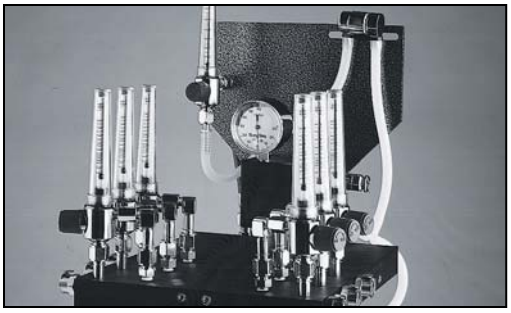
Respiration

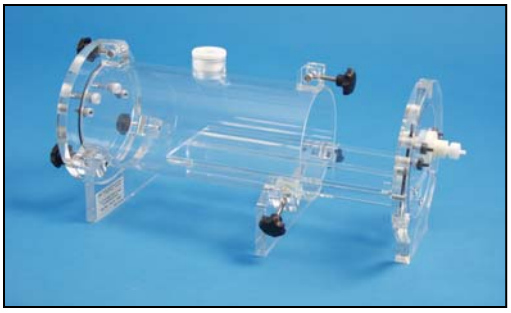
NEW Model 683 Rodent/Small Animal Ventilator, see page F7



NEW Multi-Station Research Anesthesia System, see page F19

NEW i-STAT® Portable Analyzer, see page F52

NEW G2 Digital™ Monitor, see page F53



Single Chamber Plethysmograph for Anesthetized Rodents, see page F71

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U.S. Toll Free: (800) 272-2775 • Fax: (508) 429-5732 • Online: www.harvardapparatus.com

How to Select Your Ventilator

1) In order to choose the proper ventilation product you must first decide on the mode of ventilation control required:

Volume Regulation	Constant Pressure Regulation	Both
Go to question 2	Go to question 2	Inspira Only (see page F4)

2) You must know the specie or species you want to ventilate (select all that apply). Once selected, go to 2A or 2B.

Perinatal Mice, Small Bird **Rat, Guinea Pig*** **Rabbit, Cat** **Dog**

2A) If you want **Volume Regulation Mode** you must calculate the tidal volume and respiratory rate in order to choose the correct ventilator. Use the following formula for mammals. After calculating, locate appropriate species, tidal volume and respiratory rate in the chart below. Go to the pages indicated for more information or call Technical Support at 800-272-2775 US or visit our web site for the nearest dealer.

Tidal Volume

**Vt = 0.0062 x $M_b^{1.01}$*
(M_b = Animal Mass, kg)

Respiration Rate

***Rate (min^{-1}) = 53.5 x $M_b^{-0.26}$*

2B) If you want **Constant Pressure Mode**, look at the chart below and compare Inspira to the HSE KTR and select the appropriate animal weight under the correct species. Go to the pages indicated for more information or call Technical Support at 800-272-2775 US.

** To ventilate more than one rat or guinea pig simultaneously, see the Multiple Channel Ventilator for Large Rodents on page F9.*

Ventilator Selection Chart	BS4 73-0043	BS4 55-7058	BS4 55-0001	
Model	**MiniVent**	**Inspira ASV**	**Mouse 687**	**Starling Miniature**
Control Modes BS4 73-0043	**VOLUME VENTILATORS**			
Species	mice, pre-natal rats, small birds	mice, rats, guinea pigs, rabbits, cats	mice, perinatal rats, small birds	rats, guinea pigs, rabbits, cats
Animal Weight	up to 50 g	15 g to 10 kg	up to 200 g	250 g to 10 kg (22 lbs)
Tidal Volume ml	0.03 to 0.35 ml	0.1 to 100 ml	0.1 to 1.0 ml	0.25 to 2.5 ml 1.0 to 10 ml 3.0 to 30 ml
Respiratory Rate (breath/min)	60 to 400	5 to 200	18 to 150	10 to 200
Certification	CE	CE	CE	CE, EMC
% Inspiratory Time (I:E ratio)	1:1	1:4 to 4:1	1:1	1:1
Multiple Animal	NO	NO	NO	NO
Requires Compressed Air	NO	NO	NO	NO
Sigh Pressure	NOT AVAILABLE	NOT AVAILABLE	NOT AVAILABLE	NOT AVAILABLE
Ext Trig Input	NO	5 to 12 V peak pulse	NO	NO
Pressure Range	NO	0 to 50 cmH_2O	NO	NO
Sigh Frequency	NO	auto or manual	NO	NO
Auto SET-UP	NO	YES	NO	NO
Safety Alarms	NO	YES	NO	NO
Built-in Overpressure Release	-	YES	-	-
Ventilation Pressure	NO	YES	NO	NO
Pressure Control	NO	OPTION	NO	NO
Peep	yes (attach column of water)	built in	yes (attach column of water)	yes (attach column of water)
Computer/Transducer Safety Pressure	NO	YES	NO	NO
Port Size			OD 4 mm (5/32 in), ID 2.2 mm (0.866 in)	OD 6.3 mm, ID 4.8 mm
Size	8 x 10 x 20 cm (3.2 x 3.9 x 7.9 in)	17.8 x 25.4 x 40.6 cm (8 x 10 x 17.25 in)	25 x 32.5 x 15 cm (10 x 13 x 6 in)	
Page	F8	F4	F7	F12
$				

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How to Select Your Ventilator

Harvard Apparatus has manufactured animal ventilators for more than 75 years. These ventilators are based on the designs of Dr. William T. Porter, a Professor of Physiology at Harvard Medical School, a strong proponent of physiology education and training through The American Physiological Society and the founder of Harvard Apparatus. A range of animal ventilators is available for species from mice to large dogs (15 g to 50 kg).

We now offer the most advanced animal ventilator on the market, the new Inspira, Advanced Safety Ventilator. Inspira offers microprocessor control, easy-setup and operation, alphanumeric display, airway pressure monitoring, assist mode, sigh breath, variable Inspiratory: Expiratory (I:E) ratios, digital rate and digital volume. The Inspira ventilators also feature SafeRange™, a rapid setup system which uses the animals weight to calculate 'average' ventilation parameters such as rate and tidal volume.

In addition to our line of animal ventilators we also offer virtually all of the other accessories necessary to make your animal ventilation safe and reliable. Anesthesia machines are available in several different styles and form factors suitable for a wide range of animal sizes. The multi-station ventilator, and the Coax rebreathing system, offer larger research groups the opportunity to anesthetize multiple animals using a single anesthesia setup.

Our vaporizer line has been expanded to include the three most popular styles of anesthetic vaporizers, Tech 3, Tech 4 and Ohio 100 with a choice of Isoflurane, Halothane and now Sevoflurane. Intubation tubes and cannulae have been expanded to include sizes suitable for mice, rats and guinea pigs.

BS4 55-0000 Small Animal 683	BS4 55-0798, BS4 55-0806 Intermediate Animal 665	BS4 55-0715 Large Animal 613	BS4 55-7059 Inspira	Multi-Channel Ventilator	KTR-4
VOLUME VENTILATORS			**PRESSURE VENTILATORS**		
rats, guinea pigs, rabbits, cats	rabbits, cats, dog	rats, guinea pigs, cats, dogs	mice, rats, guinea pigs, rabbits, cats	rats, guinea pigs	rats, guinea pigs, rabbits
250 g to 10 kg (22 lbs)	1 kg (2.2 lbs) to 30 kg (66 lbs)	1.5 kg (3.3 lbs) to 50 kg (110 lbs)	15 g to 10 kg	150 g to 1 kg	150 g to 5.5 kg
0.5 to 5 ml 3 to 30 ml	4 to 100 ml	30 to 750 ml	NOT AVAILABLE	NOT AVAILABLE	NOT AVAILABLE
18 to 150	10 to 200	7 to 50	5 to 200	30 to 100	1 to 199
CE	CE, EMC	CE	CE	CE	CE
1:1	35% to 65% of a single stroke cycle	25% to 50% of a single stroke cycle	1:4 to 4:1	10% to 80% of a single stroke cycle	1 to 99%
NO	NO	NO	NO	Up to eight simultaneously with individual volumes	NO
NO	NO	NO	NO	yes 4 (58 lbs) to 8 bar (116)	NO
NOT AVAILABLE	NOT AVAILABLE	NOT AVAILABLE	0 to 50 cmH_2O	NOT AVAILABLE	
NO	NO	NO	5 to 12 V peak pulse	NO	NO
NO	NO	NO	0 to 50 cmH_2O	NO	NO
NO	NO	NO	auto or manual	NO	NO
NO	NO	NO	YES	NO	NO
NO	NO	NO	YES	NO	NO
-	-	-	YES	NO	NO
NO	NO	NO	YES	100 cmH_2O	NO
NO	NO	NO	YES	2 to 100 cmH_2O	NO
yes (attach column of water)	yes (attach column of water)	yes (attach column of water)	built in	yes (attach column of water)	yes (attach column of water)
NO	NO	NO	YES	NO	NO
OD 5 mm (3/16 in), ID 3.5 mm (1/8 in)	OD 7.9 mm, ID 6.4 mm	OD 15.9 mm, ID 12.7 mm			
25 x 32.5 x 15 cm (10 x 13 x 6 in)	35 x 20 x 45 cm (14 x 8 x 18 in)	30 x 50 x 22.5 cm (12 x 20 x9 in)	17.8 x 25.4 x 40.6 cm (8 x 10 x 17.25 in)		36 x 15 x 34 cm (14.2 x 5.9 x 13.4 in)
F7	F12	F13	F4	F9	F10
				Depends on configuration	

Inspira – Advanced Safety Ventilator (ASV)

- Ventilates mice to cats with one ventilator (15 g to 10 kg)
- Easy to use
- Two models available:
  - — Volume-controlled
  - — Pressure-controlled
- Airway pressure monitoring detects over/under pressurization of lungs
- Assist Mode helps wean animal off the ventilator
- Built in sigh breath maintains optimal lung functioning
- Adjustable I:E ratio (1:4 to 4:1)
- Ability to ventilate with air or non-flammable anesthetic gases
- Quiet

Announcing two new additions to our ventilator family:

- *Inspira Advanced Safety Ventilator – Volume Controlled (ASV_V)*
- *Inspira Advanced Safety Ventilator – Pressure Controlled (ASV_P)*

Both ventilators are the result of extensive research and development. Each features an easy to use keypad, bright display, and all gas ports located on the front panel. Advanced functions include Airway Pressure Monitoring, Assist Mode, Programmable Sigh Breaths, and Adjustable I:E Ratio.

One Ventilator – Many Animals

This is Harvard Apparatus' first ventilator that can ventilate animals from mice to cats using the same machine. It provides respiration rates from 5 to 200 bpm. The tidal volume is adjustable from 0.1 ml to 100 ml. It is no longer necessary to purchase one ventilator for mice and another for large rodents. The Inspira can do it all.

Easy to Use

Simply enter the animal's weight and press run! A microprocessor recommends the respiratory profile for a user-entered animal weight. The user may override respiratory parameters if needed. The ventilators have a bright, easy-to-read display and simple to use keypad.

All gas connections are positioned on the front of the machine for convenience. In addition to the gas ports, two analog outputs, an external trigger connector, and sync out connector are also located on the front of the machine. An RS-232 port is located on the back of the machine and can be used for remote control, data logging, or printer connection.

Airway Pressure Monitoring

Built-in pressure sensor monitors airway pressure. Under and over pressure limits are monitored. Starting limits are selected by built-in controller.

Safe Range™

Setting up the ASV ventilators is both easy and safe thanks to the Safe Range™ software. Once the animal's body weight has been entered the software computes the median settings for tidal volume and respiratory rate. These same equations are used to calculate a Safe Range™ around the median values. All the default parameter settings can be overridden. If you enter a setting outside of the Safe Range for the body mass of the animal to be ventilated you are warned that the value is outside the Safe Range™ and asked to confirm the setting.

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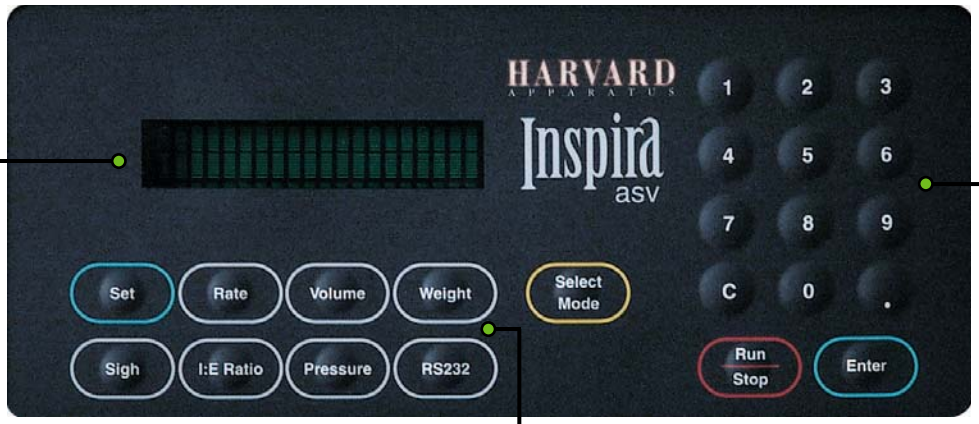
Inspira – Advanced Safety Ventilator (ASV)



Bright, Easy-To-Read Display

Easy-To-Use Keypad

Quick setup of all ventilator parameters by simply entering the animal weight. Built-in software sets default values that can be overridden to meet the specific needs of your experiment.

All Gas Connections at Front of Machine

Two Analog Outputs for Monitoring Pressure, Flow, or Other Analog Signals

Sync Out for Synchronizing Other Instruments with Ventilator

Trigger in for Externally Triggering Respiration

Side Window Allowing User to See Piston Motion

RS-232 Ports on Rear of Machine for Remote Control, Data Logging, or Printer Connection.

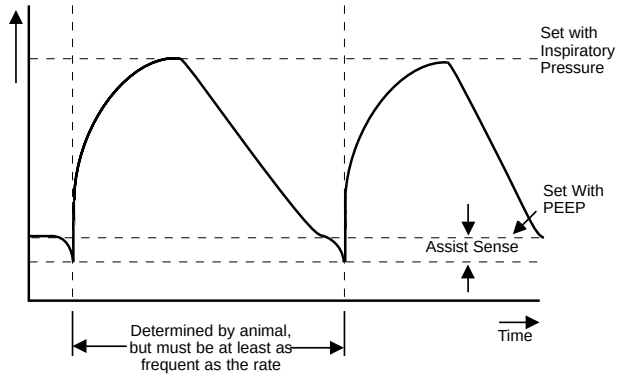
User I/O on Rear of machine

Bright & Easy to Read Display
This new display has two lines each with 20 characters. Both the respiration rate and tidal volume are brightly displayed simultaneously.

Two RS-232 Ports
The rear of the machine has two RS-232 ports for remote control, data logging, or printer connection and also User I/O. To the side of the machine there is a window allowing the user to view piston motion.

Membrane Keypad
The new keypad is simple and intuitive. Respiration rate, tidal volume, animal weight, sigh breath, I:E ratio, and pressure limits are all accessed directly via a button on the keypad. For customized ventilation protocols, simply press the 'SET' button and then the desired button to enter the required value on the numeric keypad. Pressing the 'ENTER' button inputs the value.

Inspira – Advanced Safety Ventilator (ASV)



Pressure Assist Mode

Assist Mode

Both the volume and pressure controlled ventilators support an Assist Mode. This feature helps to wean the animal off the ventilator. When the animal attempts to initiate a breath on its own, a pressure sensor detects the drop in lung pressure. This drop initiates a ventilation cycle.

The sensitivity of the Assist Mode is adjustable from –1 to –10 cmH_2O. The ventilator lets the animal initiate breaths independently as long as its breathing rate is greater than the respiration rate set by the user or calculated by the microprocessor.

Sigh Breath

With continuous, long term ventilation and the force of gravity, the animal's lungs begin to collapse. Introducing a larger than normal tidal volume over inflates the animal's lungs, periodically replicating the natural sigh. It allows the lungs to expand and opens the collapsed alveoli. The frequency of the sigh breath is user selectable and available in both the ASV_V and the ASV_P models.

For both ventilators, the sigh breath information is entered via the keypad. For Inspira ASV_V, the user enters a sigh breath volume. With the Inspira ASV_P, the user enters a sigh breath pressure. For both ventilators the sigh breath frequency may be programmed which automatically initiates sigh breaths. These breaths may also be triggered manually by pressing the SIGH button on the keypad during respiration.

Volume-Controlled vs. Pressure Controlled

The Inspira ASV_V delivers the desired tidal volume to the animal by precisely controlling the stroke of the piston. Stroke speed is controlled during inspiration and expiration allowing variable inspiration-to-expiration ratios.

The Inspira ASV_P delivers gas during inhalation by moving the piston while continuously monitoring the airway pressure. The microprocessor reads the increasing pressure and compares it to the maximum inspiration pressure set by the user. When the maximum pressure is reached, the piston stops. The exhale valve opens at the appropriate time determined by % inspiration time and closes when the PEEP (positive end expiratory pressure) setting is reached.

PEEP - Positive End Expiratory Pressure (Inspira ASV_P Only)

The Inspira ASV_P also has a PEEP feature. This feature allows a positive pressure to be maintained between inspirations instead of falling to zero or near zero at the end of the expiratory phase. When the PEEP pressure is reached, the expiration valve closes until the next inspiration cycle begins. This allows the lungs to maintain a positive pressure through most or all of the breathing cycle which is a more natural state for the lungs.

Piston/Cylinder Assembly

The Inspira Ventilators use a glass and graphite piston/cylinder assembly and a microprocessor controlled actuation mechanism to precisely control respiration profiles. Two easily interchangeable piston/cylinder assemblies are available to provide 0.1 ml to 10 ml and 10 ml to 100 ml tidal volumes. Changing the piston/cylinder assembly is simple. Open the top chassis cover, unscrew the assembly, and install the new piston/cylinder assembly. The ventilator automatically detects which size cylinder is installed. Variable flow valves control the inhalation and exhalation gas flow. A window shows the piston/cylinder assembly at work inside!

Anesthetic Ventilator

Both Inspira ventilators can be used with anesthesia machines to deliver non-flammable anesthetic gases such as Nitrous Oxide, Enflurane, Sevoflurane, Halothane or Isoflurane, see pages F16 to F23 for our complete line of anesthesia machines and accessories. A future option for the Inspira ASV_V and ASV_P ventilators will be anesthetic agent monitoring for Nitrous Oxide, Enflurane, Sevoflurane, Halothane or Isoflurane. Please call Harvard Apparatus for more information.

Specifications

Animal Size	15 g to 10 kg
Tidal Volume	0.1 to 100 ml
Port Size	Adjustable 1/16 in, 1/8 in, 3/16 in
Control Modes	Volume or assist (pressure optional)
Respiratory Rate	5 to 200 breaths/min
% Inspiratory Time	20 to 80% of cycle time
Sigh Pressure	0 to 50 cmH_2O
Inspiratory Flow	0 to 12 SLPM
Pressure Signal	0 to 5 V analog (representing 0 to 50 cmH_2O)
Gas Supply	Room air or non-flammable mixed gas
External Trigger Input	+5 to +12 V peak pulse
Resolution	1 breath/min
I/E Ratio	4:1 to 1:4
Pressure Range	0 to 50 cmH_2O
Sigh Frequency	Auto or manual
Respiratory Assist	Available
Signal Inputs	External trigger
Signal Outputs	Sync out, 2 analog outputs (user selectable)
Display	2 line x 20 character VFD display
Power	AC 85 to 132 V, 170 to 264 V, 50/60 Hz
Dimensions, H x W x D	20.3 x 25.4 x 43.8 cm (8 x 10 x 17.25 in)
Weight	9.1 kg (20 lb)

Catalog No.	$	Product
BS4 55-7058		Inspira - Advanced Safety Ventilator, Volume Controlled
BS4 55-7059		Inspira - Advanced Safety Ventilator, Pressure Controlled

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NEW Mouse (687) and Small Animal (683) Volume Controlled Ventilators

Harvard Apparatus's new 683 Mouse Ventilator. The same great Ventilator with a new, more functional design

- Two models available:
  - **Model 683** for small animals from 250 g to 10 kg (22 lb) e.g. rats, hamsters, rabbits, cats, monkeys, small dogs, etc.
  - **Model 687** for mice and perinatal rats up to 200 g (7 oz)
- CE approved

Harvard Apparatus is proud to announce the NEW 683 and 687 Ventilators. Beside the sleek new look, these ventilators have some advantages over the older style ventilators:

- Ability to monitor PEEP
- New tubing graduated sizing connectors that are accommodate different size tubing easily
- Permanent etched volume graduations on the cylinder so they can't rub off
- Volume and rate control are now linear

The Model 683 Small Animal Ventilator comes standard with two piston and cylinder assemblies. The smaller piston (which comes installed) allows tidal volumes to be set from 0.5 to 5.0 cc in 0.5 cc increments and the larger cylinder allows tidal volumes of 3.0 to 30 cc in 0.3 cc increments. Setting the cylinder stroke between gradations it is possible to achieve finer resolution in tidal volume settings.

The Model 687 Mouse Ventilator has a single piston and cylinder assembly. The tidal volume range is 0.1 to 1 cc in 0.1 cc increments. Setting the cylinder stroke between gradations it is possible to achieve finer resolution in tidal volume settings. For both ventilator models, the piston travels to the end of the cylinder completely emptying the cylinder and minimizing the dead space of the breathing circuit.

Both models feature a numerical LED to display the respiratory rate which can be set from 18 to 150 strokes/minute. Volume and rate settings can be adjusted while the ventilator is running. Both ventilators have four gas inlet and outlet ports: supply gas in, gas out (to animal), gas return (from animal) and ventilator exhaust. The ventilator exhaust can be attached to a column of water to achieve PEEP (positive end expiratory pressure) when long term animal ventilation is necessary.

Overhaul kits are available for both ventilator models and are specific for the type of cylinder used. Overhaul kits include complete instructions and replacement parts.

Specifications

Rate	Adjustable from 18 to 150 strokes/min while the ventilator is running	
Phase Ration	1:1 fixed	
Dimensions, H x L x W	25 x 32.5 x 15 cm (10 x 13 x 6 in)	
Weight	8 kg (18 lb)	
Power	115/230 VAC, 50/60 Hz	
Ventilator	**Small Animal**	**Mouse**
Tidal Volume	Adjustable from 0.2 to 30 ml/stroke while the ventilator is running	Adjustable from 0.05 to 1 ml/stroke while the ventilator is running
Port Size:		
ID	3.5 mm (1/8 in)	2.2 mm (0.086 in)
OD	5 mm (3/16 in)	4 mm (5/32 in)
Model	683	687

Catalog No.	$	Product
BS4 55-0000		Model 683, Small Animal Volume Controlled Ventilator
BS4 55-0001		Model 687, Mouse Volume Controlled Ventilator
BS4 55-5281		Overhaul Kit for 687 Ventilator with 1 cc Cylinder*
BS4 55-5282		Overhaul Kit for 683 Ventilator with 5 cc Cylinder*
BS4 55-5283		Overhaul Kit for 683 Ventilator with 30 cc Cylinder*
BS4 55-5284		Overhaul Kit for Older 68x Ventilators, including Models 680, 681 and 683 ventilators without a numeric LED rate display*

**Overhaul Kits do not include cylinder*

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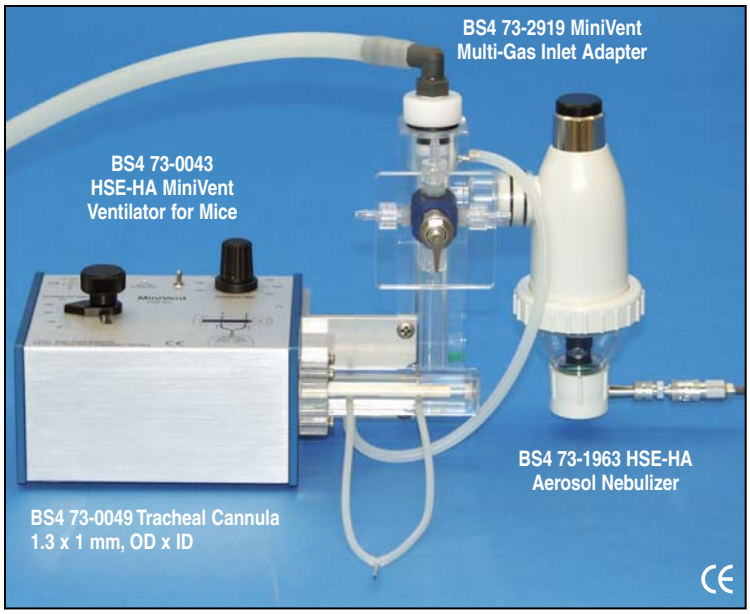
HSE-HA MiniVent Ventilator for Mice



- Ideal ventilator for mice
- Stroke volume range from 30 to 350 µl
- Ventilation rate from 60 to 400 breaths/minute
- Simple adjustment of stroke volume while running
- Valveless piston pump, no valves to clog
- Very small instrument/circuit dead space volume
- Compact construction, easy to install close to animal
- No vibrations, very low noise

The newly developed MiniVent Model 845 Ventilator is a quiet, compact and light weight ventilator. While it was designed specifically for mice, the MiniVent can be used for any animal (e.g. birds and perinatal rats) which requires tidal volumes in the range of 30 to 350 µl and respiratory rates of 60 to 400 breaths per minute.

The MiniVent Ventilator is a constant-volume respiration pump operating on the Starling principle. Unlike conventional units for larger animals, this ventilator employs a rotary plunger and has no valves. During each ventilation cycle, the plunger performs a synchronized forward and rotating movement. Cleverly arranged bores and channels in the cylinder and plunger control inspiration and expiration during each stroke of the plunger.

The extremely light weight and compact construction, in addition to the convenient rod clamp, allow the MiniVent ventilator to be positioned directly next to the animal. Typical setups with larger ventilators produce large tubing and instrument dead space volumes. These larger volumes introduce greater system compliance which can affect the accuracy with which the full tidal volume is introduced into the animal's lungs. With the MiniVent, the tidal volume error due to system compliance is reduced to 3 µl.

Tidal volume and respiration rate can be set exactly to the values required for mouse ventilation. The level of precision and control available to the investigator minimizes the danger of hyperventilation or hypoventilation.

The tidal volume can be varied continuously from 30 to 350 µl during operation without having to interrupt ventilation. The respiration rate is also continuously adjustable from 60 to 400 strokes/min. The expired air can be recovered at the collection port for sampling, recycling or for the generation of a positive end-expiratory pressure (PEEP). Room air or any non-explosive gas mixture can be used to feed the pump intake.

A multi-gas inlet adapter is available for the MiniVent so that alternate gas mixtures and nebulized substances are delivered to the MiniVent inlet port at atmospheric pressure. The adapter provides ports for multiple selectable gas mixtures (hypoxic, anesthetic...) and a port for the Aerosol Nebulizer.

The MiniVent Ventilator is supplied with the following components:

Qty.	Product
1	AC Wall Mounted Power Supply (115 V or 220 V)
2	Silicone Tubing, 1.5 mm ID, 3.0 mm OD, 14cm Length
1	1.3 mm OD Tracheotomy Cannula (BS4 73-2730)
1	1.2 mm OD Intubation Cannula (BS4 73-2844)

Specifications

Stroke Volume	Continuously adjustable from 30 to 350 µl
Respiratory Rate	Continuously adjustable from 60 to 400 breaths/min
Power	12 V DC, 0.5 A through external main adapter
Dimensions, H x W x D	8 x 10 x 20 cm (3.2 x 3.9 x 7.9 in)
Weight:	
MiniVent	1 kg (2.2 lb)
AC Adapter	0.3 kg (0.7 lb)

Catalog No.	$	Model	Product
BS4 73-0043		845	MiniVent Ventilator for Mice, 110 VAC
BS4 73-0044		845	MiniVent Ventilator for Mice, 230 VAC
BS4 73-0049			Repl. Y-piece with 1.3 mm OD Tracheal Cannula and Connecting Tubes
BS4 73-2730			Repl. Tracheotomy Cannula, 1.3 mm OD
BS4 73-2844			Repl. Intubation Cannula, 1.2 mm OD
BS4 73-0027			Package of 10 small Y adapters, each with 2x silicone tubing 1.5 mm ID, 3 mm OD, 14 cm long
BS4 73-0032			Package of 5 medium Y adapters, each with 2x silicone tubing 6 mm ID, 9 mm OD, 80 cm long
BS4 73-1963			Aerosol Nebulizer, see page F54
BS4 73-3300			Tubing Connection Kit for Aerosol Neubulizer
BS4 73-2919			MiniVent Multi-Gas Inlet Adapter

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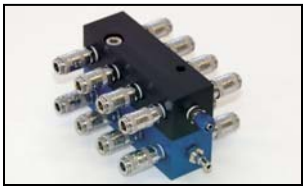
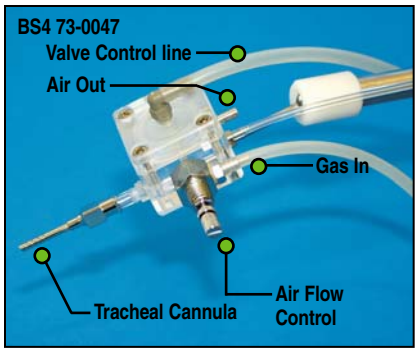
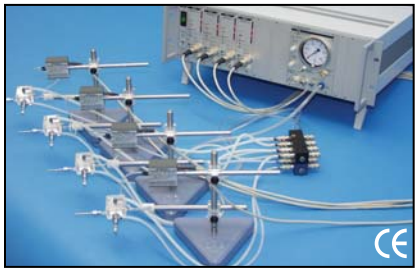
HSE-HA Multiple-Channel Ventilator for Rodents

BS4 73-0046



BS4 73-0048





Set up for 4 Animals

- Ventilate up to eight rodents at the same time
- Adjust tidal volume individually
- Very small dead space volume
- For applications where multiple rodents must be ventilated simultaneously (e.g. multiple blood pressure measurement)
- For Einthoven bronchospasmolysis test on multiple animals

Specifications

Compressed Air Supply:	
Minimum	4 bar (58 lbs)
Maximum	8 bar (116 lbs)
Respiratory Rate	30, 40, 50, 60, 70, 80, 90, 100 breaths/min
Inspiratory Time	10, 20, 30, 40, 50, 60, 70, 80 % of total cycle duration
Control of Ventilation Heads:	
Ventilation Pressure	150 mmHg
Control Pressure	Adjustable 0 to 50 cmH_2O, safety pressure set at 'Max. Insp. Pressure'

Ventilator Sequencer Module (VSM)

Indication	LED lights up during inspiration
Trigger Output	BNC socket on front panel (TTL open collector; inspiration = low level; expiration = high level); trigger signal also available on PLUGSYS bus system
Power Supply	5 V 0.4 A and 24 V 0.18 A through connector from PLUGSYS bus system
Dimensions, H x W x D	1128.7 x 101.6 x 220 mm (5.1 x 4 x 8.7 in)
PLUGSYS Width	5 slot units
Connector	DIN 41612, 96-pin VG

Catalog No.	$	Product
BS4 73-0045		PLUGSYS Basic System Case
BS4 73-1523		PLUGSYS Minicase[1]
BS4 73-1537		PLUGSYS Minicase Case Extension Option[1]
BS4 73-1538		PLUGSYS Minicase 24 V Option[1]
BS4 73-0046		Ventilator Sequencer Module (VSM)[4]
BS4 73-0048		Connecting Block for up to 8 Ventilation Heads
BS4 73-0047		Ventilation Head Kit[2]
BS4 73-0500		Stand with Triangular Plate
BS4 73-0557		Perspex X-Block[3]
BS4 73-0064		MPX Pressure Transducer[4]
BS4 73-0065		TAM-A Amplifier Module[4]

1 Alternative case if pressure monitoring not used.
2 Kit includes ventilation head, stand and block clamp.
3 One required for each MPX transducer.
4 For more information on VSM, MPX Transducer or TAM-A, see Section I.

The HSE-HA Multiple-Channel Ventilator is a modular system for ventilation of one to eight large rodents. The respiratory rate is adjustable from 30 to 100 breaths per minute. It is based on the PLUGSYS system, see Section I for a complete description of the PLUGSYS system. The primary component is the Ventilator Sequencer Module (VSM) which plugs into a PLUGSYS mainframe case and is used to set the respiratory rate, inspiratory:expiratory (I:E) ratio and the maximum inspiratory pressure (i.e. safety pressure) for all animals. The safety pressure is set by the researcher and is used to prevent over inflation of the animal's lungs. The VSM requires a compressed air supply and, using both electronic and pneumatic controls, directs the air flow to the VSM ventilation head.

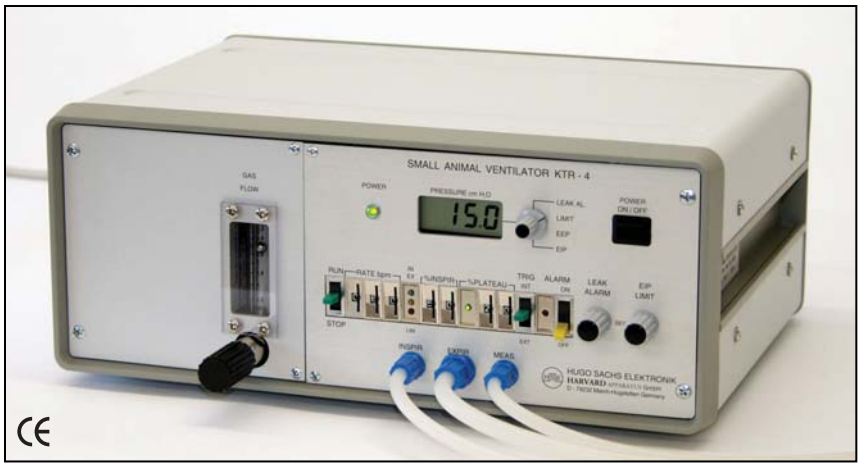
One to eight ventilation heads BS4 73-0047 can be connected to the VSM. If more than one ventilation head is used, a connecting block BS4 73-0048 is required. A directional valve within the ventilation head is controlled by the VSM to regulate the inspiratory and expiratory cycle. The VSM ventilation head includes all necessary tubing.

An optional MPX pressure transducer, BS4 73-0064, can be connected to the ventilation head. This pressure transducer attached to a TAM-A Transducer Amplifier, BS4 73-0065, can be used to record tracheal/airway pressures. This setup is described more thoroughly in the Einthoven Anti-asthmatics system, see our website. All components must be purchased separately.

HSE-HA Ventilation Sequencer Module (VSM)

The HSE-HA Ventilation Sequencer Module (VSM) consists of an electronic and a pneumatic section and requires a compressed air supply. The VSM module with the ventilation head operates on the principle of 'intermittent constant flow ventilation'. A continuously adjustable air flow is passed by a main valve either to the animal (during inspiration) or to an overflow outlet (during expiration). The design of the main valve provides an adjustable, pressure controlled, protection against excessive pressure rise in the animal's lung. The main valve is controlled electronically according to the selected respiration rate (RATE) and the selected inspiratory cycle (INSP. CYCLE %). The safety pressure which is the maximum admitted inspiratory pressure can be adjusted on the VSM module. The timing and the safety pressure are the same for all the ventilation heads, the constant air flow during inspiration can be adjusted individually on each ventilation head.

NEW HSE-HA Small Animal Pressure Controlled Ventilator KTR-4



- From rodent to rabbit
- Avoids the danger of excessively extending and damaging the lung
- Variable Ins/Exp ratio
- "Plateau" function to maintain the end-inspiratory pressure

Tracheal Cannula for Tracheotomy for Large Animal BS4 73-2943

The KTR-4 is used for ventilating the most frequently used animals in the laboratory, from rodent to rabbit. It employs electronic control. This permits flexible adaptation of the ventilation parameters to the most diverse experimental conditions. The functional sequence is signaled by suitably marked signal LEDs. The ventilation sequence can also be influenced by external signals.

Unlike a STARLING piston pump, use of the KTR-4 avoids the danger of excessively extending and damaging the lung of the ventilated animal through incorrect setting of the stroke volume. The electronic control of the KTR-4 also permits free selection of the ventilation timing over a wide range in order to adapt it to the requirements of your experiment. Due to the basic design of a STARLING pump, it is impossible to vary the ratio of inspiration to expiration, for example.

The KTR-4 operates on the principle of intermittent positive pressure ventilation. A continuously adjustable air (gas) stream is passed by solenoid valves either to the animal or to an overflow outlet. The effective pressure in the ventilation cannula is measured and indicated. By suitable settings on the unit it is possible to utilize the measuring circuit to terminate the inspiration process when a given adjustable ventilation pressure has been reached (EIP LIMIT: 0–29 cmH_20). This effectively protects the animal against excessive pressure rise in the lung.

Through the "Plateau" function, the end-inspiratory pressure can be maintained constant over an adjustable period of time. This function permits direct control of the inspired air retention. Measurements can also be performed in the inspired condition.

The air flow to the ventilated animal is adjusted by means of a built-in needle valve. The set air flow is indicated on a float flowmeter (rotameter).

The connection to the tracheal cannula is made through a specially formed Y-shaped ventilation cannula. It carries the following tubing on its three ends: inspiration (4 mm dia.), expiration (6 mm dia.) and pressure measurement (4 mm dia.).

The ventilation air required is normally supplied by a built-in pump. There is also a provision for introducing ventilation gas from outside (max. pressure: 0.5 bar). A special version has the internal pump replaced by a precision pressure regulator; in this case the supply has to be provided by external pressure source (pressure range: 2 - 8 bar).

Adjustable ventilation parameters:

- Ventilation rate: 1–199 bpm (breaths per minute), digital setting.
- Ratio of inspiration to expiration period: 1–99%, digital setting.
- Plateau duration: 0–99% (of total cycle time); measurements can be performed in the inspired condition.
- Adjustable continuous air flow: 4 l/min max.
- Minute volume range: up to 2000 ml/min ("INSPIR" = 50%).

Pressure measurement and selected digital display (range: 29.9 cmH20):

- EIP (end-inspiratory pressure).
- EEP (end-expiratory pressure).
- LIMIT display of set pressure limit EIP LIMIT (0 - 29 cmH_20).
- LEAK AL. Display of alarm setting for pressure drop.

Electrical outputs:

- Recording output for ventilation pressure: 0.1 V/cmH_20
- Trigger output (TTL) to synchronize external equipment.

Other functions:

- Alarm function: audible/visual on pressure drop, alarm level adjustable.
- Indication of function sequence by LEDs.

External control facilities (TTL level, active low):

- Stop Cycle: the cyclic sequence is stopped immediately.
- Trigger one cycle (in TRIG.EXT. mode).
- Stop after expiration.
- Stop after inspiration.
- Close expiration valve (in TRIG.EXT. mode).
- Open inspiration valve (in TRIG.EXT. mode).

Air/gas connections:

- Outlet for expiration air/gas (EXHAUST EXPIR), immersion tube for PEEP adjustment is connected here, gas is sampled here for analysis of expired gas.
- Outlet for unused air or gas (EXHAUST OVERFLOW).
- Connections for Halothane vaporizer (FROM/TO HALOTHANE VAPORIZER).

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HSE-HA Small Animal Pressure Controlled Ventilator KTR-4


Rear view of ventilator KTR-4

The ventilator is delivered with the tracheal cannula adapter (BS4 73-2943) and two cannulae with 2.5mm (BS4 73-2725) and 3.0mm (BS4 73-2724) OD. All cannulae with Luer connector for tracheotomy or intubation can be connected to this adapter, see pages F54 and F55.

For larger animals like rabbits or small cats, special cannulae with 4.0mm (BS4 73-2938), 5.0mm (BS4 73-2939) or 6.0mm (BS4 73-2940) are available.

