Life Science Suite™

# Plethysmograph Chambers Manual

Model: 600-2100-001, 600-2200-001, 600-2400-001, 600-2500-001, & 600-2600-001
Manual: MU00249-001
Revision 57

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DSI™



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# Contents

# Overview

## Introduction

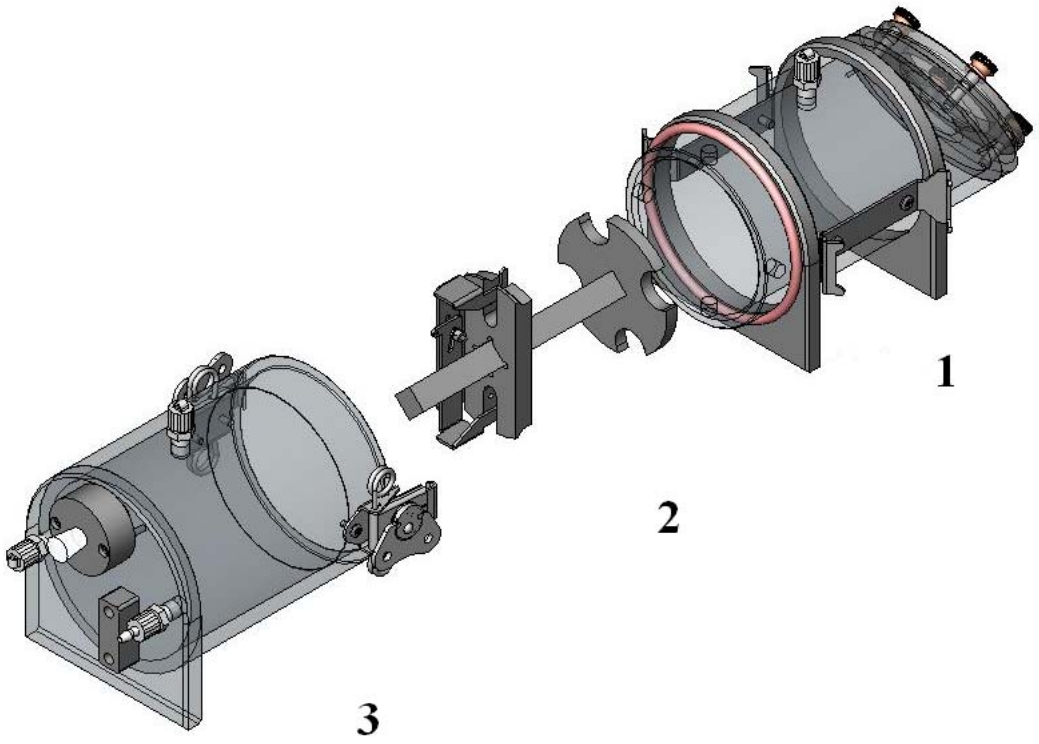
The DSI plethysmograph chambers are designed and built for optimal performance along with the Ponemah Physiological Platform and DSI telemetry systems. Product offerings in this document include the Rat Head-Out Plethysmograph Chamber, the Mouse Head-Out Plethysmograph Chamber, the Guinea Pig Unrestrained Whole Body Plethysmograph Chamber, the Rat Unrestrained Whole Body Plethysmograph Chamber, and the Mouse Unrestrained Whole Body Plethysmograph Chamber.

# Components

## Rat Head-Out Plethysmograph Chamber

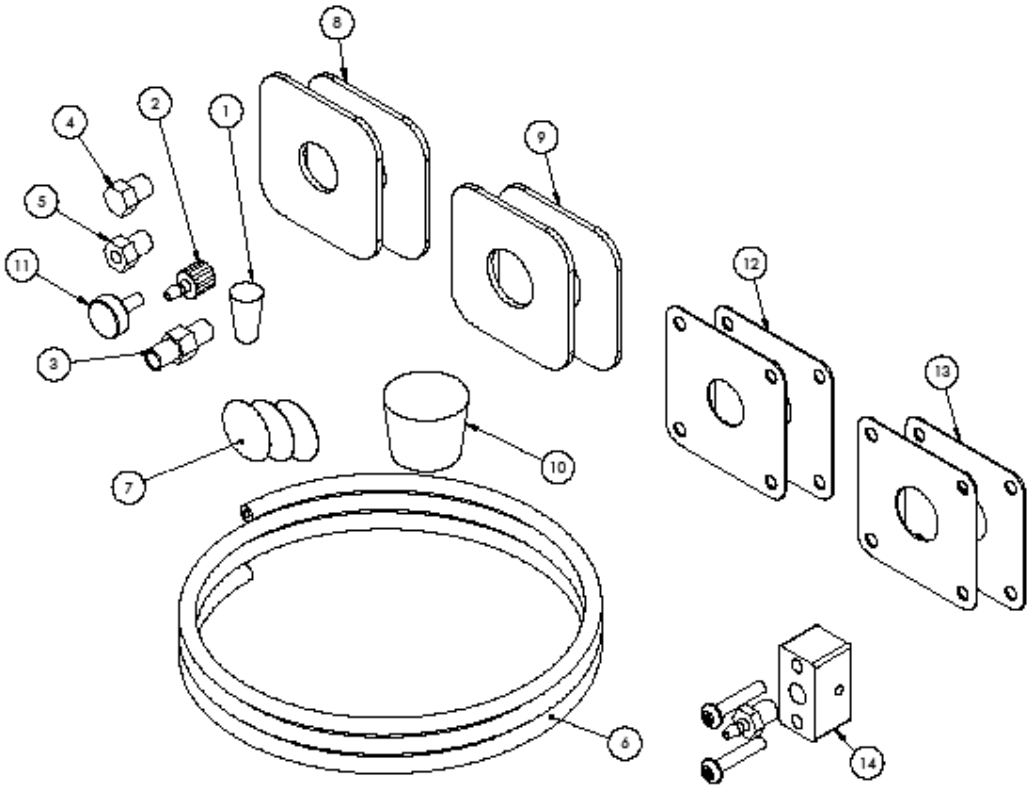
Rat Head-Out Plethysmograph Chamber (600-2100-001) pictured on a telemetry RPC1 receiver plate

Rat Head-Out Plethysmograph Chamber components:




1. Rat Head-Out Plethysmography Chamber Accessory (Front) (600-2110-001)
2. Squeeze plate mechanism (600-2112-001)
3. Rat Head-Out Plethysmography Chamber Accessory (Rear) (600-2111-001)

The Rat Head-Out Plethysmograph Chamber (600-2100-001) is packaged with the following items:

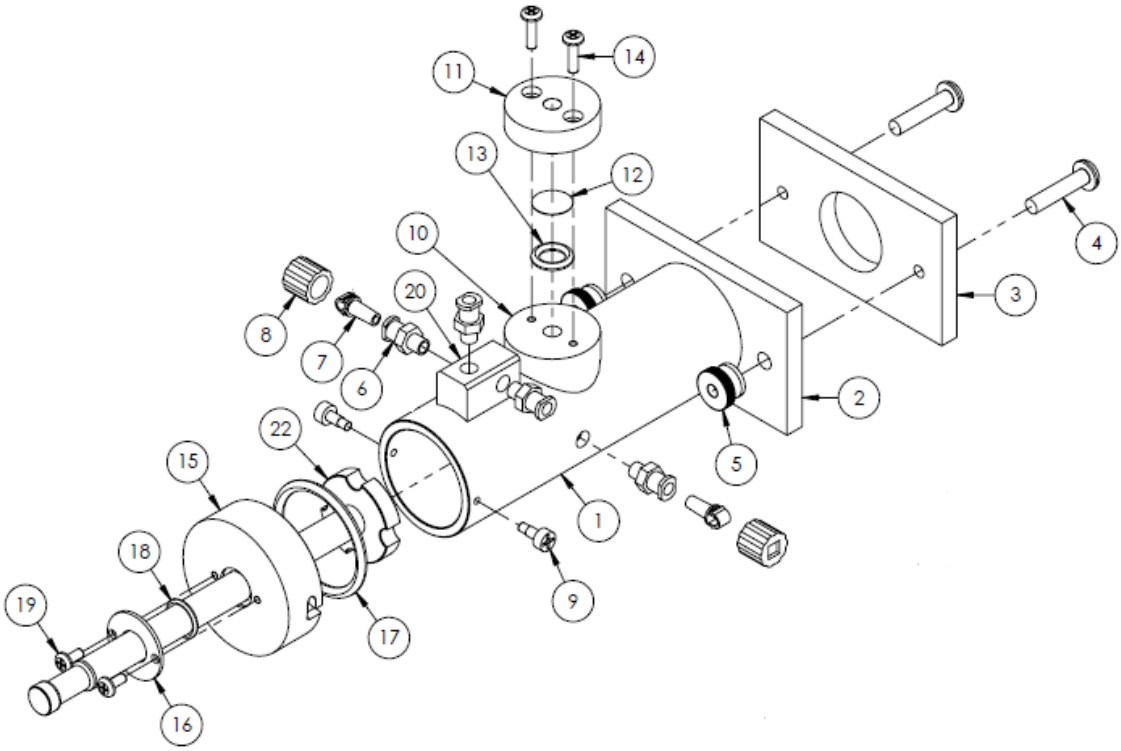



1. Taper Plug 5/16 to ½ OD
2. 1/8-27 NPT to 1/8 barb
3. 1/8-27 NPT to 1/8-27 NPT
4. 1/8-27 NPT Plug
5. 1/8-27 NPT to ¼-28 UNF
6. Tygon tubing 1/8 in. ID (24 in. long)
7. Extra Pneumotachograph Screens (3)
8. Neck seals (2) 0.80 diameter hole
9. Neck seals (2) 0.95 diameter hole
10. Taper Plug 1 1/32 to 1 17/64 OD
11. Knurled thumb screw
12. Neck seals (2) silicon 0.75 hole
13. Neck seals (2) silicon 0.875 hole
14. Input block

# Mouse Head-Out Plethysmograph Chamber

Mouse Head-Out Plethysmograph Chamber (600-2200-001)

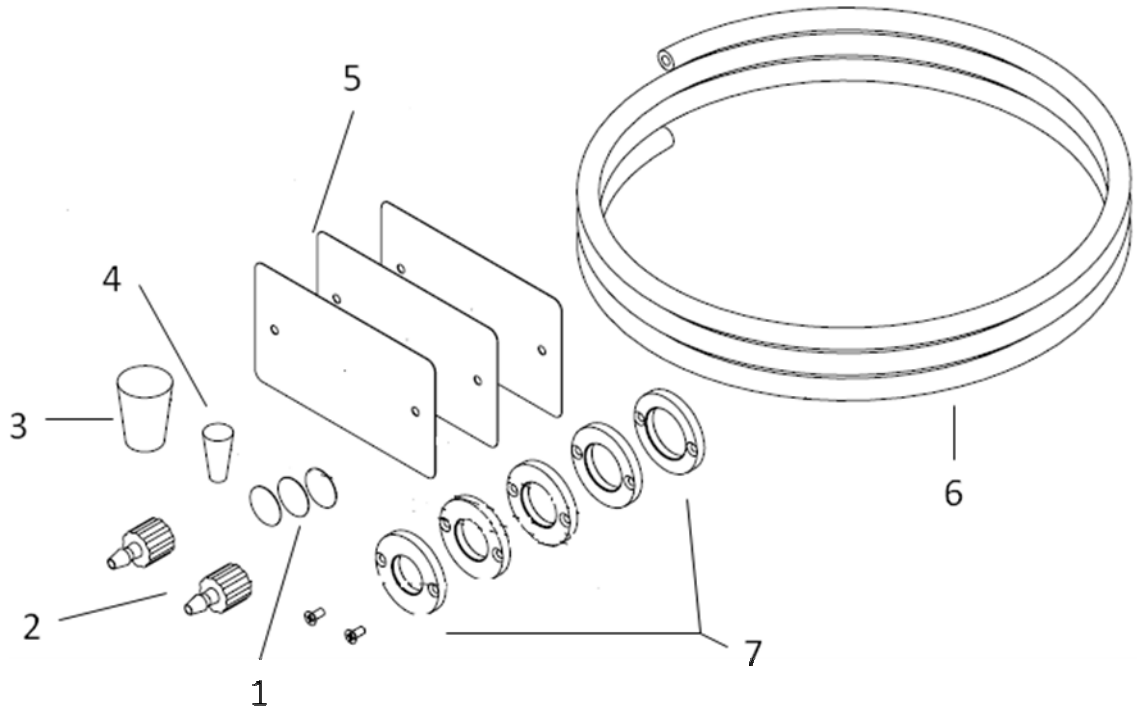
Mouse Head-Out Plethysmograph Chamber (600-2200-001) components:




1. Body Chamber

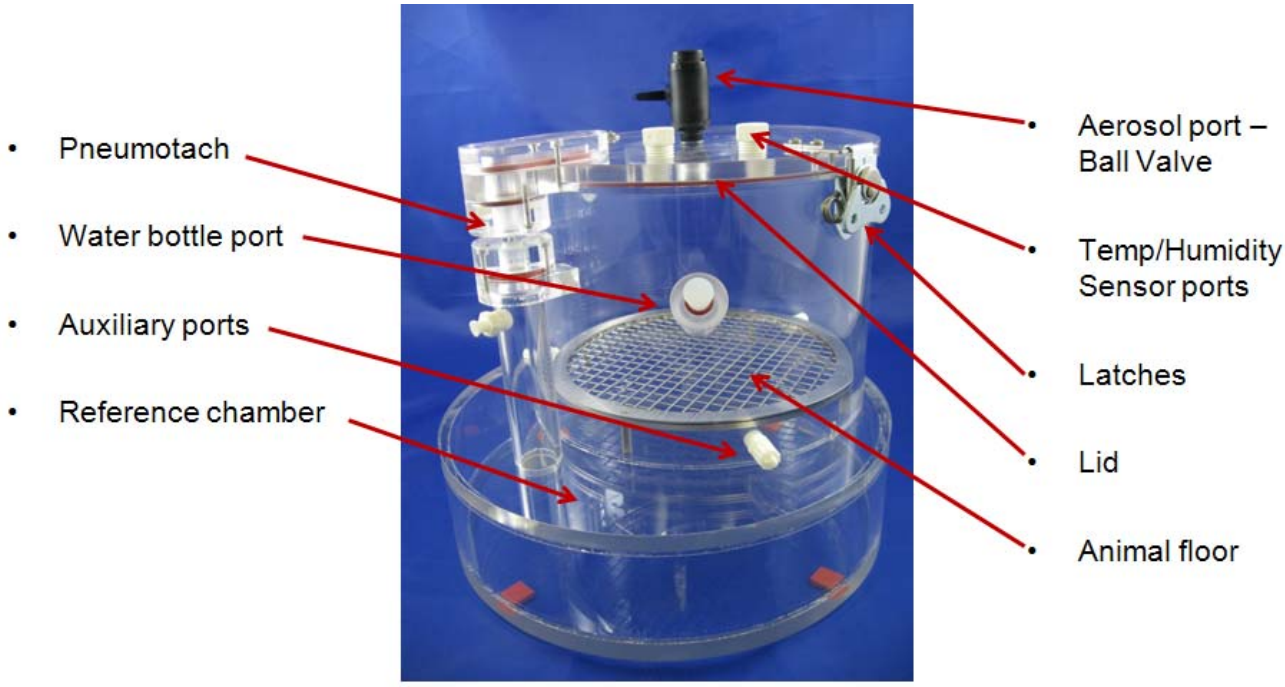
2. Head Mount Plate
3. Head Plate
4. Screw Pan HD 10-32x7/8
5. Knurled Thumb Nut
6. Female Luer Adaptor
7. Male Luer Plug
8. Male Luer Intergral Lock Ring
9. 1/8 dia x 3/16 screw
10. Stack Airway
11. Screen Retainer Plate
12. Pneumotachograph Screen
13. Black Silicone O-Ring
14. Screw Pan HD 4-40 x 7/16
15. Push Rod Guide
16. Push Rod Retainer Plate Seal
17. Red Silicone O-Ring Seal
18. Black Silicone O-Ring Seal
19. Screw Pan HD 4.40 x 1/4
20. Block Transducer Connection
22. Push Rod Assembly

