
PY2 50-8382  Double Baker Warming Coil
PY2 50-8366  Baker Heart Cannula
PY2 50-8374  Baker Heart Chamber

Single ‘Baker’ Heart Perfusion Set

Harvard Apparatus also offers a Baker Type Single Warming Coil Set. This Set contains the same components as the Double Baker Heart Perfusion Set except that it comes with a Baker Single Warming Coil in place of the Double Warming Coil.

Order #  Product
PY2 50-0876  Single Baker Heart Perfusion Set
PY2 50-8358  Single Baker Warming Coil
PY2 50-8366  Baker Heart Cannula
PY2 50-8374  Baker Heart Chamber

**Vertical Thermometer**

This Thermometer is graduated to be read when the Thermometer is vertical, as in baths.

Harvard offers this Thermometer in two lengths: 10 cm (4 in) and 15 cm (6 in).

Order #  Product
PY2 50-0355  Vertical Thermometer, 10 cm (4 in)
PY2 50-2401  Vertical Thermometer, 15 cm (6 in)

**Thermometer Holder**

This Thermometer Holder is a one-piece plastic design that hooks over the top edge of a water bath, beaker or other apparatus. The Thermometer is held vertically and can be raised or lowered in the Holder to obtain the desired depth of immersion.

Order #  Product
PY2 50-0355  Thermometer Holder
Heart Mounting Junction Block

This clear acrylic 25 mm (1 in) thick Junction Block brings together the Heart Cannula, Thermometer, Manometer and the warmed perfusate from the Jacketed Fluid Warming Coil. The block is 10.2 cm (4 in) long and 3.8 cm (1-1/2 in) wide and has a 13 mm (1/2 in) hole and locking screw for mounting on the rod of the PY2 50-0470 Pharmacology Stand, see page O18.

The front of the Block has three 9.5 mm (3/8 in) tapered holes and a stainless steel Luer connector joining at a central cavity. The Luer connector accepts the PY2 50-0637 Heart Cannula on which the excised heart is attached. The PY2 50-0629 Thermometer with Rubber Bung is fitted into one of the horizontal holes and the PY2 50-0611 Manometer is fitted into the other. The plastic male connector from the PY2 50-0512 Jacketed Warming Coil fits into the top hole. The Block has a vertical 9.5 mm (3/8 in) hole with locking screw for a 7.5 cm (3 in) long mounting rod provided. This is used for mounting transducers or kymograph levers. A horizontal 9.5 mm (3/8 in) hole and locking screw accepts the mounting rod of the PY2 50-0611 Manometer.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 50-0603</td>
<td>Heart Mounting Junction Box</td>
</tr>
</tbody>
</table>

Heart Cannula

- To mount the heart and pass the warmed perfusant to the heart
- Allows direct injections into the heart chambers

The cannula is made completely of nylon and has three Luer fittings. The bottom section to which the aorta is tied is detachable and fits to the bottom Luer fitting of the main body of the cannula. A shoulder on the plastic spigot facilitates tying the aorta. The main cannula itself fits to a Luer fitting on the bottom of the PY2 50-0603 Junction Block. The third Luer fitting is located off the side of the main body of the cannula. A tiny funnel in this limb has a fine 0.36 mm nylon tube attached to it that extends down through the cannula and protrudes through the bottom, thereby serving as a fine injection cannula inside the main cannula. This limb is covered with a rubber cap, through which a needle can be passed to make injections directly into the heart chambers.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 50-0637</td>
<td>Heart Cannula</td>
</tr>
</tbody>
</table>

Manometer

This sturdy Manometer with heavy-walled 3.2 mm (1/8 in) tubing is mounted on a white 4.8 mm (3/16 in) thick plastic block measuring 5 x 24.1 cm (2 x 9-1/2 in). It is mounted on a 10.2 cm (4 in) long, 9.5 mm (3/8 in) diameter rod for mounting in the PY2 50-0603 Junction Block, or a clamp. The scale is bright plated metal calibrated from 0 to 250 mmHg. The scale slides up and down behind the tubing for easy zeroing.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 50-0611</td>
<td>Manometer</td>
</tr>
</tbody>
</table>
**NEW Perfadex® Perfusion Media & STEEN Solution**

**NEW Perfadex Perfusion Media for Organ Preservation**

**Key Features**
- Improves immediate post-transplant lung function (PO₂/FiO₂ ratio)
- Reduces 30-day mortality
- Prevents ischemia-reperfusion injury
- Protects surfactant function

Perfadex® is a colloid containing lightly buffered “extracellular” low K⁺ electrolyte solution for rapid cooling, perfusion and storage of organs in connection with transplantation. Extensive experimental and clinical documentation in lung transplantation has shown Perfadex® to be superior to EuroCollins solution.