Specifications

Ventilation Rate	1 to 199 breaths/min, digital setting
Ratio of Insp / Exp	1 to 99%, digital setting
Plateau Duration	0 to 99% (of total cycle time); measurements can be performed in the inspired condition
Adjustable Air Flow	4 L/min max
Minute Volume Range	up to 2000 ml/min ("INSPIR" = 50%).
Ambient Conditions:	
Operating Temperature	15 to 35°C
Storage Temperature	-10 to 50°C
Humidity	20 to 80%, no condensation
Supply	115/230 VAC, 50/60 Hz, 100 VA
Dimensions, H x W x D	36 x 15 x 34 cm (14.2 x 5.9 x 13.4 in)
Weight	8 kg (17.6 lbs)

Catalog No.	$	Product
BS4 73-2160		Small Animal Ventilator KTR 4 with Built-In Pump for Internal Air Supply, 230 VAC
BS4 73-2965		Small Animal Ventilator KTR 4 with Built-In Pump for Internal Air Supply, 115 VAC
BS4 73-2937		Small Animal Ventilator KTR 4 without Pump, with Built-In Precision Pressure Regulator for External Air Supply, 230 VAC
BS4 73-3460		Small Animal Ventilator KTR 4 without Pump, with Built-In Precision Pressure Regulator for External Air Supply, 115 VAC
BS4 73-2941		Tracheal Cannnula for Tracheotomy to KTR-4, 3.5 mm OD
BS4 73-2938		Tracheal Cannnula for Tracheotomy to KTR-4, 4.0 mm OD
BS4 73-2942		Tracheal Cannnula for Intubation to KTR-4, 4.5 mm OD
BS4 73-2939		Tracheal Cannnula for Tracheotomy to KTR-4, 5.0 mm OD
BS4 73-2940		Tracheal Cannnula for Tracheotomy to KTR-4, 6.0 mm OD
BS4 73-2943		Adapter for Tracheal and Intubation Cannulae with Luer to KTR4 Ventilator, pkg. of 5

Hugo Sachs Elektronik (HSE), a division of Harvard Apparatus, offers complete systems for Respiratory Mechanics Studies. The following models are available, please see our website or call for additional information.

Investigation of bronchial musculature in situ - Ideal for Fast Screening and Toxicology Studies

- *EINTHOVEN*
  - *Method by measuring airway pressure (constant-volume lung inflation)*
  - *For measurement of lateral tracheal pressure*
  - *Multiple channel version available for up to 8 animals*
- *KONZETT-ROESSLER*
  - *Method by measuring the overflow volume (constant-pressure lung inflation)*
  - *For bronchial overflow measurements*
  - *More physiological and safer than Einthoven test*
- *Respiratory air flow or tidal volume measured directly with spontaneous respiration*
  - *For measurement of bronchospasmolysis in anesthetized rodents*
  - *Offers evaluation of typical respiratory parameters including resistance and compliance*
  - *Method can also be performed with a single chamber Plethysmograph box*

Extended evaluation of respiratory mechanics through measurement of flow, pressure and volume on the whole animal.

- *Single Chamber Plethysmograph Box for Anesthetized Mice or Small Rodents*
  - *Low dead space volume*
  - *Temperature controlled chamber*
  - *Esophogeal pressure, flow and pressure are known, allows calculation of resistance and compliance*
- *Single Chamber Plethysmograph Box for Anesthetized Rat/Guinea Pig*
  - *Low dead space volume*
  - *No surgical intervention required beyond intubation*
  - *Esophogeal pressure, flow and pressure are known, allows calculation of resistance and compliance*
- *Dual Chamber Plethysmograph Box for Conscious Restrained Rat/Guinea Pig*
  - *Specific Airway Resistance measurement in addition to standard respiratory parameters*
  - *Option for aerosol challenge*
  - *Ideal method for studying long term drug effects or environmental studies*

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Intermediate Animal Volume Controlled Ventilator Model 665

- For animals from 1 to 30 kg (2.2 to 66 lb) in body weight
- CE approved

This Ventilator is supplied with two interchangeable brass piston and cylinder assemblies. The piston travels to the end of the cylinder regardless of volume setting thus minimizing dead air space.

The smaller piston and cylinder assembly adjusts from 4 to 25 ml per stroke. The larger assembly adjusts from 17 to 100 ml per stroke. The rate is adjustable from 10 to 100 strokes/minute. The volume and rate are adjustable while the pump is running. Air/gas valving is by the four port system.

Specifications

Tidal Volume	Adjustable from 4 to 100 ml/stroke while the Ventilator is running
Respiratory Rate	Adjustable from 10 to 100 breaths/min while the Ventilator is running
Phase Control	Percentage of inspiration can be adjusted from 35 to 65% of respiratory cycle while ventilator is running
Port Size:	
ID	6.4 mm (1/4 in)
OD	7.9 mm (5/16 in)
Dimensions, H x W x D	35 x 20 x 45 cm (14 x 8 x 18 in)
Weight	18 kg (37 lb)

Catalog No.	$	Product
BS4 55-0798		Intermediate Animal Volume Controlled Ventilator, Model 665, 115 VAC, 60 Hz
BS4 55-0806		Intermediate Animal Volume Controlled Ventilator, Model 665A, 230 VAC, 50 Hz
BS4 55-2810		Overhaul Kit for Intermediate Animal Ventilator; Contains O-rings, Valve Springs, Lubricants, etc. to Overhaul Ventilator*

**Overhaul Kit does not include cylinder*

NEW Starling's Miniature 'Ideal' Ventilator

- Stroke volumes of 0 to 2.5, 0 to 10 and 0 to 30 ml
- LED digital readout of rate and volume
- Extremely quiet operation
- Electromagntically quiet (meets EMC-CIS-B regulation)
- Rate and stroke adjustable during ventilation

The Harvard Apparatus Starling 'Ideal' ventilator features negligible dead space, low noise, low wear and high reliability. The rate is indicated on a LED display. Both the rate and stroke can be changed while the ventilator is running. The fine pitch of the stroke control allows the stroke to be accurately set and the actual stroke is clearly displayed on a static pointer scale, not on the side of the piston, or moving scale.

Three different sizes are available: 0.25 to 2.5 ml, 1.0 to 10 ml and 3.0 to 30 ml. All air drawn into the pump is expelled on each stroke. The negligible dead space feature ensures that the piston reaches the end of the cylinder at the top of every stroke.

The speed of the motor is continuously monitored and regulated to maintain a constant stroke rate. The precision-machined valve assembly has four ports which provide maximum air channelling flexibility. The input may be room air or non-explosive gas mixtures. The exhaust air can be partially or completely recycled, or collected for analysis.

The Harvard Apparatus Starling 'Ideal' ventilator is designed to generate minimal electro-radiated noise and meet the stringent EMC CIS-B regulations for radiated noise, as well as other current CE directives.

Specifications

Tidal Volume	0.25 to 2.5 , 1.0 to 10 or 3.0 to 30 ml, continuously variable
Respiratory Rate	10 to 200 breaths/min
Display	Digital readout of rate and volume
Port Size	OD 6.3 mm (1/4 in) ID 4.8 mm (3/16 in)
Certifications	Meets all EMC and CE requirements
Power	115 V, 60 Hz or 220 V, 50 Hz
Dimensions, H x W x D	20 x 29 x 31 cm (7.9 x 11.4 x 12.2 in)
Weight	10.6 kg (23.4 lb)

Starling's Miniature 'Ideal' Ventilator

Volume	Voltage 115 VAC, 60 Hz	$	220 VAC, 50 Hz	$
0 to 2.5 ml	BS4 40-1000		BS4 40-1001	
0 to 10 ml	BS4 40-1002		BS4 40-1003	
0 to 30 ml	BS4 40-1004		BS4 40-1005	

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Large Animal Volume Controlled Ventilator

- For animals from 1.5 to 50 kg (3.3 to 110 lb) in weight
- Volume adjustable from 30 to 750 cc/stroke
- Variable Inspiratory: Expiratory Ratio

This is the workhorse of the Harvard Apparatus Volume Controlled Ventilators. There are literally thousands of these Ventilators in use in leading research laboratories throughout the world. Their design has been essentially unchanged over the years. There are dozens of examples of these Ventilators giving continuous service for more than thirty years with proper care and maintenance.

Note that the volume adjustment is made on the piston shaft, and that therefore accurate volume adjustment cannot be made while the ventilator is running. However, the rate and the I:E % can be varied while the ventilator is running.

Air/gas valving is by the four port system with separate ports for gas inlet, gas outlet (to animal), gas return (from animal), and ventilator exhaust.

The gas inlet can be used to supply air or any non-flammable gas supply. Like the other Harvard Apparatus mechanical ventilators, attachment of the ventilator exhaust to a column of water can be used to produce a positive and expiratory pressure (PEEP).

Specifications

Volume	Adjustable from 30 to 750 cc/stroke. Note that the volume adjustment is made on the crank, and therefore accurate volume adjustments cannot be made while the ventilator is running
Rate	Adjustable from 7 to 50 strokes/min while the ventilator is running
Phase	Adjustable from 25 to 50% of a single stroke cycle continuously variable while the pump is in operation
Port Size:	
ID	12.7 mm (1/2 in)
OD	15.9 mm (5/8 in)
Dimensions, H x W x D	30 x 50 x 22.5 cm (12 x 20 x 9 in)
Weight	21 kg (45 lb)

Catalog No.	$	Product
BS4 55-0715		Large Animal Volume Controlled Ventilator, Model 613, 115 VAC, 60 Hz
BS4 55-0723		Large Animal Volume Controlled Ventilator, Model 613A, 230 VAC, 50 Hz
BS4 55-0731		Overhaul Kit for Harvard Apparatus Large Animal Ventilator; Contains O-rings, Valve Springs, Lubricants, etc. to Overhaul Ventilator*

**Overhaul Kit does not include cylinder*

Ventilator Connection Kits

- For convient connection of your rodent or small animal ventilator to anesthesia equipment
- 4 sets available to work with:
  - Inspira Advanced Safety Ventilator, see page F4
  - Model 683 Small Animal Ventilator, see page F7
  - Model 687 Mouse Ventilator, see page F7
  - MiniVent Mouse Ventilator, see page F8

These connecting kits are used to connect rodent ventilators to an anesthesia machine and evacuation system. Four kits are available, one for the larger Inspira Advanced Safety Ventilator, one for the Rodent Ventilator Model 683, one for the Mouse Ventilator Model 687 and one for the Minivent for mouse ventilation.

Application

This apparatus is intended to be used for connecting an anesthesia system to an animal ventilator or the MINIVENT in physiological and pharmacological research laboratories. Each kit contains the necessary connectors and tubing to properly connect the ventilator to the anesthesia system.

- Direct connection of anesthesia to ventilator for delivery to animal via intubation or tracheotomy (see tracheal/intubation cannulas)
- Removes pressurized gas to waste port – the introduction of pressurized gas into a ventilator will damage the system and over-inflate the animal's lungs. The connection kits depressurize the incoming gas to atmospheric pressure for safe delivery.

NOTE: Waste gas will contain anesthetic gas and MUST be connected to an evacuation system.

Items Required

In addition to the connecting kit and the essential consumables (e.g. Oxygen, compressed air, N2O, anesthetic agent) it is necessary to provide the following items and equipment to operate a complete anesthetic system:

- Anesthesia Machine – Table Top, Vaporstick, or equivalent
- Anesthetic Vaporizer – Tech 3, Tech 4, or Ohio
- Animal Ventilator – Inspira, Model 683, Model 687 or Minivent (based on the species you are working with)
- Evacuation System – Active Evacuation system, F/Air Canister, fume hood

Catalog No.	$	Product
BS4 55-0002		Ventilation Connection Kit for Inspira Advanced Safety Ventilator
BS4 55-0003		Ventilation Connection Kit for Small Animal Ventilator Model 683
BS4 55-0004		Ventilation Connection Kit for Mouse Ventilator Model 687
BS4 55-0005		Ventilation Connection Kit for MiniVent Mouse Ventilator

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Anesthesia Machine Selection Guide

The anesthesia machine you select is dependent on a couple of parameters. Ask yourself the following questions:

- *How many animals are you working with?*
- *What species you are working with?*
- *Do you want a mobile system or table top system?*

Multiple Animal Systems

We only offer one system that is suitable for simultaneous multiple animal anesthesia delivery. It is our Multi-Station Research Anesthesia System. There are 3 models available for either 2, 4 or 6 animals delivery. See page F19 for complete details.

Single Animal Systems

We offer a variety of single animal anesthesia machines. We offer both non-rebreathing and rebreathing systems. Each type is available in either a mobile or table top model, see below.

Non-Rebreathing vs. Rebreathing Systems

If you are working with animals under 4.5 kg (10 lbs) you can use a non-rebreathing system. If you are working with animals over 4.5 kg (10 lbs) you will need a rebreathing system.

A non-rebreathing system takes the exhaled gas and directs it to a scavenging system. This system removes any leftover anesthetic agent from the gas so it is safe to release to the environment. Smaller animals have smaller respiratory capacities and therefore very little anesthetic agent is wasted.

On the other hand, larger animals breathe larger volumes of gases and require more anesthetic agent. The advantage of a rebreathing system is that it takes the exhaled gas from the animal and recirculates it. A device scrubs the waste CO_2 from the gas and redirects the cleaned gas back to the inhalation circuit. This permits the system to reclaim the exhaled anesthic agent and recirculate it to the animal. This recirculation process substantially reduces the amount of anesthetic agent used during the procedure.

Non-Rebreathing Systems

These systems are for use with animals 4.5 kg (10 lbs) or less. You can select from a variety of anesthesia machines. They are listed below and are classified as suitable for mobile use or for table top use only. Please note that the CDS 2000, Vaporstick Plus and Advanced Table Top Anesthesia Machines may also be used for non-rebreathing applications, but they are less economical if you only need a non-rebreathing system. They are listed under the Rebreathing Systems to the right.

Catalog No.	$	Product
Mobile Non-Rebreathing System		
BS4 72-3007		Vaporstick Single O_2 Flowmeter (0.2 to 4 LPM), see page F17
BS4 72-3009		Vaporstick O_2 and N_2O Flowmeters and Failsafe (0.2 to 4 LPM), see page F17
Table Top Non-Rebreathing System		
BS4 72-3011		Table Top Anesthesia Machine with Single O_2 Flowmeter (0.2 to 4 LPM), see page F18
BS4 72-3012		Table Top Anesthesia Machine with Single O_2 Flowmeter (0 to 1000 cc), see page F18
BS4 72-3013		Table Top Anesthesia Machine with Dual O_2 Flowmeter (0.2 to 4 LPM and 0 to 1000 cc), see page F18
BS4 72-3014		Table Top Anesthesia Machine with Single O_2 and N_2O Flowmeters and Failsafe (0.2 to 4 LPM), see page F18

Rebreathing Systems

We offer three anesthesia machines that are suitable for a rebreathing system. These systems are for use with animals 4.5 kg (10 lbs) or more. All may be easily converted to a non-rebreathing system. Please call our technical support staff for assistance with this procedure.

Catalog No.	$	Product
Mobile Rebreathing System		
BS4 72-2998		CDS 2000 Single O_2 Flowmeter (0.2 to 4 LPM), see page F16
BS4 72-2999		CDS 2000 with Dual O_2 Flowmeters (0.2 to 4 LPM), see page F16
BS4 72-3000		CDS 2000 with Dual O_2 and N_2O Flowmeters and Failsafe (0.2 to 4 LPM), see page F16
BS4 72-3001		Vaporstick Plus Single O_2 Flowmeter (0.2 to 4 LPM), see page F17
BS4 72-3002		Vaporstick Plus with Dual O_2 Flowmeters (0.2 to 4 LPM), see page F17
BS4 72-3003		Vaporstick Plus with Dual O_2 and N_2O Flowmeters and Failsafe (0.2 to 4 LPM), see page F17
Table Top Rebreathing System		
BS4 72-3004		Advanced Table Top Anesthesia Machine with Single O_2 Flowmeter (0.2 to 4 LPM), see page F18
BS4 72-3005		Advanced Table Top Anesthesia Machine with Dual O_2 Flowmeter (0.2 to 4 LPM and 0 to 1000 cc), see page F18
BS4 72-3006		Advanced Table Top Anesthesia Machine with Single O_2 and N_2O Flowmeters and Failsafe (0.2 to 4 LPM), see page F18

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Vaporizer Selection Guide

Vaporizers are designed to work with a specific anesthetic agent. Select the vaporizer based on the agent you will be using in your laboratory. We offer vaporizers for Isoflurane, Halothane, or Sevoflurane. Key Fill and Funnel Fill models are available. See page F21 for complete product offering. Please note that vaporizer endcaps are included with the anesthesia machine NOT the vaporizer. Therefore, if you are ordering a vaporizer ONLY you will need to order endcaps separately (1 x BS4 72-3043 and 1 x BS4 72-3044).

Why choose Key Fill over Funnel Fill?

Funnel Fill allows for the direct pouring of the anesthetic agent into the vaporizer. It should be used when ONLY one agent is used in the lab.

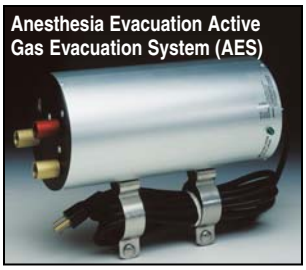
Key Fill should be used when different agents will be used in the lab to prevent cross-contamination. Key Fill vaporizers require the use of a filler adapter (purchased separately) that screws onto the anesthetic agent bottle. The adapter will only allow the addition of the correct agent into the vaporizer.

What is the difference between the vaporizers?

	Tech 3	Tech 4	Ohio
Precision Vaporizer	Flow and Temp Compensated	Flow and Temp Compensated	Flow and Temp Compensated
22 to 23 mm Tapered Inlet and Outlet Manifold	No Check Valve	No Check Valve	With Reverse Flow Check Valve
Dial Settings	½ and full increments	½ and full increments	½ and full increments up to 3%, then ½ up to 5% for Iso/Halo and 7% for Sevo
Sight Glasses	One	One	Two – "FULL" and "REFILL"
Sump Capacity	135 ml (35ml absorbed by wick)	135 ml (35ml absorbed by wick)	225 ml (100ml absorbed by wick)
ID Features	Color Coated Labels	Color Coated Labels	Color Coated Labels
Dimensions	5 ¾ x 5 ¼ x 7 ¼ in	7 ½ x 4 x 8 ¾ in	6 ½ x 5 x 8 in
Weight	13 ½ lbs	16 ½ lbs	11 lbs for Iso and Sevo 18 lbs for Halothane

*The vaporizer endcaps are included with the anesthesia machine, **NOT** the vaporizer. Therefore, if you are ordering a vaporizer only, you will need to order endcaps separately (1 x **BS4 72-3043** and 1 x **BS4 72-3044**).*

Evacuation System Selection Guide


Anesthesia Evacuation Active Gas Evacuation System (AES)

BS4 60-0979 F/AIR Filter Canister

Evacuation Systems are necessary when the waste gas from the animal still contains anethetic agents. It must be removed from the exhausted gas before it can be released into the environment.

What kinds of evacuation systems are available for waste anesthesia gas?

F/Air Filter Canister	Anesthesia Evacuation Active Gas (AES) System
Each canister can remove 50 g of pure halogenated anesthetic gases	Can be mounted on Vaporstick pole or used as a free standing unit
Does not require venting to a hood	Two standard inlet ports and one exhaust port hook up to existing equipment
Easy disposal in regular trash	Passive flow collects waste gas from anesthesia machines
	Must be vented to another room or outside
	Includes a 3 inch and a 10 ft. length of 19 mm ID hose and 12.5 mm PVC adapter

Why Use an Anesthetic Manifold?


BS4 60-5244 Manifold with 8 Ports

Manifolds allow the use of both an anesthetizing box and a mask. It permits the reserarch to direct the flow of gas to where they need it. The anesthetizing box can be used to initially anesthetize the animal and then the mask can maintain the anesthetized state during procedures.

Also, manifolds can be used to anesthetize multiple animals simultaneously. PLEASE NOTE, with a manifold, the amount of agent flowing into each port cannot be controlled – for individual control, see the Multi-Station Research System on page F19 of this catalog. One side of the manifold directs the fresh gas to the animal, while the other directs the waste gas collection.

Catalog No.	$	Product
BS4 60-5242		4 Port Manifold – connects to 2 Anesthetic devices
BS4 60-5243		6 Port Manifold – connects to 3 Anesthetic devices
BS4 60-5244		8 Port Manifold – connects to 4 Anesthetic devices

Advanced Small Animal Anesthesia Machine CDS 2000


BS4 72-2998
Advanced Small Animal Anesthesia Machine CDS 2000
(Vaporizer not included)

BS4 72-3017
Add-on Mayo Tray


BS4 72-3018
Oxygen E-Cylinder Regulator and Double Tank Holder

- Advanced, high end anesthesia systems
- Stainless steel construction
- Suitable for rebreathing & non-rebreathing circuits
- Shelf space for pulse oximeter and other monitors
- Vaporizer at eye level for easy setup and adjustment
- Convenient pull handle for maneuverability

The CDS 2000, Advanced small animal anesthesia machine is a high end anesthesia system. The one-piece frame assembly provides a small work shelf suitable for holding a table top pulse oximeter or other vital signs monitors. The universal mounting bracket accepts any current out-of-circuit vaporizer such as Tech3, Tech4 and Ohio-style vaporizers, see page F21.

The bored block system minimizes the use of hoses and fittings, which reduces the chance of leaks occurring in your anesthesia machine. The tapered ports allow an easy conversion from a rebreathing system to a non-rebreathing system. The directional valves are trouble-free, and the vertical style virtually eliminates valves being stuck in the open position.

The absorber canister is located under the block. This location protects the canister from breakage and reduces the space needed. The canister system is stabilized by center mounted attachment which draws the canister to the top with a few easy turns.

The flush valve, by design, is limited to half the amount of oxygen flow of other manufacturer's machines. This lower flow rate will help prevent dangerous pressures from building as quick, but still allows ample flow for quick oxygenation of the animal. The graduated scale of the flowmeter, ranging from 0.2 to 4 LPM, allows accurate settings for the animal and virtually eliminates the need for a dual flowmeter.

The fresh gas outlet allows you to easily switch from rebreathing to non-rebreathing circuits without extra adapters or hoses, unlike all the other machines in the industry.

The unit is mounted on a spider base (5 legs) for maximum stability and maneuverability. The optional oxygen yokes, BS4 72-3020, see page F22, can easily be added to the stand for portability. An optional universal vaporizer mounting bracket, BS4 72-3045, can be added to accept a second vaporizer of any style.

An owners manual is included with the anesthesia machine. The following accessories are also included: F-circuit with 2-liter bag, BS4 72-3071, page F26, Modified Jackson Rees non-rebreathing circuit with 1/2 liter bag, BS4 72-3073, page F26, CO_2 Absorbent, BS4 72-3022, and end caps, BS4 72-3043 and BS4 72-3044

Catalog No.	$	Product
BS4 72-2998		CDS 2000 Anesthesia Machine
BS4 72-2999		CDS 2000 with Dual O_2 Flowmeter
BS4 72-3000		CDS 2000 with N_2O and O_2 Flowmeters and Failsafe
BS4 72-3018		Single E-Cylinder Regulator and Double Tank Holder
BS4 72-3020		Dual E-Cylinder O_2 Tank Yokes Holder and Regulator
BS4 72-3017		Add-on Mayo Tray
BS4 72-3045		Vaporizer Mounting Bracket for Second Vaporizer
BS4 72-3043		Vaporizer End Cap, Male
BS4 72-3044		Vaporizer End Cap, Female

NEW *See our New Gas Anesthesia Platform for Mice on page L39.*

For Vaporizers, see page F21.
For Anesthesia Machine Accessories, see page F22.
For Anesthesia Masks, see page F25.
For Anesthesia Circuits, see page F26.

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11,000 Specialty Products to Enhance Your Bioresearch

Vaporstick Plus


BS4 72-3001 Small Animal Anesthesia Machine (Vaporizer not included)

- Economical full featured anesthesia system
- Suitable for rebreathing and non-rebreathing circuits
- Vaporizer at eye level for easy setup and adjustment
- Optional mounting for second vaporizer

The Vaporstick Plus, anesthesia delivery system features a one-piece aluminum frame construction and provides a universal mounting bracket for an out-of-circuit vaporizer such as the Tech3, Tech4 or Ohio-Style vaporizers, see page F21. The baked on 'powder-coat' finish makes it easy to clean and virtually chip-proof.

The bored block system minimizes the use of hoses and fittings, which reduces the chance of leaks occurring in your anesthesia machine. The tapered ports allow an easy conversion from a rebreathing system to a non-rebreathing system. The directional valves are trouble-free, and the vertical style virtually eliminates valves being stuck in the open position.

The absorber canister is located under the block. This location protects the canister from breakage and reduces the space needed for the Vaporstick Plus. The canister system is stabilized by center mounted attachment system which draws the canister to the top with a few easy turns.

The flush valve, by design, is limited to half the amount of oxygen flow of other manufacturer's machines. This lower flow rate will help prevent dangerous pressures from building as quick, but still allows ample flow for quick oxygenation of the patient. The graduated scale of the flowmeter, ranging from 0.2 to 4 LPM, allows accurate settings for the patient and virtually eliminates the need for a dual flowmeter.

The unit is mounted on a spider base (5 legs) for maximum stability and maneuverability. The optional oxygen yokes, BS4 72-3020, see page F22, can easily be added to the stand for portability. An optional universal vaporizer mounting bracket, BS4 72-3045, can be added to accept a second vaporizer of any style.

An owners manual is included with the anesthesia machine. The following accessories are also included: F-circuit with 2-liter bag, BS4 72-3071, page F26, Modified Jackson Rees non-rebreathing circuit with 1/2 liter bag BS4 72-3073, page F26, CO_2 Absorbent, BS4 72-3022, page F22 and end caps BS4 72-3043 and BS4 72-3044, see page F21.

Catalog No.	$	Product
BS4 72-3001		Vaporstick Plus Anesthesia Machine
BS4 72-3002		Vaporstick Plus with Dual O_2 Flowmeter
BS4 72-3003		Vaporstick Plus with O_2 and N_2O Flowmeters and Failsafe
Optional Accessories		
BS4 72-3018		Single O_2 E-cylinder Regulator and Double Tank Holder, see page F22
BS4 72-3020		Dual E-Cylinder O_2 Tank Yokes Holder and Regulator, see page F22
BS4 72-3017		Add-on Mayo Tray, see page F16
BS4 72-3045		Mounting Bracket for Second Vaporizer
BS4 72-3043		Vaporizer End Cap, Male
BS4 72-3044		Vaporizer End Cap, Female

Vaporstick


Vaporizer not included

- Economical anesthesia delivery system
- Dedicated unit for non-rebreathing circuits
- Available with optional universal vaporizer mounting bracket
- Can be upgraded to a rebreathing system with addition of free-standing CO_2 absorber system

The Vaporstick is a utility unit designed to supply oxygen to non-rebreathing systems, intensive care units and nebulizers. The flowmeter, adjusts from 0.2 to 4 LPM for accurate patient settings. A flush valve is included for fast immediate oxygen.

The unit is mounted on a stable spider base (5 legs) and a post assembly. An owner's manual and modified Jackson Rees non-rebreathing circuit with 1/2 liter bag, BS4 72-3073, see page F26, are included with the anesthesia machine. By adding your choice of options, you can customize the Vaporstick to suit your research anesthesia requirements. Z-bracket and endcaps are included.

Catalog No.	$	Product
BS4 72-3007		Vaporstick Anesthesia Machine
BS4 72-3009		Vaporstick with O_2 and N_2O Flowmeters and Failsafe
Optional Accessories		
BS4 72-3010		Freestanding CO_2 Absorber System, see page F18
BS4 72-3018		Single O_2 E-cylinder Regulator and Double Tank Holder, see page F16
BS4 72-3020		Dual E-Cylinder O_2 Tank Yokes Holder and Regulator
BS4 72-3017		Add-on Mayo Tray, see page F16
BS4 72-3049		Z-Bracket Universal Vaporizer Mounting Bracket

For Vaporizers & Vaporizer Accessories, see page F21.
For Anesthesia Machine Accessories, see page F22.
For Anesthesia Masks, see page F25.
For Anesthesia Circuits, see page F26.

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Advanced Table Top Anesthesia Machine

- Economical benchtop anesthesia system
- Suitable for rebreathing and non-rebreathing circuits
- Accepts Tech3, Tech4 and Ohio-style vaporizers

The Advanced Table Top Anesthesia machine is a compact table top version of the Vaporstick Plus, see page F17. The unit may be easily moved from room-to-room or with the optional bracket, BS4 72-3015, mounted on the wall. The lightweight design and compact size, L x W x H, 12 x 8 x 17 inches, allows the unit to be placed in areas where space is a premium.

The balanced handle makes it easy to move the unit. The baked-on 'powder-coat' finish makes it easy to clean and is virtually chip-proof. This system features the same bored block design and CO_2 absorber circuit as the Vaporstick Plus. It is available in three models with either a single O_2 flowmeter, dual O_2 flowmeters or a N_2O and O_2 flowmeter.

An owners manual is included with the anesthesia machine. The following accessories are also included: F-circuit with 2-liter bag (BS4 72-3071, page F26), Modified Jackson Rees non-rebreathing circuit with 1/2 liter bag (BS4 72-3073, page F26), and CO_2 Absorbent (BS4 72-3022, page F22) and endcaps BS4 72-3043 and BS4 72-3044.

Catalog No.	$	Product
BS4 72-3004		Table Top Machine with 0.2 to 4 LPM O_2 Flowmeter
BS4 72-3005		Table Top with Dual O_2 Flowmeter 0.2-4 LPM and 0-1000 cc
BS4 72-3006		Table Top with N_2O and O_2 Flowmeter and Failsafe
BS4 72-3015		Wall Mounting Bracket

NEW *See our New Gas Anesthesia Platform for Mice on page L39.*

For Vaporizers & Vaporizer Accessories, see page F21.

For Anesthesia Machine Accessories, see page F22.

For Anesthesia Masks, see page F25.

For Anesthesia Circuits, see page F26.

Basic Table Top Anesthesia Machine

- Economical benchtop anesthesia system
- Dedicated system for non-rebreathing circuits
- Accepts Tech3, Tech4 and Ohio-style vaporizers
- Can be upgraded to a rebreathing system with the addition of a freestanding CO_2 absorber system

The Basic Table Top Anesthesia Machine is a table top non-rebreathing system similar to the Vaporstick, see page F17. The Basic Table Top Anesthesia Machine is an extremely compact anesthesia machine, L x W x H, 8 x 8 x 13 inches, making it ideal for locations where space is limited. Four models are available which differ only by the type of flowmeter supplied.

An owners manual and Modified Jackson Rees non-rebreathing circuit with 1/2 liter bag, BS4 72-3073, page F26, and endcaps BS4 72-3043 and BS4 72-3044 are included with the anesthesia machine. The optional freestanding CO_2 Absorber System, BS4 72-3010, features the same board block rebreathing circuit design as the Advanced Table Top.

Catalog No.	$	Product
BS4 72-3011		Table Top Research with 0.2 to 4 LPM O_2 Flowmeter
BS4 72-3012		Table Top Research with 0 to 1000 cc Flowmeter
BS4 72-3013		Table Top Research with Dual O_2 Flow Meters 0.2-4 LPM and 0-1000 cc
BS4 72-3014		Table Top Research with N_2O and O_2 Flowmeter and Failsafe
BS4 72-3010		Freestanding CO_2 Absorber System

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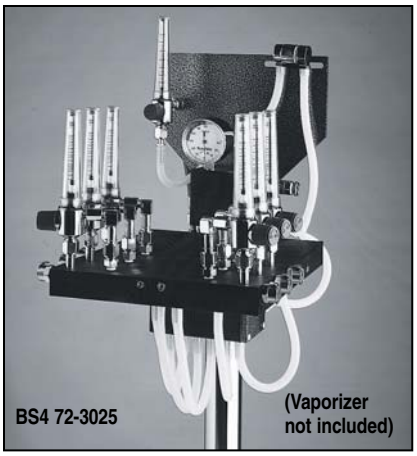
Multi-Station Research Anesthesia System



- Anesthesia delivery system designed specifically for research
- Multiple, individually controlled stations in a single unit
- Unique rodent circuit, mask and diaphragm system for safe, effective anesthetic agent delivery
- Use with lab animal evacuation system

The Multi-Station Research Anesthesia System is the latest technology for rodent and small animal anesthesia. The multi-station unit offers a base unit with multiple stations each individually controlled. The master flowmeter and auxiliary flowmeters all receive the same gas supply. The master flowmeter combined with an anesthetic vaporizer, Tech3, Tech4 or Ohio style, see page F21, are used to set the maximum percentage of anesthetic agent delivered to each station. Using the auxiliary flowmeters, the percentage of anesthetic agent can be diluted using the fresh gas supply from the auxiliary flowmeter. Using an easy-to-follow flow chart, each individual station can deliver a different percentage of anesthetic agent as needed, without effecting any other station.

The unique rodent circuit, BS4 72-3026 features a coaxial tube used in conjunction with a mask. By placing the animal's nose into the mask diaphragm, it receives the delivered gas/anesthetic agent mixture. Three different size diaphragms are available. The waste gas exhaled from the animal and any unused gas delivered by the anesthesia machine, is pulled around the inner cone through the outside hose of the Rodent Circuit. This waste gas can be removed from the breathing circuit using either in-house vacuum or the Lab Animal Evacuation system, BS4 72-3066. The unit is a simple to use, safe and effective anesthetic delivery and evacuation system designed specifically for laboratory research use.

The Multi-station Research Anesthesia system is available with two (2), four (4), or six (6) stations. It is supplied with an operational manual, station hoses, rodent circuits which include, a mask, hose and a medium diaphragm and endcaps. A vaporizer, see page F21, and evacuation system must be purchased separately.

An alternative to the Lab Animal Evacuation system is to connect each rodent circuit exhaust/exhalation line to it's own F-Air Filter canister, see page F20.

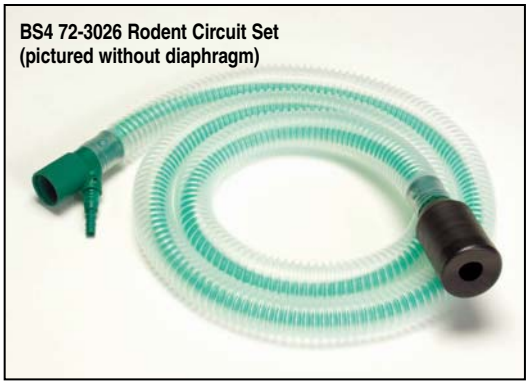
Catalog No.	$	Product
BS4 72-3023		Lab Animal 2 Station Multi-Station Research System, 2 animal
BS4 72-3024		Lab Animal 4 Station Multi-Station Research System, 4 animal
BS4 72-3025		Lab Animal 6 Station Multi-Station Research System, 6 animal
BS4 72-3026		Circuit Set, Rodent, see page F26
BS4 72-3121		Universal Table Top Mount for 2, 4 or 6 Animal Multi-Station Research System
BS4 72-3027		Mask, Rodent (no diaphragm)
BS4 72-3028		Rodent Mask Diaphragm Small (7/16 in Diameter)
BS4 72-3029		Rodent Mask Diaphragm Medium (9/16 in Diameter)
BS4 72-3030		Rodent Mask Diaphragm Large (3/4 in Diameter)

Lab Animal Evacuation System

The Multi-station Evacuation System was designed for those facilities that do not have a built-in evacuation system or a fume hood is not available. The waste gas from the system may be vented to a 2 inch outside line or pulled through activated charcoal so that the air can be recirculated in to the room. When using the filtration system, the activated charcoal must be changed on a regular basis, to maintain it's effectiveness. Typically, 8 to 10 hours of anesthesia delivery can be performed for each new supply of charcoal. The lab evacuation system, will accommodate waste gas supply from 1 to 6 stations.

Catalog No.	$	Product
BS4 72-3066		Lab Animal Evacuation System, 110 VAC, 60 Hz
BS4 72-3067		Charcoal Refill

NOTE: When using in-house suction, a scavenger interface valve must be used when operating more than one station, to reduce the pull of air.



NEW *See our New Gas Anesthesia Platform for Mice on page L39.*

Anesthesia Evacuation Active Gas Evacuation System (AES)

- Powered unit for safe and effective removal of anesthetic waste gas
- Can be mounted to anesthesia machine pole or used as a free standing unit
- Two inlet ports allow connection to an induction chamber and an anesthesia machine simultaneously

The Anesthetic Evacuation System (AES) will safely and actively remove waste gas associated with everyday inhalation anesthesia. It can be mounted on the pole of the CDS-2000, Vaporstick Plus or Vaporstick, see pages F16 to F17. It can also be used as a freestanding unit and simply placed on the benchtop. Two standard 19 mm (0.75 inch) inlets and one exhaust port allows easy hook-up to existing equipment. A 12 foot grounded electrical cord and lightweight tubing, allows for machine maneuverability.

The waste gas from the pop-off valve on most rebreathing anesthesia machines is collected by passive flow to the AES. This allows for safe operation of the anesthesia machine with little or no vacuum exposure. Using a push blower, the AES actively removes the waste gas from the unit. The blower has the capacity of moving 12 cubic feet/minute through up to 150 feet of tubing to an outside vent or fume hood. The on/off switch illuminates a green light when the unit is activated. The 'on' light assures the operator that the unit is functioning.

The Anesthetic Evacuation System includes a 3 inch and a 10 foot length of 19 mm ID hose and a 12.5 mm (0.5 inch) PVC Adapter. Additional lengths of tubing may be required and are available as an option along with an adapter to interconnect the 19 mm outlet tubing. An optional outlet line ceiling plate is available when connection to an outside wall is not convenient.

Catalog No.	$	Product
BS4 72-3064		AES Active Gas Evacuation, 110 VAC 60 Hz
BS4 72-3065		AES Active Gas Evacuation, 220 VAC 50 Hz
Accessories		
BS4 72-3093		Tubing 19 mm (0.75 in) ID , 3 m (10 ft) length
BS4 72-3085		Male Adapters 19 mm X 19 mm
BS4 72-3070		Ceiling Plate Cover

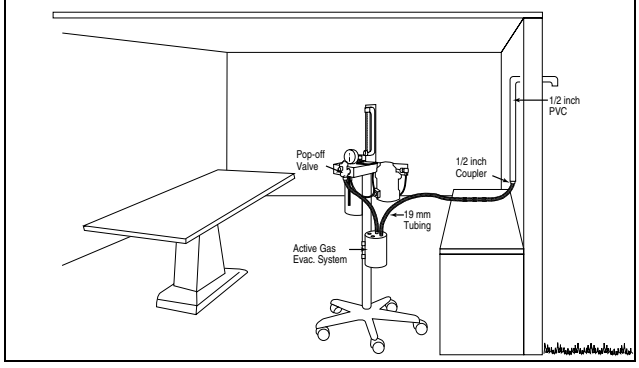
F/AIR Filter Canister

- The easy and economical way to scavenge anesthetic gases

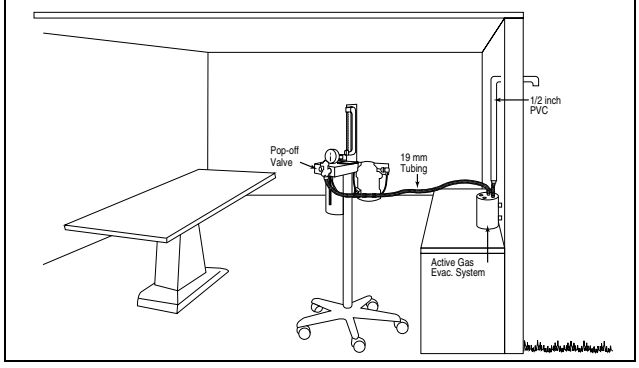
This canister is the sensible answer for the removal of excess halogenated gases from the operating room environment. It can remove 50 grams of pure halogenated anesthetic gases. It is convenient to use and does not require a venting hood. Once used, the canister is then simply disposed of. A connector for tubing is sold separately, see below. The canister is 15.2 cm (6 in) high with a diameter of 8.3 cm (3-1/4 in). Weight of active component is 200 grams.

Catalog No.	$	Product
BS4 60-0979		F/AIR Filter Canister, pkg. of 1
BS4 72-1294		Case of 8 F/AIR Filter Canisters
BS4 60-5251		Connector for Tubing for F/AIR Filter Canister

Setup Showing AES Mounted to Pole of Anesthesia Machine



Setup Showing AES Mounted to Wall



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Anesthetic Vaporizers

- Vaporizers available for Isoflurane, Halothane, Sevoflurane*
- Three different vaporizer styles from which to choose
- Key and Funnel Fill versions available for all vaporizers
- Annual service and vaporizer conversion available upon request

Harvard Apparatus now offers a wide range of remanufactured anesthetic vaporizers. These vaporizers from the two most popular manufacturers of vaporizers in the world, Cyprane and Ohmeda (formerly Ohio Medical) come with a full warranty and with annual maintenance will offer a lifetime of service. Three different styles are available Tech3, Tech4 and Ohio 100 series each with two different fill options, Key-Fill or Funnel-Fill. Halothane and Isoflurane specific vaporizers are available in all styles. Sevoflurane vaporizers are available in Tech3 and Tech4 styles only.