The Mouse Head-Out Plethysmograph Chamber (600-2200-001) is packaged with the following items:

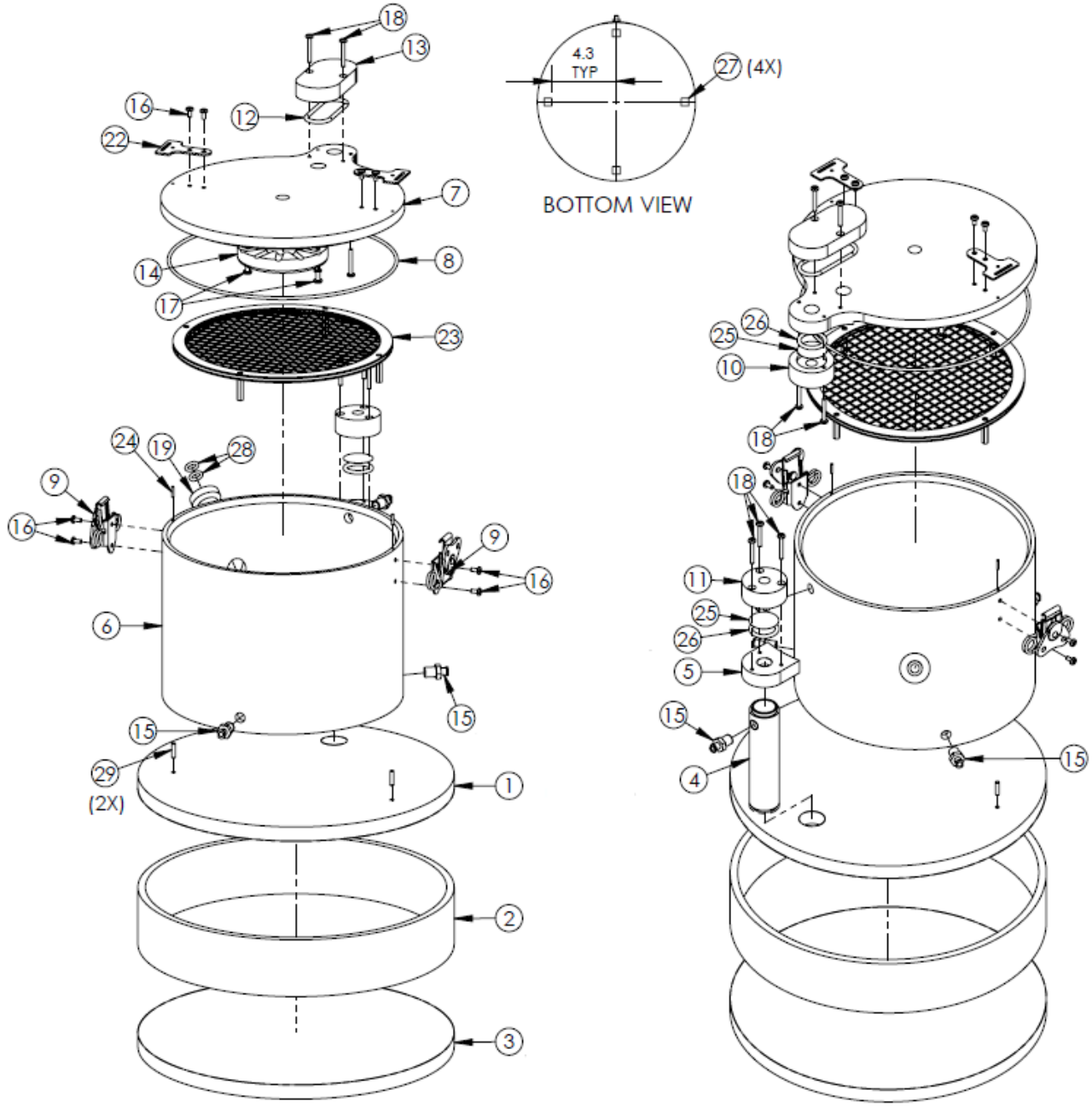



1. 3 extra Pneumotachograph Screens
2. 2 Fittings, Luer male to 1/8 barb
3. Taper plug 7/16 to 5/8 OD
4. Taper plug 3/16 to 11/32 OD
5. 3 Latex neck seals
6. Tygon tubing 1/8 in. ID (24 in. long)
7. Head orifice reduction rings

## Rat and Guinea Pig Unrestrained Whole Body Plethysmograph Chamber

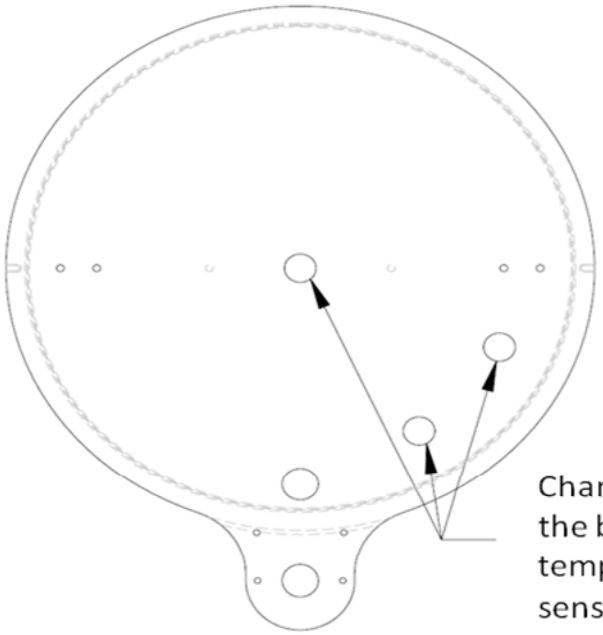


Rat and Guinea Pig Unrestrained Whole Body Plethysmograph Chamber (600-2400-001, 600-2600-001) components:

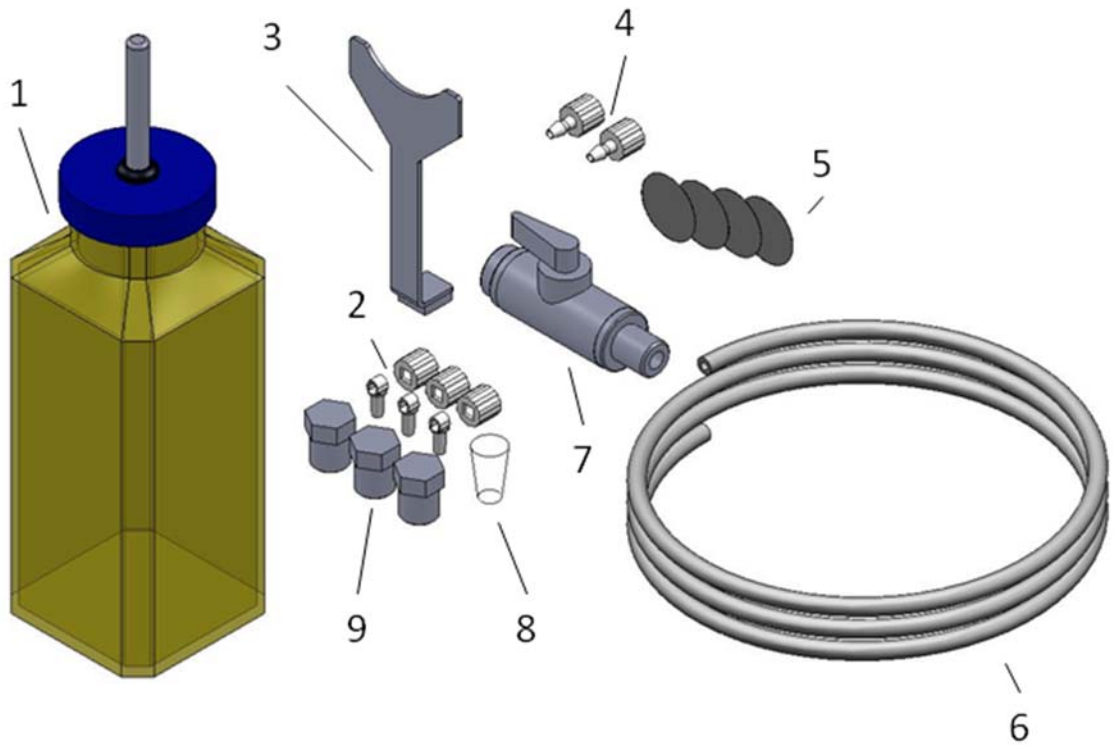



1. Reference Chamber, Top
2. Reference Chamber, Cylinder
3. Reference Chamber, Bottom
4. Reference Chamber, Tube
5. Reference Chamber, Screen Mount
6. Main Chamber, Cylinder
7. Main Chamber, Top

8. O-Ring Silicone Red
9. Latch
10. Body Box Screen Plate
11. Reference Chamber, Screen Plate
12. O-Ring Silicone Red
13. Plate, Air Path
14. Aerosolization port
15. Fitting, Luer Female to 1/8-27NPT
16. Screw Pan HD 4-40x1/4
17. Screw Pan HD 6-32x5/16
18. Screw Pan HD 4/40x7/8
19. Water Bottle Adapter
22. Latch Bracket
23. Screen Floor Assembly
24. Dowel Pin, SS .0626x0.5
25. Pneumotachograph Screen: SS 200x600
26. O-Ring, 1.00 OD
27. Rubber Silicone Foot .50SQ
28. O-Ring Silicone Red .50OD
29. Dowel Pin .125x .5 SS

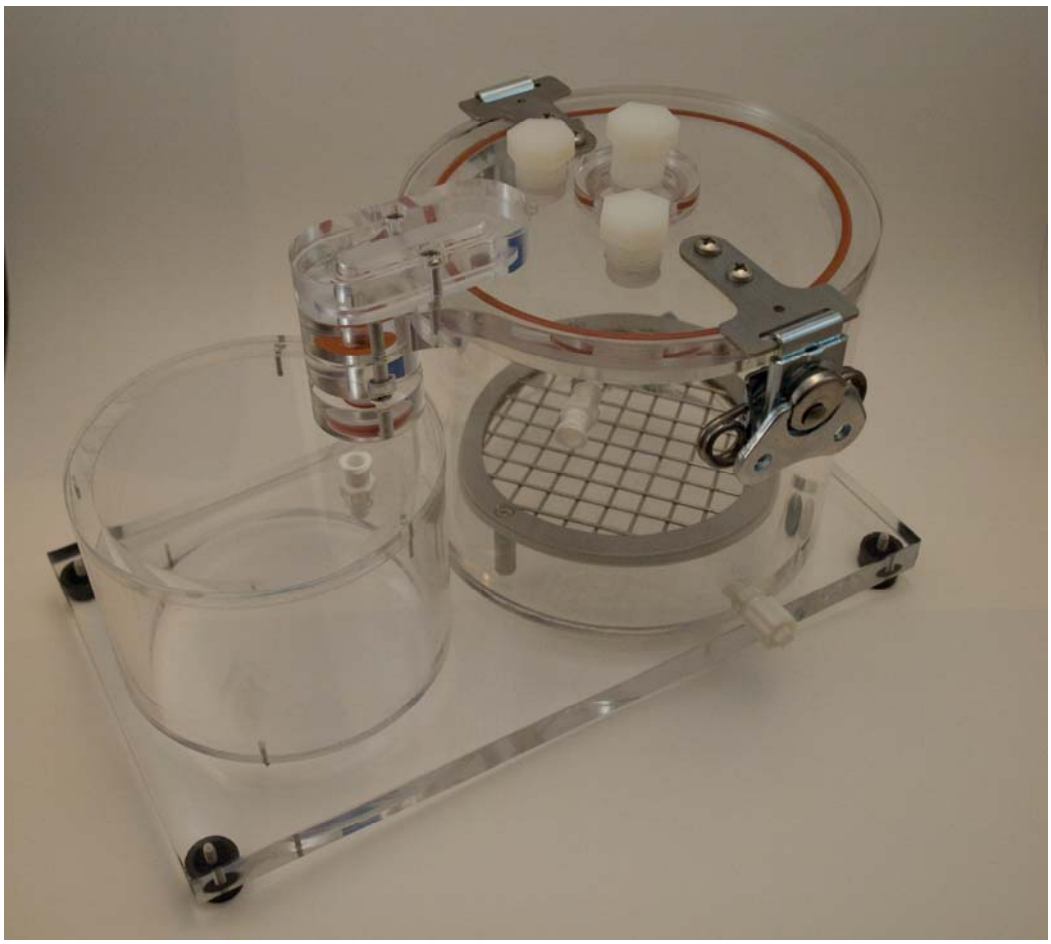


The Rat and Guinea Pig Unrestrained Whole Body Plethysmograph Chambers are packaged with the following items:

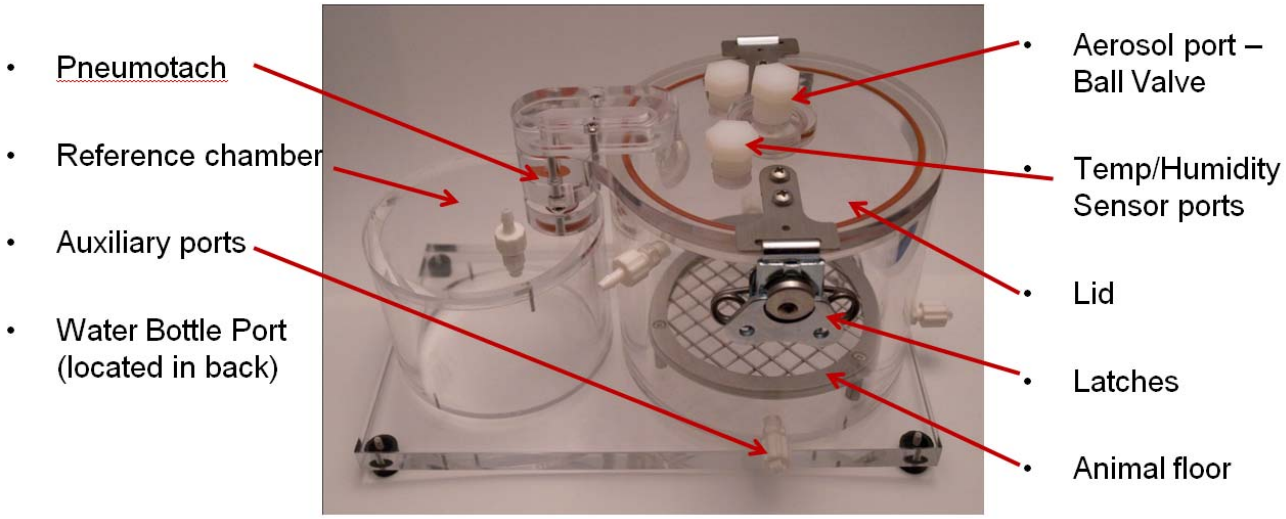



1. One water bottle with sipper tube
2. Three luer cap plugs to seal chamber ports
3. One water bottle support bracket
4. Two 1/8” barb luer male fittings to attach tubing to the chamber
5. Four extra pneumotachograph screens
6. 24 inch length of Tygon tubing (1/8 ID) to plumb the pressure transducer
7. One ball valve (for aerosol administration) that fits center lid port
8. One tapered stopper to seal water bottle port
9. Three 1/4” threaded hex bolt to seal lid ports

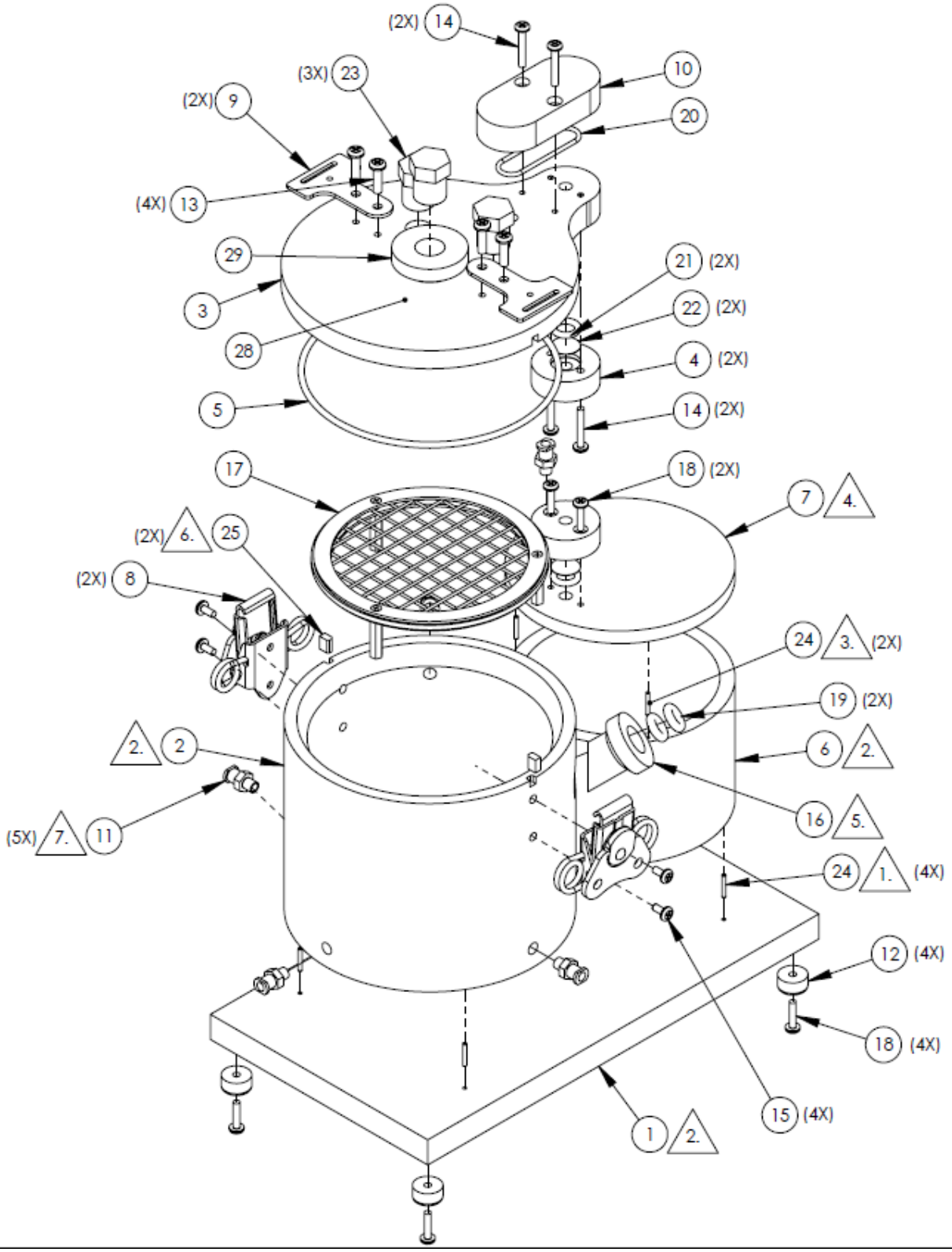
# Mouse Unrestrained Whole Body Plethysmograph Chamber



Mouse Unrestrained Whole Body Plethysmograph Chamber (600-2500-001)