**Mechanism of action**

The composition of Perfadex® has been specifically formulated to preserve the function and integrity of organs rich in endothelium during flushing and cold ischemic storage prior to transplantation and reperfusion. Its colloid component, dextran 40, particularly protects the microvasculature against post-ischemic reperfusion injury, primarily by preventing pathological leukocyte-endothelial interaction. It also prevents edema and counteracts thrombosis. Perfadex® is thus an ideal solution for the preservation of vascular grafts, pancreas and lungs in particular. It may also be used as a base or ‘carrier’ solution for other organ-specific electrolytes or active components such as scavengers, immunosuppressants or gene therapy.

**Composition**

- 5% dextran 40 (Mw 40,000)
- Na⁺ 138 mmol
- K⁺ 6 mmol
- Mg²⁺ 0.8 mmol
- Cl⁻ 142 mmol
- SO₄²⁻ 0.8 mmol
- H₂PO₄⁻ plus HPO₄²⁻ 0.8 mmol
- glucose 5 mmol

**Order #**  
**Product**  
PY2 72-9596  
Perfadex® 250 ml, 20 x 250 ml Bottles

**NEW STEEN Solution™ for Organ Perfusion**

**Key Features**
- A more refined functional ex-vivo evaluation of physiological parameters
- Normothermic functional evaluation without edema formation
- Permits more rational and efficient use of organ specimens

Originally developed for normothermic perfusion of human lungs for transplant, STEEN Solution™ is appropriate for perfusion of any isolated organ where prevention of edema and limitation of leukocyte-induced tissue injury is desired.

**Composition and Mechanism of action**

- Human Serum Albumin – provides normal oncotic pressure preventing edema formation
- Dextran – a mild scavenger which coats and protects endothelium from subsequent excessive leukocyte interaction11,11 and thrombogenesis.12
- Extra-cellular electrolyte composition (low K⁺) – reduces free radical generation13 and avoids vascular spasm under normothermic conditions.

**Order #**  
**Product**  
PY2 72-9598  
STEEN Solution™, 1 x 125 ml Bottle

**Harvard Apparatus distributes Perfadex® and STEEN Solution for animal research purposes only.**
Aedesta Liquid Media

Aedesta Liquid Media for Cells, Tissues and Organs

Aedesta Cryopreservation Medium allows for the full elimination of DMSO from all culturing and cryopreservation protocols. This not only bypasses the deleterious effects of DMSO on tissue and cells, but also eliminates the time-consuming and potentially harmful process of DMSO removal and allows the researcher to move directly to downstream experimental procedures.

This unique, proprietary solution is specifically designed for longer-term preservation of tissues and cells over a broad range of temperatures. Ideally suited as a physiological transportation medium, it is now possible for the first time to store and ship most cells and tissues for seventy-two hours (3 days) at room temperature or one hundred sixty-eight hours (7 days) at refrigerated temperatures.

This preservation solution can also be used for perfusion, transportation, or static storage of animal organs and tissues. Aedesta Tissue and Cell Preservation Medium not only significantly extends the preservation time, but also continuously nourishes the organ or tissue cells through its proprietary oxygen and nutrient carrying properties. These characteristics can significantly extend the life of isolated organs and tissues at room temperature while helping to maintain tissue metabolism and prevent tissue necrosis.