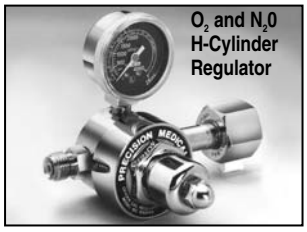
All styles are designed to be unaffected by pressure, temperature and flow rate to give you accurate levels of agent concentrations. For Isoflurane, Halothane, or Sevoflurane, all vaporizers are available in Funnel-Fill or Key-Fill styles. Key-Fill vaporizers require the use of a filler adapter which is screwed onto the anesthetic agent bottle. The use of Key-Fill prevents the unintentional addition of the wrong anesthetic agent into a vaporizer. The vaporizer styles provide accurate delivery of anesthetic agent in the following ranges: For Tech4 Style settings are from 0.5% - 5% in 1/2 and full increments, for Ohio Style settings are from 0.25% -5% in 1/4 increments up to 3% then 1/2 increments up to 5% and for Tech3 Style settings are from 0.5% -5% in 1/2 and full increments. Simply choose the anesthetic agent and fill method and the vaporizer which offers the range and resolution desired.

**Note: Vaporizer Endcaps are not included with the Vaporizer. If you are only purchasing a vaporizer, you must also purchase the endcaps.*

Catalog No.	$	Product
BS4 72-3035		Tech4 Isoflurane Funnel-Fill Vaporizer
BS4 72-3036		Tech4 Halothane Funnel-Fill Vaporizer
BS4 72-3037		Tech4 Isoflurane Key-Fill Vaporizer
BS4 72-3038		Tech4 Halothane Key-Fill Vaporizer
BS4 72-3047		Tech4 Sevoflurane Funnel-Fill Vaporizer
BS4 72-3048		Tech4 Sevoflurane Key-Fill Vaporizer
BS4 72-3039		Ohio Isoflurane Funnel-Fill Vaporizer
BS4 72-3040		Ohio Halothane Funnel-Fill Vaporizer
BS4 72-3042		Ohio Halothane Key-Fill Vaporizer
BS4 72-3031		Tech3 Isoflurane Funnel-Fill Vaporizer
BS4 72-3032		Tech3 Halothane Funnel-Fill Vaporizer
BS4 72-3136		Tech3 Sevoflurane Funnel-Fill Vaporizer
BS4 72-3033		Tech3 Isoflurane Key-Fill Vaporizer*
BS4 72-3034		Tech3 Halothane Key-Fill Vaporizer*
BS4 72-3137		Tech3 Sevoflurane Key-Fill Vaporizer*
Vaporizer Accessories		
BS4 72-3123		Tech4 Manifold
BS4 72-5984		Tech3 Manifold
BS4 72-3051		Filler Adapter for Key-Fill Vaporizer - Isoflurane
BS4 72-3052		Filler Adapter for Key-Fill Vaporizer - Halothane
BS4 72-3053		Filler Adapter for Key-Fill Vaporizer - Sevoflurane
BS4 72-3054		Anti-Spill Device - Isoflurane
BS4 72-3055		Anti-Spill Device - Halothane
BS4 72-3056		Anti-Spill Device - Sevoflurane
BS4 72-3043		Male Endcap - Outlet
BS4 72-3044		Female Endcap - Inlet

**NOTE: Tech 3 Key-Fill Vaporizers require BS4 72-3122 Mounting Cup to work with Table Top Anesthesia Machines. Annual maintenance and service available, call for details.*

Anesthesia Machine Accessories



- Economical - permits more than one coaxial breathing device to be used with one vaporizer
- Available with 4, 6, or 8 ports providing 2, 3, or 4 anesthetic channels

Manifold

These Manifolds permit multiple surgeries to be conducted while only using one vaporizer. One side of the Manifold directs the delivery of fresh gas while the other side directs the waste gas collection. Stopcocks, available separately, may be added to the circuit for increased control over the gas flow. Two stopcocks are required for each set of ports.

These manifolds can also be used with the rodent circuit and induction chamber to initially anesthetize and maintain without disconnecting the circuit. Requires tubing with ID of 8 mm (0.25 in).

Catalog No.	$	Product
BS4 60-5242		Manifold with 4 Ports for 2 Anesthetic Devices
BS4 60-5243		Manifold with 6 Ports for 3 Anesthetic Devices
BS4 60-5244		Manifold with 8 Ports for 4 Anesthetic Devices
BS4 60-5245		Stopcock for use with Manifolds, pkg. of 2

NEW *See our New Gas Anesthesia Platform for Mice on page L39.*

Manifolds, Regulators, Flowmeters and Hoses

A number of accessories to connect a gas source (O_2 or N_2O) to an anesthesia machine are available. Regulators are specific for the type of gas and tank size (small, E-cylinder or large, H-cylinder) used. All regulators terminate in a gas specific male DISS fitting. E-cylinder regulators attach to tank using a yoke and can only be used with E-size tanks with a post block. Other fittings and connectors are available, call Harvard Apparatus Tech Support for more information.

Cat. No.	$	Product
BS4 72-3099		O_2 Regulator for E-Cylinder
BS4 72-3100		O_2 Regulator for H-Cylinder
BS4 72-3103		O_2 Regulator for E-Cylinder with 0 to 15 LPM Flowmeter
BS4 72-3104		O_2 Regulator for H-Cylinder with 0 to 15 LPM Flowmeter
BS4 72-3102		N_2O Regulator for H-Cylinder
BS4 72-3018		Single O_2 E-Cylinder Regulator & Double Tank Holder, see page F17
BS4 72-3020		Dual E-Cylinder O_2 Tank Yokes Holder and Regulator
BS4 72-3112		0 to 3 LPM O_2 Flowmeter[2]

Cat No.	$	Product
BS4 72-3113		0 to 5 LPM O_2 Flowmeter[2]
BS4 72-3114		0 to 15 LPM O_2 Flowmeter[2]
BS4 72-3115		O_2 Hose, 10 ft[3]
BS4 72-3116		O_2 Hose, 15 ft[3]
BS4 72-3117		O_2 Hose, 20 ft[3]
BS4 72-3118		N_2O Hose, 10 ft[3]
BS4 72-3119		N_2O Hose, 15 ft[3]
BS4 72-3120		N_2O Hose, 20 ft[3]
BS4 72-3022		CO_2 Absorbent, Refill, 1 Gal
BS4 72-5810		DISS Female Hose Barb - O_2
BS4 72-5811		DISS Female Hose Barb - N_2O

1. Replacement flowmeters for anesthesia machines are available, call for details
2. Flowmeter with Female DISS inlet and Male DISS outlet
3. Connectors on both ends are Female DISS

Respiratory Adapters

These polypropylene adapters are used to connect different tubing sizes together in respiratory circuits.

Catalog No.	$	Product
BS4 72-2889		Respiratory Adapter, 6 to 22 mm (0.24 to 0.87 in), pkg. of 10
BS4 72-2890		Respiratory Adapter, 8 to 22 mm (0.31 to 0.87 in), pkg. of 10
BS4 72-2891		Respiratory Adapter, 10 to 22 mm(0.39 to 0.87 in), pkg. of 10
BS4 72-2892		Respiratory Adapter, 12 to 22 mm(0.47 to 0.87 in), pkg. of 10
BS4 72-2893		Respiratory Adapter, 15 to 22 mm (0.59 to 0.87 in), pkg. of 10
BS4 72-2894		Respiratory Adapter, 18 to 22 mm (0.71 to 0.87 in), pkg. of 10

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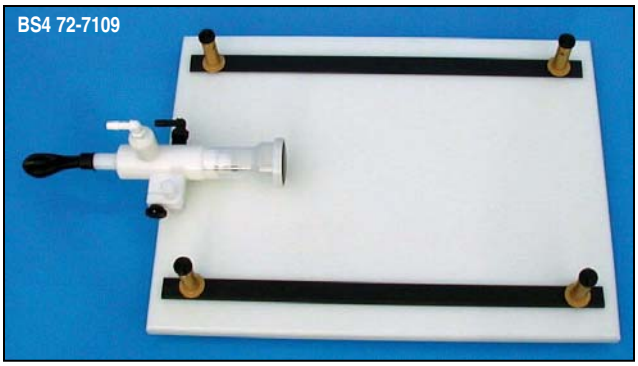
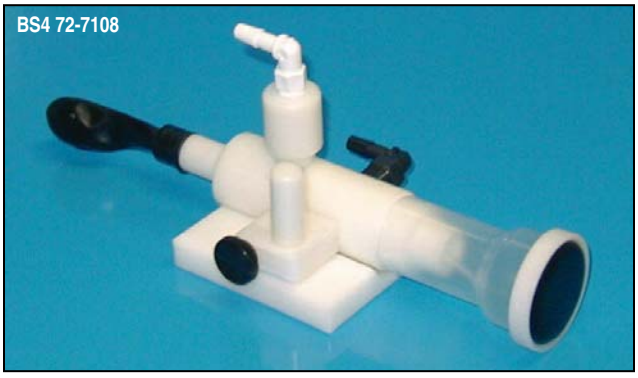
NEW COAX Breathing Device





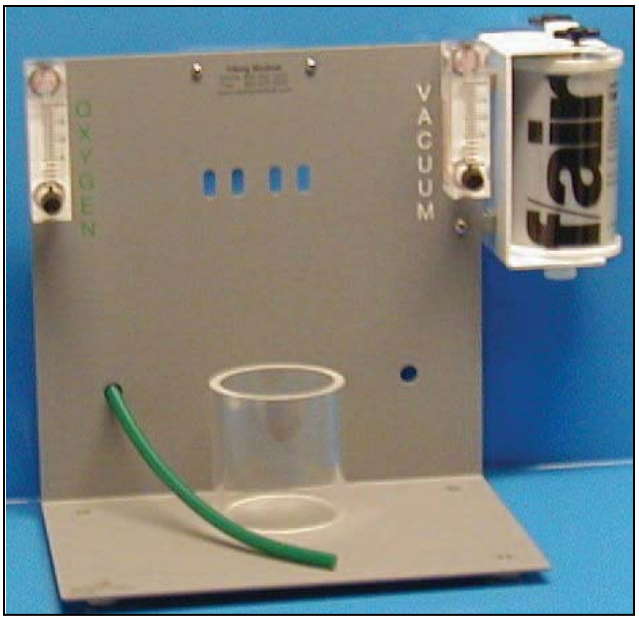
- For rodents, guinea pigs, and birds
- Durable – constructed of Detrin

This COAX breathing device is a precisely machined apparatus which maintains the surgical plane. The fresh anesthetic gas enters the side port and then passes to the nose cone. At this point the anesthetic gas is mixed with the patient's respiration and then passes out through a ball check valve to the gas outlet for scavenging. The positive pressure from the oxygen source and the patient's respiration lifts the precision ball valve for scavenging. A #10 balloon acts as a diaphragm or breathing bag.

The COAX is available as a free standing unit or mounted to a durable HDPE procedures table. This table includes metal strips to hold heating pads in place and points for tie downs. This unit is supplied with face masks (2 rat and 2 mouse), height adjustment collars and 10 ft. of 0.25" ID tubing. The unit measures H x W x L, 2 x 40.6 x 31.8 cm (4 x 16 x 12-1/2 in).

Catalog No.	$	Product
BS4 72-7108		Height Adjustable Delrin COAX
BS4 72-7109		Height Adjustable Delrin COAX with Table

Economy Vaporizer Stand



- Ideal when working with small animals
- Permits vaporizer to be used on a table top
- For use with halothane or isoflurane vaporizers
- Tech3 only

This stand permits a Tech3 vaporizer to be used on a tabletop. This creates the ideal situation when working with small animals or where space is limited. This portable, stainless steel stand has two flowmeters. The left controls the oxygen flow to the vaporizer. The right controls the flow for the vacuum circuit used for waste gas scavenging. Vaporizers are sold separately and require both the Inlet and Outlet Endcaps, see page F21. For information on Tech3 vaporizers, see page F21. For information on other benchtop anesthesia products, see page F18.

Catalog No.	$	Product
BS4 60-5241		Vaporizer Stand with 2 Flowmeters
BS4 72-7111		Vaporizer Stand with 2 Flowmeters and Vertical Side Mount Canister Holder
BS4 72-3031		Tech3 Isoflurane Funnel-Fill Vaporizer
BS4 72-3032		Tech3 Halothane Funnel-Fill Vaporizer
BS4 72-3136		Tech3 Sevoflurane Funnel-Fill Vaporizer
BS4 72-3043		Male Endcap-Outlet
BS4 72-3044		Male Endcap-Inlet

NEW *See our New Gas Anesthesia Platform for Mice on page L39.*

Induction Chamber, Anesthetizing Boxes and Backdraft Anesthesia Table

- Clear acrylic for easy animal observation
- Two sizes
- Ideal for small animals
- Stainless steel false bottom

Induction Chamber

This cylindrical acrylate chamber is ideal for anesthetizing small animals such as rodents, guinea pigs, and birds. It has two, 1/4 inch barbed hose fittings. One for gas delivery and one for gas scavenging. The gas delivery barb directs the flow of anesthetic gas towards the bottom of the chamber. The chamber has a routed top that ensures a perfect fit. There are no corners so cleaning is easy. Includes 10 ft. of 0.25" ID tubing.

Dimensions

Inner, H x Dia	20.3 x 20.3 cm (8 x 8 in)
Small	8.89 x 13.3 cm (3.5 x 5.25 in)
Large	20.3 x 20.3 cm (8 x 8 in)
Overall, H x Dia	30.5 x 27.9 cm (12 x 11 in)
Small	17.8 x 17.8 cm (7 x 7 in)
Large	30.5 x 27.9 cm (12 x 11 in)
Barbs	Accepts, ID x OD, 6 x 8 mm (1/8 x 1/4 in) tubing

Catalog No.	$	Product
BS4 72-7110		Induction Chamber, Small
BS4 60-5246		Induction Chamber, Large

Anesthetizing Boxes

These anesthetizing boxes are constructed of 6 mm (1/4 in) thick, transparent plastic, with all joints securely cemented. The transparent plastic allows the animal to be under constant observation. Two clear 9.5 mm (3/8 in) plastic tubing connectors, 25 mm (1 in) long, are cemented on opposite ends of the box, one at the top and the other at the bottom, for introducing the gas.

These boxes are available in two sizes: small and large. The small box is for rodents. The top slides open lengthwise on machined grooves. The large box is for larger animals such as rabbits and cats. Its top has three hinges for easy opening. Two fasteners squeeze the top down against a rubber gasket to seal the joints.

The small box measures, H x W x D, 10.7 x 25.7 x 11 cm (4 x 10 x 4.5 in). The large box measures, H x W x D, 29 x 44 x 29 cm (11.5 x 19.5 x 11.5 in).

Catalog No.	$	Product
BS4 50-0108		Anesthetizing Box, Small
BS4 50-0116		Anesthetizing Box, Large
BS4 72-3926		Replacement tubing connectors, pkg. of 20

- Pulls anesthetic waste gases down and away from surgeon
- Better access to animal than conventional fume hoods
- One-piece table top construction, prevents debris accumulation

Backdraft Anesthesia Table

The Backdraft Anesthesia Table is a mobile surgical station used to pull anesthetic gases away from the surgeon. The open top design and table top work height mean that the typical workspace restrictions of fume hoods are avoided. The high air flow (155 cubic feet/minute) provides safety for the researcher. The sturdy one-piece construction of the 16 g type 304 stainless steel work top is sanitary and easy to clean.

Waste gases are carried away from the table through a 3 inch flexible tube which must be vented to the outside. Fifteen feet of the tubing is provided with the table. The table rests on 4 large swivel locking casters. It features a retractable power cord and size 'E' anesthetic gas tank holders. The on/off switch and duplex AC power outlet are located on the backsplash of the table top.

Specifications

Dimensions, H x W x D:	
Overall	106.7 x 78.7 x 127 cm (42 x 31 x 50 in)
Work Surface Dimensions	91.4 x 55.9 x 111.7 cm (36 x 22 x 44 in)
Power Supply	110 V

Catalog No.	$	Product
BS4 72-2625		Back Draft Anesthesia Table

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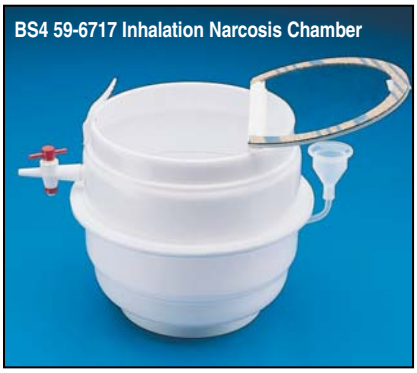
Anesthesia Masks and Inhalation Narcosis Chamber

Cat Ventilation/Anesthesia Masks

These soft pliable vinyl plastic masks conform to the facial contours of a cat. They are fitted with a standard 15 mm (3/5 in) taper for connection to anesthesia machines, see pages F16 to F19. They are available in three sizes and are supplied individually or as a convenient set containing one mask of each size.

The mask diameters are 25 mm (1 in), 38 mm (1-1/2 in), and 50 mm (2 in) for the small, medium and large size masks respectively.

Catalog No.	$	Product
BS4 59-8201		Cat Ventilation/Anesthesia Mask, Small
BS4 59-8202		Cat Ventilation/Anesthesia Mask, Medium
BS4 59-8203		Cat Ventilation/Anesthesia Mask, Large
BS4 59-8204		Set of 3 Masks, one of each size



- Convenient for anesthetizing small animals, such as mice, hamsters, rats, or guinea pigs

Inhalation Narcosis Chamber

A clear acrylic hinged cover permits observation of animals. All other components are made of polypropylene and are not affected by anesthetic compounds.

A folding perforated platform is removed to fill the bottom with cotton and replaced to support the animal. Anesthetic is poured into the small funnel at the side and runs into the bottom of the chamber where it is absorbed by cotton. A second stopcock on the other side of the chamber permits the entrance of fresh air during anesthesia to prevent suffocation.

Maximum ID is 197 mm (7-3/4 in); top ID is 178 mm (7 in); height from platform to top is 127 mm (5 in); height under platform is 57 mm (2-1/4 in); overall height is 197 mm (7-3/4 in).

Catalog No.	$	Product
BS4 59-6717		Inhalation Narcosis Chamber

Canine Ventilation/Anesthesia Masks

These masks provide a convenient way of providing artificial ventilation or administration of anesthetic gases to dogs. They are constructed of rugged transparent polycarbonate. One end has a standard 15 mm (3/5 in) taper for connection to anesthesia tubing, while the other end has a soft flexible rubber diaphragm that molds itself to the contours of a dog's snout.

Two sizes are available. The small mask has an unstretched diaphragm opening of 2.5 cm (1 in), while the large mask has an unstretched opening of 4.4 cm (1-3/4 in).

Catalog No.	$	Product
BS4 59-7976		Canine Ventilation/Anesthesia Mask, Small
BS4 59-7977		Canine Ventilation/Anesthesia Mask, Large
BS4 59-7978		Replacement Diaphragm for Small Mask
BS4 59-7979		Replacement Diaphragm for Large Mask

- For rats, guinea pigs, birds, and mice
- Simple, yet effective design

Small Animal Anesthesia Masks

These Anesthesia Masks were designed with smaller animals in mind. They have a simple cylindrical shape with a rubber diaphragm. A small slit is cut in the diaphragm to accommodate the animal's snout or beak. The opposite end tapers down to a standard press fitting port measuring 15.3 mm OD x 11.9 mm ID. These Masks can be used with bain circuits, non-rebreathing systems, or 'Y' pieces. Includes 1 diaphragm.

Catalog No.	$	Product
BS4 59-8254		Mouse Anesthesia Mask
BS4 59-8255		Rat, Guinea Pig and Bird Anesthesia Mask
BS4 72-3923		Replacement Diaphragms, pkg. of 10

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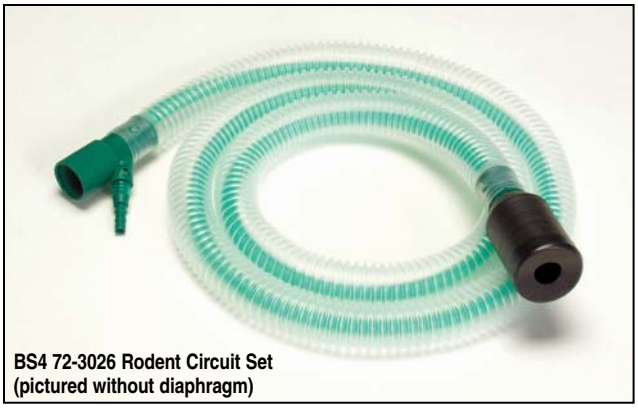
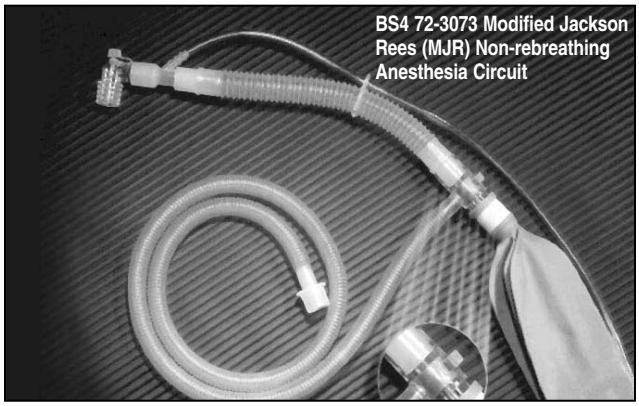
Anesthesia Circuits



BS4 72-3026 Rodent Circuit Set
(pictured without diaphragm)



BS4 72-3073 Modified Jackson Rees (MJR) Non-rebreathing Anesthesia Circuit

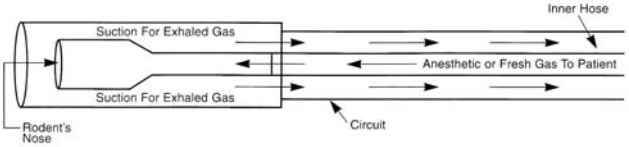
Rodent Circuit Mask

- Unique circuit designed specifically for rodent anesthesia
- Best suited for use with Multi-station Research Anesthesia System, see page F19
- Will work with any non-rebreathing anesthesia machine

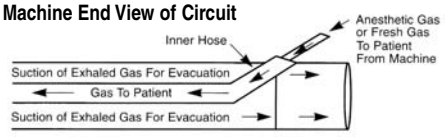
Developed in conjunction with leading research facilities, the Rodent circuit is the most effective, user-friendly, mask for rodents. Available with 3 different size diaphragms, the mask easily fits most rodents. With the use of a C-Pram circuit shown below, the mask is designed to deliver and evacuate the gas through one tube. Traditionally, the open mask system has caused problems because of the contamination of waste gas to the staff and the patient rebreathing CO_2. These problems are avoided with the Rodent circuit and mask design. When combined with in-house suction or the Lab Animal Evacuation System or F/Air canister, see page F19, there is minimal risk of untoward anesthetic agent exposure for the researcher. Inlet tubing: 6.25 mm (0.25 in) ID, silicone tubing. Outlet from rodent circuit is a 22 mm (0.866 in) respiratory fitting. Respiratory Adapters are available to connect the rodent circuit outlet to tubing of various sizes from 6 to 15 mm ID, see page F22.

Catalog No.	$	Product
BS4 72-3026		Circuit Set, Rodent (hose, mask and medium diaphragm)
BS4 72-3027		Mask, Rodent (no diaphragm)
BS4 72-3028		Rodent Mask Diaphragm Small (7/16 in DIA)
BS4 72-3029		Rodent Mask Diaphragm Medium (9/16 in DIA)
BS4 72-3030		Rodent Mask Diaphragm Large (3/4 in) DIA)

Rodent Mask and C-Pram Circuit



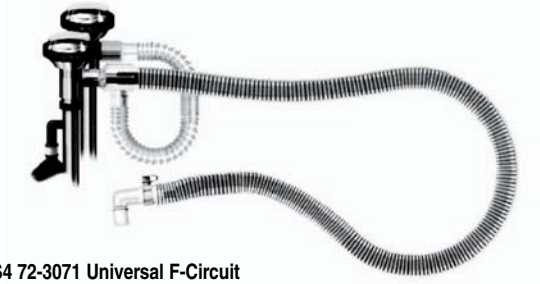
Machine End View of Circuit



Modified Jackson Rees (MJR) Non-Rebreathing Anesthesia Circuit

The Modified Jackson Rees (MJR) is a new design for non-rebreathing. Unlike the old scavenging units, this system incorporates a relief valve on the main unit which allows the use of any size bag. This system will adapt to all anesthesia machines and does not require a Bain Block.

Catalog No.	$	Product
BS4 72-3073		Modified Jackson Rees (Non-Rebreather) and 1/2 Liter Bag
BS4 72-3075		Avian/Research MJR and 1/4 Liter Bag
BS4 72-3043		Male Endcap (to connect at outlet end of vaporizer)
BS4 72-3074		Add on Non-Rebreather Adapter



BS4 72-3071 Universal F-Circuit Rebreathing Anesthesia Circuit

Universal Rebreathing Anesthesia F-Circuit

The Universal F-circuit is a rebreathing circuit that can be used on small animals up to 200 lbs. Rebreathing circuits allow the animal to rebreathe exhaled and excess vaporized anesthetic agent which have circulated through a CO_2 absorber system thus reducing the amount of anesthetic agent used. The unique single limb circuit 1) replaces the need for a traditional adult and pediatric circuit, 2) reduces the clutter around the animal and 3) takes the weight off the end of the endotracheal tube. The tube within a tube design allows heat and moisture to be retained in the circuit, which helps to maintain body temperature and recover the patient more quickly.

Catalog No.	$	Product
BS4 72-3071		40 inch F-Circuit (rebreathing)
BS4 72-3072		60 inch F-Circuit (rebreathing)
BS4 72-3082		F-Circuit Elbow

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NEW Mobile Anesthetic Workstation

- A Large Working Surface
- Easy-Reach Controls
- Cylinders That are Easily Loaded from the Side
- High Maneuverability
- Rubber Wheels for Silent Movement (Two Brakes)
- Heavy Duty Steel Shelves with White Epoxy Coating

This equipment has been designed specifically to give greater flexibility to our range of anesthetic products, with the outstanding advantage of also providing a work area.

One rear panel is used to secure flowmeters and vaporizers or other equipment. The second panel is louvered to accommodate plastic bins in which small items can be stored.

The Workstation also houses the Fluovac and its accessories. As the working top is 920 mm high, the operator can work comfortably either standing or sitting.

Specifications

Frame	1in Square Section Steel (White)
Joints	Nylon Covered Steel (Grey)
Rear Panels	Grey PVC Flowmeter Support And Grey Steel Louvered Panel
Wheels	4 Rubber Wheels, 2 Braked
Standard Size:	
Work Top	770 x 610 mm (30.3 x 24 in)
Overall Size, H x W x D	1505 x 920 x 610 mm (59.3 x 36.2 x 24 in)
Small Size:	
Work Top	460 x 610 mm (18.1 x 24 in)
Overall Size, H x W x D	1505 x 610 x 610 mm (59.3 x 24 x 24 in)

Catalog No.	$	Model	Product
BS4 34-0417		8.12.0	Mobile Anesthetic Work Station Standard Size, White Epoxy Finish
BS4 34-0939		8.12.3	Mobile Anesthetic Work Station Small Size, White Epoxy Finish
BS4 34-0418		8.12.1	Bins, Medium Size
BS4 34-0419		8.12.2	Bins, Small Size

NEW Complete Anesthetic Systems

- Fittings and gauges for 1 x O_2 and 1 x N_2O size E cylinders
- O_2 and N_2O tapered veterinary flowmeters
- O_2 flush
- Low O_2 alarm with N_2O safety cut out device
- Smooth running anti static castors
- Stainless steel shelving
- Stainless steel fittings and tubing

As well as the modular systems already offered in this catalog, International Marketing Supply now to offers an "off the shelf" complete anesthesia system designed specifically for the research laboratory.

Specifications

Dimensions:	
Over All, H x W x D	1415 x 480 x 720 mm (55.7 x 18.9 x 28.4 in)
Top Shelf, D x W	480 x 400 mm (18.9 x 15.8 in)

Catalog No.	$	Model	Product
BS4 34-0480		8.35.0	Complete Anesthetic System with Halothane Funnel Fill Vaporizer
BS4 34-0481		8.35.0A	Complete Anesthetic System with Halothane Key Fill Vaporizer
BS4 34-0482		8.35.1	Complete Anesthetic System with Isoflurane Funnel Fill Vaporizer
BS4 34-0483		8.35.1A	Complete Anesthetic System with Isoflurane Key Fill Vaporizer

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NEW Anesthetic Bracket Unit, Vaporizers and Tube Mounts

NEW Anesthetic Bracket Unit

An alternative means of mounting the anesthetic components (rather than using the Anesthetic Workstation), is the IMS Anesthetic Bracket Unit. The Anesthetic Bracket Unit can either be FREE STANDING on a bench or WALL MOUNTED, with the fixings supplied. It is drilled ready to accept one flowmeter (single gas unit) or two flowmeters (two gas unit).

Specifications

Dimensions, H x W x D 460 x 450 x 170mm (18.1 x 17.7 x 6.7 in)

Catalog No.	$	Model	Product
BS4 34-0411		8.9.0	Anesthetic Bracket for Single Gas
BS4 34-0412		8.9.1	Anesthetic Bracket for Two Gases

- Graduated in 0.5% divisions
- For continuous flow 'Out of circuit' use
- Single control, locks in 'off' position
- Compatible with most types of anesthetic machines and fittings
- Supplied as 8% version

NEW The Halovet Vaporizer

This unit is a flow and temperature compensated vaporizer. It is supplied complete with mounting block and screws. Servicing is carried out directly with the manufacturer.

Catalog No.	$	Model	Product
BS4 34-0397		8.3.0	Halovet Vaporizer, Funnel Fill
BS4 34-0398		8.3.0A	Halovet Vaporizer, Key Fill
BS4 34-0401		8.3.4	Key Fill Adapter

NEW Isoflurane Vaporizer

Based on the Halovet Vaporizer but calibrated for Isoflurane. Can be used with the Halovet tube mounts as above.

Catalog No.	$	Model	Product
BS4 34-0470		8.26.0	Isoflurane Vaporizer, Funnel Fill
BS4 34-0471		8.26.0A	Isoflurane Vaporizer, Key Fill
BS4 34-0401		8.3.4	Key Fill Adapter

NEW Halovet Tube Mounts

Catalog No.	$	Model	Product
BS4 34-0399		8.3.1	Halovet Inlet Tube Mount
BS4 34-0400		8.3.2	Halovet Outlet Tube Mount

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11,000 Specialty Products to Enhance Your Bioresearch

NEW Fluovac System

- Absorbs anesthetic vapors from the work area, protecting personnel from exposure
- Allows optimal access to the animal particularly important when carrying out close-up or micro surgery
- A self-contained, portable unit requiring no extra ducting or ventilation
- Three different size masks available
- Incorporates a special double mask which supplies the anesthetic and scavenges excess vapors simultaneously
- Requires minimal maintenance
- Easy to use: simply connect to your vaporizer system and insert a Fluosorber canister
- Each Fluovac is supplied with a size 1 - Double mask

The Fluovac Systems combines small animal anesthesia with operator safety.

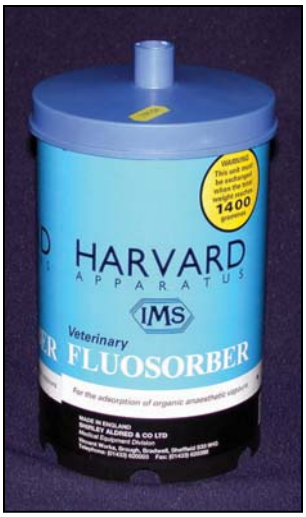
Specifications

Overall Dimensions, H x W x D	180 x 275 x 300 mm (7.1 x 10.8 x 11.8 in), case only
Weight (inc. Fluosorber)	8 kg (17.6 lbs)
Weight (exc. Fluosorber)	7 kg (15.4 lbs)
Power	240 VAC, 50 Hz; 110 VAC, 60 Hz, 37 Watts

IMPORTANT: The Fluovac must only be used with non-flammable gases

Catalog No.	$	Model	Product
BS4 34-0387		8.1.0	Fluovac, 240 VAC, 50 Hz
BS4 34-0388		8.1.0a	Fluovac, 110 VAC, 60 Hz

NEW IMS Fluosorber



The Fluosorber consists of a canister containing activated carbon, which absorbs halothane extremely efficiently.

It is used with the Fluovac to scavenge halothane from the working environment, and is quickly and simply attached to the Fluovac unit. The Fluosorber's capacity to scavenge halothane is measured by weight: During manufacturing each Fluosorber is tested to ensure an air flow of 60 liters per minute with a flow resistance not exceeding 2.0 cmH_2O.

When exhausted, the Fluosorber is sealed in the special bags provided and can then be completely incinerated.

Supplied in cases of 6 canisters.

Specifications

Active Canister Weight	1200 g (2.65 lbs)
Exhausted Weight	1400 g (3.1 lbs)

Catalog No.	$	Model	Product
BS4 34-0415		8.11.0	IMS Fluosorber, 6 canisters

NEW Fluovac Exhaust Tube Mount

The gas exhaust duct on the rear of the Fluovac unit can be fitted with a tube mount to vent exhaust gases such as nitrous oxide (Note: It is not necessary to vent if only halothane is used as the Fluovac with the Fluosorber canister removes Halothane from the atmosphere most effectively). Suitable tube for venting is the cuffed plastic tubing, see BS4 34-0426 on page F36.

Catalog No.	$	Model	Product
BS4 34-0392		8.1.4	Fluovac Exhaust Tube Mount

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Fluovac System

NEW Fluovac Anesthetic Masks

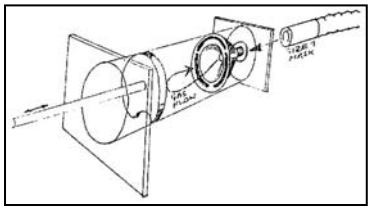
Three types of masks are available for use with the Fluovac System. Each mask is supplied with 1 meter length of tubing. Longer lengths are available by special order:

Size 1 - double mask: A 'size 1' mask is supplied with the basic Fluovac anesthesic scavenging unit. If only one mask is required for a particular procedure, one of the gas inlet tubes can be clamped off or a Gas Flow Director may be used (see order code 8.1.5). Suitable for rodents, chicks and other small animals.

Size 2 - single mask: Suitable for guinea pigs and similar sized animals.

Size 3 - single mask: For rabbits, cats and similar sized animals.

Catalog No.	$	Model	Product
BS4 34-0389		8.1.1	Fluovac Anesthetic Masks, Size 1
BS4 34-0390		8.1.2	Fluovac Anesthetic Masks, Size 2
BS4 34-0391		8.1.3	Fluovac Anesthetic Masks, Size 3



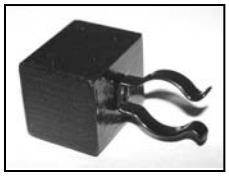
NEW Fluovac Tube Restrainer

Used for induction of anesthesia if the patient cannot be held at the Fluovac mask - the Size 1 mask end is simply plugged into the end of the unit which is then supplied with anesthetic gas and is also scavenged. The patient is kept up to the front of the tube with a holding bar. When the animal is anesthetized it is taken out of the tube, the mask is unplugged and the animal is positioned at the mask - a very quick and easy procedure.

Specifications

Internal Diameter	57 mm (2.24 in)
Length	Adjustable up to 200 mm (7.87 in)

Catalog No.	$	Model	Product
BS4 34-0457		8.20.1	Fluovac Tube Restrainer



NEW Fluovac Mask Support

Designed to hold a Fluovac mask in position on a flat surface. This support minimizes the risk of movement between the animal and the mask.

Catalog No.	$	Model	Product
BS4 34-0394		8.2.0	Fluovac Mask Support for Size 1 Mask
BS4 34-0395		8.2.1	Fluovac Mask Support for Size 2 Mask
BS4 34-0396		8.2.2	Fluovac Mask Support for Size 3 Mask

NEW Fluovac Isolator Valve

A most useful addition to our gas scavenging range, the valve redirects gas from the FLUOVAC mask when out of use for short periods. The advantage is that neither the Vaporizer setting nor the flowmeter setting have to be altered when an animal is removed from the mask thus saving time having to reset the previous settings.

Also, if the gas flow has inadvertently been set a little high then it could overcome the scavenging action at the mask when an animal is removed - the use of the valve prevents contamination of the area by stopping the gas reaching the mask.

The valve is activated by the push/pull control knob to the indicated setting. In use the gas supply and scavenged gas flow through specially machined channels in the valve. In the isolation mode the gas flow from the vaporizer is directed into the scavenged gas flow while simultaneously opening a channel to outside air which is sucked into the mask by the scavenging effect thus also clearing traces of anesthetic gas from the mask.

The units are easily fitted into existing masks by the user - full instructions are included. Please state the size of the mask to be modified as Size 1 has a smaller bore Crystaflex tube than 2 & 3.

Catalog No.	$	Model	Product
BS4 34-0402		8.4.0	Fluovac Isolator Valve*

**Note: This Valve is a registered design.*

NEW Gas Flow Directors

An effective yet simple method of eliminating the Connector Set from the IMS Fluovac system. Directs the flow of gas to either or both double rodent mask simply by turning the knob.

Catalog No.	$	Model	Product
BS4 34-0393		8.1.5	Gas Flow Directors

NEW Directavalves

Gas flow can be sent in one of two directions by simply turning a small valve on top of the assembly.

Catalog No.	$	Model	Product
BS4 34-0459		8.21.1	Directavalves

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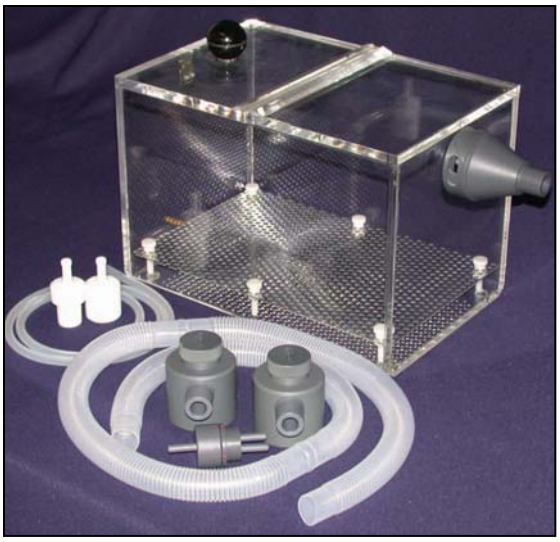
NEW Fluovac Anesthetizing Chamber With Gas Scavenging System



Further enhance the flexibility of your Fluovac system by the addition of a special anesthetizing chamber. No modifications to the existing Fluovac unit are necessary.

The system provides a safe working environment for staff while minimizing stress to the animal.

The crux of the system is the Directavalve, a valve which can control the flow of gases and vapors in either of two directions. Two Directavalves are used in the system. One is placed on the outlet tube mount of the Vaporizer, so that halothane can be directed to either the Fluovac masks or the anesthetising chamber. The other is placed on the Fluosorber canister, so that Fluovac scavenges from the mask or chamber as required.

The clear Perspex chamber has a 6mm inlet tube mount which enters the chamber under a false floor. Scavenging is via a tube mount with specially shaped air bleeds. These create a vortex in the chamber, optimizing the scavenging effect.

Removal of the animal will cause some vapor to be released: this can be overcome by placing the chamber in a flow hood.

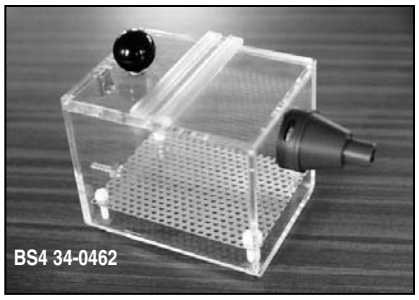
Please note that there are two sizes available, the smaller designed is specifically for a single animals.

Gas Scavenging Kit System Components

Catalog No.	Product	Qty.
BS4 34-0399	Inlet Tube Mount	1
BS4 34-0400	Outlet Tube Mount	1
BS4 34-0422	6 mm Bore PVC Tubing x 1m Long	1
BS4 34-0459	Directa Valves	2
BS4 34-0909	22 mm Bore Tubing x 1m Long	1
Plus Either		
BS4 34-0460	Large Anesthetizing Chamber Only	1
or		
BS4 34-0462	Small Anesthetizing Chamber Only	1

Catalog No.	$	Model	Product
BS4 34-0458		8.21.0	Fluovac Anesthetizing Chamber with Gas Scavenging System, Large
BS4 34-0461		8.21.3	Fluovac Anesthetizing Chamber with Gas Scavenging System, Small

NEW Anesthetizing Chamber



These anesthetizing chambers are available in two sizes. The smaller size was designed specifically for use with smaller species.