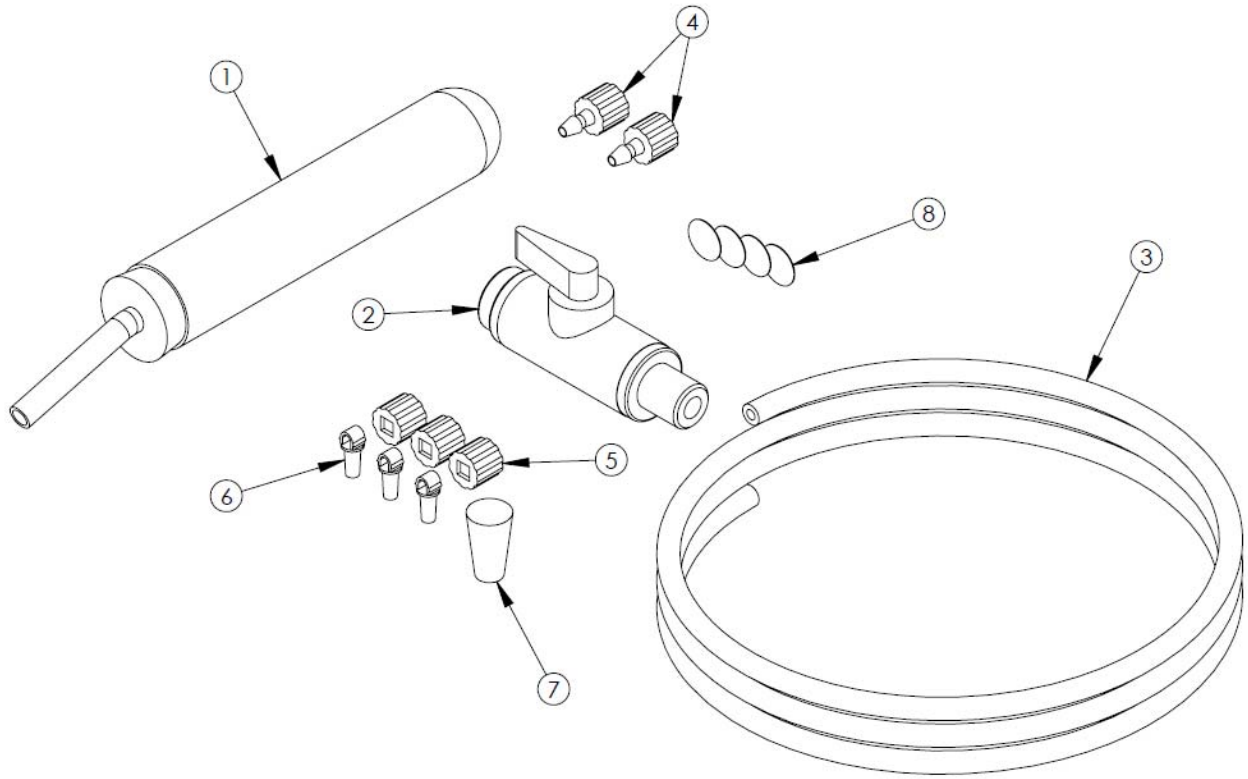


Mouse Unrestrained Whole Body Plethysmograph Chamber (600-2500-001) components:



1. Base Plate
2. Main Cylinder
3. Main Chamber Top
4. Retainer Filter Airway
5. O-Ring Silicone Red 4.193OD
6. Reference Chamber
7. Reference Chamber Top
8. Latch
9. Latch Bracket
10. Airway
11. Luer Hex to UNF
12. Bumper Rubber  Black
13. Screw Pan HD 6-32x1/2
14. Screw Pan HD 4-40x3/4
15. Screw Pan HD 4-40x1.4
16. Water Bottle Adaptor
17. Screen Floor
18. Screw Pan HD 4-40x1/2
19. O Ring Silicone Red 0.50OD
20. O-Ring Silicone Red
21. O-Ring Silicone Black 0.50OD
22. Pneumotachograph Screen: SS 200x600
23. Plug Hex Male ¼" NPT
24. Dowel Pin SS: 0.062 x0.437
25. Key Way Block
28. O-Ring Silicone Red 1.00OD
29. 22MM to 1/4NPT Adaptor

The Mouse Unrestrained Whole Body Plethysmograph Chamber is packaged with the following items:




1. One water bottle with sipper tube
2. One ball valve
3. 24 inch length of Tygon tubing (1/8 ID) to plumb the pressure transducer
4. Two 1/8” barb luer male fittings to attach tubing to the chamber
5. Three luer male integral lock tings to seal chamber ports
6. Three luer male plugs to seal chamber ports
7. One tapered stopper to seal water bottle port
8. Four extra pneumotachograph screens

**Unrestrained Whole Body Plethysmograph Chamber Sensors**

For use with Compensated Whole Body Plethysmography respiratory method, which provides a more accurate volume calculation.(Reference: Drorbaugh, J. E. & Fenn, W. O.: A barometric method for measuring ventilation in newborn infants. Pediatrics. 1955; 16;81-87).

In order to use the temperature and humidity sensors the user must unscrew the two nylon plugs from the top of the chamber and then thread the sensors into the lid taking caution not to over tighten the sensors. Over tightening the sensors will damage the threads and cause the chamber to leak air.

Rat Unrestrained Whole Plethysmograph Chamber with temperature and humidity sensors (circled in red)

Temperature and Humidity Sensors

- Interfaces to the 7700 UniversalXE signal conditioner.
- Attaches to the lid of the Unrestrained Whole Body Plethysmograph Chamber.
- Calibration values marked on the sensors for ease of calibrating the system.
- Different length cables are available (10 feet [3.05 meters] and 20 feet [6.1 meters]).

NOTE: The temperature and humidity sensors have different connectors on the sensor. The user should take care when inserting the connector into the sensor to make sure that the correct cable is being used.

Temperature sensor (left), Humidity sensor (right) with cable.

Barometric Pressure Sensor

- Interfaces to the 7700 Advanced Basic DC 4 signal conditioner or with the 7700 Advanced Basic DC 32 signal conditioner with the distribution input panel.
- Provides a calibrated high level output so that there is no need for a physical calibration.


Barometric Pressure Sensor with cables

# Accessories

Dependent on the application, there may be other items that the user requires. Below is a list of optional accessories that work with the **Rat Head-Out Plethysmograph Chamber**.

- Validyne transducer (600-1100-002, 600-1102-002) dependent on usage - contact DSI
- Replacement pneumotachograph screens, SS 200x600 (600-1000-001)
- Neck seals
  - 600-2114-001 - Polyurethane 1/8 in. thick 0.80 in. diameter
  - 600-2114-002 - Polyurethane 1/8 in. thick 0.95 in. diameter
  - 600-2115-001 - Silicon 1/32 in. thick 0.75 in. diameter
  - 600-2115-002- Silicon 1/32 in. thick 0.875 in. diameter
  - 600-2115-003- Silicon 1/32 in. thick 1.00 in. diameter
  - 600-2115-004 - Silicon 1/32 in. thick 1.125 in. diameter
  - 600-2115-005 - Silicon 1/32 in. thick 1.25 in. diameter
- O-Ring Gaskets 600-2116-001 (1 inch outer diameter), 600-2116-002 (3.88 inch outer diameter)

- Refurbishment Kit (600-2113-001) – Includes replacement pneumotachograph screens, O-Ring gaskets, luer fittings and caps, stoppers, tubing, screws

Dependent on the application, there may be other items that the user requires. Below is a list of optional accessories that work with the **Mouse Head-Out Plethysmograph Chamber.**

- Validyne transducer (600-1100-002, 600-1102-002) dependent on usage - contact DSI
- O-Ring Gaskets kit, Qty 3 (600-2212-001)
- Neck Seal (latex), Qty 25 (600-2211-01)
- Replacement pneumotachograph screens, SS 200x600(600-1001-001)
- Replacement push rod assembly (600-2210-001)

Dependent on the application, there may be other items that the user requires. Below is a list of optional accessories that work with the **Rat Unrestrained Whole Body Plethysmograph Chamber**.

- Validyne transducer (600-1100-002, 600-1102-002) dependent on usage - contact DSI
- Temperature Sensor - requires temperature sensor cable for UniversalXE (600-1210-001)
- Temperature Sensor Cable for UniversalXE, 10 feet – 3.05 meters (600-1212-001)
- Temperature Sensor Cable for UniversalXE, 20 feet – 6.1 meters (600-1213-001)
- Humidity Sensor - requires humidity sensor cable for UniversalXE (600-1211-001)
- Humidity Sensor Cable for UniversalXE, 10 feet – 3.05 meters (600-1214-001)
- Humidity Sensor Cable for UniversalXE, 20 feet – 6.1 meters (600-1215-001)

**Replacement Accessories**

- Gasket kit, 6 gaskets (600-2413-001)
- Refurbishment kit. Includes 6 gaskets, pneumotachograph screens, ball valve, water bottle with sipper tube & holder, luer fittings & caps, screws, stopper, tubing, chamber floor. (600-2414-001)
- Replacement pneumotachograph screens, SS 200x600 (600-1000-001)
- Plug and Feet kit (600-2415-001)
- Temperature sensor (600-1210-001)
- Humidity sensor (600-1211-001)
- Temperature sensor cable for UniversalXE (600-1212-001, 600-1213-001)
- Humidity sensor cable for UniversalXE (600-1214-001, 600-1215-001)

- Ball valve (600-1002-001)
- Rat Whole Body Plethysmograph chamber lid (600-2410-001)
- Rat Whole Body Plethysmograph chamber floor (600-2412-001)
- Water bottle with sipper tube for Rat or Guinea Pig (600-1003-001)
- Rat water bottle holder (600-1006-001)

Dependent on the application, there may be other items that the user requires. Below is a list of optional accessories that work with the **Mouse Unrestrained Whole Body Plethysmograph Chamber**.