Order # Product
PY2 72-7485 Aedesta Cryopreservation Medium, 25 ml
PY2 72-7486 Aedesta Cryopreservation Medium, 2x25 ml
PY2 72-7487 Aedesta Cryopreservation Medium, 100 ml
PY2 72-7488 Aedesta Organ Perfusion Medium, 1000 ml
PY2 72-7489 Aedesta Tissue and Cell Preservation Medium, 25 ml
PY2 72-7490 Aedesta Tissue and Cell Preservation Medium, 2x25 ml
PY2 72-7491 Aedesta Tissue and Cell Preservation Medium, 100 ml
PY2 72-7492 Aedesta Tissue and Cell Preservation Medium, 500 ml

• Superior performance
• Aedesta solution is ideal for:
  1) Cryopreservation
  2) Tissue and cell preservation medium
  3) Organ and tissue perfusion
• Room and refrigerated temperature applications
• Proprietary oxygen carrying capability
  – No animal serum
  – No animal proteins
  – No DMSO
• Protect tissue sample DNA/RNA
• Nanoparticle technology
PROTOWIN for Isolated Tissue & Organ Experiments

Key Features
- Simultaneous or independent start-stop for each channel (tissue)
- Data given separately for up to 16 channels (tissue preparations)
- Help included in the program
- Simple, intuitive and guided channel calibration and balancing process

Parameters Measured
- DE-50% calculation and DR-Plot graph with correlation parameters and confidence margins
- Response curves for each tissue
- Multiple plot graphics to study parallelism
- PA2 and Schild Plot calculation

Components Included
- Software CD and USB protection key
- Instructions manual
- Free technical assistance
- Free scientific support
- Cables and connectors

Specifications

<table>
<thead>
<tr>
<th>Channels</th>
<th>1 to 8 tissue Chambers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling Frequency</td>
<td>Choice of 1 to 100 Samples/Second</td>
</tr>
<tr>
<td>Available Units</td>
<td>Mmol, µg/ml, mg/ml, µg/bath, mg/bath</td>
</tr>
<tr>
<td>Computer Requirements</td>
<td>2 GHz Processor or Higher (excluding Celeron and AMD Sempron), 512 MB RAM, two USB 2.0 ports available</td>
</tr>
<tr>
<td>Software Requirements</td>
<td>Windows™ 2000 or XP Compatible Operating System</td>
</tr>
</tbody>
</table>

PROTOWIN is a complete software package for monitoring isolated tissue experiments and represents a very powerful tool saving the user time and effort in the awkward calculations involved in this research area. Its interactive design makes it very easy to use and its extensive features make it an essential tool for teaching and research.

The software can analyze and store signals from up to 8 channels (i.e., from up to 8 tissue preparations) simultaneously or in an independent manner. The analog signal charts can be viewed on the screen one by one or in sets of four units at a time. Independent adjustment of full scale range, time axis and offset are available for each channel, as well as independent base—maximum plot for each point.

The system facilitates the extraction of data into a spreadsheet for further analysis. Regular data back-up is automatically performed as a safety measure in case of accidental computer shutdown.

Order #  Model  Product
PY2 76-0038  PROTOWIN  Software for Organ Bath, Up to 8 Channels, Dose/Response

Citations
- Neto Mde M et al. (2007) Orally administered rapamycin does not modify rat aortic vascular tone (Proto-5, vascular smooth muscle, Brazil)
- Fortunio A et al. (1999) Torasemide inhibits angiotensin II-induced vasconstriction and intracellular calcium increase in the aorta of spontaneously hypertensive rats. Hypertension 34: 138-143. (Proto-5, rat aortic rings,
HA-HSE ISOHART® W for Isolated Heart Studies

- 16 channel data acquisition software for isolated heart experiments
- For Windows® XP and VISTA Pro
- To measure signals such as: perfusion pressure, perfusion flow, left ventricular isovolumetric pressure, aortic pressure, aortic flow, atrial pressure, atrial flow, coronary flow, ECG, MAP, segment length, wall thickness, \( pO_2 \), \( pCO_2 \), pH, temperature, etc.
- Easy to use, reduced settings by using configuration files
- Storage of raw data with possibility for replay. Complete experiments can be replayed
- Indication of the measured signals and parameters online in numerical tabular form or graphical detail and trend windows
- Data exchange interface by converting the data into the ASCII delimited format to be imported into spreadsheets or statistical software
- Monitoring of the experimental sequence by placing event markers and concentration information
- Very easy graphical selection of specific data points by cursors for evaluation, data reduction and export
- Export of a raw data sequence into ASCII delimited format