Specifications

Dimensions, H x W x D:

Large Unit	200 x 200 x 305 mm (7.9 x 17.9 x 12 in)
Small Unit	134 x 128 x 170 mm (5.3 x 5 x 6.7 in)

Catalog No.	$	Model	Product
BS4 34-0460		8.21.2	Anesthetizing Chamber Large
BS4 34-0462		8.21.5	Anesthetizing Chamber Small

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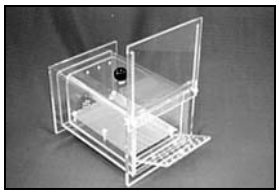
NEW Scavenged Anesthetizing Chamber



For use in conjunction with the Fluovac. It is easy to use - simply plug a size one mask into the rear socket, turn on the Fluovac and gas supply.

When the animal(s) are anesthetized the inner chamber slides forward allowing the gas supply to be diverted and the chamber scavenged. During this process fresh air is drawn into the inner chamber to help scavenge any residual Halothane.

The following sizes are the dimensions of the inner chamber only. Please note that there are two sizes available. The smaller is designed specifically for use with a single animal.

Specifications

Dimensions, H x W x D:

Large Unit	110 x 160 x 260 mm (4.3 x 6.3 x 10.2 in)
Small Unit	98 x 106 x 130 mm (3.9 x 4.2 x 5.1 in)

Catalog No.	$	Model	Product
BS4 34-0455		8.20.0	Scavenged Anesthetizing Chamber, Large
BS4 34-0456		8.20.4	Scavenged Anesthetizing Chamber, Small

Note: This system is used when one chamber is sufficient and use of both Size 1 Masks are also required. If two chambers are required to give sufficient output and masks are not required then the use of the following system is suggested.

NEW CO_2 Chamber Workstation - Timed Gas Supply

- Sturdy Construction
- Cylinders Easily Loaded from the Side
- Controls within Easy Reach and Viewing
- Supports for Regulators when They are Not In Use
- Timer with Audible Alarm
- Two Cylinder Keys (Attached To The Frame)
- Room for Two Chambers Plus Additional Space on the Bottom Shelf
- Snap Action Bayonet Type Tube Couplings on Chambers for Ease Of Removal
- Supplied as A Complete System - Only Cylinders to be Provided By User
- Maneuverable, with 4 Quiet-Running Rubber Wheels (2 Braked)

Designed specifically to meet customer requirements, the workstation offers the following features:

The gas supply is controlled by an electrically operated solenoid valve which allows the operator to administer carbon dioxide for up to thirty minutes at a time. The rate of rising concentration is controlled by a valved flow meter.

Four carbon dioxide cylinders can be mounted, two on either side, providing a large reserve of gas. Each pair of cylinders can be used and changed independently by virtue of a splitter valve mounted on the rear control panel. An audible alarm sounds when the time sequence starts and finishes.

The inlet tube mount is connected to the gas supply by a quick release bayonet fitting.

Specifications

Materials:

Mainframe	1" Square Section Steel Tube, White. Grey Nylon Covered Joints
Shelves	Heavy Duty 16G with White Epoxy Coating. Resistant to Most Chemicals
Cylinder Base	Aluminium Angle Construction with Ribbed Supports: Rubber Mats
Cylinder Ties	Nylon Straps with Quick-Release Buckles
Rear Panel	Tough Grey PVC. All Pneumatic and Electrical Fittings Protected by a Further Panel on The Rear of the Work Station

Workstation Supplied with:

One Large Anesthetic/CO_2 Chamber
315 x 305 x 455 mm (12.4 x 12 x 17.9 in) as per BS4 34-0429

One Medium Anesthetic/CO_2 Chamber
210 x 200 x 305 mm (8.3 x 7.9 x 12 in) as per BS4 34-0430

Catalog No.	$	Model	Product
BS4 34-0449		8.19.1	CO_2 Chamber Workstation - Timed Gas Supply

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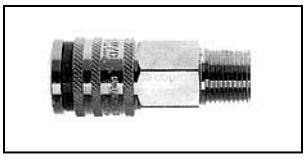
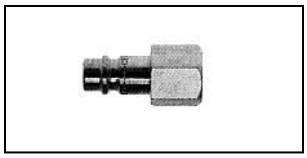
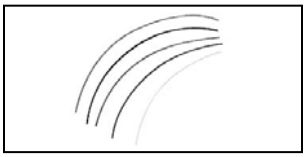
NEW Pneumatic Fittings and CO_2 Chambers



BS4 34-0451



BS4 34-0452



BS4 34-0454

BS4 34-0453

NEW Pneumatic Fittings

Spares and / or upgrades can be made to existing anesthetic systems by use of pneumatic quick release fittings.

Catalog No.	$	Model	Product
BS4 34-0451		8.19.10	1/4" UNC Thread, Female Quick Release Fitting for Use on Chambers etc.
BS4 34-0452		8.19.11	Male Quick Release Fitting with Push in Fitting for 6mm OD Pneumatic Tubing
BS4 34-0453		8.19.12	Coiled 6mm OD Tubing
BS4 34-0454		8.19.13	6mm OD Pneumatic Tubing, Natural Color, sold per meter

NEW CO_2 Chambers with Dump Door

An added option for CO_2 Chambers is to have a dump door fitted. This enables CO_2 to be cleared from the chamber without having to tip up the chamber and waiting, therefore saving time and effort.

The Chamber is easily and quickly opened and closed, and locked in place by means of a centrally placed knob. The side opening is below the false floor. Three chambers sizes are available.

Specifications

Dimensions, H x W x D:

Large Chamber	305 x 305 x 455 mm (12 x 12 x 17.9 in)
Medium Chamber	200 x 200 x 200 mm (7.9 x 7.9 x 7.9 in)
Small Chamber	150 x 100 x 255 mm (5.9 x 3.9 x 10 in)

Catalog No.	$	Model	Product
BS4 34-0434		8.17.0	CO_2 Chamber with Dump Door, Large
BS4 34-0435		8.17.1	CO_2 Chamber with Dump Door, Medium
BS4 34-0436		8.17.2	CO_2 Chamber with Dump Door, Small

BS4 34-0429

BS4 34-0430

BS4 34-0431

NEW Anesthetic/ CO_2 Chambers

These chambers have a 6mm wall thickness and can be ordered in either white or clear Perspex. The lid is 10mm thick clear Perspex and has a foam sealing strip.

Inside, the chamber has a false perforated aluminium floor resting on nylon supports. Brass straight fittings are supplied as standard. The inlet is below the grill floor and outlet at top of opposite end.

Three different sized chambers area available.

Product BS4 34-0452 Quick Release Inlet (male fitting) is available separately. This fitting is for use with coiled pneumatic fitting systems.

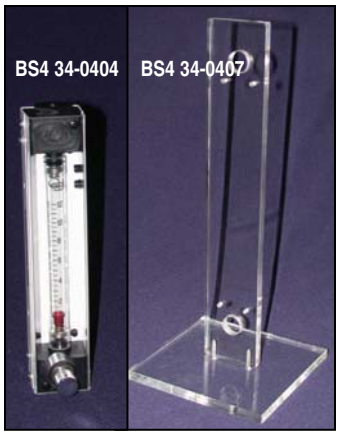
Specifications

Dimensions, H x W x D:

Large Chamber	315 x 305 x 455 mm (12.4 x 12 x 17.9 in)
Medium Chamber	210 x 200 x 305 mm (8.3 x 7.9 x 12 in)
Small Chamber	160 x 100 x 255 mm (6.3 x 3.9 x 10 in)

Catalog No.	$	Model	Product
BS4 34-0429		8.14.0	Anesthetic/CO_2 Chamber, Large
BS4 34-0430		8.14.1	Anesthetic/CO_2 Chamber, Medium
BS4 34-0431		8.14.2	Anesthetic/CO_2 Chamber, Small
BS4 72-1080		–	Silicone Tubing 3/16" ID, 1/4" OD, 25 ft
BS4 72-3043		–	Male Endcap with Barb for 3/16" to 1/4" ID Tubing

NEW Flowmeter, Regulator Valves and Tube Mounts



NEW Veterinary Flowmeters for O_2 and N_2O

These are tapered, variable area flowmeters, for use with both oxygen and nitrous oxide. Flow is controlled by a needle valve operated by a simple control knob mounted on the front of the unit.

Calibration of the oxygen flowmeter is 200cc/minute to 15 LPM, and of the nitrous oxide flowmeter 100cc/minute to 12 LPM. Tube mounts are included with each flowmeter

Low flow rates can be obtained with impressive accuracy.

The Flowmeter Bench Stand is suitable for BS4 34-0403, BS4 34-0404, BS4 34-0405 and BS4 34-0406.

Catalog No.	$	Model	Product
BS4 34-0403		8.5.0	Oxygen Veterinary Flowmeter
BS4 34-0404		8.5.1	Nitrous Oxide Veterinary Flowmeter
BS4 34-0407		8.5.4	Flowmeter Bench Stand

NEW Oxygen Flowmeter (Linear Scale)

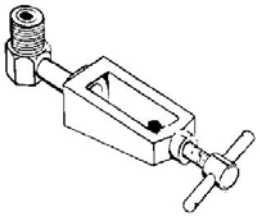
Covers range of 0 to 10LPM. It has a stainless steel needle valve with 150mm tube. Tube mounts are included.

Catalog No.	$	Model	Product
BS4 34-0405		8.5.2	Oxygen Flowmeter, Linear Scale
BS4 34-0407		8.5.4	Flowmeter Bench Stand

NEW Carbon Dioxide Flowmeter (Linear Scale)

Covers range of 0-12 LPM. Stainless steel needle valve with 150mm tube. Again, tube mounts are included.

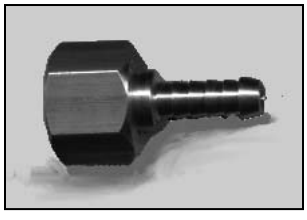
Catalog No.	$	Model	Product
BS4 34-0406		8.5.3	Carbon Dioxide Flowmeter, Linear Scale
BS4 34-0407		8.5.4	Flowmeter Bench Stand



NEW Regulator Valves

All include tube mounts, 3/8 inch nut to 1/4 inch stem.

Catalog No.	$	Model	Product
BS4 34-0438		8.18.1	Oxygen: Bull Nose Fitting, 5/8 inch BSP, 2 Gauge, Single Stage. To Fit Size F Cylinders
BS4 34-0441		8.18.4	Oxygen: Side Entry, Pin Index, 2 Gauge, Single Stage. To Fit Size E Cylinders
BS4 34-0439		8.18.2	Carbon Dioxide: 2 Gauge, Single Stage. To Fit Size F Cylinders
BS4 34-0440		8.18.3	Carbon Dioxide: Side Entry, Pin Index. 2 Gauge, Single Stage. To Fit Size E Cylinders
BS4 34-0437		8.18.0	Nitrous Oxide: 11/16 inch, 20 TPI Fitting. 2 Gauge, Single Stage. To Fit Size F Cylinders
BS4 34-0442		8.18.5	Carbon Dioxide: Side Entry, Pin Index. 2 Gauge, Single Stage. To Fit Size E Cylinders
BS4 34-0447		8.18.14	Replacement Washers for pin index regulators are also available. Metal with a rubber seal



NEW Regulator Tube Mounts

Replacements to fit any of the above. 3/8 inch nut to 1/4 inch stem.

Catalog No.	$	Model	Product
BS4 34-0443		8.18.6	Regulator Tube Mounts

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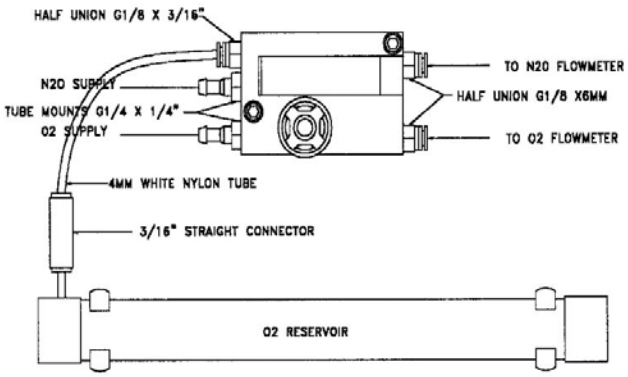
NEW Low Oxygen Warning Alarm, Oxygen Flush Control and Tubing



NEW Low Oxygen Warning Alarm

A low warning device ensuring safety and continuity during anesthesia techniques.

Simply connects in series between Regulator and Flowmeter and emits a loud whistle when Oxygen drops to a low level in the Cylinder.

This is activated between 2.5 - 2 bar in a decreasing concentration leaving ample time for the operator to change the cylinder with the minimum disruption in procedure.

Catalog No.	$	Model	Product
BS4 34-0473		8.28.0	Low Oxygen Warning Alarm

NEW Oxygen Flush Control

Incorporated into a anesthetic unit to supply oxygen directly from source to the animal, or for emergency use plus an aid to recovery.

Catalog No.	$	Model	Product
BS4 34-0474		8.28.1	Oxygen Flush Control

NEW Neoprene Antistatic Tubing

Black (with yellow line). It measures 6mm ID x 13mm OD and is supplied in 1 meter length.

Catalog No.	$	Model	Product
BS4 34-0420		8.13.0	Neoprene Antistatic Tubing

NEW Silicone Tubing

Used as the inner supply tube for Fluovac masks. It measures 6mm ID x 10mm OD and is supplied in 1 meter length.

Catalog No.	$	Model	Product
BS4 34-0421		8.13.1	Silicone Tubing

NEW PVC Tubing

This tubing is available in 2 sizes and is supplied in 1 meter lengths.

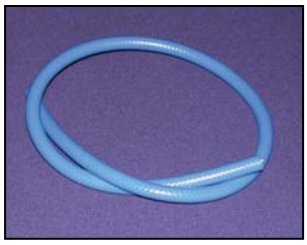
Catalog No.	$	Model	Product
BS4 34-0422		8.13.2	PVC Tubing, 6mm ID x 9mm OD
BS4 34-0782		8.13.2	PVC Tubing, 8mm ID x 11mm OD

NEW High Pressure Tubing

Black. It measures 6mm ID x 13mm OD and is supplied in 1 meter lengths. For use with CO_2 or compressed air.

Catalog No.	$	Model	Product
BS4 34-0423		8.13.3	High Pressure Tubing

NEW Tubing, Replacement Tubing, Y Pieces and Tube Clamps



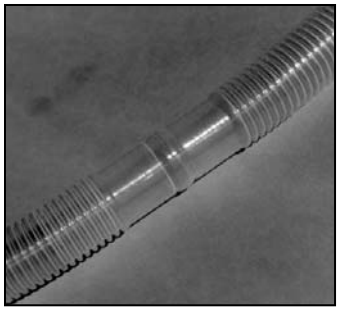
NEW Anti-Static High Pressure Tubing

This anti-static tubing measures 6 mm ID x 13 mm OD and is supplied in 1 meter lengths. It is available in two colors.

Catalog No.	$	Model	Product
BS4 34-0424		8.13.8	Anti-Static High Pressure Tubing, Oxygen (White in Color)
BS4 34-0425		8.13.9	Anti-Static High Pressure Tubing, Nitrous Oxide (Blue in Color)

NEW Fluovac Mask Replacement Tubing

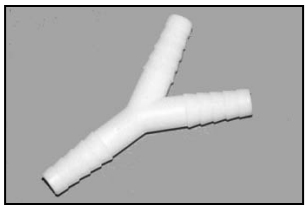
Catalog No.	$	Model	Product
BS4 34-0427		8.13.4	Fluovac Mask Replacement Tubing, Size 1, 27 mm OD x 1 m long
BS4 34-0428		8.13.5	Fluovac Mask Replacement Tubing, Size 2 & 3, 30 mm OD x 1 m long



NEW Corrugated Plastic Tubing

Corrugated tubing to fit all 22 mm tapered male tube mounts (including Directavlaves, Halovets etc.). Supplied as a continuous 10 meter length, which can be cut into 38cm sections each end having a 22 mm taper.

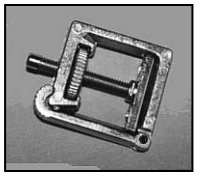
Catalog No.	$	Model	Product
BS4 34-0426		8.13.10	Plastic Tubing, 22 mm Taper, 10 meters



NEW Y Pieces

Constructed of white polypropylene. It measures 6.7 mm ID x 9 mm OD. Supplied 10 per package.

Catalog No.	$	Model	Product
BS4 34-0940		8.15.0/10	Y Pieces, pkg. of 10



NEW Tube Clamps

Hoffman. Knurled adjuster screw and hinged side plate. Supplied 10 per package.

Catalog No.	$	Model	Product
BS4 34-0941		8.16.0/10	Tube Clamps, pkg. of 10

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NEW Pneumotach Instrumentation System

- Includes software for displaying, storing, and reviewing data
- Real time display of waveform and parameter data
- Calculates flow rates and provides correction for gas density, viscosity, temperature, barometric pressure, and airway pressure
- Automatically detects start and end of breath
- Calculates over 15 ventilatory parameters

This Pneumotach Instrumentation Module is a complete flow measurement system including pressure transducers and electronics for Flow Sensor input, an auxiliary pressure input, analog outputs and Windows™ software program. This Module can be used in any application where airway flow and pressure are measured as well as an auxiliary pressure. The flow measurement can be corrected automatically for different gas mixtures and temperatures of inhaled and exhaled gases. This correction, along with the linearization and calibration features, provides a very accurate measurement of flow in a breathing circuit. This system is designed to be used with Spontaneously Breathing or Mechanically ventilated animals.

This Model is used with the Linear Bidirectional Pneumotachs, which are available in seven different calibrated flow ranges and heated or non-heated. The Pneumotachs are sold separately, see page F39. The Pneumotach Instrumentation System includes Windows™ Software and Users Manual, Dual Tube Assembly, Serial Port Cable and Power Cord Set. Please specify country when ordering.

Specifications

Auxiliary and Airway Pressure:	
Range	±120 cm H_20
Accuracy	±2% of reading
Resolution	0.1 cm H20
Sample rate	50 Hz
Operating Characteristics:	
Output Voltage	0 to 5.0 V
Accuracy	2% of Reading
Power Universal Input	90 to 264 VAC, 47 to 63 Hz, 3 W
Dimensions, H x W x D	11.4 x 28.6 x 24.8 cm (4.50 x 11.25 x 9.75 in)
Weight	2.3 kg (5 lb 1.0 oz)

Catalog No.	$	Product
BS4 72-6295		Pneumotach Instrumentation System
BS4 72-6296		Users and Software Manuals
BS4 72-6297		Software Only
BS4 72-6298		Serial port cable (9 pin)
BS4 72-6299		Dual tube assembly for Differential Pressure Pneumotach

NEW Pneumotach Amplifier Analog Output for Flow and Pressure

- For use with Linear Bidirectional Pneumotachs, see page F39
- Two pressure ranges available:
  – 70 to 70 cmH_2O or
  – 140 to 140 cmH_2O
- Zero and gain adjust ports for both outputs
- BNC type analog output jacks
- Flow direction indicator LED

This Pneumotach Amplifier provides the instrumentation necessary to produce an analog output proportional to flow when connected to any of our standard Pneumotachs, see page F39. It will also provide an analog output of an independent auxiliary pressure signal for measurement of pressure anywhere in the circuit. The Pneumotach Amplifier works with any of our Linear Bidirectional Pneumotachs that are available in seven different calibrated flow ranges in heated and non-heated versions. Please specify country when ordering.

Specifications

Analog Flow Output Ranges	0 to 2, –1 to 1, 0 to 5, –2.5 to 2.5, 0 to 10 or –5 to 5 V
Analog Pressure Output	–1 to 1 or –5 to 5 volts. Both ranges can be offset 20% to create a unipolar signal
Power	115 or 230 VAC, 50/60 Hz
Dimensions, H x W x D	63 x 203 x 178 mm (2.5 x 8 x 7 in)

Catalog No.	$	Product
BS4 72-6300		1110A Pneumotach Amplifier with –70 to 70 cmH_2O (-6.9 to 6.9 kPa) Pressure Range
BS4 72-6301		1110B Pneumotach Amplifier with –140 to 140 cmH_2O (-13.7 to 13.7 kPa) Pressure Range
BS4 72-6299		Dual Tube Assembly, 3.17 mm (.125 in) ID with Male Luer Lock for Connection to Pneumotach Amplifier
BS4 72-6302		Single Tube Assembly, 3.17 mm (.125 in) ID with Male Luer Lock for Connection to Auxiliary Pressure Port on Pneumotach Amplifier
BS4 72-6303		Hose Barb, 3.17 mm (.125 in) Pressure Port, Installed at Auxiliary Location per Customer Specifications for Pressure Measurement
BS4 72-6304		Female Luer Lock Pressure Port, Installed at Auxiliary Location per Customer Specifications for Pressure Measurement
BS4 72-6305		Coupler, Male Luer Lock, Required for connecting BS4 72-6302 Single Tube Assembly to Auxiliary Pressure Port when ordering option BS4 72-6304 Hose Barb

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Volume Calibration Syringes

Volume Calibration Syringes

- Accurate to ±1% of reading

These precision Calibration Syringes provide an easy and reliable method of calibrating and measuring the accuracy of respiratory volume measuring equipment. They are available in four sizes: 10 ml, 100 ml, 500 ml and 1 liter. Each size has a black anodized aluminum piston rod with a Teflon seal.

The 10 ml and 100 ml Syringes are made from acrylic plastic. The volume stops are located on the graduated piston rod and are engaged with a spring-loaded detent. A screw is tightened with a socket-hex wrench (supplied) to secure the volume stop.

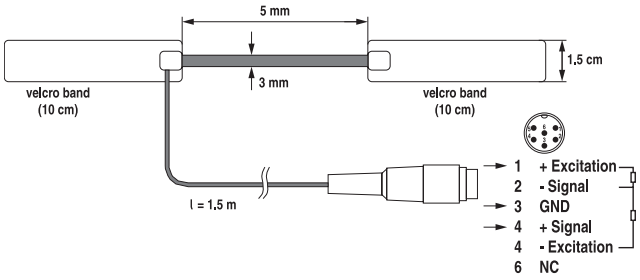
The larger 500 ml and 1 liter Syringes have anodized aluminum cylinders. The volume stops are located on the graduated piston rod and are tightened with a socket-hex wrench (supplied). For each Syringe these stops are set at predetermined minimum graduations throughout the full range of the Syringe volume. They provide easy, accurate duplications of fixed volumes.

Each Syringe is serialized and traceable to the National Institute of Standards and is calibrated against ASTM E542-85. It is important to select the Syringe with the appropriate outlet port adapter to fit specific applications. Outlet port adapters with an OD or ID of 10.5, 15 or 22 mm are standard medical tapers. All other sizes are straight connectors.

Volume Calibration Syringe Specifications

Syringe Size	10 ml	100 ml	500 ml	1 Liter
Volume Stop Minimum Graduation	2 ml	20 ml	50 ml	50 ml
Outlet Port				
Adapters, OD x ID				
15 x 10.5 mm $	**BS4 59-9390**	**BS4 59-9391**	–	–
22 x 15 mm $	**BS4 59-9653**	**BS4 59-9654**	**BS4 59-9655**	**BS4 59-9645**
28.6 x 22 mm $	–	–	**BS4 59-9656**	**BS4 59-9646**
35 x 28.6 mm $	–	–	**BS4 59-9392**	**BS4 59-9644**

Rubber Respiration Belt ML



This new Rubber Respiration Belt can be used for rodents, cats and dogs up to humans. Together with any Bridge Amplifier it offers a complete system for recording thoracic excursions and calculation of the respiration rate with a ratemeter. The transducer itself consists of two insulated copper wires, wound into a double helical spring, which forms a capacitor. This arrangement is encased in a flexible silicone jacket. The variation in capacitance is proportional to the extension of the copper spring, so the output voltage is also proportional to the extension.

The 5 cm long flexible silicone jacket is mounted on velcro bands on both sides and comes with an additional band extension for adaption.

Please note: excessive strain will destroy the transducer

Specifications

Supply voltage	+1.5 to 15 V DC from any bridge amplifier, power consumption to 120 µA at 5 V
Connector	6 pin Binder connector HSE, Hellige. Please specify input connector of bridge amplifier if different connector is required.
Dimensions	length of transducer 5 cm, width 3 mm length over all 25 cm length of cable 1.5 m
Weight	50 g total

Catalog No.	$	Product
BS4 73-0864		Rubber Respiration Belt ML

References

1. *Brimacombe, J.R. et al.: The Extensometer, Anesthesia, 1991, 46, 756-761*
2. *Brimacombe, J.: Non-invasive Monitoring of Tidal Wolume with an Extensometer: Laboratory and Clinical Studies, 1992*
3. *Thwaites, T.: How do astronauts measure up? New Scientist (1995) 15.April*

For Large Volume Calibration Syringes, please contact customer service.

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11,000 Specialty Products to Enhance Your Bioresearch

Pneumotachs

- For use with Differential Pressure Transducers, see page F42
- Available heated or non-heated

A pneumotachometer converts the flow of gases through it into a proportional signal of pressure difference on either side of a central screen. These Linear Pneumotachometers have a special screen design which assures a linear signal over a range of flow rates and have minimum dead space.

These Pneumotachometers are available in heated or non-heated versions. The Heated Pneumotachometers require a Heater Controller and are recommended when condensation of water vapor occurs. The heater shell is removable if heating is not required.

Two Heater Controllers are available to heat one or two Pneumotachometers. The cable from the Pneumotachometer heater shell connects to the rear panel of the Controller.

Both the Heated and Unheated Pneumotachometers are linear and bidirectional (produce signals for gas flow in either direction). They are available in seven flow ranges.

All Pneumotachometers are supplied with calibration curves. Adapter diameters measuring 7.5, 10.5, 15 or 22 mm are standard medical tapers. All other connectors are straight. When selecting a Pneumotachometer it is important to select the appropriate adapter size and style to match existing equipment.

Heater Controller*

Power	For use with One Pneumotachometer	For use with Two Pneumotachometers
115 VAC, 60 Hz $	BS4 59-9702	BS4 59-9704
230 VAC, 50 Hz $	BS4 59-9703	BS4 59-9705

** Note: Pneumotachometer must be ordered separately, see below.*

Linear Pneumotachometer

Animal(s)	Flow Range	Dead Space Volume	DP Input to Transducer Signal Pressure (mm/H2O)	Recommended Differential Pressure Transducer, see F42	$	Linear Pneumotachometer Heated**	$	Non-Heated	$
Mouse	0 to 3 L/min	0.30 ml	10 mmH_2O	BS4 60-0349 or BS4 60-0350		BS4 59-9325		BS4 59-9327	
		0.39 ml	10 mmH_2O	BS4 60-0349 or BS4 60-0350		BS4 59-9322		BS4 59-9324	
Mouse/Rat/	0 to 5 L/min	0.59 ml	8 mmH_2O	BS4 60-0348 or BS4 60-0349		BS4 59-9331		BS4 59-9333	
Guinea Pig		0.71 ml	8 mmH_2O	BS4 60-0348 or BS4 60-0349		BS4 59-9328		BS4 59-9330	
Cat	0 to 10 L/min	1.06 ml	10 mmH_2O	BS4 60-0349 or BS4 60-0350		BS4 59-9337		BS4 59-9339	
		1.30 ml	10 mmH_2O	BS4 60-0349 or BS4 60-0350		BS4 59-9334		BS4 59-9336	
Rabbit	0 to 10 L/min	1.66 ml	7 mmH_2O	BS4 60-0348 or BS4 60-0349		BS4 59-9340		BS4 59-9342	
		2.65 ml	7 mmH_2O	BS4 60-0348 or BS4 60-0349		BS4 59-9346		BS4 59-9348	
		3.28 ml	7 mmH_2O	BS4 60-0348 or BS4 60-0349		BS4 59-9349		BS4 59-9351	
		5.06 ml	7 mmH_2O	BS4 60-0348 or BS4 60-0349		BS4 59-9343		BS4 59-9345	
Small Dog	0 to 35 L/min	6.81 ml	7 mmH_2O	BS4 60-0348 or BS4 60-0349		BS4 59-9352		BS4 59-9354	
		8.74 ml	7 mmH_2O	BS4 60-0348 or BS4 60-0349		BS4 59-9355		BS4 59-9357	
		11.45 ml	7 mmH_2O	BS4 60-0348 or BS4 60-0349		BS4 59-9358		BS4 59-9360	
Medium Dog	0 to 100 L/min	18.15 ml	10 mmH_2O	BS4 60-0349 or BS4 60-0350		BS4 59-9361		BS4 59-9363	
Large Dog	0 to 160 L/min	13.87 ml	16 mmH_2O	BS4 60-0350		BS4 59-9367		BS4 59-9369	
		14.18 ml	16 mmH_2O	BS4 60-0350		BS4 59-9364		BS4 59-9366	

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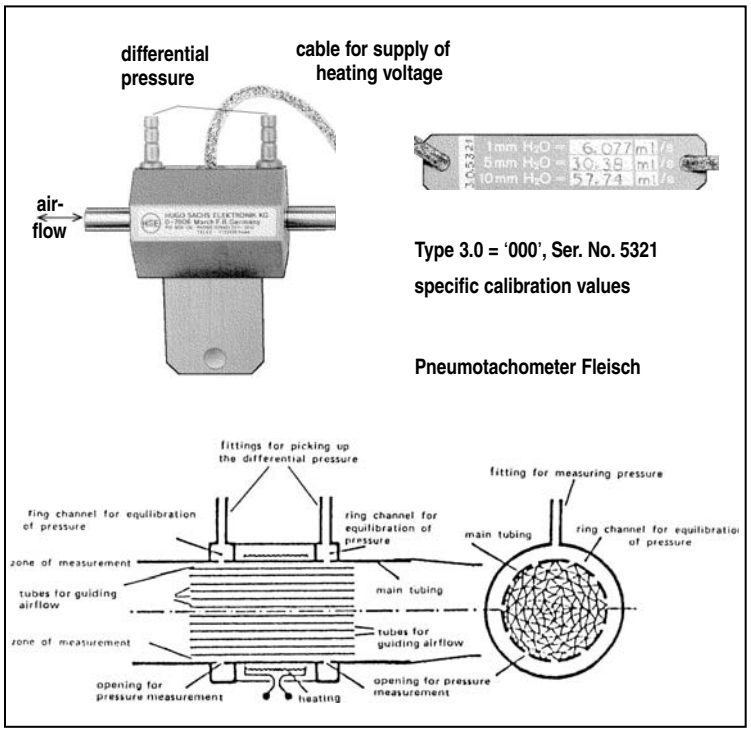
Pneumotachs



There are various sizes of pneumotachometers with various ranges of flow rate, designed for use in a wide range of animals. The differential pressure is 6.25 mmH_2O at the normal flow rate of all models. The tube has a 4-Volt heating element which prevents condensation of the moisture in the expired air (4-Volt power supply for heating Fleisch Tube). Respiratory flow during inspiration and expiration is measured in ml/sec by a pneumotachometer (Fleisch Tube) in form of a differential pressure. For converting this pressure into an electrical signal the pneumotachometer has to be connected to a differential pressure transducer, see page F42. Rigid and short plastic tubing is required for connection to the differential pressure transducer.

• For use with Differential Pressure Transducers, see page F42

The Natural Frequency of Pneumotachometers:

f_o = 20 Hz

Catalog No.	Model	Nominal Flow Rate (ml/sec)	Differential Pressure (mmH2O)	Nominal Sensitivity (ml/sec/mmH2O)	Maximum Flowrate (ml/sec)	Sample Calibrations (pressure) (flow)	Animal(s)	Inner Diameter (mm)	Connection Diameter (mm)	Length (mm)	Dead Space (ml)	Weight (g)
BS4 73-0944 $	00000 5.0	9	6.25	1.4	12	6 mmH_2O = 6 ml/sec 10 mmH_2O = 10 ml/sec	mouse (50 gr)	1.35	7	75	0.1	140
BS4 73-0945 $	0000 4.0	15	6.25	2.08	20	1 mmH_2O = 2 ml/sec 5 mmH_2O = 10 ml/sec 10 mmH_2O = 20 ml/sec	small guinea-pig or rat (170 gr)	6	7	75	0.8	140
BS4 73-0946 $	000 3.0	40	6.25	6.4	60	1 mmH_2O = 6.4 ml/sec 5 mmH_2O = 32 ml/sec 10 mmH_2O = 64 ml/sec	guinea-pig or rat (350 gr)	6	7	75	0.9	140
BS4 73-0947 $	00 2.0	100	6.25	10.56	150	1 mmH_2O = 1.12 ml/sec 5 mmH_2O = 5.61 ml/sec 10 mmH_2O = 07.9 ml/sec	smal animal, cat (750 gr)	9	10	75	2	140
BS4 73-0948 $	0	250	6.25	52.8	350	1 mmH_2O = 52.8 ml/sec 5 mmH_2O = 264 ml/sec 10 mmH_2O = 528 ml/sec	cat, dog, (5.5 kg)	10	11	60	4	140
BS4 73-0949 $	1	1000	6.25	160	1200	1 mmH_2O = 140 ml/sec 5 mmH_2O = 700 ml/sec 10 mmH_2O = 1327 ml/sec	dog, pig, (27 kg)	18	19	60	14	140
BS4 73-0950 $	2	2500	6.25	320	3000	1 mmH_2O = 321 ml/sec 5 mmH_2O = 605 ml/sec 10 mmH_2O = 3076 ml/sec	Large Animal	28	30	60	35	150
BS4 73-0951 $	3	6500	6.25	800	8000	1 mmH_2O = 800 ml/sec 5 mmH_2O = 4000 ml/sec 10 mmH_2O = 8000 ml/sec	Large Animal	43	45	60	80	250
BS4 73-0952 $	4	11000	6.25	1600	14000	1 mmH_2O = 1400 ml/sec 5 mmH_2O = 7000 ml/sec 10 mmH_2O = 14000 ml/sec	Large Animal	58	60	70	172	400
BS4 73-0963 $	5	21000	6.25	3200	25000		Large Animal	78		100	460	650

Catalog No.	$	Product
BS4 73-0482		Power Supply for Heating the Fleisch Tube, 230 VAC, 50 Hz
BS4 73-2656		Power Supply for Heating the Fleisch Tube, 115 VAC, 60 Hz

Specialized Tools For Bioresearch

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Pneumotachs

- Ideal pneumotachs for mice, rats or guinea pigs
- For isolated lung applications
- Small dead space volume
- Transparent design permits early detection of mucus in the pneumotach which helps to eliminate erroneous measurements

The HSE pneumotachometer PTM is a transducer for airflow measurement on rodents. The main feature of the new design is the small dead space. This ensures a good gas exchange in acute experiments. In combination with the silicon rubber tubing and the tracheal cannula the PTM is used for acute experiments (Intubation or tracheotomy). It is also designed for respiratory flow measurement on isolated lung of rats, guinea pigs or mice.

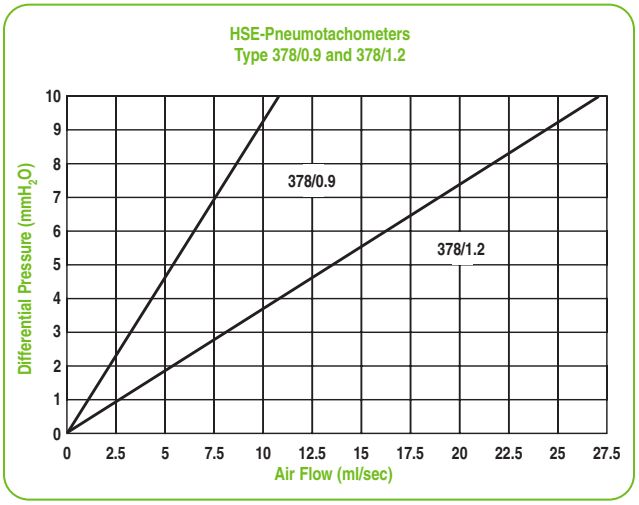
These pneumotachs are made of transparent perspex, which allows good viewing of the inside during the experiment. It also makes these units easier to clean. The flow resistance consists only of straight boring and also is easy to clean.

The transparent design allows easy detection of any mucus that comes up into the PTM during the experiment. This prevents measurement errors caused by artificial increases of the airway resistance due to pneumotach obstruction. In addition the perspex has low heat transfer properties compared to metal so that heating is not needed to prevent condensation of the moisture in the expired air.

The basic principle of the transducer is the generation of a pressure proportional to the airflow across a flow resistance. For the measurement of the pressure we recommend the Validyne differential pressure transducer type DP 45-14, see page F42.

Calibration

The PTM type 378/X are only calibrated approximately. The values in the technical specifications are only nominal values and are subject to change in the range of manufacturing tolerance. Volume calibration (injection of a specific volume using a calibrated syringe, see page F38, and integration of the flow signal) must be performed for each experiment.



Specifications

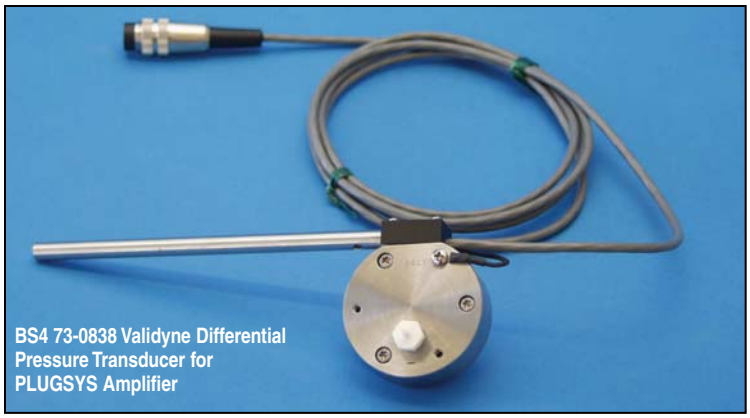
For Use With	Rats, guinea pigs	Mice
Model Number	378/1.2	378/0.9
Nominal Sensitivity	10 mmH_2O for 27 ml/sec	10 mmH_2O for 10.5 ml/sec
Nominal Flow Range	±27 ml/sec	±10.5 ml/sec
Flow Resistance, approx.	0.4 mmH_2O/ml/sec	1.0 mmH_2O/ml/sec
Dead Space, approx.	50 µl	25 µl

Catalog No.	$	Product
BS4 73-0980		PTM Type 378/1.2 for Rats
BS4 73-0981		PTM Type 378/0.9 for Mice

For Validyne Differential Pressure Transducers, see page F42.

For Volume Calibration Syringes, see page F38.

Differential Pressure Transducers



BS4 73-0838 Validyne Differential Pressure Transducer for PLUGSYS Amplifier

- For very low differential pressure measurements
- Suitable for applications in plethysmography, pneumotachography
- Highly resistant to mechanical shock and overpressure
- All exposed parts made from 410 stainless steel to prevent corrosion
- For connection to pneumotachometer FLEISCH or HSE - PTM or plethysmograph box
- Range ± 2 cm H_20
- Inductive system, needs CF-bridge Amplifier (or CFAB with DC-bridge amplifier)

This Differential Pressure Transducers is for very low differential pressure measurements. They are especially suitable for applications in plethysmography and pneumotachography.

This Transducer has very small internal volume and volumetric displacement to achieve high frequency response. It is highly resistant to mechanical shock and over-pressure. A diaphragm of magnetically permeable material clamped between two symmetrical assemblies completes a magnetic circuit with each E-core. Application of pressure causes diaphragm deflection, increasing the gap in the magnetic flux path of one core and decreasing the gap equally in the other core. The magnetic reluctance varies with the size of the gap, changing the inductance ratio. The inductance ratio is then measured by an Carrier Frequency bridge amplifier in which an output voltage proportional to pressure is obtained. The CFBA Amplifier for the PLUGSYS or a regular bridge amplfier in combination with the Carrier Frequency Adapter Box on can be used.

All exposed parts of these Transducers are made from 410 stainless steel to prevent corrosion. They have a 3.1 m (10 ft) cable and are supplied individually with two pieces of 4.8 mm (0.31 in) ID hose for connection to a Pneumotachometer, see pages F40 to F41. Interchangeable Replacement Diaphragms are offered separately to change the Transducer's operating pressure range.