- Validyne transducer (600-1100-002, 600-1102-002) dependent on usage - contact DSI
- Temperature Sensor - requires temperature sensor cable for UniversalXE (600-1210-001)
- Temperature Sensor Cable for UniversalXE, 10 feet – 3.05 meters (600-1212-001)
- Temperature Sensor Cable for UniversalXE, 20 feet – 6.1 meters (600-1213-001)
- Humidity Sensor - requires humidity sensor cable for UniversalXE (600-1211-001)
- Humidity Sensor Cable for UniversalXE, 10 feet – 3.05 meters (600-1214-001)
- Humidity Sensor Cable for UniversalXE, 20 feet – 6.1 meters (600-1215-001)

**Replacement Accessories**

- Plug, gasket, & water bottle replacement kit (600-2513-001)
- Refurbishment kit. Includes gaskets, pneumotachograph screens, ball valve, water bottle, luer fittings & caps, screws, stopper, tubing, chamber floor. (600-2514-001)
- Replacement pneumotachograph screens, SS 200x600 (600-1000-001)
- Temperature sensor (600-1210-001)
- Humidity sensor (600-1211-001)
- Temperature sensor cable for UniversalXE (600-1212-001, 600-1213-001)
- Humidity sensor cable for UniversalXE (600-1214-001, 600-1215-001)
- Ball valve (600-1002-001)
- Mouse Whole Body Plethysmograph chamber lid (600-2510-001)
- Mouse Whole Body Plethysmograph chamber floor (600-2512-001)
- Mouse water bottle with sipper tube (600-1004-001)

Dependent on the application, there may be other items that the user requires. Below is a list of optional accessories that work with the **Guinea Pig Unrestrained Whole Body Plethysmograph Chamber**.

- Validyne transducer (600-1100-002, 600-1102-002) dependent on usage - contact DSI
- Temperature Sensor - requires temperature sensor cable for UniversalXE (600-1210-001)
- Temperature Sensor Cable for UniversalXE, 10 feet – 3.05 meters (600-1212-001)
- Temperature Sensor Cable for UniversalXE, 20 feet – 6.1 meters (600-1213-001)
- Humidity Sensor - requires humidity sensor cable for UniversalXE (600-1211-001)
- Humidity Sensor Cable for UniversalXE, 10 feet – 3.05 meters (600-1214-001)
- Humidity Sensor Cable for UniversalXE, 20 feet – 6.1 meters (600-1215-001)

**Replacement Accessories**

- Plug, Feet, & Gasket replacement kit (600-2613-001)
- Refurbishment kit. Includes gaskets, pneumotachograph screens, ball valve, water bottle with sipper tube & holder, luer fittings & caps, screws, stopper, tubing, chamber floor. (600-2614-001)
- Replacement pneumotachograph screens, SS 200x600 (600-1000-001)
- Plug and Feet kit (600-2415-001)
- Temperature sensor (600-1210-001)
- Humidity sensor (600-1211-001)
- Temperature sensor cable for UniversalXE (600-1212-001, 600-1213-001)
- Humidity sensor cable for UniversalXE (600-1214-001, 600-1215-001)
- Ball valve (600-1002-001)
- Guinea Pig Whole Body Plethysmograph chamber lid (600-2610-001)
- Guinea Pig Whole Body Plethysmograph chamber floor (600-2612-001)
- Water bottle with sipper tube for Rat or Guinea Pig (600-1003-001)
- Guinea Pig water bottle holder (600-1011-001)

# Operation

## Setup and Operation

**NOTE:** If using Validyne transducers (or equivalent), ensure the Validyne is secure and is not moved between calibration and measurement, else a baseline shift may result.

For usage of DSI chambers please refer to the following Getting Started Guides for detailed information on the usage of the chambers:

- DSI Mouse or Rat Head-out chambers : Respiratory Flow Derived Parameters
- DSI Mouse, Rat, or Guinea Pig Unrestrained Whole Body Plethysmograph Chamber: Respiratory DSI Whole Body Plethysmography

### DSI Head-Out Chambers Animal Loading Tips

- The neck seal gasket opening should be large enough that the animals head can pass through when stretched.
- The neck seal gasket opening should be small enough to close around the animals' neck such that air cannot pass around the neck but not so tight as to constrict the upper airway in the neck.
- The neck seal gasket opening can be trimmed to accommodate the animals' size.
- If possible cover the chamber so that it is darkened. Rodents tend to be more comfortable.
- When inserting the animal into the chamber angle the chamber so that the head is up. But not so steep that cannot crawl into the chamber.
- Pressure applied to the animal by the squeeze plate should be just enough to keep the animal from being able to retract its head from the chamber opening and maintain a seal around the neck.
- The animal's tail should align along the bottom of the chamber and through one of the opening in the squeeze plate.
- Excessive pressure resulting in a folding of the animals' abdomen can cause restrictive breathing pattern and animal discomfort. The folding of the animals' abdomen may not be avoided when using excessively small animals (chambers are designed for use with adult sized animals).

- Animals that cannot be easily placed into the chamber entrance should not be forced.

See also “Animal Acclimation” located in Appendix A.

### DSI Whole Body Chamber Animal Loading Tips

- Remove the top of the chamber.
- Gently place the animal inside the chamber.
- Replace the lid on the chamber and tighten both clasps of the chamber at the same time. This is to assure that the chamber lid secures evenly.
- Apply bias flow to the chamber.

## Maintenance and Cleaning

Hand wash with a mild dishwasher detergent and dry.

Do NOT use paper towels. Paper fibers act like a fine sand paper and cloud surfaces over time.

Do NOT submerge the unrestrained whole body chambers as this will cause moisture to contaminate the reference chamber.

Window cleaners that contain alcohol or ammonia can craze acrylic.