The HA-HSE ISOHART software for Windows can be adapted to virtually any experimental investigation of isolated hearts (according to Langendorff or Working Heart). Acquisition can cover signals such as perfusion pressure, perfusion flow, left ventricular pressure, aortic pressure, aortic flow, atrial pressure, coronary flow, segment length or wall thickness measurement, \( pO_2 \), \( pCO_2 \), pH, temperature, etc. Various parameters can be derived from these signals, (e.g., systolic, diastolic, mean and rate (frequency) values for pressures); \( dP/dt \), contractility index CI; minimal, maximal, and mean flows, etc. During data acquisition all acquired signals and derived parameters are stored on the hard disk and can be displayed on the screen.

The HA-HSE ISOHART software is available in a basic version which includes the minimal necessary algorithms. It can be upgraded to a more complex system including all the available algorithms. The configuration of the system is defined in configuration files to reduce the amount of settings necessary and to ensure a stable and secure system. The user has only to calibrate the signals and to fix the graphics scaling. All the hardware definitions and the algorithms used are defined in the configuration files. This reduces the amount of information necessary in the SOP’s and the possibilities of wrong settings. The configuration files can of course be changed and the software can be used in combination with a set of different configuration files to match the different experiments. ISOHART is a menu-controlled software and employs special algorithms to calculate the standard parameters.

The HA-HSE ISOHART software has a maximum of 16 channels, i.e. up to 16 different raw signals can be handled (32 channel available as option, special hardware is required). The assignment of the signals to the individual channels is determined in the configuration files. The sample rate, the type of signals and the algorithm used for analysis are also defined in the configuration file.
HA-HSE ISOHEART® W for Isolated Heart Studies (continued)

The arrangement of the graphic detail (raw signals) and trend (calculated parameters) is defined in the menu. The user has only to set up which of the available signals he wants to acquire and display, which of the possible parameters he wants to evaluate and display; to enter the experimental protocol and finally to calibrate before he starts the data acquisition.

HSE-HA Data Acquisition Hardware for ISOHEART Software is available in two versions:
- **PLUGSYS Version**
  This version consists of the PCI A/D board DT301, ROM-DL, DIM and the cable for connecting to a DIM Data Interface Module installed in the PLUGSYS basic system case type 603
- **USB Stand Alone Version**
  This version consists of the 16 channel USB A/D converter box with BNC inputs and USB cable

**Hardware Requirements for ISOHEART:**
Both the PLUGSYS and Stand Alone Versions require the following computer hardware:
- **Computer**
  PC Pentium IV with 1 GHZ or More with One Free Long PCI Slot and US B2.0
- **RAM**
  256 MB of RAM
- **Operating System**
  Windows XP/Vista PRO
- **Hard Disk Space**
  At least 100 GByte
- **Floppy Drive**
  1.44 MByte
- **CD-ROM Drive**
  Required
- **Monitor**
  17 or 19 inch Flat Panel
- **Backup Media**
  CD Recorder

**Commonly Used Signals for Langendorff Preparation are:**
- **LVP**
  Isovolumetric LVP or Contraction Force
- **PP**
  Perfusion Pressure
- **CF**
  Coronary Flow
- **WT**
  Wall Thickness or Left Ventricle Diameter
- **EG**
  Electrogram
- **MAP**
  Monophasic Action Potential
- **pO₂/a / e**
  Oxygen Partial Pressure in the Affluent/Effluent
- **pH**
  pH in the Effluent

**Commonly Used Signals for Working Heart Preparation are:**
- **PrP**
  Preload Pressure
- **AoP**
  Aortic Pressure (afterload)
- **LVP**
  Left Ventricular Pressure, Measured with Tip Catheter
- **AF**
  Aortic Flow
- **CO**
  Cardiac Output (flow into left atrium)
- **EG**
  Electrogram
- **MAP**
  Monophasic Action Potential
- **WT**
  Wall Thickness or Left Ventricle Diameter
- **pO₂/a / e**
  Oxygen Partial Pressure in the Affluent/Effluent
- **pH**
  pH in the Effluent

It is also possible to acquire other signals (e.g., temperature); maximum is 16 signals.