Specifications

Ranges	DP 45-14 ±2 cm H_20 (PTM and FLEISCH tube)	**Thermal zero shift**	0.2%/10°K (25°C ±40°K)
Volumetric displacement	0.006 mm^3 FS	**Sensitivity**	25 mV/V FS nominal
Natural frequency	< than 600 Hz	**Accuracy**	±0.25% FS
Measuring System	Half bridge inductance (2 x 20 mH nominal)	**Size, OD x Width**	57 x 20.5 mm
Pressure cavity volume	6.5 mm^3	**Weight**	0.6 kg
Excitation voltage	5 V at 5 kHz		

Catalog No.	$	Product
BS4 73-0838		Differential Pressure Transducer Validyne Type 45-14
BS4 73-0500		Stand with Triangular Plate

HSE-HA Differential Pressure Transducer

BS4 73-0064 Differential Pressure Transducer MPX, for PLUGSYS Amplifier

- Ideal for measuring esophageal pressure with air-filled catheter, mouth pressures and transdiaphragmatic pressures
- For use with most research animals

This differential pressure transducer is mainly used for measuring esophageal pressure using air filled catheter. It is ideal for use with mouse, hamster, rat, guinea pig, rabbit, ferret, cat and dog.

Specifications

Pressure Range	±100 cmH_2O (±100 mbar)
Sensitivity	0.3 to 0.8 mV/mbar, excitation of 5 V
Linearity	±1.5%
Thermal Zero Shift	5 mbar (0° to 85°C)
Input Resistance	400 to 550 Ω
Output Resistance	600 to 1000 Ω
Offset Voltage	1 mV maximum
Excitation Voltage	0 to 5 VDC or AC
Overpressure	±1000 mbar (750 mmHg)
Inlet/Outlet Nozzle	2.0 x 4.7 x 9.0 mm, ID x OD x L
Housing Size, H x W x D	24 x 42 x 36 mm (0.9 x 1.7 x 1.4 in)
Weight	190 g (6.7 oz)
Application	Only for dry air

Catalog No.	$	Product
BS4 73-0064		Differential Pressure Transducer MPX, for PLUGSYS
BS4 73-3108		Differential Pressure Transducer MPX, for Harvard Apparatus
BS4 73-3109		Differential Pressure Transducer MPX, for Grass
BS4 73-3110		Differential Pressure Transducer MPX, for Gould 6600
BS4 73-3111		Differential Pressure Transducer MPX, for Gould 4600

Interchangeable Replacement Diaphragms to BS4 73-0838 are offered separately to change the Transducer's operating pressure range.

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NEW V8401 Capnocheck

- Spot-check end-tidal CO_2 at an affordable price
- Easy to read LED displays for $ETCO_2$ and respiration rate
- CO_2 waveform
- Quantitative breath indicator bar
- Reliable sidestream technology for use on intubated and non-intubated animals
- One-touch function keys for easy operation
- Ergonomic design and lightweight, just 650 grams (22 oz)
- Sidestream monitor not suitable for rodents
- Sample rate = 120 ml/min

The V8401 Capnocheck is a highly transportable monitor designed to provide spot-check reading of End Tidal CO_2 ($ETCO_2$). It also provides inspired CO_2 and respiration measurement on most animals. Simple one-touch controls make it easy to use. The V8401 operates on internal rechargeable batteries or can be connected to an AC adapter. An infrared link sends data to an external printer.

Now the accuracy and reliability of capnometry is available in a lightweight transportable unit that runs on AC or battery power. A bright LED display provide $ETCO_2$ and respiration rate measurements. One-touch, direct function keys and the lightweight ergonomic design offer ease of operation with both intubated and non-intubated animals. The V8401 draws a sample of gas through the sample cell. It uses an infrared (IR) light source, optical band pass filter and detector to measure the amount of CO_2 in the sample. The $ETCO_2$ is displayed as an average of 4 breaths. The continuous CO_2 waveform is used to detect each breath and to compute the respiratory rate. When using N_2O in an anesthesia setup, the N_2O compensation can be 'Enabled' to compensate for the interference of N_2O on the CO_2 measurement.

The V8401 Capnocheck comes complete with an instruction manual, AC adapter/charger, and protective boot.

Specifications

End Tidal CO_2:	
Measurement	Non-Dispersive IR absorption
Range	0 to 100 mmHg or 0 to 10.0% CO_2 or 0 to 13.3 kPa
Accuracy	±2 mmHg; ±0.3%; ±0.3 kPa, or 4% of reading, whichever is greater (0 to 10% CO_2)
Resolution	1 mmHg; 0.1%; 0.1 kPa
Response Time	2.46 sec to 90% of value with 8 ft patient line
Averaging	4-breath average (updated with every breath)
Respiration Rate:	
Range	0 - 150 ± 1 bpm
Averaging	4-breath average (updated with every breath)
Power Requirements:	
Input	(Optional) 120 V-, 50/60 Hz; (Optional) 230 V-, 50/60 Hz
Battery	Li^+ (lithium ion), 7.4 VDC Replaceable, internal rechargeable, life of 6 hours
AC Chargers	120V-, 50/60 Hz 230 VAC 50/60 Hz (optional) 100 VAC 50/60 Hz (optional)
Dimensions, H x W x D	127 x 111 x 73.7 mm (5 x 4.4 x 2.9 in)
Weight	630 g (22 oz)

Catalog No.	$	Product
BS4 72-6016		Hand Held Capnometer, 120 VAC, 60 Hz
BS4 72-6017		Hand Held Capnometer, 220 VAC, 50 Hz

Did you know ?

Harvard Apparatus now owns Hugo Sachs Elektronik. The HSE isolated organ baths set the industry standard. They can be found in the Isolated Organ and Tissue Section K.

V9004 Series Intelligent Capnography and More

- Sampling rate of 120 ml/min
- High resolution vacuum fluorescent display
- Simplified menu structure
- Monitoring of both intubated and non-intubated patients
- Flexibility to incorporate SpO_2 and FiO_2
- Patented moisture removal system
- Sidestream monitor not suitable for rodents

The V9004 is a versatile Table Top capnograph with a graphical vacuum fluorescent display which can be ordered with either pulse oximetry, or pulse oximetry and fractional inspired oxygen, FiO_2. Available parameters (CO_2 or CO_2 and SpO_2 plethysmogram) can be displayed as waveforms or trends. In addition to waveforms, the V9004 also displays an average of $ETCO_2$, respiration rate and when available % SpO_2, heart rate and % O_2.

Four user-selectable averaging modes are available for oximetry, along with numeric and audible alarms for high and low values of all measured parameters. Low priority alarms warn the user of system setup malfunctions such as a disconnected probe. The audible indicators and alarms vary in rate and pitch to indicate changes in pulse rate and SpO_2 level.

The V9004 Table Top capnograph comes complete with an instruction manual, AC adapter/charger, and the animal attachment kit, BS4 72-3232. When ordered with oximetry the system also includes a 5 foot Oximeter Extension cable, BS4 72-3157, small reflectance probe, BS4 72-3254, and the small to medium Y-Clip probe BS4 72-3256 are included. The FiO_2 T-Adapter, BS4 72-3138, and the FiO_2 sensor, BS4 72-3139, and cable, BS4 72-3140, are included when the V9004 is ordered with FiO_2. A gas calibration kit and other airway accessories are available, see below. A graphics printer, BS4 72-3279, is available to printout displayed waveforms from the V9004. The AC adapter for the graphics printer is not included but is recommended. The PC/Printer Interface Cable, BS4 72-3179, is used to export data to a PC running Windows™ 95 or higher.

Catalog No.	$	Product
BS4 72-3240		Table Top Capnograph, 110 VAC, 60 Hz
BS4 72-3276		Table Top Capnograph, 220 VAC, 50 Hz
BS4 72-3241		TT Capnograph and Oximeter, 110 VAC, 60 Hz
BS4 72-3277		TT Capnograph and Oximeter, 220 VAC, 50 Hz
BS4 72-3242		TT Capnograph, Oximeter and FiO_2, 110 VAC, 60 Hz
BS4 72-3278		TT Capnograph, Oximeter and FiO_2, 220 VAC, 50 Hz
Capnograph Accessories[1]		
BS4 72-3138		Adapter T, FiO_2
BS4 72-3139		FiO_2 Sensor
BS4 72-3140		FiO_2 Sensor Cable
Other Accessories[2]		
BS4 72-3279		V3408 Graphics Printer and Cable
BS4 72-3214		AC Adapter/Charger, 110 VAC, 60 Hz
BS4 72-3215		AC Adapter/Charger, 208 to 252 VAC, 50 Hz
BS4 72-3205		Printer Paper, pkg. of 4
BS4 72-3179		PC/Printer Interface Cable
BS4 72-3175		IV Pole Bracket

Specifications

Display:	
Displayed Trends	Graphical display, factory selectable sample rate, user selectable trend
Displayed Waveforms	15 hr display at 12 sec sample rate 9 hr display at 4 sec sample rate, Selectable CO_2 or CO_2 /Plethysmogram waveform
CO_2:	
Measurement	Non-Dispersive IR absorption
Measurement Range	0 to 10% CO_2
Units	User-selectable: mmHg Vol. %, kPa
Display Range	0 to 100 mmHg or 0 to 10.0% CO_2 or 0 to 13.3 kPa
Accuracy	±2 mmHg; ±0.3%; ±0.3 kPa, or 4% of reading, whichever is greater (0 to 10% CO_2)
Resolution	1 mmHg; 0.1%; 0.1 kPa
N_2O Compensation	User-selectable 40% (default = OFF)
Averaging	4-breath average
Respiration Rate:	
Range	0 to 150 ±1 bpm
Averaging	4-breath average
SpO_2 (Optional):	
Range	0 to 100%
Accuracy	±2% at 70 to 100%; ±3% at 50 to 69%
Averaging	4, 8, 16 beat, user-selectable
Pulse Rate (Optional):	
Range	20 to 350 bpm
Accuracy	±1 beat or 2% whichever is greater
Averaging	8 or 16 seconds, user-selectable
Pulse Tone	Pitch corresponds to SpO_2 value, Volume adjustable or OFF
FiO_2 (Optional):	
Range	0 to 100%
Accuracy	±2%
Response Time	< 10 sec. to 90%
Drift	< 2% full scale per month
Battery Requirements	Nickel Cadmium battery, 6 VDC, internal rechargeable, not replaceable, fully charged continuous - use life 2 hours approximate, maximum full charge time 4 hours
Serial Output	RS232C: tabular trends, patient data
Analog Output	Any three of : CO_2 waveform, Plethysmogram, End Tidal CO_2 Respiration Rate, Inspired CO_2, % SpO_2, Pulse Rate Fractional Inspired Oxygen, 0V or 1V Cal signal, Range 0 to 1 VDC full scale
Safety Approvals	Designed to meet IEC 601-1, CSA 125, UL 544, and IEC 601-1-2 (EMC CE), ISO 9001 Certified
Dimensions, H x W x D	88.9 x 254 x 139.7 mm (3.5 x 10.0 x 5.5 in)
Weight	2.27 kg (5 lbs)

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NEW V3395 Temperature, SpO_2 and Respiration Monitor with SAC™ Technology

- Advanced Digital oximetry with SAC™ technology for demanding veterinary applications
- Good for low perfusion and/or high motion situations
- Print at intervals up to 15 minutes
- Plethysmographic wave-form displayed
- Can be used in a wide variety of applications including: surgery, and prep areas, as well as in the field
- SpO_2 rates on patients from small animals to horses
- Monitors respiration rates and temperature
- Quantitative pulse bar strength
- Adjustable, visible and audible alarm limits
- 99 patient memory

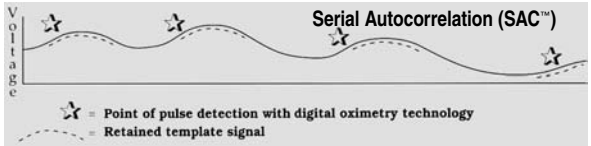
This is the newest addition to our line of animal monitors. This monitor is ideal for a wide variety of applications including surgery, pre and post operative montitoring as well as monitoring in the field. It's small size makes it very portable so it may be easily taken from one lab to the next. It has a rechargeable battery that allows 2 hours of use before recharging in necessary. It is supplied complete with the following:

- AC charger
- 1 - Universal "Y" sensor
- 1 - Reflectance sensor
- 1 - Temperature Cable and Probe
- 1 - Respiration cable and probe
- 1 - 5 foot Oximetry extension cable
- Operations manual
- Protective boot

Specifications

$Sp0_2$:	
Range	50% to 100% $Sp0_2$
Accuracy	±2% at 70% to 100% $Sp0_2$
Calibration	Factory calibrated
Alarm Ranges	50% to 100% (1% increments), and OFF
Pulse Rate:	
Range	Sensitivity level 100, used for larger animals Sensitivity level 70, used for smaller animals
Rate	5 to 150 breathes per minute (BrPM)
Accuracy	> of ±2% or ±2 BrPM over full range
Minimal Signal	10 ml passing thermister
Temperature:	
Range	0 to 60°C, 32 to 140°F
Accuracy	±1°C
Alarms	No alarms for temperature
Environment:	
Temperature Operating	0°C to 55°C
Storage	40°C to 75°C
Relative Humidity Operating	15 to 95%
Storage	10 to 95%
Dimensions, H x W x D	12.7 x 11.1 x 7.4 cm (5.0 x 4.38 x 2.9 in)
Weight	624 g (22 oz)
Battery Life	NiMH rechargeable battery allow for 2 hours of continuous use

Catalog No.	$	Product
BS4 72-6008		Temperature, SpO_2 and Respiration Monitor
Replacement Parts		
BS4 72-6009		AC Charger, 110 V
BS4 72-3256		Universal Y Sensor
BS4 72-3254		Reflectance Sensor
BS4 72-6012		Temperature Probe
BS4 72-6011		Temperature Cable
BS4 72-6013		Respiration Cable/Probe
BS4 72-6014		Operations Manual
Accessories		
BS4 72-6010		AC Charger, 220 V
BS4 72-3258		Universal C Sensor
BS4 72-6015		Mini Clip Sensor



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V3402 Hand-Held Pulse Oximeter with SAC™ Technology

BS4 72-3192 with protective boot

- Powered by AC charger or 6 disposable AA batteries
- Easy-to-read LED display with adjustable brightness
- Variety of reusable sensors designed for animal applications
- Quantitative pulse strength bar
- Advanced Digital SAC™ oximetry for demanding research environments

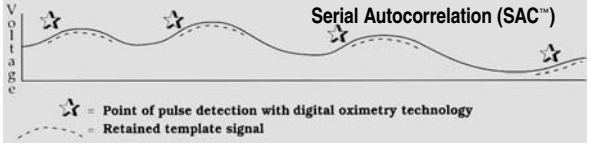
Using refined noise-reduction hardware (digital processing) and a unique patented software algorithm (SAC™), the V3402 is able to look at pulse oximetry data in a whole new way. This technology analyzes a digital signal at a rate of 120 times per second, and compares it to previous pulse data. These pulses are constantly stored, updated, and used as dynamic templates to determine the validity or invalidity for newly encountered pulsatile signals. The new V3402 digital hand held oximeter offers advanced pulse oximetry specifically for animal applications. The V3402 offers advanced digital signal analysis to a wide range of user-customizable features. Two user-selectable averaging modes are available, visual and audible indicators for SpO_2 and pulse rate, an 8 segment LED bar indicator for pulse strength as well as high and low limit adjustable alarms for SpO_2 and pulse rate. Low priority alarms warn the user of system setup malfunctions such as a disconnected probe. The audible indicators and alarms vary in rate and pitch to indicate changes in pulse rate and SpO_2 level, respectively.

Animal IDs from 0-99 are used by the V3402 to delineate multiple animal data measurements. An optional serial printer, BS4 72-3173, can be used to output animal trend data either as it is collected (data log mode) or from stored data. The V3402 can store up to 90 hours of trend data for up to 99 individual animals. The trend storage interval is user selectable from 4-30 seconds. Output of data to a computer requires the use of BS4 72-3166 printer interface cable and BS4 72-3155 PC adapter cable. The V3402 Pulse Oximeter comes with an instruction manual, BS4 72-3193 protective rubber boot, BS4 72-3254 small reflectance probe and the BS4 72-3256 small to medium Y-Clip probe. The unit is powered by six 'AA' alkaline batteries. An optional AC adapter is available. Other pulse oximeter probes and accessories are available, see to the right.

Specifications

Displays:	
SpO_2	LED numeric display, 7.62 mm (0.3 in) high
Pulse Rate	LED numeric display, 7.62 mm (0.3 in) high
Pulse Strength	Logarithmically scaled, 8-segment bar graph
SpO_2:	
Range	0 to 99%
Accuracy	±2 at 70 99%; ±3 at 50 to 69%
Averaging	4, 8, 16 beat average
Alarms	Low 50 to 99% and Off High 50 to 99% and Off
Pulse Rate:	
Range	20 to 350 bpm
Accuracy	±1 beat or 2% whichever is greater
Averaging	8 or 16 second average
Alarms	Low 5 to 350 and Off High 5 to 350 and Off
Storage:	
Parameters	SpO_2 Pulse rate and Relative Time
Interval	4 to 30 sec
Capacity	14 hrs of storage at 30 sec intervals
Battery Life	35 hrs continuous use
Printer Output	RS232C for trend output via computer, Infra-Red Link for HP 82240B Infra-Red Printer
Safety Approvals	UL 544 Listed, Certified by TUV to 601-1, CSA 125, EN865, CE to the MDD version available
Voltage Requirements	(6) 'AA' Alkaline or NiCAD Batteries
Dimensions, H x W x D	16.76 x 6.98 x 6.36 cm (6.6 x 2.75 x 1.43 in)
Weight	0.6 kg (1 lb 5 oz) with batteries and boot

Catalog No.	$	Product
BS4 72-3192		V3402 Pulse Oximeter
Sensors and Sensor Accessories		
BS4 72-3254		Small Reflectance or Rectal Pulse Ox Sensor
BS4 72-3255		Regular Reflectance or Rectal Pulse Ox Sensor
BS4 72-3256		Small to Medium Universal Y or Lingual Pulse Ox Sensor
BS4 72-3258		C-Clip Pulse Ox Sensor
BS4 72-3259		C-Clip Replacement
BS4 72-3260		Y-Clip Replacement
BS4 72-3157		Oximetry Cable, 5 ft.
BS4 72-3163		Oximetry Simulator with 5 ft. Cable
Optional Accessories		
BS4 72-3194		Infrared Printer
BS4 72-3173		Printer for BS4 72-3164, 110 VAC, 60 Hz
BS4 72-3181		AC Adapter for V3402, 105-125 VAC, 60 Hz
BS4 72-3183		AC Adapter for V3402, 208-252 VAC, 50 Hz
BS4 72-3179		Printer Interface Cable
BS4 72-3180		PC Adapter Cable
BS4 72-3175		Pole Mounting Bracket



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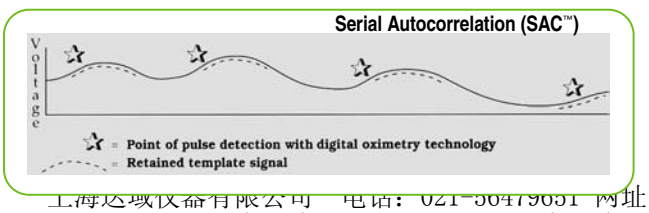
V3304 Pulse Oximeter with SAC™ Technology

- Internal rechargeable battery
- Easy-to-read LED display with adjustable brightness
- Variety of reusable sensors designed for animal applications
- Quantitative pulse strength bar
- Advanced Digital SAC™ oximetry for demanding research environments

Using refined noise-reduction hardware (digital processing) and a unique patented software algorithm Serial Auto Correlation (SAC™), the V3304 is able to look at pulse oximetry data in a whole new way. This innovative oximeter technology analyzes a digital signal at a rate of 120 times per second and compares it to previous pulse data. These pulses are constantly stored and updated, and used as dynamic templates to determine the validity or invalidity for newly encountered pulsatile signals. The V3304 offers the same advanced features as the V3402, see page F46, but in a table top package with extended data storage capabilities. Three user-selectable averaging modes are available, visual and audible indicators for SpO_2 and pulse rate, an 8 segment LED bar indicator for pulse strength as well as high and low limit adjustable alarms for SpO_2 and pulse rate. Low priority alarms warn the user of system setup malfunctions such as a disconnected probe. The audible indicators and alarms vary in rate and pitch to indicate changes in pulse rate and SpO_2 level, respectively.

Animal IDs from 0-99 are used by the V3304 to delineate multiple animal data measurements. An optional serial printer, BS4 72-3173, is available which can be used to output animal data in continuous datal log mode (every 5 seconds) or trend mode (every 4-30 seconds). Trend data continues to be stored even when data is being printed using the data log mode. The V3304 can store up to 90 hours of trend data for up to 99 individual animals. The trend storage interval is user selectable from 4-30 seconds. Decreasing the trend storage interval decreases the maximum length of time data can be stored in memory. Output of data to a computer requires the use of BS4 72-3166 printer interface cable and BS4 72-3155 PC adapter cable. The V3304 Pulse Oximeter comes with an instruction manual, AC adapter/charger, BS4 72-3157 5 foot oximeter extension cable, BS4 72-3254 small reflectance probe and the BS4 72-3256 small to medium Y-Clip probe. The unit is powered by an internal rechargeable lead acid battery. Other pulse oximeter probes and accessories are available, see to the right.



Specifications

SpO_2 & Plus Rate	3-digit LED display, 10 mm (0.43 in) high
SpO_2:	
Range	0 to 100%
Accuracy	±2% at 70 to 100% ±3% at 50 to 69%
Alarm Range	High: 50 to 100% and Off (1% steps) Low: 50 to 99% and Off (1% steps)
Averaging	4, 6, or 16 pulse beat average
Pulse Rate:	
Range	20 to 350 BPM
Accuracy	±1 beat or 2% whichever is greater
Alarm Range	High: 5 to 350 BPM and Off (5 BPM steps) Low: 5 to 350 BPM and Off (5 BPM steps)
Averaging	8 or 16 sec average
Battery Life	Standard Lead-Acid battery: Internal rechargeable; not user replaceable. Fully charges in about 6 hrs. Approximately 4.5 hrs continuous use
Printer Output	SpO_2 and pulse rate can be printed every five (5) sec (data log). Data saved every four (4) to thirty (30) sec can be printed (trend) Analog Output (optional) Digital Output (optional)
Safety Approvals	Designed to meet IEC-601-1, CSA 125, UL 544, and CE (EMC)
AC Charger Voltage Requirements:	
Wall Mount	105 to 125 VAC, 60 Hz 100 V – Hz (Optional)
Table Top	230 VAC; 50/60 Hz
Dimensions, H x W x D	216 x 82 x 140 mm (3.4 x 8.5 x 5.5 in)
Weight	850 grams (30 ounces)

Catalog No.	$	Product
BS4 72-3174		V3304 Digital Table Top Pulse Oximeter, 110 VAC, 60 Hz
BS4 72-3264		V3304 Digital Table Top Pulse Oximeter, 220 VAC, 50 Hz
Sensors and Sensor Accessories		
BS4 72-3254		Small Reflectance or Rectal Pulse Ox Sensor
BS4 72-3255		Regular Reflectance or Rectal Pulse Ox Sensor
BS4 72-3256		Small to Medium Universal Y or Lingual Pulse Ox Sensor
BS4 72-3258		C-Clip Pulse Ox Sensor
BS4 72-3259		C-Clip Replacement
BS4 72-3260		Y-Clip Replacement
BS4 72-3157		Oximetry Cable, 5 ft.
BS4 72-3163		Oximetry Simulator with 5 ft. Cable
Optional Accessories		
BS4 72-3185		Printer and Cable, 110 VAC, 60 Hz
BS4 72-3179		Printer Interface Cable
BS4 72-3180		PC Interface Cable
BS4 72-3178		Digital Output Adapter
BS4 72-3177		Analog Output Adapter
BS4 72-3175		IV Pole Bracket

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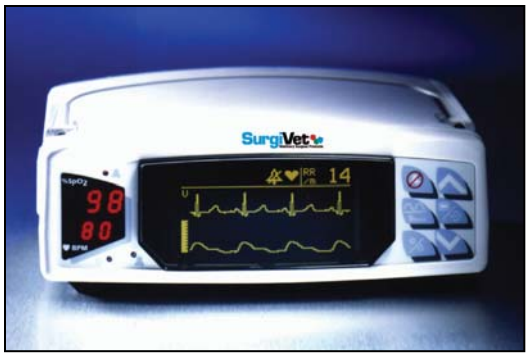
NEW V3404 Plus ECG/Pulse Oximeter with SAC™ Technology



- 3 or 5 lead ECG
- Bright dual trace on a electroluminescent display
- Expanded heart rates for animal use
- Variety of sensors for animal applications
- Optional graphics printer provides high resolution graphic printing
- Advanced Digital SAC™ oximetry for unparalleled oximetry accuracy

The V3404 Plus incorporates a selectable ECG lead system and the advanced digital hardware (serial auto correlation)/SAC™ software oximetry, all in one unit. Basic and easy to use, this transportable monitor offers a practical low cost solution for combined ECG and Oximetry.

The V3404 Plus offers the same advanced pulse oximetry features as the V3304, see page F47, and offers the added convenience of integrated 3 or 5 position ECG. The advanced graphic electroluminescent display presents the oximetry data as a plethysmogram and any one of the ECG leads (I, II, III, aVR, aVL, aVF or V).

Three user-selectable averaging modes are available, along with numeric and audible indicators for SpO_2 and pulse rate, a bar indicator for pulse strength as well as high and low limit adjustable alarms for SpO_2 and pulse rate. Low priority alarms warn the user of system setup malfunctions such as a disconnected probe. The audible indicators and alarms vary in rate and pitch to indicate changes in pulse rate and SpO_2 level.

All waveforms can be output using the optional BS4 72-3204 graphics printer. The optional power jumper, BS4 72-3206, is not included but is recommended.

The V3304 Pulse Oximeter comes with an instruction manual, AC adapter/charger, BS4 72-3157 5 foot Oximeter Extension cable, BS4 72-3254 small reflectance probe and the BS4 72-3256 small to medium Y-Clip probe, BS4 72-3198 ECG Cable for 3-lead set and the BS4 72-3199 ECG 3-lead set. The unit is powered by an internal rechargeable lead acid battery. Other pulse oximeter probes and accessories are available, see to the right.

Specifications

Display:	
Type	Electroluminescent, 160 x 80 pixels
Waveforms	ECG, Plethysmogram
Graphic Trends	SpO_2 Pulse Rate (Heart Rate) and Pulse Signal Strength
SpO_2 & Pulse Rate	3-digit (LED display), 14.2 mm (0.56 in) high 3-digit (LED display), 10.9 mm (0.43 in) high
SpO_2:	
Range	0 to 100%
Accuracy	±2% at 70 to 100% ±3% at 50 to 60%
Alarm Range	High: 50 to 100% and Off (1% steps)
Averaging	4, 8, 16 pulse beat average (fast, normal, slow)
Pulse Rate (SpO_2) or Heart Rate (ECG):	
Range	20 to 350 bpm
Accuracy	±1 bpm or ±2% whichever is greater
Alarm Range	High: 20 to 350 bpm and Off (1 bpm steps)
Averaging	8 or 16 sec average (normal, slow)
ECG:	
Configuration	3- or 5-lead
Lead Selection	I, II, III, aVR, aVL, aVF and V
Gain	XI, X2, X4, X8
Pace Detect	Yes
Pace Reject	Yes
Sweep Speed	12.5, 25 or 50 mm/sec
Printer Output	
Serial	RS232C serial data output
Safety Approvals	EN60601-1, EN60601-1-1, UL 544, CSA Std. C22.2, No. 125-1984, EN60601-1-2, ISO 9001 Certified
Trends	17 hrs at 30 sec intervals
Battery Life	Standard Lead - Acid Battery. Internal rechargeable; not user replaceable. Approximately 1.5 hrs continuous use. Fully charges in 6 hrs
Dimensions, H x W x D	88.9 x 139.7 x 254 mm (3.5 x 10.0 x 5.5 in)
Weight	2.27 kg (5 lbs)

Catalog No.	$	Product
BS4 72-6018		V3404 Plus Digital Pulse Oximeter/ECG, 110 VAC, 60 Hz
BS4 72-6019		V3404 Plus Digital Pulse Oximeter/ECG, 220 VAC, 50 Hz
ECG Leads, Sensors and Sensor Accessories*		
BS4 72-3254		Small Reflectance or Rectal Pulse Ox Sensor
BS4 72-3255		Regular Reflectance or Rectal Pulse Ox Sensor
BS4 72-3256		Small to Medium Universal Y or Lingual Pulse Ox Sensor
BS4 72-3258		C Clip Pulse Oxygen Sensor
BS4 72-3198		ECG Cable for 3-Lead Set
BS4 72-3268		ECG Cable for 5-Lead Set
Optional Accessories*		
BS4 72-3204		V3408 Graphics Printer and Cable
BS4 72-3200		AC Adapter/Charger 110 VAC, 60 Hz
BS4 72-3202		AC Adapter/Charger 208 to 0252 VAC, 50 Hz
BS4 72-3205		Printer Paper, pkg. of 4
BS4 72-3179		Serial Printer Interface Cable
BS4 72-3180		PC Interface Cable
BS4 72-3175		IV Pole Bracket
BS4 72-3206		Power Jumper Cable from V3408 to printer
BS4 72-3197		Printer Interface Cable

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Research Spirometry System

- Measure pressure, flow and definitive parameters
- For spontaneously breathing or mechanically ventilated subjects
- Large graphic display
- Two different sized sensors available for a wide range of applications
- Dual pressure measurements
- Data displayed in real time
- Calculates over 15 respiratory parameters
- Can be interfaced to a computer
- No calibration needed
- Works with a wide range of pneumotachs

This complete spirometry system is for use in any application where airway flow and pressure are measured. Flow is measured using the differential-pressure method. As gas flows through the pneumotach, the microprocessor-based system converts the measured differential pressure to volumetric flow rate. Flow and pressure measurements are used to calculate several ventilator management parameters such as respiratory rate, lung compliance, tidal volume, minute volume, positive and expiratory pressure, etc.

This spirometer has a graphic LCD which shows flow, pressure, and volume strip-chart plots as well as flow-volume and pressure-volume loops. Calculated parameters are also displayed on the screen.

The system can also be interfaced to a computer through a serial data port. A Windows™ software program is available separately and permits acquisition of waveforms and data obtained by the spirometer. It may be displayed, stored or viewed using this program.

Flow, pressure, volume, and auxiliary pressure signals are available as analog outputs for convenient and reliable interfacing to a strip chart recorder, oscilloscope or other instruments.

This system works with precision molded fixed-orifice pneumotachs. They do not require any user calibration and are available in two sizes. These pneumotachs are robust even under the extreme heat and moisture conditions. This system is also designed to work with a wide range of linear (Fleisch and Hans Rudolph) differential pressure pneumotachs, see pages F39 to F41.

This system is supplied with software, small and large sensors with tubing, RS-232 serial cable, standard North American power cord and user's manual. Other international power cords are available. Please call Harvard Apparatus for details and requirements.

Specifications

Calculated Parameters	Positive end expiratory pressure, peak inspiratory pressure, mean airway pressure, inspiratory pause pressure, compliance, tidal volume, minute volume, respiratory rate, inspiratory and expiratory time, inspiratory to expiratory ratio (I:E), peak inspiratory and expiratory flow rates
Flow:	
Accuracy	±3% of Reading
Large Sensor	±1.0 to 180 LPM
Small Sensor	±0.24 to 40 LPM
Resolution:	
Large Sensor	0.1 LPM
Small Sensor	0.01 LPM
Linear Pneumotach (Sensor Dependent):	
Accuracy	±1%, Typical
Range	±1000 LPM Max.
Auxiliary and Airway Pressure:	
Accuracy	±2% of Reading
Range	±120 cmH_2O
Resolution	0.2 cmH_2O
Power	Universal Input 90 to 264 VAC, 47 to 63 Hz, 3 W
Certification	CE Mark IEC 61010

Catalog No.	$	Product
BS4 63-0241		Research Spirometry System
BS4 63-0242		Research Spirometry Software
BS4 63-0243		Small Sensor with Tubing, ±0.24 to 40 LPM
BS4 63-0244		Large Sensor with Tubing, ±1.0 to 180 LPM
BS4 63-0245		RS-232 Serial Cable

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Harvard Apparatus Recording Spirometer

BS4 50-1825
Cart Mounted
Recording Spirometer

- Ideal for education
- 9 liter capacity; for flow and volume measurements
- One-way air valve with mica discs minimizes resistance
- 30 mm ID tubing result in nearly 50% greater cross-sectional area than traditional 22 mm tubing
- Tubing offers minimum distortion on bending so that maximum cross-sectional area is maintained
- Stainless steel bell
- Mouthpiece on double ball and socket universal joint
- Gas sampler located near the mouthpiece
- Externally-mounted, transparent absorbent canister allows use of color-indicating absorbent
- Choice of bench use or cart-mounted spirometer

The ideal spirometer would offer so little resistance to the movement of air to and from the subject's lungs that it wouldn't affect the subject's respiratory movements. The Harvard Apparatus Recording Spirometer approaches this ideal with wide bore airways, a lightweight, perfectly counterpoised gas bell, and a low-inertia recording device.

This Recording Spirometer has the least airflow resistance of any similar instrument, making it ideal for maximum respiratory flow rates. The 9 liter capacity is adequate for:

- Recording the largest vital capacities
- Extended period oxygen uptake determinations
- Spirometry during mild exercise

The spirometer directly records basal minute ventilation, exercise ventilation or maximum breathing capacity. The ventilation equivalent for oxygen can be calculated directly from the spirogram slope lines for ventilation and oxygen uptake.

Wide-Bore Airways

The mouthpiece is molded from soft rubber with a cross-section of 30 mm. It has two bites and is easily removed for sterilization. The one-way air valve permits the gas stream to flow in only one direction, with minimum resistance. Three arms and a universal joint provide full adjustability for easy positioning of the mouthpiece whether the subject is sitting, standing or lying down. The ethylene vinyl acetate copolymer tubing supplied with the Spirometer has a 30 mm bore, and its cross-sectional area is nearly 50% greater than that of traditional 22 mm bore tubing. The tubing has extremely low profile annular rings, minimizing distortion on bending and preserving maximum cross-sectional area. A two-way valve allows the test subject to be connected to the atmosphere while becoming accustomed to the equipment. By rotating the valve, the circuit is closed and the subject is connected to the Spirometer. The valve permits precise determination of when the experiment starts. A 900 ml absorbent canister can be mounted on the side of the Spirometer allowing use of a color-indicating absorbent.

Lightweight, Perfectly Counterpoised Gas Bell

The gas bell is made from corrosion-free stainless steel. It is housed in a brass cylinder with brass interior fittings and piping, and weighs 480 g (17 oz). The water chamber is of the minimum dimensions that allow the bell to travel and provide a proper water seal. The gas bell has a hook on top that is connected to a counterweight by a line travelling over two lightweight pulleys. This counterweight fits in a tube that has graduations from 0 to 9 liters in 0.1 liter increments. On the bottom of the counterweight is a marker which permits direct reading of the gas measurement from the spirometer. The marker holds a pen arm and disposable cartridge pen for recording on the kymograph. The entire counterweight tube housing can be rotated by a handle at its base so that the pen can either be turned away from the kymograph or towards it to make a recording. The Spirometer is available for bench use or mounted on a cart with four casters for easy mobility.

Recording Device

A 4-speed kymograph with a crystal-controlled electronic drive is mounted on the base of the Spirometer. The four chart speeds are 25, 150, 600 and 1200 mm per minute. The slower kymograph speeds are used for conventional metabolism tests. The faster speeds are for timed vital capacity measurements and the determination of 'mid-expiratory flow' or 'expirograms'. The pen with disposable cartridge has free-flowing ink, yet is quick drying and permits immediate use of the charts. This Recording Spirometer is supplied complete with the kymograph, one-way valve, 3 mouth pieces, 2 nose clips, 100 sheets kymograph paper, color-indicating absorbent (3 kg), 6 disposable pen cartridges, pen arm, and thermometer.

Specifications

Gas Bell Weight	480 g (17 oz)
Dimensions:	
Spirometer Overall, H x W x D	950 x 850 x 350 mm (37.4 x 33-1/2 x 13.8 in)
Cart, H x W x D	860 x 600 x 600 mm (33.9 x 23.6 x 23.6 in)
Gas Bell, OD x H	195 x 400 mm (7-3/4 x 16 in)
Brass Cylinder, ID x H	250 x 400 mm (10 x 16 in)

Catalog No.	$	Product
BS4 50-1809		Recording Spirometer, Bench Use, 115 VAC, 60 Hz
BS4 50-1817		Recording Spirometer, Bench Use, 230 VAC, 50 Hz
BS4 50-1825		Recording Spirometer, Cart Mounted, 115 VAC, 60 Hz
BS4 50-1833		Recording Spirometer, Cart Mounted, 230 VAC, 50 Hz

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11,000 Specialty Products to Enhance Your Bioresearch

Student Spirometer

- 9 liter capacity
- 30 mm ID airways result in nearly 50% greater cross-sectional area than traditional 22 mm bore tubing
- A one-way air valve with mica disc construction minimizes resistance
- Counterweight minimizes weight of gas holder
- For use with the Transducer Interface, see page I60 and the Student Oscillograph, see page I68

The ideal spirometer offers so little resistance to the movement of air to and from the subject's lungs that it does not affect the subject's respiratory movements. As a teaching device, this spirometer has a number of important extra features:

- Double channel air line valve for open/closed circuit work that connects subject to atmosphere while regulating his/her breathing and becoming accustomed to apparatus. When the valve is turned and the line is connected to the Spirometer, it is possible to determine the exact moment the test starts.
- 600 ml transparent canister can be placed in or out of circuit and can hold color-indicating absorbent.

The Spirometer is equipped with a low inertia potentiometer which provides resistance changes as a function of volume changes. This transducer is activated by the movement of the bell and is powered by two 1-1/2 volt batteries supplied. The 300 mV signal produced is suitable for recording.

The Spirometer housing is made of heavy plastic 6.5 mm (1/4 in) thick. It measures, H x W x D, 300 x 375 x 375 mm (12 x 15 x 15 in) overall. This Spirometer is supplied complete with tubing, mouthpiece, nose clip and a battery powered transducer with cable. It is also supplied with three cartridge pens and a pen arm for kymograph recording.

Catalog No.	$	Product
BS4 50-1676		Student Spirometer
BS4 50-1098		Color-Indicating CO_2 Absorbent, 3 kg (6.5 lb), 5 to 10 mesh
BS4 50-7814		Disposable Cartridge Pens, pkg. of 6
BS4 50-7822		Spare Pen Arm
BS4 50-1866		Replacement Transducer Cable, miniature stereo jack to 7-pin Binder; for direct connection of Spirometer's transducer to BS4 50-8861 Transducer Interface

Dry Gas Meter

- Ideal for measuring the volume of expired gases collected in Douglas Bags or the volume of gases drawn through a system

This industrial Meter has been adapted for experimental use. It is a diaphragm-type, positive displacement Meter that is accurate to ±1.5%.

The inlet and outlet tubing connections fit the two most frequently selected hose sizes for gas equipment. Hoses with a nominal bore of 22 mm fit directly onto the first step of the connectors. A tapered fitting accepts the 30 mm airway systems with such equipment as Harvard Douglas Bags.

An optically-coupled detector drives a 4-digit LED display in cumulative 0.1 liter increments from 0.1 to 999.9 liters maximum with an electrical zero reset. A 2.5 mm output socket produces a TTL compatible, 5 V pulse with each 0.1 liter increment.

This Meter is portable. It measures, H x W x D, 30 x 20 x 17.5 cm (12 x 8 x 7 in), weighs 4 kg (9 lb) and operates on one 9 V transistor battery (included).

Catalog No.	$	Product
BS4 50-6162		Dry Gas Meter, 230 V
BS4 50-6163		Dry Gas Meter, 220 V
BS4 50-6164		Dry Gas Meter, 115 V

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Blood Analyzer

NEW i-STAT® Portable Analyzer

- Fast Results - Results in < 2 minutes, minimizing animals anxiety and/or waiting for results
- Versatile - Animal-side, operating rooms, and field testing
- Wide selection of tests
- Economical
- Operational Advantages
  - No maintenance, portable, battery operated

This simple to use diagnosis meter only requires 3 drops of fresh blood to perform the analysis. You simply place the drops of blood in the cartridge, insert the cartidge into the anaysis unit, and in less than 2 minutes, you have your reults. It is that simple.

The i-STAT® Analyzer stores up to 50 animal records and permits on-screen viewing of test results as well as transmission of records to a data management system using infrared signals.