# Appendix A

## Specifications

**Rat Head-Out Chamber**

**Dimensions**

| | |
|---|---|
| Length | 12.5 inches (31.8 cm) |
| Width | 4 inches (10.2 cm) |
| Height | 4 inches (10.2 cm) |
| Volume | 76 cubic inches (1,245.42 cubic cm) |
| Weight | 2.4 lbs (1.1 kg) |

**Mouse Head-Out Chamber**

**Dimensions**

| | |
|---|---|
| Length | 10 inches (25.4 cm) |
| Width | 3 inches (7.6 cm) |
| Height | 2.75 inches (7 cm) |
| Volume | 4.8 cubic inches (78.66 cubic cm) |
| Weight | 0.4 lbs (0.2 kg) |

**Rat Unrestrained Whole Body Chamber**

**Overall Dimensions**

| | |
|---|---|
| Length | 10.5 inches (26.7 cm) |
| Width | 10.5 inches (26.7 cm) |
| Height | 12 inches (30.5 cm) |
| Weight | 7.8 lbs (3.5 kg) |

**Animal Chamber Dimensions**

| | |
|---|---|
| Width | 7.5 inches (19.1 cm) |
| Height | 5.5 inches (14 cm) |
| Volume | 245 cubic inches (4,014.83 cubic cm) |

**Mouse Unrestrained Whole Body Chamber**

**Overall Dimensions**

| | |
|---|---|
| Length | 9 inches (22.9 cm) |
| Width | 5 inches (12.7 cm) |
| Height | 6.75 inches (17.1 cm) |
| Weight | 2.9 lbs (1.34 kg) |

**Animal Chamber Dimensions**

| | |
|---|---|
| Width | 4.375 inches (11.1 cm) |
| Height | 3.75 inches (9.5 cm) |
| Volume | 54 cubic inches (924 cubic cm) |

**Guinea Pig Unrestrained Whole Body Chamber**

**Overall Dimensions**

| | |
|---|---|
| Length | 12.5 inches (31.8 cm) |
| Width | 12.5 inches (31.8 cm) |
| Height | 13.25 inches (33.7 cm) |
| Weight | 10.7 lbs (4.85 kg) |

**Animal Chamber Dimensions**

| | |
|---|---|
| Width | 9.5 inches (24.1 cm) |
| Height | 7.5 inches (19.1 cm) |
| Volume | 535 cubic inches (8767 cubic cm) |

# Troubleshooting

## Insufficient Screen Resistance

Inadequate screen resistance prevents a suitable differential pressure from being developed on the transducer, resulting in high noise and drift compared to the signal being measured.

Screen resistance that is set too high acts as an air flow restriction to the subject, resistance set too high can cause the subjects inhalation and exhalation to be labored.

It is recommended to use just one screen on the chamber pneumotachograph. Replacement screens are available in multi-screen packs.

- Pneumotachograph Screens (600-1000-001) for use with:
  - Rat Head-Out Chamber
  - Mouse Unrestrained Whole Body Chamber
  - Rat Unrestrained Whole Body Chamber

- Guinea Pig Unrestrained Whole Body Chamber

- Pneumotachograph Screens (600-1001-001) for use with:
  - Mouse Head-Out Chamber

## Compromised Neck Seal

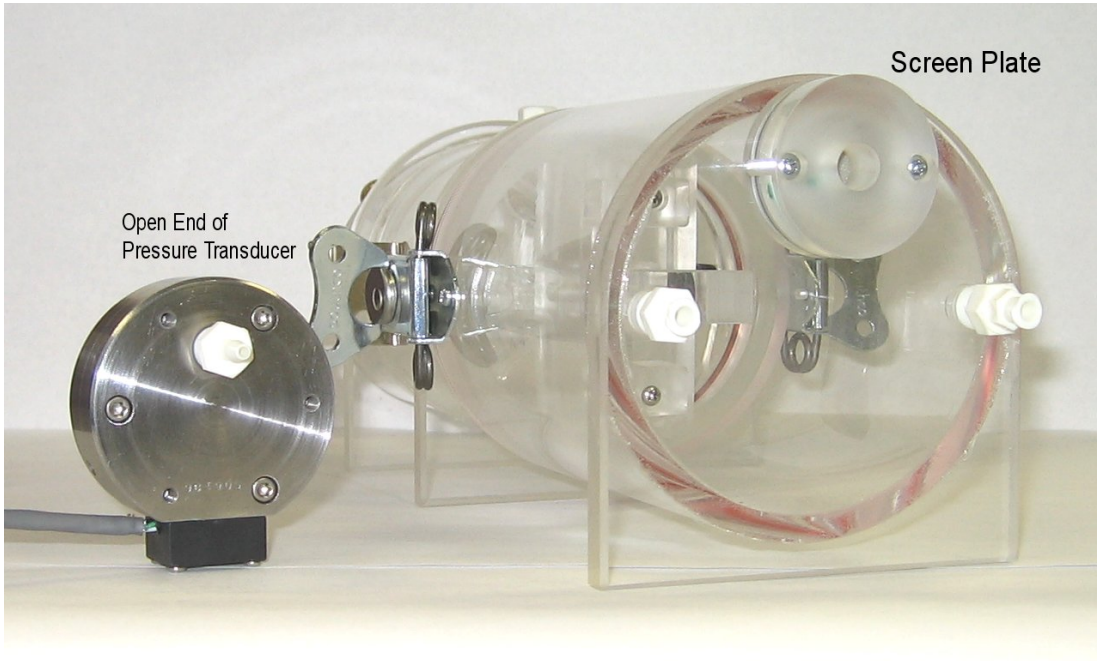
If gains are being set extremely high where noise and temp drift are causing major shifts in the signal, the neck seal may have become compromised. Also, if the signal volume drops out randomly, the neck seal may have become compromised. Replace the neck seal.

## Incorrect Gain Settings

If the gain is set too high and the signal is being clipped, the gain settings need to be adjusted. Also, the screen resistance and neck seal may need to be checked.

## Turbulent Air Flow

The plethysmograph chamber can be sensitive to external air flows, especially air passing across the screen plate or the open end of the pressure transducer. A constant draft across either of these parts will cause an offset to the input signal. Turbulent airflows across these parts can add noise to the input signals. If airflow is excessive input signals can be masked. Shielding these ports from external airflow is recommended. See picture below.




Rat Head-Out Plethysmograph Chamber with Validyne DP45 pressure transducer

## Animal Acclimation

In order to obtain the best quality data from the Head-Out Chambers it is recommended that the test subjects undergo acclimation training. The following is a for acclimation training:

- After receiving the animals and following 1 week general acclimation test subjects are allowed to explore the chamber without any restrain. This step is repeated 2-3 times for about 5 minutes each period.
- Next test subjects are placed in the chamber with an appropriate sized neck seal. Initial exposure is approximately 15 minutes in the chamber. This is repeated 3-5 times with each phase increasing in duration up to a maximum of approximately 2 hours.
- After each training session test subjects are rewarded with a special treat like cheese pellets or sunflower seeds.
- Note approximately one in ten rats will not acclimate to being placed in the chamber.

In order to obtain the best quality data from the whole body plethysmograph chambers it is recommended that the test subjects undergo acclimation training. The following is a for acclimation training:

- After receiving the animals and following 1 week general acclimation test subjects are allowed to explore the chamber with the lid off. This step is repeated 2-3 times for about 10 minutes each period.
- Next test subjects are placed in the chamber with the lid closed. NOTE: Unless using a bias flow generator, all ports on the lid and animal chamber should be open to allow for a sufficient source of fresh air. Initial exposure is approximately 15 minutes in the chamber. This is repeated 3-5 times with each phase increasing in duration up to a maximum of approximately 2 hours.
- After each training session test subjects are rewarded with a special treat like cheese pellets or sunflower seeds.

# Product Issue Report

## Product Issue Report Form

Sales Person: Issue:

Customer Name:
Company:
Address:

Phone Number:
Email Address:

P3 Plus Version (including Service Pack):
Serial Number:
Priority:
Date:
Hardware: Steps to Repeat

Status of issue (check one)
[] Unreproduced [] Reproduced
[] Needs repair [] As intended

Computer hardware/software
Brand/Model:
CPU Speed:
RAM:
Operating System (including Service Pack):

Networked
[] Yes [] No

# Feature Request

## Feature Request Form

Sales Person:

Description:

Customer Name:
Company:
Address:

Phone Number:
Email Address:

P3 Plus Version (including Service Pack):
Serial Number:
Priority:
Date:
Hardware:

Feature (check one)

[] Unevaluated [] Pending
[] Implement [] Already Exists