**Standard ISOHEART Software is able to Calculate Following Parameters Online:**
- **From LVP Signal:**
  LVPsys, LVPdia, LVPEDP, dLVP/dtmin, dLVP/dtmax, Heart Rate, Mean Pressure
- **From all Pressures:**
  Systolic, Diastolic and Mean Pressure
- **From all Flows:**
  Mean, Maximum and Minimum Flow
- **From Distance:**
  Maximum, Minimum and Amplitude (max - min)
- **From Electrogram:**
  Heart Rate
- **From pO₂, pCO₂ and pH:**
  Mean Value

**For Specific Applications, Software Modules with More Parameters are Available:**
- **Advanced LVP:**
  Tau, Time to Peak, Relaxation Time, Contractility Index C=dp/dtmax/P, Ejection Time
- **Advanced Flow:**
  End Systolic Flow ESFL, End Diastolic Flow EDFL
- **MAP Module:**
  Max, Min, Amp, Rate, ±dv/dt, Duration at 10% of Monophasic Action Potentials (APD 90)
- **Dimension Module:**
  End-Systolic Length ESL, End-Diastolic Length EDL, +dL/dt, -dL/dt

**Software Options for Controlling External Devices:**
- **Control of Programmable Stimulator PSM**
- **Triggering of an External Stimulator**
- **Control of Syringe Pump for Flow Controlled Drug Infusion**

**Order # | Product**
--- | ---
PY2 73-0162 | HA-HSE ISOHEART W Software
PY2 73-0161 | HA-HSE Data Acquisition Hardware PLUGSYS Version
PY2 73-3330 | HSE-USB Data Acquisition Hardware, Stand Alone Version
PY2 73-3704 | HA-HSE Data Acquisition Hardware Stand Alone Version 32 Channels
PY2 73-3705 | Option 32 Channels Extension Requires PY2 73-3704
PY2 73-0237 | Option LVP Advanced Module
PY2 73-0238 | Option Flow Advanced Module
PY2 73-2715 | Option Monophasic Action Potential Module
PY2 73-2716 | Option Dimensions Module
PY2 73-0224 | Option PSM Stimulator Control Module
PY2 73-3819 | Option for Flow Controlled Drug Addition with Pump 22 or PHD2000 Syringe Pump
PY2 73-2799 | PV Loop Module
The HA-HSE ACAD software can be adapted to virtually any experimental investigation in tissue bath experiments. It is possible to acquire signals from isotonic (displacement) or isometric (force) measurements. The isotonic displacement measurement is used on smooth muscles, for example on ileum, ductus deferens, lung strips, also bladder... Isometric force measurement is used with tracheal muscle, atrium, papillary muscle, aortic rings, veins or other vessel rings. Experiments on spontaneously beating or electrically stimulated tissues are also possible. Various parameters can be derived from these signals depending on the model used. During data acquisition all acquired signals and derived parameters are stored on the hard disc and can be displayed graphically on the screen.

The HA-HSE ACAD software is available in a basic version which includes the minimal necessary algorithms to evaluate the resting tension. This version can be upgraded to a more complex system including all the available algorithms. The configuration of the system is defined in configuration files to reduce the settings necessary and to ensure a stable and secure system. The user has only to calibrate the signals and to fix the graphics scaling, all the hardware definitions and the algorithms used are defined in the configuration files. This reduces the amount of information necessary in the standard operating procedures and the possibilities of wrong settings. The configuration files can of course be changed and the software can be used in combination with a set of different configuration files to match the different experiments.

It was developed for use with our universal setup for isolated organ studies. It can also be used with any existing manually-operated organ bath setup. The HA-HSE ACAD software has a maximum of 16 channels, i.e. up to 16 different raw signals can be handled (32 channel available as option, special hardware is required). The assignment of the signals to the individual channels is determined in the configuration files. The sample rate, the type of signals and the algorithm used for analysis are also defined in the configuration file. The arrangement of the graphic detail (raw signals) and trend (calculated parameters) is defined in the menu. The user has only to set up which of the available signals he wants to acquire and display, which of the possible parameters he wants to evaluate and display, to enter the experimental protocol and finally to calibrate before he starts the data acquisition. The ACAD software operates only with the PLUGSYS hardware when electrical stimulation using PSM modules is required!