This unit consists of a basic analysis unit and a test specific cartridge. Each cartridge is designed to measure a specific parameter. There are no other hidden costs. Each cartidge is single use and is disposed of after the test. There is no costly cleanup or electrodes to replace/clean. The i-STAT® Portable Analyzer includes 2 9V lithium batteries, IR Link Assembly, Manual and User Guide. The optional Portable Printer System includes a Printer Cradle. The optional IR Link Assembly includes a Printer Cradle with IR Link, Power Adapter PC-IR Link and an IR Cable with Phone Jack.

Catalog No.	$	Product
BS4 72-7692		i-STAT® Analysis Unit

i-STAT® Catridges

The single use, disposable cartridge contains many of the subassemblies typically found in today's complex laboratory analyzers.

The sensors are micro-fabricated thin film electrodes. The integration of semi-conductor manufacturing process technology with well defined electrochemical principles results in the production of micro-miniaturized sensors with highly reproducible characteristics.

Calibrant solution is contained in the cartridge within a foil pouch. The fluid is a pH buffered aqueous solution of the analyties at known concentrations.

The text cycle is started by placing the cartridge containing the blood sample into the Analyzer. During the test cycle, the analyzer presses the front of the catridge, causing a barb to puncture the pouch. The calibrant fluid is release to flow over the sensor array for measurement.

When the calibration is completed, the analyzer presses the cartridge air bladder which pushes the calibrant solution into the waste reservoir and sends the blood sample over the sensor array for measurement.

1. Fill the cartridge with 3 drops of fresh whole blood

2. Insert cartridge in i-STAT® Analyzer

3. Critical results in less than 2 minutes for immediate therapy decisions

i-STAT® Cartridges, Box of 25

	ACT	G	Crea	E3+	EC4+	CG4+	6+	EG7+	EC8+	CG8+
Catalog No.	BS4 72-7693	BS4 72-7694	BS4 72-7695	BS4 72-7696	BS4 72-7698	BS4 72-7699	BS4 72-7700	BS4 72-7702	BS4 72-7703	BS4 72-7704
$										
Celite ACT	•									
Glucose		•			•		•		•	•
Creatinine			•							
Sodium				•	•		•	•	•	•
Potassium				•	•		•	•	•	•
Hematocrit				•	•		•	•	•	•
Hemoglobin*					•		•	•	•	•
pH						•		•	•	•
PCO_2						•		•	•	•
PO_2						•		•		•
Bicarbonate*						•		•	•	•
Total CO_2*						•		•	•	•
Base Excess*						•		•	•	•
O_2 Saturation*						•		•		•
Lactate						•				
Chloride				•			•		•	
Urea Nitrogen							•		•	
Ionized Calcium								•		•
Anion Gap*									•	

** Denotes calculated result*

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Cat. No.	$	Product
i-STAT® Portable Analyzer Accessories		
BS4 72-7728		Portable Printer for i-STAT®
BS4 72-7729		AC Adapter for Portable Printer
BS4 72-7730		Paper for Portable Printer, 3 rolls
BS4 72-7731		EG7+ Cartridges, Mini Pack, pkg. of 5
BS4 72-7732		EC8+ Cartridges, Mini Pack, pkg. of 5
BS4 72-7684		ACT Cartridges with 2 ACT Controls, Mini Pack, pkg. of 5
BS4 72-7685		Quality Control Solution, Level 1, box of 10
BS4 72-7686		Quality Control Solution, Level 2, box of 10
BS4 72-7687		Quality Control Solution, Level 3, box of 10
BS4 72-7688		Quality Control Solution, Level 1 ACT, box of 5
BS4 72-7689		Quality Control Solution, Level 1,2,3, one vial each
BS4 72-7721		Capillary Pipettes, 100 µl, pkg. of 100
BS4 72-7722		Electronic Simulator, pkg. of 1
BS4 72-7723		IR Link Assembly
BS4 72-7724		L. Hep Tubes, 1.3 ml, pkg. of 100
BS4 72-7726		Printer Cradle without IR Link
BS4 72-7727		Software Upgrade for i-STAT® Portable Analyzer
G2 Digital™ Monitor Accessories		
BS4 72-7718		Printer for G2 Digital™ Monitor
BS4 72-7719		Battery Pack for Printer
BS4 72-7720		Paper for Printer, Box of 5
BS4 72-7691		Belt Clip
BS4 72-7697		Cage Mount
BS4 72-7701		IV Pole Mount
BS4 72-7705		Power Cord
BS4 72-7706		Power Supply, 9 V DC
BS4 72-7707		Quick Steps Guide Reference Sheet
BS4 72-7708		Digital Sensor, Large Equine "C" Clamp
BS4 72-7709		Digital Sensor, Lingual "Y" with Clip
BS4 72-7710		Digital Sensor, Lingual "Y" without Clip
BS4 72-7711		Digital Sensor, Reflectance
BS4 72-7712		Digital Sensor, Standard "C" Clamp
BS4 72-7713		Patient Cable, 5 ft
BS4 72-7714		Sensor Clip, SM/MED Lingual
BS4 72-7715		Sensor, Respiration with 2 Airway Adapters
BS4 72-7716		Temperature Cable and Probe
BS4 72-7717		Temperature Probe

NEW G2 Digital™ Monitor

Introducing the G2 Digital™ Monitor, the only fully digital pulse oximeter with a digital SpO_2 sensor. The G2 Digital™ Monitor includes a Tilt Stand and a Digital Sensor Lingual Y with Clip. The optional Printer includes a Null Modem DB9M to DB9M Adapter, IR Link and Power Supply.

- Get the Next Generation Digital Monitor Today!
- The G2 Monitor excels at:
  - Eliminating motion errors
  - Accurate monitoring while using electrosurgery and ultrasonic dental units.
  - Finding and holding a weak pulse.
  - Monitoring very small patients.
  - Measures %SpO_2, Pulse rate, pulse strength bar, temperature, respiration rate, alarms, status messages

Specifications

Display	Custom backlit LCD with single and 7-segment numeric and iconized symbols for % SpO_2, Pulse Rate, Pulse Strength Bar, Temperature, Respiration Rate, Alarms, Status messages
SpO_2 Range	0 to 100% SpO_2 (functional, in 1% steps)
Accuracy	±2% at 70 to 100% SpO_2, normal perfusion ±3% at 70 to 100% SpO_2, low perfusion (< 0.2% signal)
Alarm Limits:	
High	21 to 100% (1% steps) or OFF
Low	20 to 99% (1% steps) or OFF
Display	3-digit, 7-segment LCDs with alarm limit indicators
Sensor	660-nm and 905-nm wavelengths, nominal
AC/DC Ratio	0.02 to 20%
Calibration	Factory calibrated, in-service calibration not required
Pulse Rate Range	10 to 450 beats per minute (1 bpm steps)
Accuracy	±3 beats per minute at 30 to 240 bpm, normal perfusion, ± 5 beats per minute at 30 to 240 bpm, low perfusion (<0.2% signal)
Alarm Limits:	
High	25 to 450 beats per minute (1 bpm steps) or OFF ("—")
Low	10 to 449 beats per minute (1 bpm steps) or OFF ("—")
Display	3-digit, 7-segment LCDs, 10-segment bar graph indicates relative pulse strength
Pulse Tone	5-level volume adjustable or OFF
Temp. Range	33.8° to 138.9°F (1.0° to 59.9°C in 0.1° steps) (F or C)
Accuracy	±0.2°, not including inherent sensor accuracy
Alarm Limits:	
High	91 to 110° F (32.8° - 43.3° C, 0.1° steps) or OFF ("—")
Low	90 to 109° F (32.2° - 42.8° C, 0.1° steps) or OFF ("—")
Display	3-1/2 digit display
Respiration Range	3 to 100 breaths per minute (in1 bpm steps)
Accuracy	± 3 breaths per minute
Alarm Limits:	
High	10 to 100 breaths per minute (1 bpm steps) or OFF ("—")
Low	3 to 99 breaths per minute (1 bpm steps) or OFF
Display	3 digit >display
Output Communications	IrDA protocol (Physical Layer)
Trend Data	3 hours memory capacity; newest to oldest patient output, data stored in 30-second sequence intervals, printout shows sequence interval indicator, SpO_2, Pulse Rate, Temperature, Respiration Rate, Index Marker(s) and end of transmission; battery-protected EEPROM (sequence interval indicators, SpO_2, Pulse Rate, Temperature, Respiration Rate), Real-time DataData transmitted in 30-second sequence intervals, printout shows sequence interval indicator, SpO_2, Pulse Rate, Temperature and Respiration Rate
Environmental:	
Oper. Temp.	23° – 113° F (-5° – 45° C)
Relative Humidity	5 - 95% RH, non-condensing Pressure: 503 – 1,059 mbar, approximate elevation of -378 – 5,946 m (-1,240 – 19,508 ft)
Storage Temp.	-4° – 140° F (-20° – 60° C) Relative Humidity: 5 – 95% RH, non-condensing
Physical, L x W x H	17.8 x 19.1 x 5.1 cm (7 x 7.5 x 2 in)
Weight	1.1 kg (2.5 lbs)
Electrical Power Supply:	
Voltage input	110 to 240 VAC
Frequency	50 to 60 Hz
Max Consumption	5 VA power
Output	9 VDC
Leakage Current	< 100 mA
Ground Resistance	< 0.1 Ω
Battery	6 VDC, 1.5 A-hr, maximum 4-hour battery operation, recharge to 95% capacity in 10 hours

Catalog No.	$	Product
BS4 72-7690		G2 Digital™ Monitor

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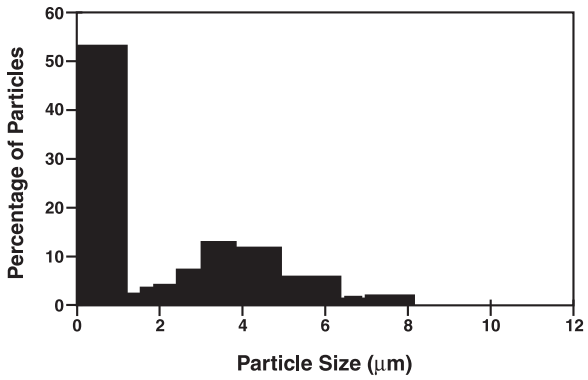
Nebulizers & Tracheal Cannulae

NEW Aerosol Nebulizer

- Low particle sizes (100% of the particles are below 10 µm)
- No solution warming required
- Recommended for nebulizing drugs sensitive to ultrasonics

This aerosol jet nebulizer requires an operating pressure of approximately 1.5 bar (22 psi) from a compressed air source. All of the particles generated by the jet nebulizer are 10 µm or less in size with 60% of the particles being 2.5 µm or less. The data presented below in the bar graph and table list particle sizes obtained when 5 ml of a 0.9% saline solution was nebulized with a gas inlet pressure of 1.5 bar. A special connecting block is used to attach the nebulizer to the HSE-HA single and double chamber plethysmographs, see our website, and are configured in a number of respiratory mechanics applications, see our website.



Size	
Micron	Below
10.5	100
8.19	99.7
6.37	98
4.97	92.2
3.88	80.9
3.04	68.3
2.40	61.5
1.90	57.7
1.52	54.5
1.22	52

Band in Micron	% in Band
13.6 to 10.5	0
10.5 to 8.19	0.2
8.19 to 6.37	1.7
6.37 to 4.97	5.8
4.97 to 3.88	11.3
3.88 to 3.04	12.6
3.04 to 2.40	6.8
2.40 to 1.90	3.8
1.90 to 1.52	3.2
1.52 to 1.22	2.5
1.22 to 0	52.0

Catalog No.	$	Product
BS4 73-1963		Aerosol Nebulizer
BS4 73-3300		Tubing Connection Kit for Aerosol Neubulizer

Tracheal Cannulae

A tracheal cannula is the most common method of connecting an animal to a ventilator. This 'Vee' form tracheal cannula is normally preferred because it minimizes air/gas 'dead space'. This tracheal cannula consists of two parts which are offered separately: a cannula vee and a cannula nozzle. The cannula vee is offered in two sizes, small and large.

The nozzles are available in various sizes. They screw onto the vee, and a neoprene O-ring seals the joint. For tracheal cannula selection there are two basic considerations:

- The outside diameter of the cannula vee must approximately match the outside diameter of the ports of the ventilator to ensure a tight fit of the tubing
- The outside diameter of the nozzle of the cannula must ensure a tight fit to the inside diameter of the animal's trachea. For the inside diameters of tracheas of various animals.

These tracheal cannulae are constructed of heavily nickel-plated brass. The cannula vees and cannula nozzles must be ordered separately.

Catalog No.	$	Product
BS4 50-3359		Small Cannula Vee, 6.5 mm OD
BS4 50-3367		Large Cannula Vee, 16 mm OD
BS4 50-3177		Small Cannula Nozzle, 2 mm OD*
BS4 50-3193		Small Cannula Nozzle, 3 mm OD*
BS4 50-3219		Small Cannula Nozzle, 4 mm OD*
BS4 50-3235		Small Cannula Nozzle, 5 mm OD*
BS4 50-3250		Small Cannula Nozzle, 6 mm OD*
BS4 50-3284		Large Cannula Nozzle, 6 mm OD**
BS4 50-3300		Large Cannula Nozzle, 8 mm OD**
BS4 50-3326		Large Cannula Nozzle, 11 mm OD**
BS4 50-3342		Large Cannula Nozzle, 14 mm OD**

*Note: For use with BS4 50-3359.
**Note: For use with BS4 50-3367.

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Tracheal Cannulae

Tracheal Cannula Only

Tracheal Cannula with Y-Adapter

Tracheal Cannula with Luer-Adapter

- Cannulae for tracheotomy or intubation
- Number of various diameters
- Various versions:
  - Cannula only
  - With Y-adapter
  - With Luer-adapter

The tracheal cannula is used for general ventilation or repiratory mechanics studies. It is used in the case of a tracheotomy for acute studies. The outside diameter of the cannula must ensure a tight fit to the inside diameter of the animal's trachea. The cannulae are available in 3 versions:

- cannula only, for your own assembly
- with Y-adapter for connecting to a ventilator, the outside diameter of the Y-adapter matches to most of the ports diameter of the ventilators.
- with Luer-adapter for connecting to ventilation head of the multivent, see page F9.

Tracheotomy Cannulae (Stainless Steel)

OD (mm)	Length§ (mm)	Animal	Cannula only	with Y-adapter	with Luer-adapter
1.0 $	20	mouse	BS4 73-0029	BS4 73-2731*	BS4 73-2835
1.2 $	20	mouse	BS4 73-2825	BS4 73-2830*	BS4 73-2836
1.3 $	20	mouse	BS4 73-0028	BS4 73-2730*	BS4 73-2837
1.5 $	25	small rat	BS4 73-2826	BS4 73-2831#	BS4 73-2729
1.8 $	25	small rat	BS4 73-2827	BS4 73-2832#	BS4 73-2728
2.0 $	25	small rat	BS4 73-2828	BS4 73-2833#	BS4 73-2727
2.3 $	25	rat/guinea pig	BS4 73-2829	BS4 73-2834#	BS4 73-2726
2.5 $	25	rat/guinea pig	BS4 73-0033	BS4 73-2732#	BS4 73-2725
3.0 $	25	rat/guinea pig	BS4 73-0034	BS4 73-2733#	BS4 73-2724
3.5 $	30	rat/guinea pig	BS4 73-0035	BS4 73-2734#	BS4 73-2723
4.0 $	35	rabbit	BS4 73-0036	BS4 73-2735~	–
5.0 $	35	rabbit	BS4 73-0037	BS4 73-2736~	–
6.0 $	40	rabbit	BS4 73-3319	BS4 73-2891~	–

** Y-adapter for Minivent OD 3.0 mm*
 # Medium Y-adapter OD 7.5 mm
~ Large Y-adapter OD 10.0 mm

§ Length listed is total cannula length. If cannula is used with Luer Adapter, the length is 4 mm less than listed. If the cannula is used with a Medium Y-adapter, the length is 3 mm less than listed. If the cannula is used with a Large Y-adapter, the length is 6 mm less than listed.

Intubation Cannulae

Intubation Cannula Only

Intubation Cannula with Y-Adapter

Intubation Cannula with Luer-Adapter

The intubation cannula is used in chronic studies. The outside diameter of the cannula must ensure a tight fit to the animal's trachea. These cannulae are also available in the 3 versions.

Intubation Cannulae (Material Stainless Steel)

OD (mm)	Length§ (mm)	Animal	Cannula only	with Y-adapter	with Luer-adapter
1.0 $	28	mouse	BS4 73-0030	BS4 73-2737*	BS4 73-2848
1.1 $	28	mouse	BS4 73-2838	BS4 73-2843*	BS4 73-2849
1.2 $	30	mouse	BS4 73-2839	BS4 73-2844*	BS4 73-2850
1.5 $	35	small rat	BS4 73-2840	BS4 73-2845#	BS4 73-2851
1.8 $	35	small rat	BS4 73-2841	BS4 73-2846#	BS4 73-2852
2.0 $	45	small rat	BS4 73-0038	BS4 73-2738#	BS4 73-2853
2.3 $	45	rat/guinea pig	BS4 73-2842	BS4 73-2847#	BS4 73-2854
2.5 $	50	rat/guinea pig	BS4 73-0039	BS4 73-2739#	BS4 73-2855
3.0 $	55	rat/guinea pig	BS4 73-0040	BS4 73-2740#	BS4 73-2856
3.5 $	60	rat/guinea pig	BS4 73-0041	BS4 73-2741~	BS4 73-3112
4.5 $	70	rabbit	BS4 73-0042	BS4 73-2742~	-

** Y-adapter for Minivent OD 3.0 mm*
 # Medium Y-adapter OD 7.5 mm
~ Large Y-adapter OD 10.0 mm

§ Length listed is total cannula length. If cannula is used with Luer Adapter, the length is 4 mm less than listed. If the cannula is used with a Medium Y-adapter, the length is 3 mm less than listed. If the cannula is used with a Large Y-adapter, the length is 6 mm less than listed.

Catalog No.	$	Product
BS4 73-2943		Adapter for Cannulae with Luer Connection and Pressure Measurement Port for KTR-4 Ventilator, pkg. of 5, see page F10

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Endotracheal Tubes for Small Animals

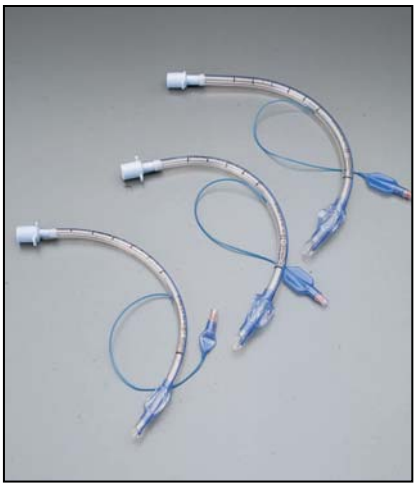
These uncuffed endotracheal tubes provide a convenient way of connecting small animals to Harvard Apparatus ventilators, see pages F4 to F13. Constructed of graduated radiopaque PVC tubing, they can be used as either nasal or oral tubes. These endotracheal tubes are supplied sterile in boxes of 10.

Endotracheal Tube For Small Animals		
Catalog No.	OD	ID
BS4 59-9070 $	3.3 mm (0.13 in)	2.5 mm (0.10 in)
BS4 59-9071 $	4.0 mm (0.16 in)	3.0 mm (0.12 in)
BS4 59-9072 $	4.7 mm (0.19 in)	3.5 mm (0.14 in)
BS4 59-9073 $	5.3 mm (0.21 in)	4.0 mm (0.16 in)
BS4 59-9074 $	6.0 mm (0.24 in)	4.5 mm (0.18 in)
BS4 59-9075 $	6.7 mm (0.26 in)	5.0 mm (0.20 in)
BS4 59-9076 $	7.3 mm (0.29 in)	5.5 mm (0.22 in)
BS4 59-9077 $	8.0 mm (0.31 in)	6.0 mm (0.24 in)
BS4 59-9078 $	8.7 mm (0.34 in)	6.5 mm (0.26 in)

For Cannula Vee and Nozzles, see page F54.

For Tracheal and Intubation Cannulae, see page F55.

Cuffed Endotracheal Tubes



- Murphy style for oral or nasal use
- Flexible, implant tested polyvinyl chloride

These clear cuffed endotracheal tubes have a high-volume, low-pressure Soft-Seal® Profile™ cuff with a one-way, spring-activated inflation valve which ensures cuff inflation/integrity. A radiopaque blue line extends the full length of the tube. These tubes have a standard 15 mm connector and are available in ten sizes. Supplied in a package of 10.

Cuffed Endotracheal Tubes		
Catalog No.	OD	ID
BS4 60-4640 $	6.8 mm (0.28 in)	5.0 mm (0.20 in)
BS4 60-4641 $	7.5 mm (0.29 in)	5.5 mm (0.22 in)
BS4 60-4642 $	8.2 mm (0.32 in)	6.0 mm (0.24 in)
BS4 60-4643 $	8.8 mm (0.34 in)	6.5 mm (0.26 in)
BS4 60-4644 $	9.6 mm (0.38 in)	7.0 mm (0.28 in)
BS4 60-4645 $	10.2 mm (0.40 in)	7.5 mm (0.30 in)
BS4 60-4646 $	10.8 mm (0.43 in)	8.0 mm (0.32 in)
BS4 60-4647 $	11.5 mm (0.45 in)	8.5 mm (0.34 in)
BS4 60-4648 $	12.1 mm (0.48 in)	9.0 mm (0.35 in)
BS4 60-4649 $	12.8 mm (0.50 in)	9.5 mm (0.37 in)

Uncuffed Endotracheal Tubes

- Murphy style for oral or nasal use
- Flexible, implant tested polyvinyl chloride

These clear uncuffed endotracheal tubes are flexible, implant-tested polyvinyl chloride. A radiopaque blue line extends the full length of the tube. These tubes have a standard 15 mm connector and are available in eight sizes. Supplied in a package of 10.

Uncuffed Endotracheal Tubes		
Catalog No.	OD	ID
BS4 60-4650 $	3.6 mm (0.14 in)	2.5 mm (0.10 in)
BS4 60-4651 $	4.2 mm (0.17 in)	3.0 mm (0.12 in)
BS4 60-4652 $	4.9 mm (0.19 in)	3.5 mm (0.14 in)
BS4 60-4653 $	5.5 mm (0.22 in)	4.0 mm (0.16 in)
BS4 60-4654 $	6.2 mm (0.24 in)	4.5 mm (0.18 in)
BS4 60-4655 $	6.8 mm (0.28 in)	5.0 mm (0.20 in)
BS4 60-4656 $	7.5 mm (0.30 in)	5.5 mm (0.22 in)
BS4 60-4657 $	8.2 mm (0.32 in)	6.0 mm (0.24 in)

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Fiber Optic Laryngoscopes

Fiber Optic Laryngoscope Sets

Brilliant illumination and instrument reliability are standards with these fiber optic laryngoscopes. They are available in convenient sets or as individual handles and blades. These MacIntosh and Miller style fiber optic blades transmit cool, white halogen illumination to the site area.

- Removable fiber optic light pipe for easy cleaning and quick replacement
- Durable one-piece stainless steel construction; knurled finish for positive grip
- Brilliant Halogen illumination provides twice the light intensity of ordinary laryngoscope lamps
- Wireless blades eliminate electrical contact

Miller Fiber Optic Laryngoscope Set

Complete set includes the five Miller laryngoscope blades listed below with a small and medium handle in a compact zipper case.

Catalog No.	$	Product
BS4 59-6569		Miller Fiber Optic Laryngoscope Set

MacIntosh Fiber Optic Laryngoscope Set

Complete set includes four MacIntosh laryngoscope blades listed below with a small and medium handle in a compact zipper case.

Catalog No.	$	Product
BS4 59-6563		MacIntosh Fiber Optic Laryngoscope Set


BS4 59-6571

Laryngoscope Handles for Fiber Optic Blades

These laryngoscope handles are for use with fiber optic laryngoscope blades. They are available with disposable batteries or a rechargeable 2.5 volt nickel-cadmium battery (batteries supplied with handles). The handles with disposable battery are available in two sizes: AA Penlight and C Medium size. The rechargeable battery handle is available in the medium size only.

The rechargeable battery handles charge automatically when placed in the recharger base, which ensures full power and maximum illumination. The recharger base can hold two handles. The handles and base must be purchased separately.

Catalog No.	$	Product
BS4 59-6572		Laryngoscope Handle, Small, with Disposable AA Battery
BS4 59-6571		Laryngoscope Handle, Medium, with Disposable C Battery
BS4 59-6718		Laryngoscope Handle, Medium, with Rechargeable Battery
BS4 59-6719		Recharger Base, 115 VAC, 60 Hz
BS4 59-6721		Replacement Rechargeable 2.5 V Nickel-Cadmium Battery
BS4 59-6570		Replacement Halogen Lamp for BS4 59-6572, BS4 59-6571 and BS4 59-6718 Laryngoscope Handles, pkg. of 1

Fiber Optic Laryngoscope Blades

MacIntosh Laryngoscope Blades

Catalog No.	$	Size	Length, Measurement	Inside Base to
			Overall Length	
BS4 59-6559		1	89 mm (3.5 in)	63 mm (2.4 in)
BS4 59-6560		2	108 mm (4.3 in)	82 mm (3.2 in)
BS4 59-6561		3	126 mm (4.9 in)	101 mm (3.9 in)
BS4 59-6562		4	160 mm (6.3 in)	135 mm (5.3 in)

Miller Laryngoscope Blades

			Inside Vertical	
BS4 59-6564		0	8 mm (0.32 in)	53 mm (2.0 in)
BS4 59-6565		1	8 mm (0.32 in)	79 mm (3.1 in)
BS4 59-6566		2	10 mm (0.4 in)	132 mm (5.2 in)
BS4 59-6567		3	11 mm (0.4 in)	172 mm (6.8 in)
BS4 59-6568		4	13 mm (0.5 in)	182 mm (7.2 in)

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Standard Laryngoscopes


BS4 59-6581

- Blades and handles available separately
- All blades have identical mechanism for interchangeability
- One piece stainless steel construction; knurled finish for positive grip
- Illuminates automatically when in operation position; light turns off automatically when blade is folded

These folding standard laryngoscopes with hook-on blades offer quick interchangeability with great strength and rigidity.

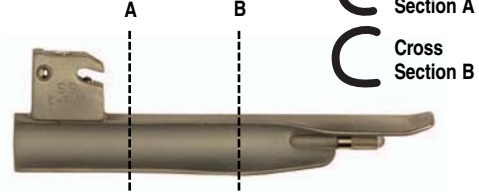
Laryngoscope Handles for Standard Blades

For use with disposable or rechargeable batteries (supplied).

Catalog No.	$	Product
BS4 59-6582		Laryngoscope Handle for Standard Blades with Disposable AA Battery (Penlight)
BS4 59-6581		Laryngoscope Handle for Standard Blades with Disposable C Battery (Medium)
BS4 59-6580		Laryngoscope Handle for Standard Blades with Disposable D Battery (Large)
BS4 59-6723		Laryngoscope Handle for Standard Blades with 2.5 V NiCad Rechargeable Battery, 115 VAC, 60 Hz*
BS4 59-6724		Laryngoscope Handle for Standard Blades with 2.5 V NiCad Rechargeable Battery, 230 VAC, 50 Hz*
BS4 59-6877		Transformer for BS4 59-6723, 115 VAC, 60 Hz
BS4 59-6721		Replacement Rechargeable 2.5 V Nickel-Cadmium Battery

**Note: Requires transformer for recharging.*

Standard Laryngoscope Blades

	Catalog No.	$	Size	Length, Measurement	Replacement Neck to Tip	Lamp, pkg. of 6	$
Miller Stainless Steel 				Inside Vertical			
	BS4 59-6573		0	8 mm (0.3 in)	53 mm (2.1 in)	BS4 59-6771	
	BS4 59-6574		1	8 mm (0.3 in)	79 mm (3.1 in)	BS4 59-6771	
	BS4 59-6575		2	10 mm (0.4 in)	132 mm (5.2 in)	BS4 59-6772	
	BS4 59-6576		3	11 mm (0.4 in)	172 mm (6.8 in)	BS4 59-6772	
	BS4 59-6577		4	13 mm (0.5 in)	182 mm (7.1 in)	BS4 59-6772	
MacIntosh Stainless Steel 				Overall Length			
	BS4 59-6767		1	87 mm (3.5 in)	63 mm (2.5 in)	BS4 59-6771	
	BS4 59-6768		2	108 mm (4.3 in)	82 mm (3.2 in)	BS4 59-6771	
	BS4 59-6769		3	126 mm (5 in)	101 mm (4 in)	BS4 59-6772	
	BS4 59-6770		4	160 mm (6.3 in)	135 mm (5.3 in)	BS4 59-6772	
Flagg Stainless Steel 				Inside Vertical			
	BS4 59-6773		0	6 mm (0.2 in)	75 mm (3 in)	BS4 59-6771	
	BS4 59-6774		1	11.5 mm (0.4 in)	88 mm (3.5 in)	BS4 59-6771	
	BS4 59-6775		2	13 mm (0.5 in)	102 mm (4 in)	BS4 59-6772	
	BS4 59-6776		3	13 mm (0.5 in)	135 mm (5.3 in)	BS4 59-6772	
	BS4 59-6777		4	13.5 mm (0.5 in)	165 mm (6.5 in)	BS4 59-6772	
Guedel Stainless Steel 				Inside Vertical			
	BS4 59-6778		1	12 mm (0.5 in)	75 mm (3 in)	BS4 59-6771	
	BS4 59-6779		2	16 mm (0.6 in)	98 mm (3.9 in)	BS4 59-6772	
	BS4 59-6780		3	19 mm (0.8 in)	148 mm (5.8 in)	BS4 59-6772	
	BS4 59-6781		4	19 mm (0.8 in)	165 mm (6.5 in)	BS4 59-6772	
Wisconsin Stainless Steel 				Inside Vertical (at A and B)			
	BS4 59-6782		1	A: 11.5 mm (0.4 in) B: 14 mm (0.6 in)	88 mm (3.5 in)	BS4 59-6771	
	BS4 59-6783		2	A: 13 mm (0.5 in) B: 15 mm (0.6 in)	102 mm (4 in)	BS4 59-6772	
	BS4 59-6784		3	A: 13 mm (0.5 in) B: 16 mm (0.6 in)	135 mm (5.3 in)	BS4 59-6772	
	BS4 59-6785		4	A: 14 mm (0.6 in) B: 18 mm (0.7 in)	165 mm (6.5 in)	BS4 59-6772	

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One-Way Respiratory Valves

- Function in any position; not gravity dependent
- Long life, non-sticky diaphragm maintains elasticity and sensitivity
- Wide range of port sizes

These One-Way Respiratory Valves, sometimes referred to as check valves, are for uni-directional respiratory circuits. They permit the flow of gases in only one direction. They have a non-sticky Spiral-Type™ diaphragm that is very sensitive to low flow ranges, has excellent elastic memory and is not gravity dependent. The valves have two ports of the same size. The outlet port is transparent permitting diaphragm viewing. All body parts are threaded for easy disassembly.

The valves are available in a variety of sizes. Select a valve according to the subject size and resistance to flow required. The BS4 60-3172 One-Way Valve is the only valve that is constructed from autoclavable materials and that has a hose barb for gas sampling or drainage of condensation.

Two types of connectors are available: straight and standard medical tapers. Ports having an OD or ID of 7.5, 10.5, 15 or 22 mm are standard medical tapers. All other sizes are straight connectors. Both types allow quick, leak-free, twist attachment of the Valve to other components.

One-Way Respiratory Valves					Resistance to Flow, Differential Pressure (dP) in cm H_2O								
			Ports		Flow in L/min								
Catalog No.	$	Valve Size	OD	ID	2	4	6	8	10	15	20	25	30
BS4 60-3164		Miniature	10.5 mm	7.5 mm	0.5	0.6	0.7	0.8	1.0	1.8	3.0	4.6	6.4
BS4 60-3165		Miniature	15 mm	10.5 mm	0.4	0.5	0.6	0.7	1.1	2.2	3.8	5.7	8.1
BS4 60-3166		Miniature	22 mm	15 mm	0.6	0.7	0.8	0.9	1.1	2.2	3.8	5.6	7.7
BS4 60-3167		Extra Small	10.5 mm	7.5 mm	0.6	0.8	0.9	1.0	1.2	1.6	2.1	2.6	3.4
BS4 60-3168		Extra Small	15 mm	10.5 mm	0.5	0.6	0.7	0.7	0.8	1.1	1.3	1.7	2.1
BS4 60-3169		Extra Small	22 mm	15 mm	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.5	1.8
					Resistance to Flow, Differential Pressure (dP) in cm H_2O								
					Flow in L/min								
					20	60	100	140	180	200	300	400	500
BS4 60-3170		Small	22 mm	15 mm	0.5	0.9	1.7	2.9	5.0	6.3	—	—	—
BS4 60-3171		Small	25.4 mm	22 mm	0.6	1.0	1.7	3.0	5.0	6.3	—	—	—
BS4 60-3172		Small*	22 mm	15 mm	0.5	0.9	1.7	2.9	5.0	6.3	—	—	—
BS4 60-3173		Medium	35 mm	28.6 mm	—	—	1.6	—	—	4.7	8.8	—	—
BS4 60-3174		Large	35 mm	28.6 mm	—	—	0.5	—	—	0.8	1.3	2.0	3.0

** Note: Autoclavable One-Way Respiratory Valve.*

Two-Way Non-Rebreathing Valves for Small Animals

These valves are available in either a T- or Y-shaped configuration. They have three ports: inhalation, exhalation and the subject's mouth port. These valves allow the separation of expired air either for collection or for use with pneumotachometers.

These valves are available in a variety of sizes for small animals to large dogs. Select a valve according to the animal size used and the resistance to flow as shown on the chart on F59.

Two types of connectors are available: straight and standard medical tapers. Connectors having an OD or ID of 7.5, 10.5, 15 or 22 mm are standard medical tapers. All the other sizes are straight connectors. Both types allow quick, leak-free, twist attachment of the valves to other components.

- Function in any position; not gravity dependent
- Standard medical tapered connectors are male and female tapers in four diameters of 7.5, 10.5, 15 and 22 mm
- Transparent body for viewing of diaphragm
- All threaded body parts for easy disassembly
- Long life, non-sticking diaphragm maintains elasticity and sensitivity

Two-Way Non-Rebreathing Valves For Small Animals

		Inhalation, Exhalation and Mouth Ports				Resistance to Flow, Differential Pressure (dP) in cm H_2O						
						Flow in Liters/min						
Catalog No.	Size/Shape	OD	ID	Flow Path**	Dead Space***	2	4	6	8	10	20	26
BS4 59-9370	Miniature T	3.2 mm diameter hole in valve body		I	0.5 ml	0.7	1.2	2.0	3.2	5.1	–	–
$		7.9 mm	6.4 mm*	E	0.5 ml	0.7	1.4	2.3	3.4	4.9	–	–
BS4 59-9371	Miniature T	Female Luer Lock with 2.8 mm flow orifice		I	0.8 ml	0.9	1.6	2.8	4.3	6.2	–	–
$		7.9 mm	6.4 mm*	E	1.0	2.2	4.0	6.2	9.2	–	–	
BS4 59-9372	Miniature T	7.9 mm	5.1 mm	I	1.3 ml	0.5	0.8	1.0	1.4	1.9	6.3	–
$		7.9 mm	6.4 mm*	E	1.3 ml	0.5	1.0	1.5	2.2	3.0	9.3	–
BS4 59-9373	Miniature T	22 mm	15 mm	I	3.6 ml	0.6	0.8	1.2	1.7	2.3	8.4	–
$		7.9 mm	6.4 mm*	E	3.6 ml	0.6	0.9	1.4	2.0	2.9	9.8	–
BS4 59-9377	Miniature Y	7.9 mm	6.4 mm	I	1.4 ml	0.5	0.6	0.8	1.1	1.5	5.2	9.1
$		7.9 mm	6.4 mm	E	1.4 ml	0.5	0.6	0.7	0.9	1.2	3.8	6.2
BS4 59-9374	Miniature Y	10.5 mm	7.5 mm	I	1.7 ml	0.6	0.8	1.0	1.3	1.8	5.5	9.0
$		10.5 mm	7.5 mm	E	1.7 ml	0.4	0.6	0.7	1.0	1.2	3.9	6.1
BS4 59-9375	Miniature Y	15 mm	10.5 mm	I	2.1 ml	0.5	0.7	1.0	1.3	1.8	6.0	9.7
$		15 mm	10.5 mm	E	2.1 ml	0.4	0.6	0.8	1.1	1.5	4.7	7.4
BS4 59-9376	Miniature Y	22 mm	15 mm	I	3.4 ml	0.5	0.8	1.0	1.3	1.7	5.9	9.3
$		22 mm	15 mm	E	3.4 ml	0.5	0.7	0.9	1.2	1.5	4.4	7.0
BS4 60-3121	Extra Small T	10.5 mm	7.5 mm	I	3.8 ml	0.6	0.6	0.8	0.9	1.0	2.0	2.7
$		10.5 mm	7.5 mm	E	3.8 ml	0.6	0.7	0.8	1.0	1.2	2.5	3.4
BS4 60-3122	Extra Small T	15 mm	10.5 mm	I	4.2 ml	0.5	0.6	0.7	0.8	0.9	1.5	1.8
$		15 mm	10.5 mm	E	4.2 ml	0.5	0.6	0.7	0.8	0.9	1.6	2.1
BS4 60-3123	Extra Small T	22 mm	15 mm	I	5.8 ml	0.5	0.6	0.7	0.8	0.9	1.6	2.0
$		22 mm	15 mm	E	5.8 ml	0.5	0.6	0.7	0.8	1.0	1.7	2.2
BS4 59-9378	Extra Small Y	10.5 mm	7.5 mm	I	3.3 ml	0.3	0.5	0.6	0.8	1.0	2.1	2.8
$		10.5 mm	7.5 mm	E	3.3 ml	0.4	0.6	0.8	0.9	1.1	2.2	2.9
BS4 59-9379	Extra Small Y	15 mm	10.5 mm	I	3.8 ml	0.5	0.6	0.7	0.8	1.1	1.7	2.1
$		15 mm	10.5 mm	E	3.8 ml	0.5	0.6	0.7	0.8	0.9	1.5	1.8
BS4 59-9380	Extra Small Y	22 mm	15 mm	I	5.3 ml	0.5	0.6	0.7	0.8	0.9	1.6	2.1
$		22 mm	15 mm	E	5.3 ml	0.5	0.6	0.7	0.8	0.9	1.6	2.0

** Note: Inhalation and exhalation port measurements.*
*** Note: (I) is inspired and (E) is expired.*
**** Note: Dead space volume includes housing and mouth port tube.*

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Rebreathing/Gas Collection Bags and Stopcocks

Non-Diffusing Gas Collection Bags

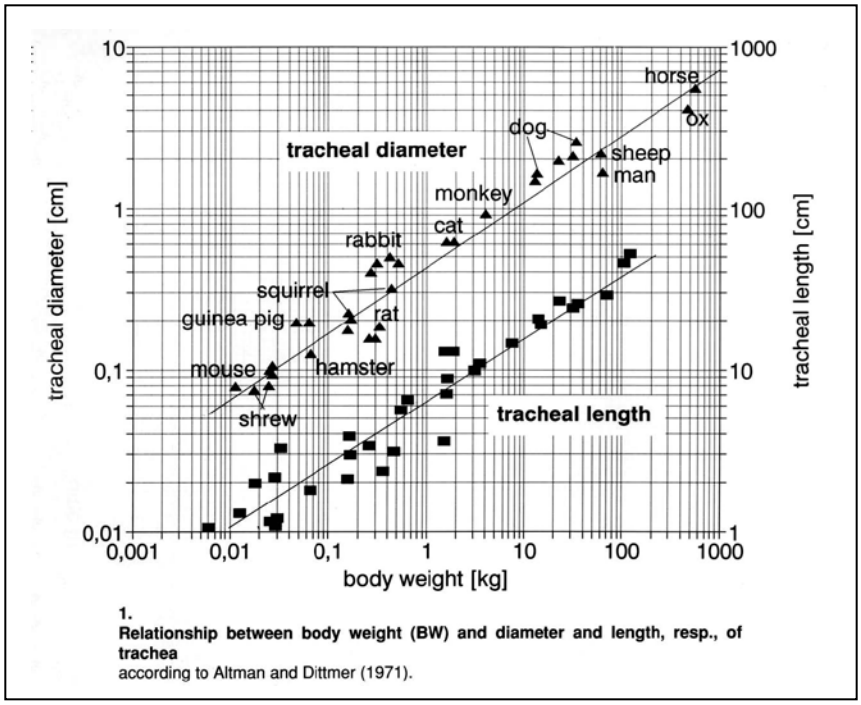
- For the collection of physiological gases or the delivery of known gas concentrations

These lightweight bags are made of five layers of different materials bonded to form one 0.14 mm (5.5 mil), flexible, leakproof, impermeable material. The materials are inert and will not react with or absorb gas.