**The HA-HSE Data Acquisition Hardware for ACAD Software is Available in Two Versions:**

- **PLUGSYS Version for Case Type 603**
  
  This version consists of the PCI A/D board DT301, ROM-DL, DIM and the cable for connecting to a DIM Data Interface Module installed in the PLUGSYS basic system case, in Section I of this Catalog.

- **USB Stand Alone Version**
  
  This version consists of the 16 channel USB A/D converter box with BNC inputs and USB cable.

- 16-channel data acquisition software for isolated tissue studies
- For Windows® XP and Vista Pro
- To measure isometric or isotonic tissue contractions
- Can handle smooth muscle as well as beating or electrically stimulated muscle
- Possibilities of controlling electrical stimulation, pretension adjustment and flushing
- Easy to use, reduced settings by using configuration files
- Storage of raw data with possibility for replay; complete experiments can be replayed
- Indication of the measured signals and parameters online in numerical tabular form or graphical detail and trend windows
- Data exchange interface by converting the data into the ASCII delimited format for importing into spreadsheets or statistical software
- Monitoring of the experimental sequence by placing event markers and concentration information
- Very easy graphical selection of specific data points by cursors for evaluation, data reduction and export
- Export of a raw data sequence into ASCII delimited format
HA-HSE ACAD for Isolated Tissue Studies (continued)

Hardware Requirements for ACAD:
Both the PLUGSYS and Stand Alone versions require the following computer hardware:

- **Computer**: PC Pentium IV with 1 GHz or More with One Free Long PCI Slot and US B2.0
- **RAM**: 256 MB of RAM
- **Operating System**: Windows XP and Vista
- **Hard Disk Space**: At Least 100 GByte
- **Floppy Drive**: 1.44 MByte
- **CD-ROM Drive**: Required
- **Monitor**: 17 or 19 Inch Flat Panel
- **Backup Media**: CD Recorder

The PLUGSYS Maincase can receive the Transducer Amplifiers TAM-A. The housing takes also the Programmable Stimulator Modules PSM or the PPG Module for triggering an external Stimulator.

The Basic Version of HA-HSE ACAD for Smooth Muscles Calculates the Following Parameter:
- **Resting tension**

The Option for Beating Tissues Additionally Calculates the Following Parameters:
- **Amplitude, rate, ±dF/dt**

The Advanced Version for Stimulated Beating Tissues Additionally Calculates the Following Parameters:
- **Amplitude, rate, ±dF/dt, contraction time CT, relaxation time RT, response duration RD, peak duration PD**

This version can be used for beating tissues and stimulated beating tissues such as atrium or papillary muscle. To calculate the Latency Period computer-controlled stimulation of the tissue is necessary. It is possible to use the HSE-HA Programmable Stimulator PSM or to trigger an external stimulator by using a PPG module.

<table>
<thead>
<tr>
<th>Order #</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY2 73-1688</td>
<td>HA-HSE ACAD W Software</td>
</tr>
<tr>
<td>PY2 73-0161</td>
<td>HA-HSE Data Acquisition Hardware PLUGSYS Version</td>
</tr>
<tr>
<td>PY2 73-3330</td>
<td>HSE-USB Data Acquisition Hardware, Stand Alone Version</td>
</tr>
<tr>
<td>PY2 73-3704</td>
<td>HA-HSE Data Acquisition Hardware</td>
</tr>
<tr>
<td>PY2 73-3705</td>
<td>Option 32 Channels Extension requires PY2 73-3704</td>
</tr>
<tr>
<td>PY2 73-1715</td>
<td>Option Beating Tissue Module</td>
</tr>
<tr>
<td>PY2 73-1703</td>
<td>Option Beating and Stimulated Tissue Module</td>
</tr>
<tr>
<td>PY2 73-0224</td>
<td>Option PSM and PPG Control Module</td>
</tr>
</tbody>
</table>
PowerLab Data Acquisition Systems are complete data acquisition and analysis solutions for academic institutions, government organizations and private industry. Supplied with Chart™ and Scope™ software, PowerLab® systems offer comprehensive data recording, display and analysis features for a wide variety of research applications.

Around the PowerLab system we provide a range of amplifiers, instruments and specialized analysis software to provide a complete research solution.

The PowerLab Advantage:

**Hardware**

PowerLab systems combine software-controlled input of parameters, extensive signal conditioning options, variable sampling speeds and powerful real-time computations with the advantages of computer-based data display and analysis. They offer the functionality of a chart recorder, X-Y-T plotter, digital voltmeter and storage oscilloscope in one compact unit.

PowerLab systems connect to Windows and Macintosh computers using high-speed USB. Four, eight and sixteen-channel models are available with sampling and online computation speeds of up to 200 kHz per channel (400 kHz aggregate). They feature independently selectable input sensitivities, high-pass, low-pass and anti-aliasing filters, 16-bit resolution, analog outputs as well as digital input and output connections for triggering and controlling external devices.

**Signal Conditioners**

A wide range of software-controlled preamplifiers is available for use with PowerLab data acquisition systems. Once connected, the signal conditioners are automatically identified and configured by the PowerLab system with all settings stored when the data file is saved on your computer.

**Instruments, Transducers and Accessories**

An extensive selection of instruments, transducers and accessories is also available to cover numerous life science applications. Third-party products sourced from gold-standard manufacturers are fully compatible with PowerLab recorders and signal conditioners.

*Proven track record with installations in thousands of research institutes, universities, hospital and commercial laboratories around the world.*

*Power and flexibility to be used in a variety of life science applications. Start with a PowerLab system and simply add an appropriate amplifier, instrument or transducer.*

*Quality and reliability: all products are manufactured under a quality system certified by an accredited body as complying with ISO 9001:2000.*

*Data integrity is paramount. PowerLab data acquisition systems are calibrated and tested to deliver data you can trust.*

*GLP and 21 CFR Part 11 compliance is facilitated when a PowerLab system is used with the GLP Module and GLP Server software. Together they provide the required user interface, audit trail and signing components for non-repudiation of data.*

*Intuitive and powerful software allows researchers to concentrate on the science. With no programming required, the software is mastered quickly and provides comprehensive recording, display and analysis features.*

*Combine with Harvard Apparatus research systems to create complete solutions for virtually any bio-research application.*
**Software**

**LabChart**

LabChart is suitable for research on any species – from humans 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 set up of experimental parameters, powerful computation and analysis features are just the beginning.

Configuring recording parameters, such as range and filters, takes seconds, with all of the information, including settings, calibrations 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.

**The LabChart Advantage**

- Data integrity
- Display and recording of up to 16 channels in real-time
- Vast selection of online calculations including rate, differential, integral, mean, maxima and minima
- Easy units conversion (two-point and multipoint signal calibration) in Flexible triggering and stimulation options
- Automation of experimental procedures
- Automated online and offline data extraction to Data Pad

**Chart Modules**

Chart modules are software add-ons that provide comprehensive analysis feature sets for specific research applications. For the latest list of modules see the software updates section of our website.

**Blood Pressure**

Analyze blood and cardiac pressure recordings online or offline. As well as standard pressure measurements, derived parameters include EDP, Tau, Pressure Time Index and Contractility Index.

**ECG Analysis**

For online or offline analysis of ECG signals from numerous species including humans, mice and rats. Results feature PQRS amplitudes and intervals displayed as graphs and tables.

**Heart Rate Variability**

Analyze variations in the intervals between heartbeats from ECG recordings. Normal, ectopic or artifact intervals are distinguished and analyzed online or offline.

**Spike Histogram**

Discriminate and analyze extracellular recordings using online or offline functions including ratemeter, amplitude, interspike interval and peristimulus time histograms.

**GLP**

The GLP Module and GLP Server provide PowerLab users with an easy and reliable data acquisition solution for a GLP and 21 CFR Part 11 compliant environment.

**Scope**

Scope software provides the functionality of a two-channel storage oscilloscope and XY plotter. It is ideal for recording high-frequency signals, such as action potentials and evoked responses, that are time locked to a stimulus. Scope also features a number of triggering and stimulation features.