These collection bags have a large 35 mm (1-3/8 in) ID molded opening with 'O' rings for a slip sealing fit over standard 35 mm (1-3/8) male fittings. For volume calibration syringes, see page F38. On one side of this opening is a female Luer lock port and on the opposite side is a hose barb. Both can be used for sampling or injection. The female Luer port is connected to an internal 1.6 mm (1/16 in) bore tubing looped inside the bag for mixing and sampling. Mounted on the lower portion of the bag is a self sealing septum for syringe withdrawal or injection. The opposite side has an on/off valve with a hose connection. These bags are available in 6 sizes and are supplied non-sterile. Their functional volumes are listed below, and they have little back pressure. These bags are typically used with a stopcock, having one port measuring 35 mm (1-3/8 in) OD.

Non-Diffusing Gas Collection Bags

Specifications	Functional Volume 5 Liters	15 Liters	30 Liters	60 Liters	100 Liters	170 Liters
Total Bag Volume	5 Liters	22 Liters	44 Liters	70 Liters	100 Liters	170 Liters
Dimensions, L x W	68.8 x 20.3 cm (27 x 7.9 in)	73.6 x 40.6 cm (28.9 x 15.9 in)	71 x 61 cm (27.9 x 24 in)	79 x 61 cm (31.1 x 24 in)	79 x 83 cm (31.1 x 32.6 in)	79 x 140 cm (31.1 x 55.1 in)
Weight, approx.	164 g (5.8 oz)	220 g (7.7 oz)	285 g (10 oz)	295 g (10.4 oz)	340 g (12 oz)	482 g (17 oz)
Catalog No. **$**	**BS4 59-9394**	**BS4 59-9395**	**BS4 59-9396**	**BS4 59-9397**	**BS4 59-9398**	**BS4 59-9399**



1.
Relationship between body weight (BW) and diameter and length, resp., of trachea
according to Altman and Dittmer (1971).

Breathing Tubes, Nose Clips and Mouthpieces

Nose Clips

These disposable and reusable Nose Clips are for keeping the nose closed during respiratory procedures. The Disposable Nose Clip is made of plastic with soft vinyl nose pads. The Reusable Nose Clip has a stainless steel torsion spring with silicone rubber nose pads and foam cushions. Supplied individually.

Catalog No.	$	Product
BS4 59-9672		Disposable Nose Clip, pkg. of 10
BS4 59-9673		Reusable Nose Clip

NEW Silicone Reusable Mouthpieces

- 2 Types & 3 Sizes
- Silicone rubber is soft and inert
- Flexible and durable
- Autoclavable

These mouthpices are molded from soft silicone rubber and are offered in two different styles in three sizes each. The Standard Type are clear while the translucent green mouthpieces have a new built in Saliva Trap. Both models have an improved bite design for increased comfort over vinyl mouthpieces. Silicone rubber is more flexible for mating to various port diameters, more durable, and easier to work with than vinyl. These mouthpieces are steam autoclavable, pasteurizable, and liquid sterilizable.

Catalog No.	$	Product
Silicone Mouthpieces, Standard		
BS4 72-5990		Small, 22 to 26 mm adapter port OD
BS4 72-5991		Medium, 28 to 33 mm adapter port OD
BS4 72-5992		Large, 35 to 38 mm adapter port OD
Silicone Mouthpieces, Saliva Trap		
BS4 72-6306		Small, 22 to 26 mm adapter port OD
BS4 72-6307		Medium, 28 to 33 mm adapter port OD
BS4 72-6308		Large, 35 to 38 mm adapter port OD

Breathing Tubes

These large, 35 mm (1-3/8 in) ID smooth bore Breathing Tubes are made of clear Ethylene Vinyl Acetate with no plasticizers. The insides of the tubes are perfectly smooth for the least flow resistance, and the end fittings are integrally molded.

Breathing Tubes	End Connector, ID			
Tube Length	35 mm (1-⅜ in)	$	22 mm (⅞ in)	$
61.0 cm (24 in)	BS4 59-9668		–	–
91.4 cm (36 in)	–	–	BS4 60-3156	
152.4 cm (60 in)	BS4 59-9670		BS4 60-3158	
274.6 cm (108 in)	BS4 59-9671		–	–

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Harvard Apparatus Douglas Bag Sets


BS4 50-0918 Direct Fill Double Bag Set

- Soft, flexible, ethylene vinyl acetate copolymer tubing
- 30 mm ID tubing has nearly 50% greater cross-sectional area than traditional 22 mm ID tubing
- Tubing has extremely low profile annular rings resulting in minimum distortion on bending so that maximum cross-sectional area is maintained
- One-way air valve with mica discs
- Absorbent indicator canister can be set directly in the circuit at any point

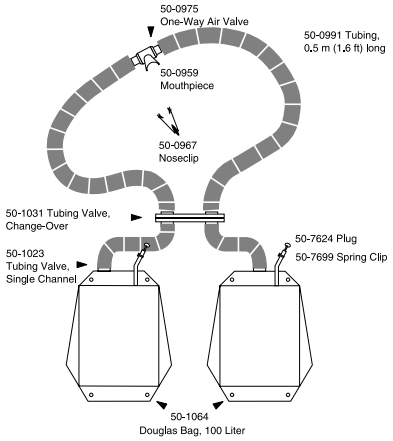
These Douglas bag sets offer flexibility and convenience in outdoor metabolic and respiratory studies, various types of muscular exercise and conventional pulmonary function tests.

The one-way air valves have a mica disc construction that minimizes resistance. The aluminum alloy tubing valves are equipped with a heavy polyethene washer and have strong, positive action.

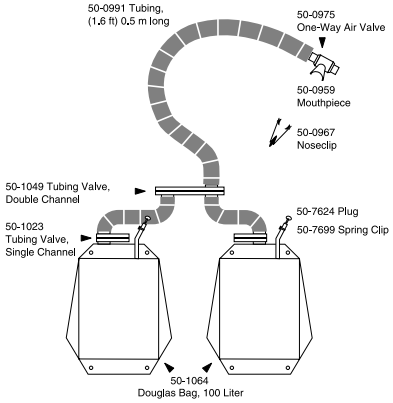
The polyvinyl chloride gas collection bags have electrically welded seams. They are lighter, tougher and more flexible than other bags and significantly reduce errors caused by gas permeability.

A transparent plastic absorbent indicator canister, offered as an accessory, can be connected into the circuit at any desired point and used with a color-indicating CO_2 absorbent, see page F65.

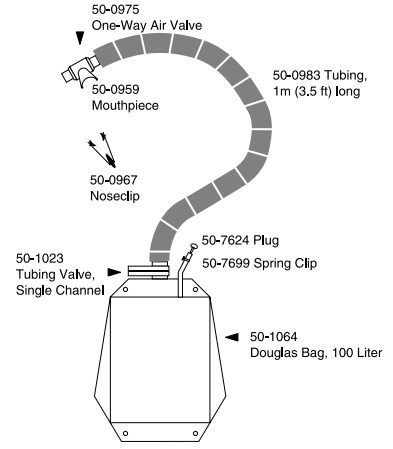
Douglas Bag Sets			Set		
Set Components	$	Product	Direct Fill, Single Bag Set	Direct Fill, Double Bag Set	Closed Circuit, Double Bag Set
Catalog No.			BS4 50-0900 $	BS4 50-0918	BS4 50-0926
BS4 50-0959		Mouthpiece	1	1	1
BS4 50-0967		Nose Clip	1	1	1
BS4 50-0975		One-Way Air Valve	1	1	1
BS4 50-0983		Tubing, 1 m (3.3 ft)	1	–	–
BS4 50-0991		Tubing, 0.5 m (1.6 ft)	–	3	4
BS4 50-0943		Tubing, 15.2 cm (1/2 ft)	1	2	–
BS4 50-1023		Tubing Valve, Single Channel	1	2	–
BS4 50-1031		Tubing Valve, Change-Over	–	1	–
BS4 50-1049		Tubing Valve, Double Channel	–	–	1
BS4 50-1064		Douglas Bag, 100 liter	1	2	2



BS4 50-0926
Closed Circuit Double Bag Set



BS4 50-0918
Direct Fill Double Bag Set

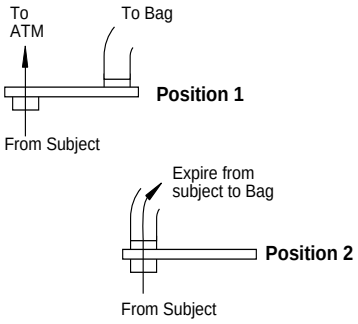


BS4 50-0900
Direct Fill Single Bag Set

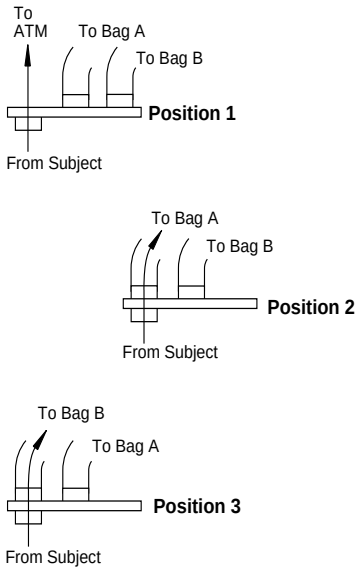
Harvard Apparatus Douglas Bag Sets and Tubing Valves

Tubing Valves

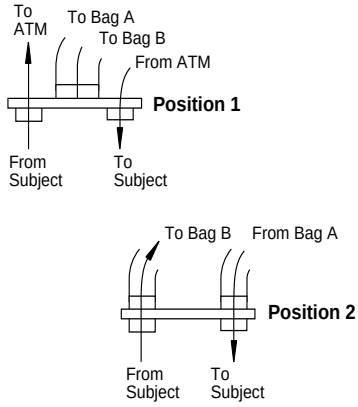
50-1023 Single Channel Tubing Valve



50-1031 Change-Over Tubing Valve



50-1049 Double Channel Tubing Valve



- Three types are available: Single Channel, Change-Over and Double Channel

Tubing Valves

These Tubing Valves have two 115 mm (4-1/2 in) diameter, aluminum alloy sections held against each other by a bolt with a heavy spring. A thick polythene washer between the valve sections makes their junction gas-tight and provides an appropriate surface on which they can rotate. The desired connections can be made by rotating the valve sections against each other to the stops provided.

All three valve types allow the subject to be connected to the atmosphere while they regulates their breathing. By rotating the aluminum alloy sections, the single channel valve provides a direct connection to a single Douglas bag. The change-over valve allows a direct connection to either Douglas bag A or Douglas bag B. The double channel valve provides a closed circuit so that the subject's inspiratory tube is connected to the gas supply bag A and the expiratory tube is connected to the gas collection bag B.

Catalog No.	$	Product
BS4 50-1023		Single Channel Tubing Valve
BS4 50-1031		Change-Over Tubing Valve
BS4 50-1049		Double Channel Tubing Valve

Closed Circuit Double Bag Set

This closed circuit double Douglas bag set can be used in an extensive range of tests including:

- Metabolic rate before, during and after exercise
- Effects of humidity and temperature on ventilation
- Calculation of oxygen consumption
- Effects of breathing high and low CO_2 concentrations on ventilation, respiratory rate and O_2 consumption

The BS4 50-1049 double channel tubing valve has two settings. The first setting allows exhaust air from the test subject to be routed to the atmosphere. The second setting connects the subject's inspiratory tube to the gas supply bag and the expiratory tube to the gas collection bag. Residual volume, functional residual capacity and total lung capacity can also be tested by adding an additional BS4 50-1049 tubing valve at the mouth of one of the bags.

Catalog No.	$	Product
BS4 50-0926		Closed Circuit Double Bag Set

Direct Fill Double Bag Set

This double bag set is intended for the same kinds of tests as the single bag set with the following additional advantages:

- Greater capacity
- Allows isolation of two discrete samples during the same test

The BS4 50-1031 change-over tubing valve has three different settings allowing exhausted air from test subject to be routed to the atmosphere or to either of the bags. The BS4 50-1023 single channel tubing valve at the mouth of each bag offers a positive seal after the bag has been filled.

Catalog No.	$	Product
BS4 50-0918		Direct Fill Double Bag Set

Direct Fill Single Bag Set

This basic set is for tests such as pulmonary ventilation, metabolic rate estimation and metabolic rate during work. The set is supplied with a 100 liter capacity Douglas bag.

Catalog No.	$	Product
BS4 50-0900		Direct Fill Single Bag Set

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Harvard Apparatus Douglas Bags and Accessories

Douglas Bag Tubing

This soft, flexible, ethylene vinyl acetate copolymer tubing has a 30 mm bore resulting in a nearly 50% greater cross section than traditional 22 mm bore tubing. Low profile annular rings make the tubing resistant to distortion when bending occurs so that maximum cross-sectional area is maintained.

Harvard Apparatus offers the tubing in four lengths. The 15.2 cm, 0.5 m and 1 meter lengths are supplied with one 50-1015 Sealing Ring at each end. The 10 meter length, which can be cut to any desired length, is not supplied with Sealing Rings, see below.

The 1 m (3-1/4 ft) length tubing is typically used to connect the One-Way Air Valve, see to right, to the Tubing Valve. The 0.5 m (1.7 ft) length can be used to make the same connection as the 1 meter length, but can also connect the Tubing Valve to the Douglas Bag.

Catalog No.	$	Product
BS4 50-0943		Tubing, 15.2 cm (1/2 ft)
BS4 50-0991		Tubing, 0.5 m (1.6 ft)
BS4 50-0983		Tubing, 1 m (3.3 ft)
BS4 50-1007		Tubing, 10 m (32.8 ft)
BS4 50-1015		Sealing Rings, these Viton O-Rings fit into corrugations at the ends of Douglas bag tubing; they are used to seal the tubing to a plastic connector; supplied in a package of 10

One-Way Air Valve

The One-Way Air Valve is controlled by inspiration and expiration; one valve opens and the other closes on inspiration, and vice versa on expiration. The gas stream can flow in only one direction.

The Valves consist of thin mica discs mounted in a cast plastic frame. The mica disc is held in the center of the frame by a nickel-plated brass threaded shank that has a soft stainless steel spring mounted on it. The mica disc moves against this soft spring and opens with the slightest positive pressure.

The hose connectors are made of tapered plastic and have a groove at the top. An BS4 50-1015 Sealing Ring seats in this groove and effectively locks and seals the Tubing to the Valve.

Catalog No.	$	Product
BS4 50-0975		One-Way Air Valve

Douglas Bags

These tough, polyvinyl chloride collection Bags have electrically welded seams. They are tougher, lighter, more flexible and less gas permeable than rubber bags reducing measurement errors. They are available in five sizes and are supplied individually with a plug and spring clip.

Catalog No.	$	Product
BS4 50-0934		Douglas Bag, 25 Liters
BS4 50-1056		Douglas Bag, 50 Liters
BS4 50-1064		Douglas Bag, 100 Liters
BS4 50-1072		Douglas Bag, 150 Liters
BS4 50-0942		Douglas Bag, 200 Liters
BS4 50-7624		Replacement Plug
BS4 50-7699		Replacement Spring Clip

Absorbent Indicator Canister

This 600 ml Absorbent Indicator Canister can be placed in the tubing circuit at any desired point. Because the Canister is made of transparent plastic, it can be used with a Color-Indicating CO_2 Absorbent, see below. The cylinder is 80 mm in diameter x 125 mm long (3-1/4 x 5 in). End connectors with screens are provided at each end of the Canister.

Catalog No.	$	Product
BS4 50-1080		Absorbent Indicator Canister
BS4 50-1098		Color-Indicating CO2 Absorbent, 3 kg (6.5 lb), 5 to 10 mesh; for use with the BS4 50-1080 Absorbent Indicator Canister

Tubing Adapter, 30 to 22 mm

Douglas Bags with 22 mm bore tubing are still in use. This Adapter connects 22 mm and 30 mm bore tubing so that components of old and new Douglas Bags can be used together.

Catalog No.	$	Product
BS4 50-1114		Tubing Adapter, 30 to 22 mm

Methods of Whole-Animal Respiratory Mechanics

Criteria for the Selection of the Method

Animal-related aspects

- Animal immobilized by anesthesia
- Animal conscious, partly immobilized (restrained)
- Animal conscious and moving freely

Instrumental aspects

- Measuring only the pressure in the upper airways
- Measuring only respiratory flow or tidal volume
- Measuring both pressure and flow (volume) in the airways

Methods of whole-animal respiratory mechanics

- Investigation of bronchial musculature in situ.
- Extended evaluation of respiratory mechanics
- Evaluation of respiratory mechanics by breathing pattern analysis.

Selection of the Method

Investigation of bronchial musculature in situ.

The classical methods employ anesthetized animals to determine:

• pulmonary inflation pressure under artificial respiration (EINTHOVEN 1892)	See page F67
• bronchial overflow volume under artificial respiration (KIESE 1935, KONZETT and ROESSLER 1940)	See page F68
• respiratory air flow or tidal volume directly with spontaneous respiration (GUYTON 1947)	See page F68

Extended evaluation of respiratory mechanics

• Extended evaluation of respiratory mechanics through measurement of flow, pressure and volume on the whole animal (v.Neergaard and Wirz 1927, evaluation provided by Amdur and Mead 1958). Calculation of lung resistance (RL) and dynamic lung compliance (CL,dyn).	See pages F4-F7
• Respiratory mechanics evaluated in the double chamber (PENNOCK 1979). Calculation of the specific airway resistance	See page F77
• Pulmonary Manuvers	Not available
• Forced oscillation technique	Not available

Evaluation of respiratory mechanics by breathing pattern analysis.

• Respiratory mechanics evaluated in the whole-body plethysmograph with freely moving animal (Drorbaugh and Fenn, 1955). Calculation of Penh (Enhanced Pause)	Not available
• Breathing patterns evaluated in the head-out plethysmograph (Alarie 1993). Calculation of Time of brake, Time of Pause, Airflow at 0.5VTE	See page F75

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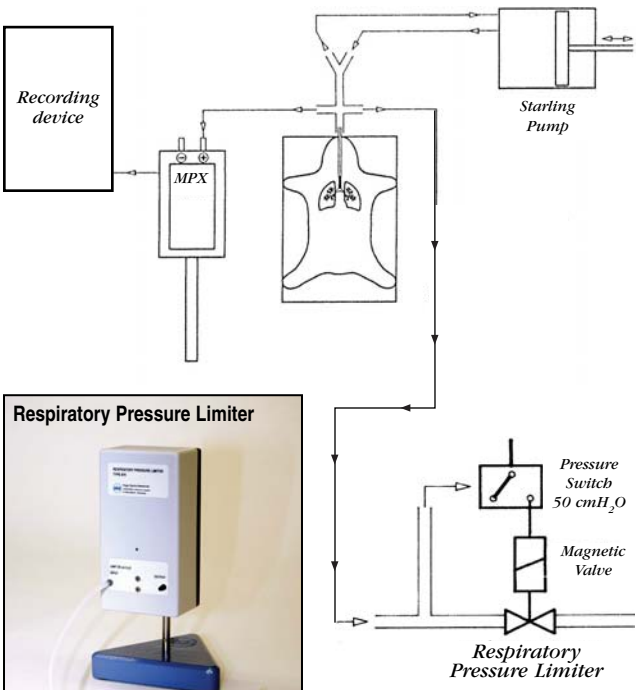
Einthoven Antiasthmatics Test on Anesthetized Rodents

Basic System for Einthoven Test

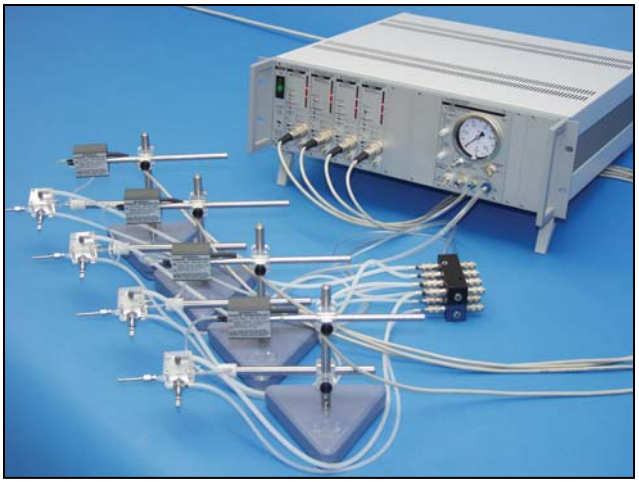


- For measurement of lateral tracheal pressure on rodents (Rat, Guinea-Pig)
- Easy method
- Multiple channel version available

The oldest method for determining airway resistance is based on the measurement of ventilation pressure in a branch of the tracheotomy tube (cf. Einthoven, 1892) during artificial ventilation of an anesthetized animal with a Starling pump. The difficulty in this method is the optimal setting of stroke volume on the respiration pump. Setting the stroke volume initially to the upper physiologically acceptable limit may cause rupture in the bronchial tree in case of bronchoconstriction. The Starling pump always forces the set volume into the lung. An overpressure valve or a better respiratory pressure limiter which is set to 50 cm H_2O can provide a remedy to release excess pressure delivered to the animal. Alternatively the respiration pump should be set to the lower, physiologically acceptable limit. This value may be rather difficult to find (pCO_2 measurement in the expired air is required).

Reference: EINTHOVEN, W.: Über die Wirkung der Bronchialmuskeln, nach einer neuen Methode untersucht, und über Asthma nervosum. (On the action of the bronchial muscles, investigated by a new method, and on asthma nervosum) Pflügers Arch. 51, 367-445 (1892).

Multichannel Einthoven Test using the PLUGSYS Ventilation Sequencer Module (VSM)



Setup for an experiment with four guinea-pigs. The pressure transducers MPX are used for tracheal pressure measurement. The PLUGSYS basic case is equipped with the VSM module and with 4 TAM-A modules.

This test is generally performed on more than one animal. The Ventilation Sequencer Module has especially been designed to create a ventilator which can handle up to eight animals. The timing (Rate and Insp. duration) is the same for all the animals, the inspiratory flow can be set individually for each animal.

- For anti-asthmatics test on rodents tracheal pressure
- Multiple animals (up to 8)
- Single ventilator module driving up to 8 ventilation heads (lower cost per animal)
- Can be extended for blood pressure measurement

The module can drive up to 8 ventilation heads. If more than one head is used they are connected to the module using a special connecting block. It consists of an electronic and a pneumatic section and requires a compressed air supply. The module VSM with the ventilation head operates on the principle of intermittent constant flow ventilation. An adjustable continuous air flow is passed by a main valve either to the animal (during inspiration) or to an overflow outlet (during expiration). The design of the main valve provides an adjustable, pressure controlled, protection for the animal against excessive pressure rise in the lung. The main valve is controlled electronically according to the selected respiration rate (RATE) and the selected inspiratory cycle (INSP. CYCLE %). The safety pressure as the maximum allowed inspiratory pressure can be adjusted on the VSM module. The timing and the safety pressure is the same for all the ventilation heads, the constant air flow during inspiration can be adjusted individually on each ventilation head. The ventilation head is equipped with the connection for the tracheal pressure transducer. See page F9 for more information.

Please refer to our website for additional information on these systems.

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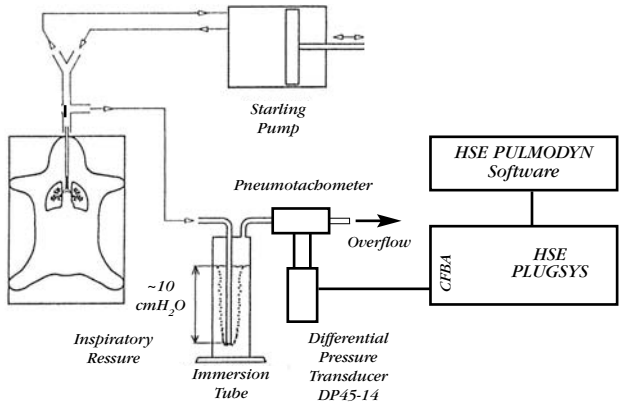
Antiasthmatics Test on Anesthetized Rodents According to Konzett-Roessler



Notes:
1. Inspiratory and expiratory pressures are limited by overpressure valves.
2. The set pump volume (PV) for ventilation must be at least 50% larger than the tidal volume (TV) of the animal.
3. The measured and recorded volume (V) of excess air represents the difference between pump volume and tidal volume and changes with bronchocon-striction.

V= PV -TV

- For bronchial overflow measurements on Rat or Guinea-Pig
- Alternative method to Einthoven
- No risk of overpressure ventilation
- More physiological and safer than Einthoven test

This classical method is an improvement on the Einthoven tracheal pressure measurement. Here the anesthetized animal is again ventilated with a STARLING pump. The respiratory stroke volume has to be set initially so that about 30% of the pump stroke is not taken up by the respiratory tract after inflation of the lung. This volume escapes from the system as overflow and is measured by a pneumotachometer. This arrangement is selected so that the pressure is limited by an adjustable water column. Drugs with bronchospastic or broncholytic action increase or reduce the overflow.

A Y-shaped tracheal tube is linked to a STARLING pump, e.g. Harvard Apparatus 683 Rodent Ventilator. The expiratory outlet of the respiration pump is connected to an immersion tube so that a positive end-expiratory pressure (PEEP) of about 1 cm water column is produced. The inspiratory pressure is limited to about 10 cm water column by a further immersion tube connected in parallel with the respiratory cannula.

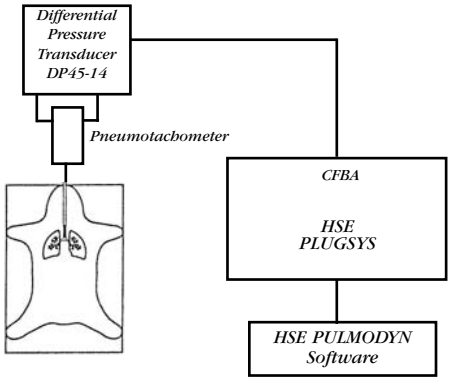
The overflow (i.e. the air volume not taken up by the lungs) is measured by means of a pneumotachometer (Fleisch tube) No. 000 or PTM and recorded by a differential pressure transducer as air flow in ml/sec. This air flow is also integrated to determine the air volume against time. It is of course necessary to ventilate the animal with a sufficiently large volume, e.g. 1.5 times its tidal volume.

References:

1) *BURDEN, D.T.; PARKES, M.W. and GARDINER, D.G.: Effect of b-adrenoceptive blocking agents on the response to bronchoconstrictor drugs in the guinea-pig air overflow preparation. Br. J. Pharmac. (1971) 41, 122-131*

2) *KONZETT, H. and ROESSLER, R.: Versuchsanordnung zu Untersuchungen an der Bronchialmuskulatur (Experimental setup for investigations on the bronchial musculature). Arch. exper. Path. u. Pharmakol. 195, 71 (1940).*

Simple Test on Anesthetized Spontaneously Breathing Rodents



- For measurement of bronchospasmolysis in anesthetized spontaneously breathing rodents (Rat, Guine-Pig, Mouse)
- Basic simple system
- Evaluation of typical parameters for respiratory studies (flow, tidal volume, minute volume, respiratory rate, inspiratory and expiratory duration)
- For acute experiments on intubated animals

The rodent is connected to a HSE-PTM or Fleisch pneumotachometer of suitable size through a tracheal or an intubation cannula. When using a Fleisch tube, a special adpater allows the connection of a trachea or intubation canula with a minimum of dead space. A heating transformer for the Fleisch tube is also available to prevent the formation of condensate. The HSE-PTM has especialy been designed to present low dead space and is made of Plexiglas to prevent condensate. The pressure difference produced at the pneumotachometer is converted by a differential pressure transducer VALIDYNE DP 45-14 into an electrical signal proportional to the respiratory flow. The tubing must be kept short to prevent the signal from being distorted by a large dead space between pneumotachometer and differential pressure transducer.

A single or multi channel system can be setup using a PLUGSYS system. A pneumotachometer, a differential pressure transducer and a CFBA amplifier are required for each animal. The HSE- PULMODYN Software is used for data acquisition and evaluation.

The following parameters are possible:

- Maximal inspiratory and expiratory air flow
- Tidal volume and minute volume
- Respiration rate
- Duration of inspiration and duration of expiration
- Apnea time
- Time of brake and time of pause
- Airflow at 0.5 TV

Please refer to our website for additional information on Konzett-Roessler systems.

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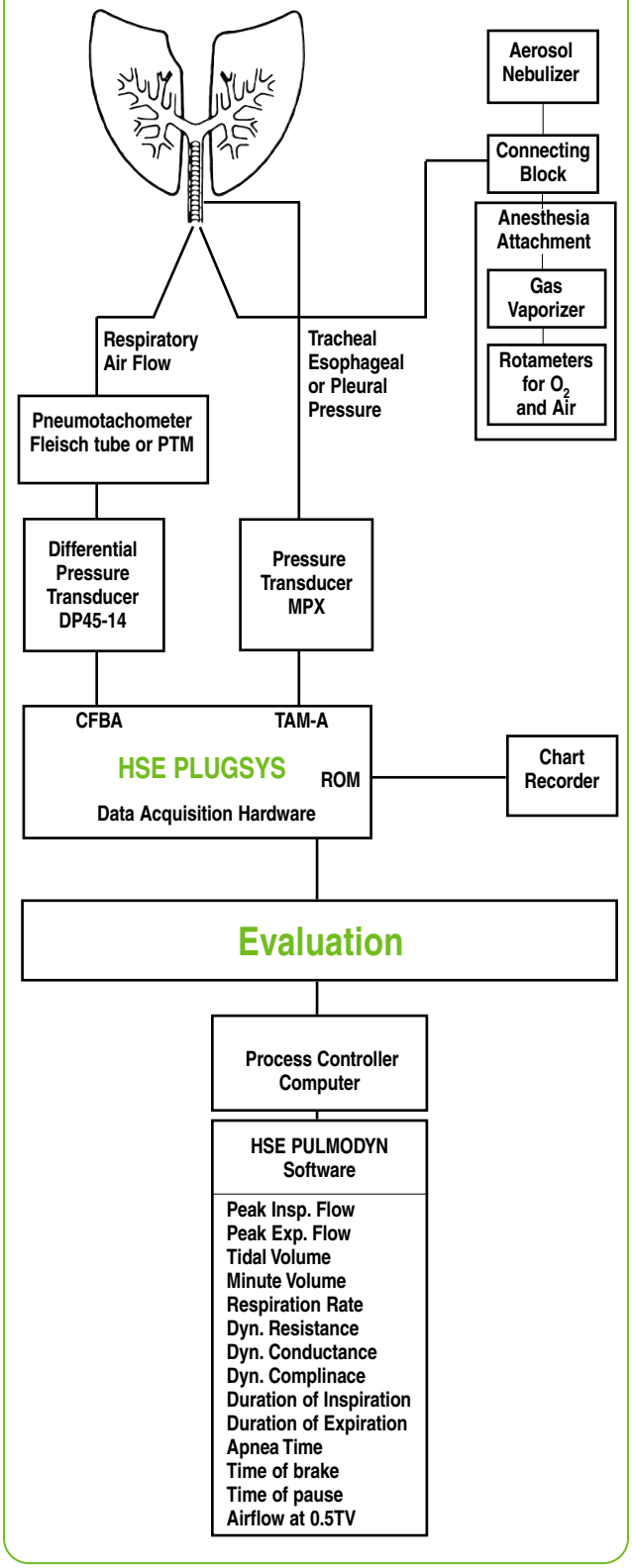
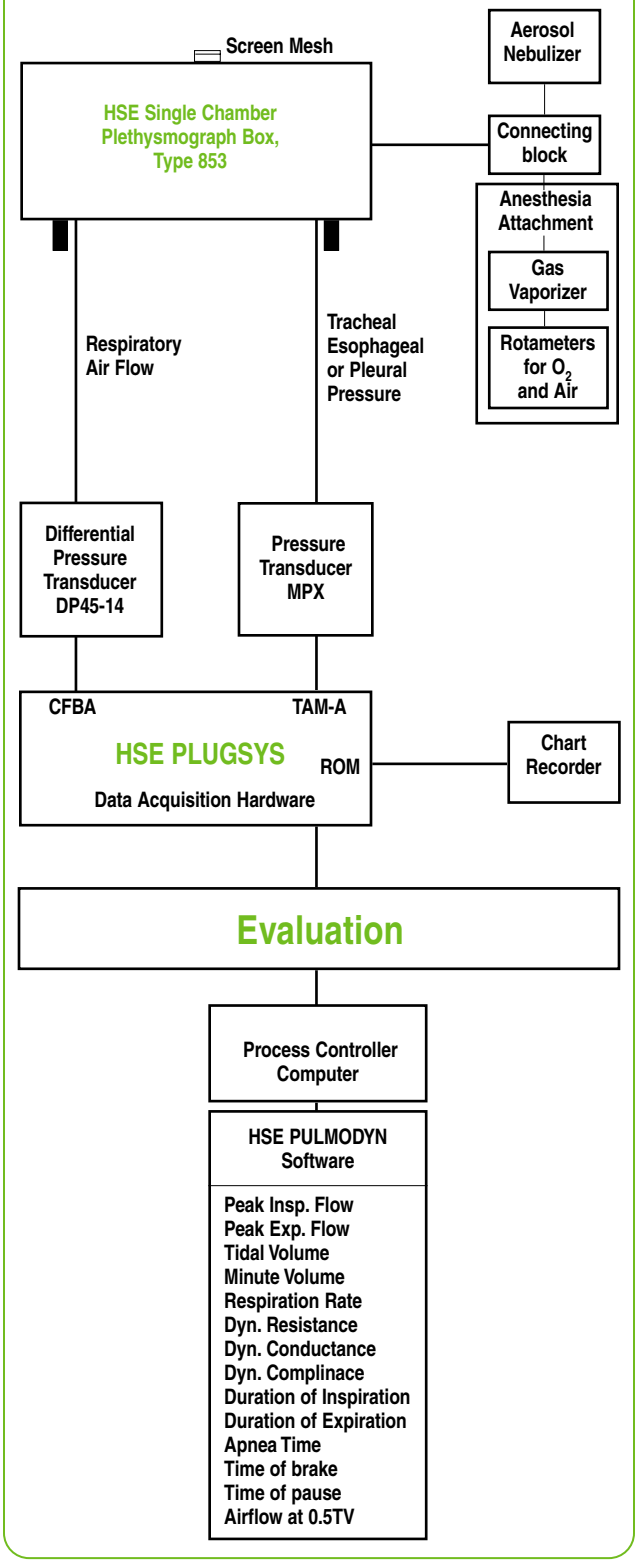
Flow Diagrams

Flow Diagram of Respiratory Measurement on the Anesthetized Animal

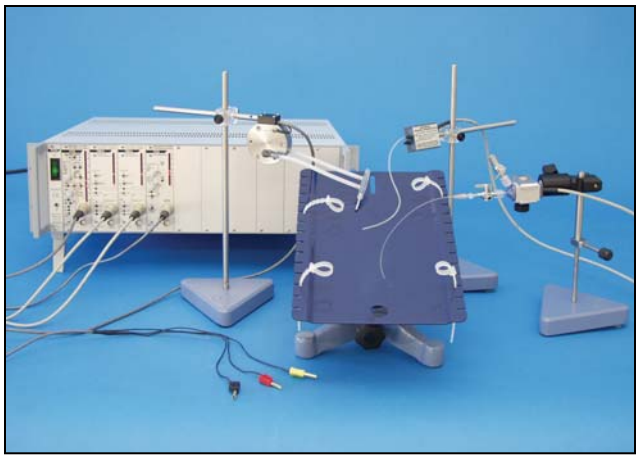
Anesthetized animal on operating table, acute experiment

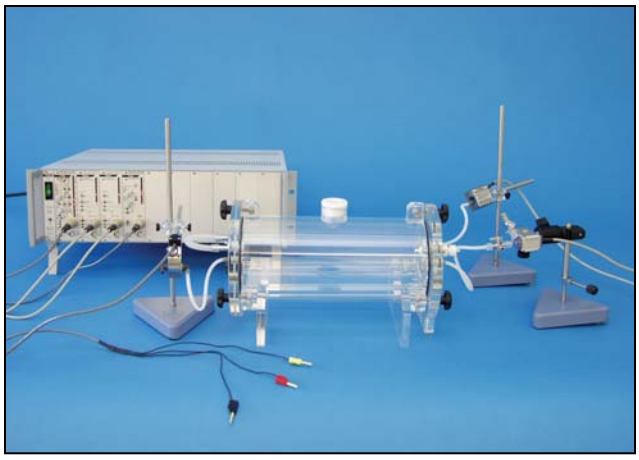


Anesthetized animal intubated in single chamber plethysmograph box — no surgical intervention



Respiratory Studies of Resistance and Compliance





- For measurement of bronchospasmolysis in anesthetized rodents
- Evaluation of typical parameters for respiratory studies (flow, tidal volume, minute volume, respiratory rate, dynamic resistance and compliance, inspiratory and respiratory duration
- For acute experiments or on intubated animals
- Long term studies using Plethysmograph box

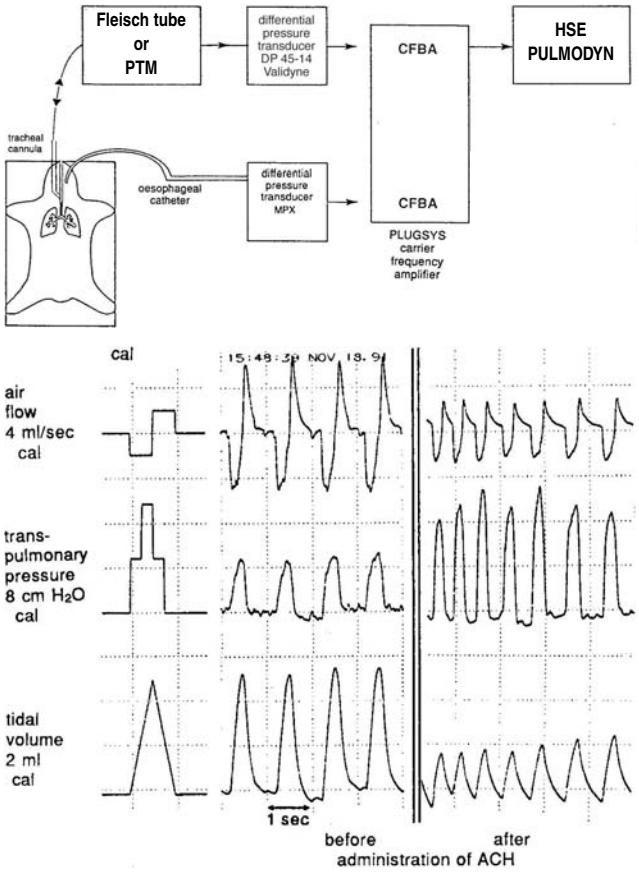
In acute experiments, the anesthetized animal is placed on an operating table and tracheotomized or intubated. The respiratory flow is measured with a pneumotachometer Fleisch tube or PTM and a differential pressure transducer. In addition the esophageal pressure is measured using an air or liquid filled tubing catheter and an adapted pressure transducer (MPX or P75). These two signals permit calculation of derived respiratory parameters such as:

- Maximal inspiratory and expiratory air flow
- Tidal volume and minute volume
- Respiration rate
- Lung resistance = pulmonary resistance = 75% airway resistance + 25% tissue resistance
- Conductance = 1 / Lung resistance
- Dynamic compliance = elasticity of the respiratory system
- Duration of inspiration and duration of expiration
- Apnea time
- Time of brake and time of pause
- Airflow at 0.5 TV

For recording and evaluation the HSE-HA PULMODYN software is used.

The same measurement can also take place with an intubated animal placed in a plethysmograph box, type 853. This reduces the dead space in the respiratory path. The pneumotachometer is not needed and is replaced by the screens in the plethysmograph box. The box can be equipped with anesthesia equipment to allow Halothane or Eflurane anesthesia during the measurement. This permits long term studies with the same animals (e.g. for toxicological studies). Possibility of aerosol application see page F71.

Hemodynamic signals such as blood pressure, ECG, blood flow can also be recorded and analyzed by the software. The adapted transducer, amplifiers and software module must be added to the system.



Experimental triggering of a bronchospasm in the anesthetized guinea-pig (Urethane anaesthesia 1.5 g/kg i.p.). Administration of 0.9 µmol/kg i.v. acetylcholine.

Please refer to our website for additional information on this systems.

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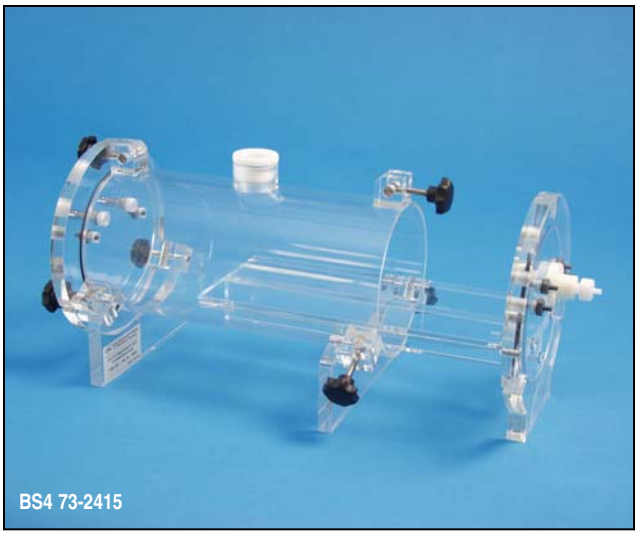
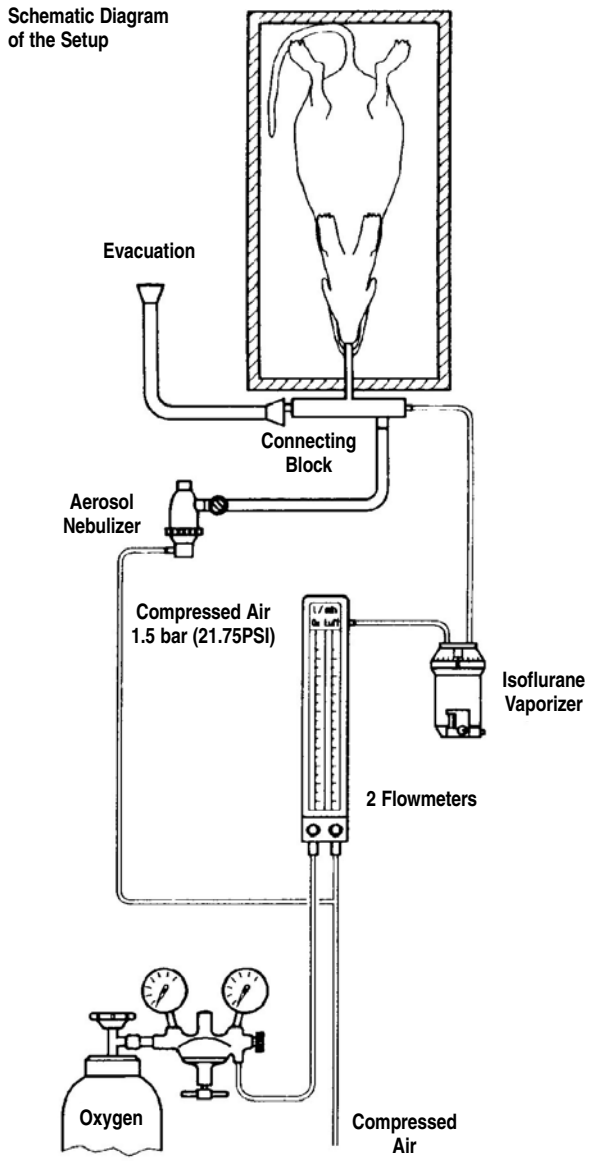
Single-Chamber Plethysmograph for Anesthetized Rodents





- Investigating resistance and compliance without surgical intervention just by intubating
- Low dead space volume (no pneumotach in-line with the trachea)
- Possibility of continuous gas anesthesia and aerosol application
- Applications
  - Toxicology
  - Environmental studies
  - Long term drug effects

The animal is investigated **without surgical intervention**. It is anesthetized so that the esophageal and tracheal catheters can be inserted and the animal can recover after measurement. The esophageal pressure is taken as the pleural pressure and measured using a fluid or air filled catheter and a pressure transducer.

The respiratory flow is determined by plethysmography using a measuring screen (metallic-mesh) in the box wall and a differential pressure transducer.

Anesthesia is delivered using a Halothane or other gas vaporizer. An aerosol nebulizer permits the administration of aerosols through the intubated tracheal tube.

Catalog No.	$	Product
BS4 73-2415		Plethysmograph, Type 853
BS4 73-0584		Connecting Block for Nebulizer and Anesthesia Attachment
BS4 73-1963		Aerosol Nebulizer
BS4 72-3037		Vaporizer Tech4 Isoflurane Key-Fill
BS4 72-3051		Filler Adapter for Key-Fill Vaporizer - Isoflurane
BS4 72-3011		Basic Table Top Anesthesia Machine with Air and O_2 Flowmeters

For anesthesia systems, see pages F16 to F23.

Respiratory Studies on Mice, Using a Plethysmograph Box

- Compact and well designed for easy preparation of the animal
- For use with spontaneously breathing or ventilated animals
- Convenient for instrumenting the animal
- Continuous measurement of respiratory mechanics (tidal volume, airway resistance, dynamic compliance)
- Possibility of continuous gas anesthesia and aerosol application
- Applications
  - Toxicology
  - Environmental studies
  - Long term drug effects

The Single Chamber for Anesthetized Mice is used to make invasive Resistance and Compliance measurements on mice and small rodents (neonatal rats). The animal is investigated without surgical intervention. It is anesthetized so that the esophageal and tracheal catheters can be inserted, and the animal can recover after measurement. The basic arrangement of the apparatus consists of a compact Plexiglas chamber. It performs two functions: it acts as an operating table and has a cork plate fitted into its base; after the animal preparation it is closed and serves as a plethysmographic box. The chamber is jacketed with warm water (37°C) from a thermostatic circulator passing through the jacket and is closed by a jacketed cover; which is also thermostated so that heat loss from the chamber is minimal. An intubation or tracheal cannula is inserted in the animal and is connected to a pneumotachometer. The pneumotachometer has to be placed as close as possible to the cannula in order to ensure minimum dead space. Incorporating it into the thermostated chamber also prevents condensation of the moisture. The modular construction of the pneumotachometer, permits easy dismantling after the experiment, thus simplifying cleaning. There are only straight bores on the pneumotachometer which can easily be cleaned; in addition the transparent Plexiglas permits easy checking for cleanliness.

Other ports in the side walls allow connections to esophageal catheter, blood pressure transducer, ECG amplifier, etc.

Measurements:
The esophageal pressure (taken as the intrapleural pressure) is measured using a fluid filled esophageal catheter and a P75 pressure transducer connected to a PLUGSYS Module TAM-A. The respiratory flow is converted by means of the built in pneumotachometer into a pressure difference and measured with a Validyne differential pressure transducer DP 45-14. This is connected to the input of a PLUGSYS CFBA module. The tidal volume is obtained by integrating the respiratory flow signal; this operation is normally performed by the evaluation software. From these three signals (esophageal pressure, respiratory flow, tidal volume) airway resistance as well as dynamic compliance is calculated. This is done by computer with suitable data acquisition hardware (HSE-HA PLUGSYS) and software (HSE-HA PULMODYN).

The box is prepared for connecting an Anesthesia vaporizer as well as an aerosol nebulizer which permits the administration of aerosols through the intubated tracheal tube.

Ventilation using the MiniVent, see page F8, is also possible using a special adapter.

Developed in cooperation with the Fraunhofer Institute of Toxicology and Experimental Medicine, 30625 Hannover, Germany.

From respiratory flow and esophageal pressure the HSE-HA PULMODYN software is used to evaluate the following parameters:

- Maximal inspiratory and expiratory air flow
- Tidal volume and minute volume
- Respiration rate
- Lung resistance = pulmonary resistance = 75% airway resistance + 25% tissue resistance
- Conductance = 1 / Lung resistance
- Dynamic compliance = elasticity of the respiratory system
- Duration of inspiration and duration of expiration
- Apnea time
- Time of brake and time of pause
- Airflow at 0.5 TV

Please refer to our website for complete information on this system.

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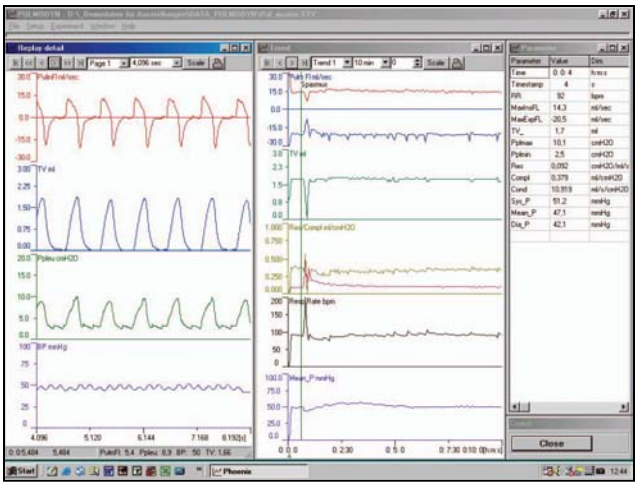
HSE-HA PULMODYN® for Respiratory Studies



- 16 channel data acquisition software for in vivo respiration experiments
- For Windows® 2000, NT and XP
- Derives and presents online the standard parameters for respiratory studies (TV, Resp. Rate, Resistance, Compliance) real time
- Possibility of combination with circulatory signals (e.g. arterial and venous pressure, LVP, aortic flow)
- In vivo:
  - Bronchodilation test and bronchospasmolytic test on anesthetized animals
  - Antiasthmatics test according to Konzett-Roessler (bronchial overflow measurement) or according to Einthoven (tracheal pressure measurement)
  - Pulmonary air flow
  - Tracheal pressure or esophageal pressure
  - Arterial pressure or venous pressure
  - pO_2, pCO_2, FiO_2, SpO_2, $ETCO_2$, pH, temperature etc.

The HSE-HA PULMODYN software can be adapted to virtually any experimental investigation in respiratory experiments. Acquisition can cover signals such as pulmonary air flow, tracheal pressure or esophageal pressure, arterial pressure or venous pressure, pO_2, pCO_2, pH, temperature etc. Various parameters can be derived from these signals, e.g. tidal volume, respiration rate, peak inspiratory flow, peak expiratory flow, maximal and minimal tracheal pressure, resistance, compliance, systolic, diastolic and mean values for pressures, dp/dt etc. During data acquisition all acquired signals and derived parameters can be displayed on the screen.

The HSE-HA PULMODYN software is available in a basic version which includes the minimal necessary algorithms for pulmonary mechanics evaluation. 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. PULMODYN is a menu-controlled software and employs special algorithms to calculate the standard pulmonary mechanics parameters.

The HSE-HA PULMODYN software has a maximum of 16 input channels, i.e. up to 16 different raw signals can be handled. 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 HSE-HA Data Acquisition Hardware for PULMODYN W Software is available in three versions:

- **PLUGSYS Version** for direct connection to PLUGSYS System BS4 73-0161
- **Stand Alone Version** BS4 73-0235
- **Stand Alone USB Version** BS4 73-3330

Hardware Requirements for Pulmodyn:

Both the PLUGSYS and Stand Alone versions require the following computer hardware:

Computer	PC Pentium at least 500 MHz with one free PCI-slot,
RAM	128 Mbytes or better 256 Mbytes
Operating System	Windows® 2000/NT or XP
Hard Disk Space	at least 20 Gbytes
Floppy Drive	1.44 Mbytes
CD-ROM Drive	Required
Monitor	17 or 19"
Backup Media	MO drive, CD recorder or ZIP drive

Commonly Used Signals for In-Vivo Respiratory Experiments:

- Pulmonary Air Flow
- Intrapleural (or esophageal) Pressure
- Tracheal Pressure
- Arterial or Venous Blood Pressure (Option)
- ECG (Option)
- Temperature

The Basic PULMODYN Calculates the Following Parameters On-Line:

From Pulmonary Air Flow	RespRate, maxInspFl, maxExpFl, TV, dynResistance, Conductance, dynCompl.
From all Pulmonary Pressures	Maximum, minimum, mean pressure
From Temperature	Mean value

Note: npmn = non pulsatile mean

Additional Software Modules:

Module Advanced Pulm Flow	Inspiratory time, Expiratory time, Apnea time, Total time, Time of brake, Time of pause, Airflow at 0.5TV
Module for Blood Pressure	Systolic, diastolic, mean pressure, npmn, Heart Rate
Module to display P-V LOOPS	
Module for LVP	LVPsys, LVPedp, dP/dtmax, dP/dtmin, heart rate
Module for ECG	RR-I, HR

Please refer to our website for additional information on the Software.

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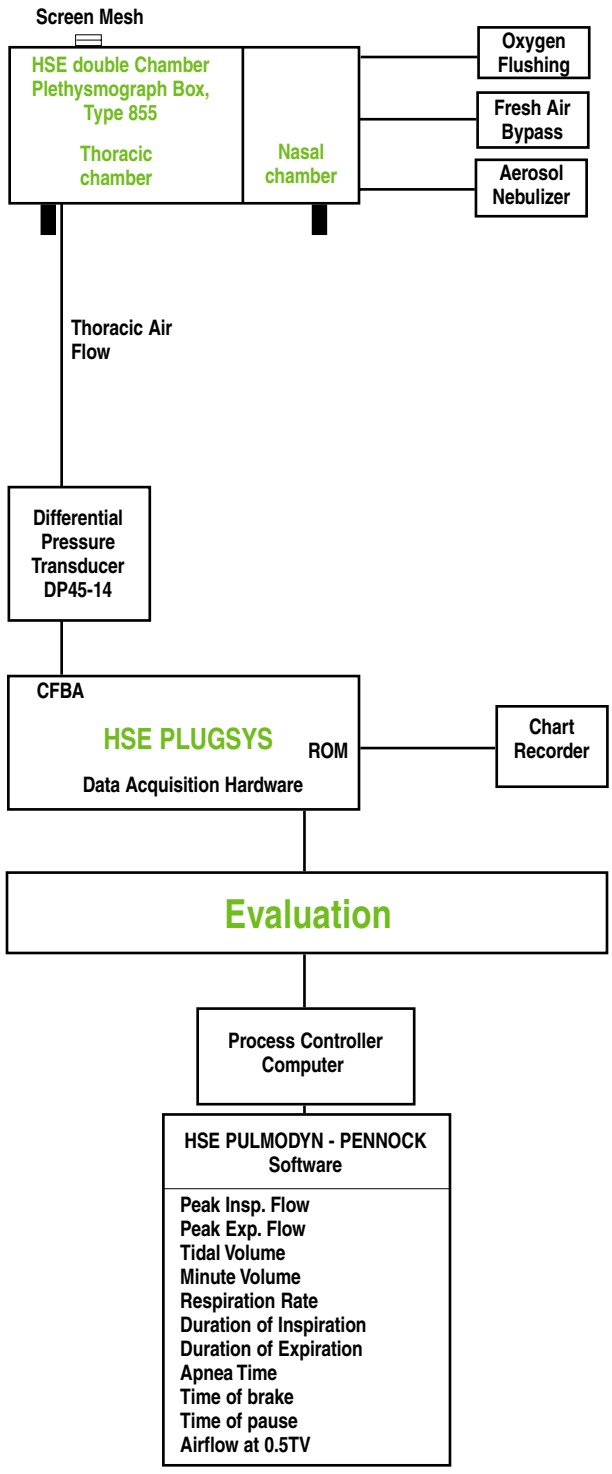
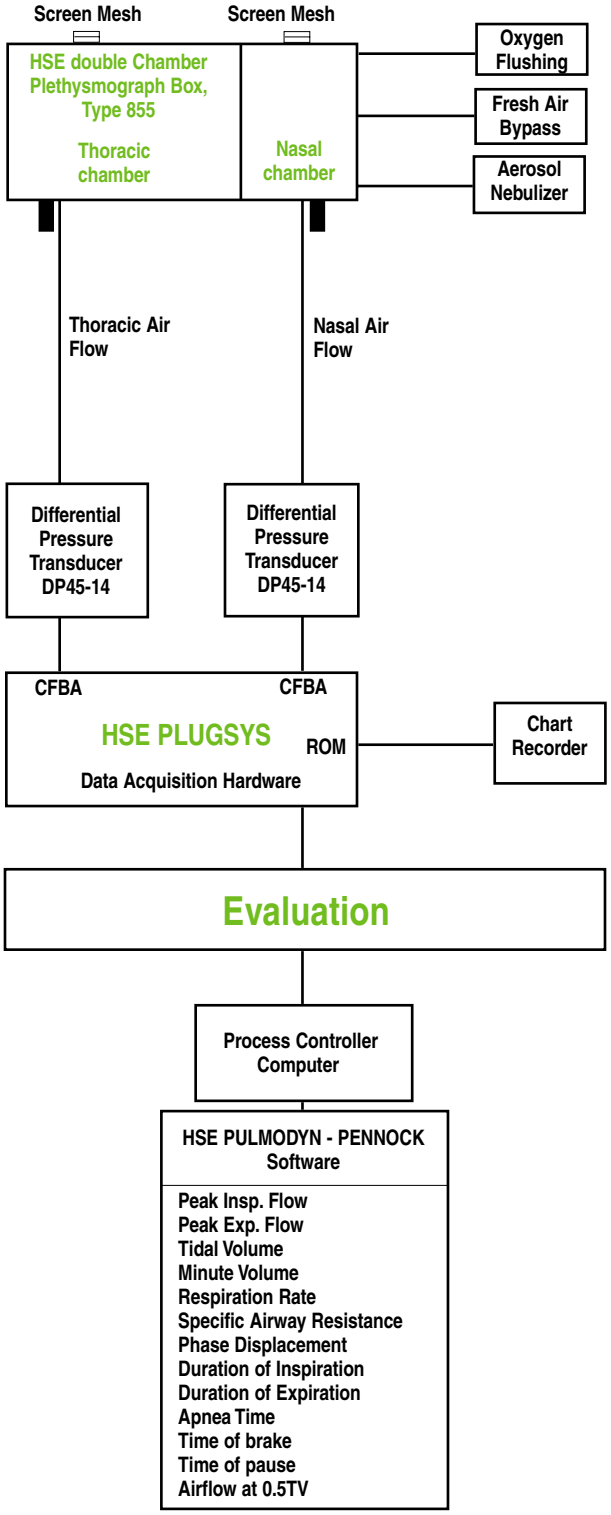
NEW Flow Diagrams

Flow Diagram of Respiratory Measurement on the Restrained Conscious Animal

Restrained Conscious Animal in Double Chamber Plethysmograph Box as Head Out Box — Aerosol Test



Restrained Conscious Animal in Double Chamber Plethysmograph Box — Aerosol Test



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Double-Chamber Plethysmograph for Restrained Rats/Guinea Pigs

- Specific airway resistance measurement together with the standard parameters tidal volume and respiratory rate, in conscious animals
- Can also be used as head-out plethysmograph with aerosol challenge possibility
- Aerosol challenge
- Applications:
  - Toxicology
  - Environmental studies
  - Long term drug effects

This plethysmograph box has been specially developed for the investigation of bronchospasmolytically active substances on the conscious animal.

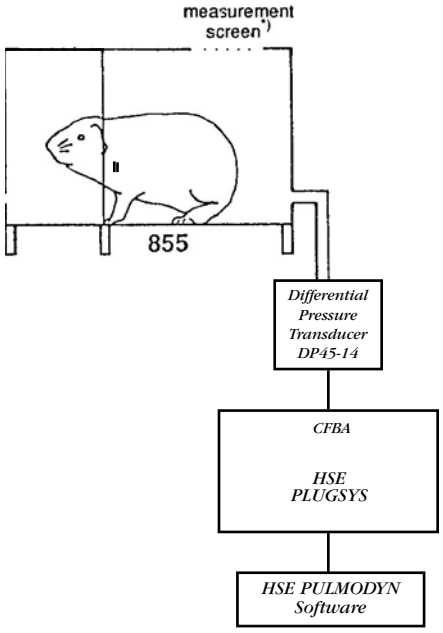
The awake animal is placed into the double chamber and is restricted so that the head protrudes into the front chamber. The neck is sealed with a soft diaphragm. The nasal air flow is measured in the front chamber, the thoracic respiratory flow in the rear chamber. Both measurements are made with measurement screens and differential pressure transducers.

There is a phase shift between the two respiratory flows from which the **specific airway resistance** after PENNOCK is calculated by HSE respiratory software PULMODYN 'PENNOCK'. The standard parameters like respiratory rate, tidal volume, peak inspiratory and expiratory flow, inspiratory and expiratory duration are evaluated from the flow measured in the thoracic chamber.

The nasal chamber is connected to the bias flow venturi-jet tube (requires stable compressed air, we recommend use of the PLUGSYS module PRM BS4 73-0195 in a housing BS4 73-1520), and can be equipped with an aerosol nebulizer and oxygen flushing (supply required). To reduce the handling of valves and switches the PCU Module BS4 73-1748 and BS4 73-1749 can be used.

The thoracic chamber can be removed and the animal can easily be placed into position. The chamber is available in two different sizes to suit different size animals. If only the thoracic chamber is used for measurement, the plethysmograph box is a head-out box with the possibility of aerosol application.

Head-Out Application of Double-Chamber Plethysmograph



- Measurement of standard respiratory parameters tidal volume and respiratory rate, in conscious animals
- Breathing patterns evaluated: Calculation of Time of brake, Time of Pause, Airflow at 0.5VTE
- Aerosol challenge
- Applications:
  - Toxicology
  - Environmental studies
  - Long term drug effects

This is a basic non-invasive method for measurement of standard respiratory parameters tidal volume and respiratory rate, in conscious animals. The guinea-pig (or rat) is placed in a Double-Chamber plethysmograph box. The thoracic respiratory flow is measured in the rear chamber with measurement screens and differential pressure transducer. A neck cuff seals the thoracic chamber.

The nasal chamber can be left open by removing the front panel of the nasal box so that the animal breathes free air. The nasal chamber can also be connected to the bias flow venturi-jet tube (requires stable compressed air, we recommend use of the PLUGSYS module PRM BS4 73-0195 in a housing BS4 73-1520), and can be equipped with an aerosol nebulizer and oxygen flushing (supply required) for aerosol applications. To reduce the handling of valves and switches the PCU Module BS4 73-1748 and BS4 73-1749 can be used.

The following parameters can be calculated from the measured pressure fluctuations in the thoracic chamber:

- **Peak Insp. Flow, Peak Exp. Flow, Tidal Volume, Minute Volume, Respiration Rate**

Optionally:

- **Duration of Inspiration, Duration of Expiration, Apnea Time, Time of brake, Time of pause, Airflow at 0.5TV**

Aerosol Test on Restrained Rodents in the Double-Chamber Plethysmograph 855

- Specific Airway Resistance measurement together with the standard parameters tidal volume and respiratory rate, in conscious animals
- Software controlled multiple animal Version (up to 4 boxes)
- Aerosol challenge software controlled
- Applications
  - — Toxicology
  - — Environmental studies
  - — Long term drug effects

Please refer to our webside for additional information on this System.

This setup has been specially developed for the investigation of bronchospasmolytically active substances on the conscious animal.

The animal is placed into the double chamber and is restricted so that the head protrudes into the front chamber. The neck is sealed with a soft diaphragm. The nasal air flow is measured in the front chamber, the thoracic respiratory flow in the rear chamber. Both measurements are made with measurement screens and differential pressure transducers.

There is a phase shift between the two respiratory flows from which the specific airway resistance according PENNOCK can be calculated. For recording and evaluation the HSE respiratory software PULMODYN 'PENNOCK' is used. The thoracic chamber can be removed and the animal can easily be placed into position. The chamber is available with two different restrainers to suit different size animals.

The nasal chamber is connected to the bias flow venturi-jet tube (requires compressed air) and the oxygen flushing (supply required). The aerosol nebulizer connected to the nasal chamber is a jet nebulizer. It requires an operating pressure of about 1.5 bar (21.75 PSI). Ports are provided on both chambers for calibration so that a defined volume can be introduced with a syringe. The pressure transducers are connected to two carrier amplifiers.

The following parameters are determined:

- From the flow signal of the thoracic chamber:
  Peak Insp. Flow, Peak Exp. Flow, Tidal Volume, Minute Volume, Respiration Rate

  Optionally:
  Duration of Inspiration, Duration of Expiration, Apnea Time, Time of brake, Time of pause, Airflow at 0.5TV
- From the time displacement between nasal and thoracic flow:
  Phase Displacement Θ , Specific Airway Resistance.

The important parameter is the specific airway resistance which is determined from the phase shift between the nasal and the thoracic flow.

The PULMODYN "PENNOCK" software is able to analyze the signals and control the valves from 4 plethysmograph boxes . The advantage of the control system is that no mistakes occur in manual settings of valves. Furthermore, the animal in the chamber is not frightened by handling the valves. The PLUGSYS system is used to interface the boxes to the computer. The PLUGSYS housing supports the CFBA preamplifiers for the Validyne pressure transducers. A special module PCU "Plethysmograph Control Unit" for the automatic control of the different valves has been developed and must be installed in the PLUGSYS housing. One housing takes all the modules for a 2-channel system. For a 4-channel system two PLUGSYS housings are required.

Each plethysmograph box is equipped with 4 special membrane valves . These valves replace the stopcocks and have to be set to specific positions depending on the operating phase (measure, challenge, flush). The membrane valves need compressed air for operation. The PCU module supplies the valves and must therefore be connected to a compressed air supply (2-10 bar) (29-145 PSI). The PCU module also produces the vacuum for the bias flow and operates the oxygen flow for flushing (an oxygen supply at a pressure of 6 bar (87 PSI) max. is required) and the compressed air for the nebulizer. The PCU module is connected to each box through 6-way ribbon tubing.

The PCU module can be computer controlled. The software automatically operates the various valves at the appropriate timing. A manual control box provides manual control of the different phases. The manual control and the software control have equal priority.

References:
1) PENNOCK, B.E., C.P.COX, R.M.ROGERS, W.A.CAIN and J.H.WELLS:A non-invasive technique for measurement of changes in specific airway resistance. J.Appl.Physiol. 46, 399 (1979)

2) PENNOCK, P.E.:A double flow body plethysmograph for measuring specific airflow conductance (unpublished)

3) SCHLEGELMILCH, R.: Respiratory measurements on conscious guinea-pigs using a double chamber plethysmograph box with aerosol challenge. FFB7 Cardiovascular and respiratory in vivo studies, 1991. Publ. by Biomesstechnik-Verlag March, D-79232 March, Germany

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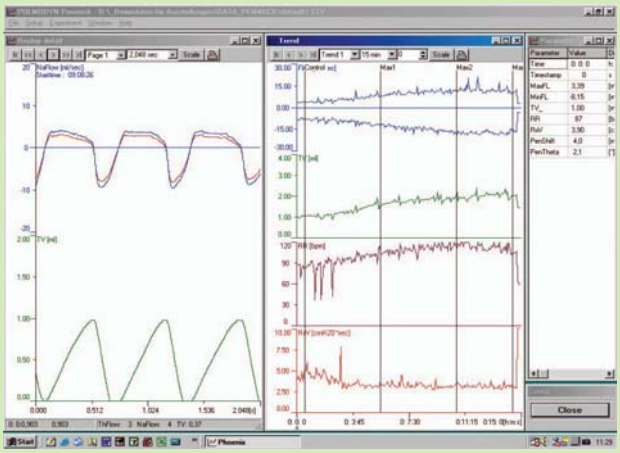
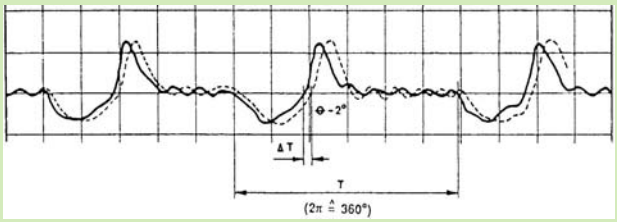
PULMODYN® Pennock for Double Chamber Plethysmograph Box



Data acquisition software for the investigation of bronchospasmolytically active substances on conscious animals in the double chamber plethysmograph box, type 855.



The formula according to Pennock et al. (1979) is as follows:

$$\tan \Theta = \omega \times R \times C$$

Θ = Phase Displacement

$\omega = 2\pi \times$ Respiration Rate f

R x C = Time Constant of the Respiratory System

C = V/p = Thoracic Gas Volume (V) / (P_{atm} – 47 mmHg)

The specific airway resistance is therefore obtained as:

$$R \times V = (P_{atm} - 47) \times 13.6 \times \frac{\tan \Theta}{\omega} [mmH_2O \times s]$$

The phase displacement is measured at the end of inspiration on the steep change over to the expiratory phase.

This software was especially developed for the investigation of bronchospasmolytically-active substances on conscious animals. In this experiment the awake animal is placed into a double chamber plethysmograph box Type 855, and is restricted so that the head protrudes into the front chamber. The neck is sealed with a soft diaphragm. The nasal air flow is measured in the front chamber, the thoracic respiratory flow in the rear chamber. Both measurements are made with wire-mesh measuring screens and differential pressure transducers. There is a phase shift between the two respiratory flows from which the PULMODYN PENNOCK software calculates the specific airway resistance according to PENNOCK. Data acquisition covers the following signals: pulmonary air flow in the nasal chamber, pulmonary air flow in the thoracic chamber. From the flow signal of the thoracic chamber the following parameters are calculated: respiration rate, tidal volume, maximal inspiratory flow, maximal expiratory flow.

From the phase shift between nasal and thoracic flow phase shift and specific airway resistance are calculated. During data acquisition all acquired signals and derived parameters can be displayed on the screen.

The system covers eight channels. This makes it possible to experiment simultaneously on 4 plethysmograph boxes. All 8 signals are sampled at 1 kHz. This means that each channel is measured 1000 times per second, or measurements on each channel are made once every millisecond. This permits measuring phase shifts of some milliseconds and calculate from this delay the specific airway resistance.

The HSE-HA Data Acquisition Hardware for PULMODYN W Software is available in three versions:

- **PLUGSYS Version** for direct connection to PLUGSYS System BS4 73-0161, required if PCU module is used for control
- **Stand Alone Version** BS4 73-0235
- **Stand Alone USB Version** BS4 73-3330

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

Computer	PC Pentium at least 500 MHz with one free PCI-slot,
RAM	128 Mbytes or better 256 Mbytes
Operating System	Windows® 2000/NT or XP
Hard Disk Space	at least 20 Gbytes
Floppy Drive	1.44 Mbytes
CD-ROM Drive	Required
Monitor	17 or 19"
Backup Media	MO drive, CD recorder or ZIP drive

The Software Receives the Following Signals from up to 4 Plethysmograph Boxes:

- Airflow from the Nasal Chamber
- Airflow from the Thoracic Chamber

From these signals the software calculates the following parameters online:

From the Pulmonary Air Flow signals:

- Respiration Rate (RR)
- Peak Inspiratory Flow (PIF), Peak Expiratory Flow (PEF)
- Tidal Volume (TV)

Optional:

- IT (Inspiratory Time), ET (Expiratory Time), AT (Apnea Time), TT (Total Time), TB (Time of brake), TP (Time of pause), Airflow at 0.5VT

From the Phase Shift between Nasal and Thoracic AirfFlow:

- Phasic Shift in msec (PenSift)
- Specific Airway Resistance (Res)

Manifold - Anesthesia Setup for Non-Rebreathing System For Animals < 4.5 kg (10 lbs)

Below are listed the necessary components to create a complete manifold non-rebreathing anesthesia system. The mobile system is detailed out completely. For the table top system, some of the information is the same as the mobile system, so it will refer you back to the mobile system for completed details.

For a Mobile System

Select an Anesthesia Machine – select the model based on your specific application.

Catalog No.	$	Product
BS4 72-3007		Single O_2 Flowmeter (0.2 to 4 LPM)
BS4 72-3009		O_2 and N_2O Flowmeters and Failsafe (0.2 to 4 LPM)

Vaporizer

Select a vaporizer based on the anethic agent you are using and what type of filling system is best for your lab. Either a key fill or a funnel fill. See the Vaporizer Selection Guide on page F15 for assistance in selecting the proper vaporizer.

Manifold

Select a manifold based on you specific application. See "Why Use an Anesthetic Manifold" on page F15.

Gas Tank Regulator and Hose

How to select a Regulator: Using O_2 – Select one E or H-cylinder regulator for each gas, E-cylinder regulators include a 2 foot hose. If using an H-cylinder regulator, gas specific hoses must be purchased separately.

Evacuation System

Select an evacuation system based on your specific need. Please see Evacuation Selection Guide on page F15 for assistance in selecting the proper evacuation system.

Rodent Circuit Set

Catalog No.	$	Product
BS4 72-3026		Rodent Circuit Set Comes with C-Pram Circuit, Medium Mask and Uncut Diaphragm

Anesthetizing Boxes

Select depending on size of animal to be anesthetized:

Catalog No.	$	Product
BS4 50-0108		Small Anesthetizing Box (10.7 x 25.7 x 11 cm)
BS4 50-0116		Large Anesthetizing Box (29 x 44 x 29 cm)

Tubing and Connectors

Catalog No.	$	Product
BS4 72-1024		3/16 inch ID Tubing (connects to Endcap on vaporizer)
BS4 72-1026		1/4 inch ID Tubing (connects to manifold)
BS4 72-1027		5/16 inch ID Tubing (connects to anesthetizing box)
BS4 72-1703		1/4 - 3/16 inch Barbed Connector (connects manifold to rodent circuit set)
BS4 72-1550		1/4 - 5/16 inch Barbed Connector (connects anesthetizing box to manifold).
BS4 72-2889		Respiratory Adapter (6 to 22 mm)
BS4 72-6000		Supply Line Adapter

****OTHER CONNECTORS MAY BE NECESSARY DEPENDING UPON EVACUATION SYSTEM AND MASK BEING USED - CONTACT TECHNICAL SUPPORT FOR ASSISTANCE.*

For a Table Top System

Select an Anesthesia Machine – select the model based on specific application.

Catalog No.	$	Product
BS4 72-3011		Table Top Anesthesia Machine with Single O_2 Flowmeter (0.2 to 4 LPM)
BS4 72-3012		Table Top Anesthesia Machine with Single Single O_2 Flowmeter (0 to 1000 cc)
BS4 72-3013		Table Top Anesthesia Machine with Single Dual O_2 Flowmeter (0.2 to 4 LPM and 0 to 1000 cc)
BS4 72-3014		Table Top Anesthesia Machine with Single O_2 and N_2O Flowmeters and Failsafe (0.2 to 4 LMP)

Vaporizer – same as for mobile system

Manifold – same as for mobile system

Gas Tank Regulator and Hose – same as for mobile system

Evacuation System – same as for mobile system

Anesthetizing Boxes – same as for mobile system

Tubing and Connectors – same as for mobile system

Rodent Mask and Diaphram – The Rodent Circuit is provided with Table Top System but the mask and diaphragm must be purchased separately.

Catalog No.	$	Product
BS4 72-3027		Rodent Anesthesia Mask – must puchase one of the below listed diaphrams to complete the mask. Select diaphram based on the size of the animal you are working with.
BS4 72-3028		Small Diaphram (7/16 inch diameter)
BS4 72-3029		Medium Diaphram (9/16 inch diameter)
BS4 72-3030		Large Diaphram (3/4 inch diameter)

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Mask Only - Anesthesia Setup for Non-Rebreathing System For Animals < 4.5 kg (10 lbs)

Below are listed the necessary components to create a complete mask only non-rebreathing anesthesia system. The mobile system is detailed out completely. For the table top system, some of the information is the same as the mobile system, so it will refer you back to the mobile system for completed details.

****OTHER CONNECTORS MAY BE NECESSARY DEPENDING UPON EVACUATION SYSTEM AND MASK BEING USED - CONTACT TECHNICAL SUPPORT FOR ASSISTANCE.*

For a Mobile System

Select an Anesthesia Machine – select the model based on your specific application.

Catalog No.	$	Product
BS4 72-3007		Single O_2 Flowmeter (0.2 to 4 LPM)
BS4 72-3009		O_2 and N_2O Flowmeters and Failsafe (0.2 to 4 LPM)

Vaporizer

Select a vaporizer based on the anethic agent you are using and what type of filling system is best for your lab. Either a key fill or a funnel fill. See the Vaporizer Selection Guide on page F15 for assistance in selecting the proper vaporizer.

Gas Tank Regulator and Hose

How to select a Regulator: Using O_2 – Select one E or H-cylinder regulator for each gas, E-cylinder regulators include a 2 foot hose. If using an H-cylinder regulator, gas specific hoses must be purchased separately.

Evacuation System

Select an evacuation system based on your specific need. Please see the Evacuation Selection Guide on page F15 for assistance in selecting the proper evacuation system.

Rodent Circuit Set

Catalog No.	$	Product
BS4 72-3026		Comes with C-Pram Circuit, Medium Mask and Uncut Diaphragm

Tubing and Connectors

Catalog No.	$	Product
BS4 72-1024		3/16 inch ID Tubing (connects to Endcap on vaporizer)
BS4 72-6000		Supply Line Adapter

****OTHER CONNECTORS MAY BE NECESSARY DEPENDING UPON EVACUATION SYSTEM AND MASK BEING USED - CONTACT TECHNICAL SUPPORT FOR ASSISTANCE.*

For a Table Top System

Table Top Select model depending on specific application.

Catalog No.	$	Product
BS4 72-3011		Table Top Anesthesia Machine with Single O_2 Flowmeter (0.2 to 4 LPM)
BS4 72-3012		Table Top Anesthesia Machine with Single Single O_2 Flowmeter (0 to 1000 cc)
BS4 72-3013		Table Top Anesthesia Machine with Single Dual O_2 Flowmeter (0.2 to 4 LPM and 0 to 1000 cc)
BS4 72-3014		Table Top Anesthesia Machine with Single O_2 and N_2O Flowmeters and Failsafe (0.2 to 4 LMP)

Vaporizer – same as for mobile system

Manifold– same as for mobile system

Gas Tank Regulator and Hose – same as for mobile system

Evacuation System – same as for mobile system

Tubing and Connectors – same as for mobile system

Rodent Mask and Diaphram

Catalog No.	$	Product
BS4 72-3027		Rodent Anesthesia Mask – must puchase one of the below listed diaphrams to complete the mask. Select diaphram based on the size of the animal you are working with
BS4 72-3028		Small Diaphram (7/16 inch diameter)
BS4 72-3029		Medium Diaphram (9/16 inch diameter)
BS4 72-3030		Large Diaphram (3/4 inch diameter)

****OTHER CONNECTORS MAY BE NECESSARY DEPENDING UPON EVACUATION SYSTEM AND MASK BEING USED - CONTACT TECHNICAL SUPPORT FOR ASSISTANCE.*

Behavioral Research Applications

This chart gives a brief description of three general classifiations of behavioral research that are conducted. Next to each type is a list of different equipment that might be used and the parameter measured. This chart is meant to provide a general guide line and is not absolute.

	Equipment	Parameter Measured	Response To	Coordination Testing	Neurological Response	Learning and Memory	Muscular Response
Motor & Sensory	**Rotorods - Unidirectional**	Assessing the effect of drugs on the motor coordination	Running	X			X
	Rotorods - Bidirectional	Faster test of coordination	Running	X			
	Tail Flick Analgesia Meters	Used to detect the analgesic effect of the properties of narcotic and strong non- narcotic drugs. This can measure latency by tail flick method	Heat		X		X
	Plantar Analgesia Meters	Measuring response to physical stimuli (heat) on the feet in response to chemical or environmental stimuli	Heat		X		X
	Hot Plates	Measuring response to physical stimuli (heat) on the feet in response to chemical or environmental stimuli	Heat		X		X
	Grip Strength Meters	Measure the physical ability to hold on to a bar as affected by environmental stimuli or chemicals	Pulling		X		X
	Von Frey Anesthesiometers	Measure sensory threshold by the reaction measured by an auditory response or when the extremity tested is withdrawn.	Pressure		X		
	Sine Wave Shock Generators	Produces cerebral seizures produced by using constant sinusoidal alternating current to determine the effect of anticonvulsive drugs	Shock		X	X	X
Activity	**Treadmills**	Exerciser to induce stress or physical activity and then measure the effect caused by chemical or environmental consideration	X motion			X	X
	Activity Wheels	Measuring gross physical activity in response to chemical or environmental stimuli	X motion			X	
	Activity Monitors	Measuring xyz physical activity in response to chemical or environmental stimuli	XYZ motion	X	X	X	X
Learning & Test Systems	**Mazes**	Measure the learning and memory response as affected by chemical or environmental stimuli	Motivation		X	X	

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