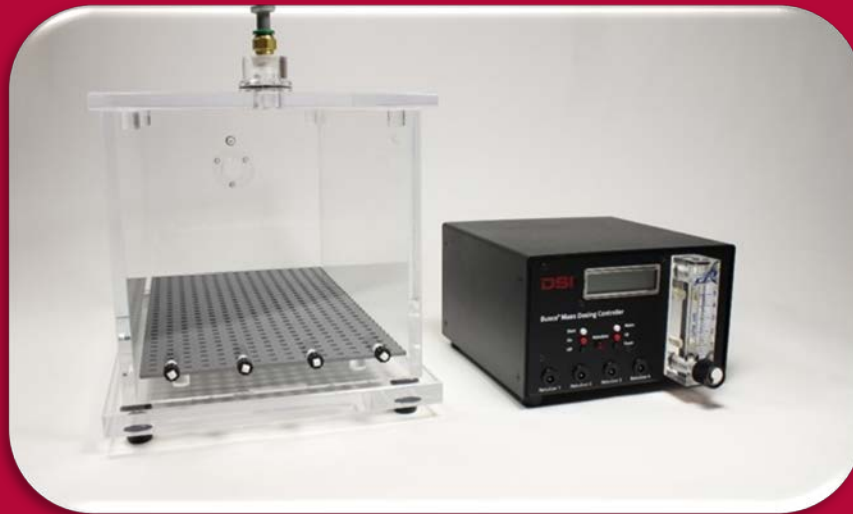


DSI Buxco® FinePointe™

Mass Dosing Application Guide



OVERVIEW

This manual highlights how DSI's Mass Dosing Controller interacts with a variety of exposure product solutions. This document will provide an overview of the system components, proper assembly, and basic operation.

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WELCOME

Congratulations on joining the community of users worldwide who rely on DSI's products to perform preclinical physiologic research. Thank you for your interest in DSI products. We are committed to providing you with quality products and services.

This manual will help you get to know your Mass Dosing System for small animals. The structure of the manual was designed to sequentially guide you through using your DSI system from set up to exposure.

WHAT YOU WILL BE LEARNING

1. Understand the Mass Dosing Chambers and their components.
2. Understand the different mass dosing control options and how to operate each.
 - a. DSI's Mass Dosing Controller
 - b. Aerogen Lab Nebulizer System
3. Proper care and cleaning techniques.

SCIENTIFIC BACKGROUND

The pretreatment of subjects with a drug, sensitizing agent, gas, or other compound is conveniently done using DSI's Mass Dosing system. Subjects are placed in a chamber and exposed to gas or aerosol for a desired period of time. The Mass Dosing system is particularly useful for exposures to proteins and other sticky substances.

A Mass Dosing chamber is a rectangular acrylic box with a flexible design that accommodates various types of aerosol and bias flow sources. A port on the lid is designed for an Aerogen Aeroneb® nebulizer. A port on one end accepts 22 mm aerosol fittings. Five Luer fittings are provided for other aerosol configurations, bias flow sources, and exhaust.

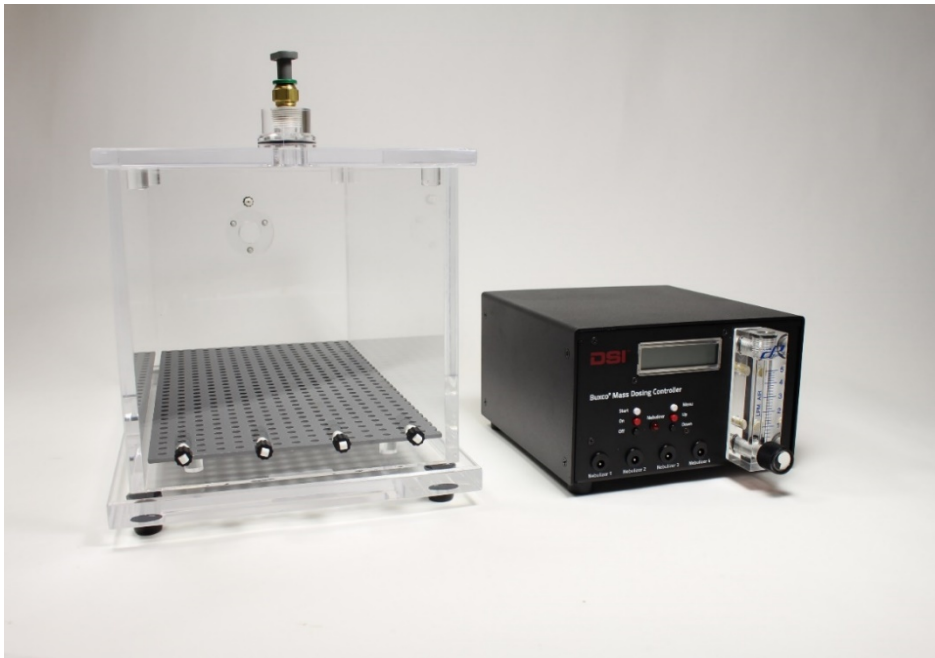


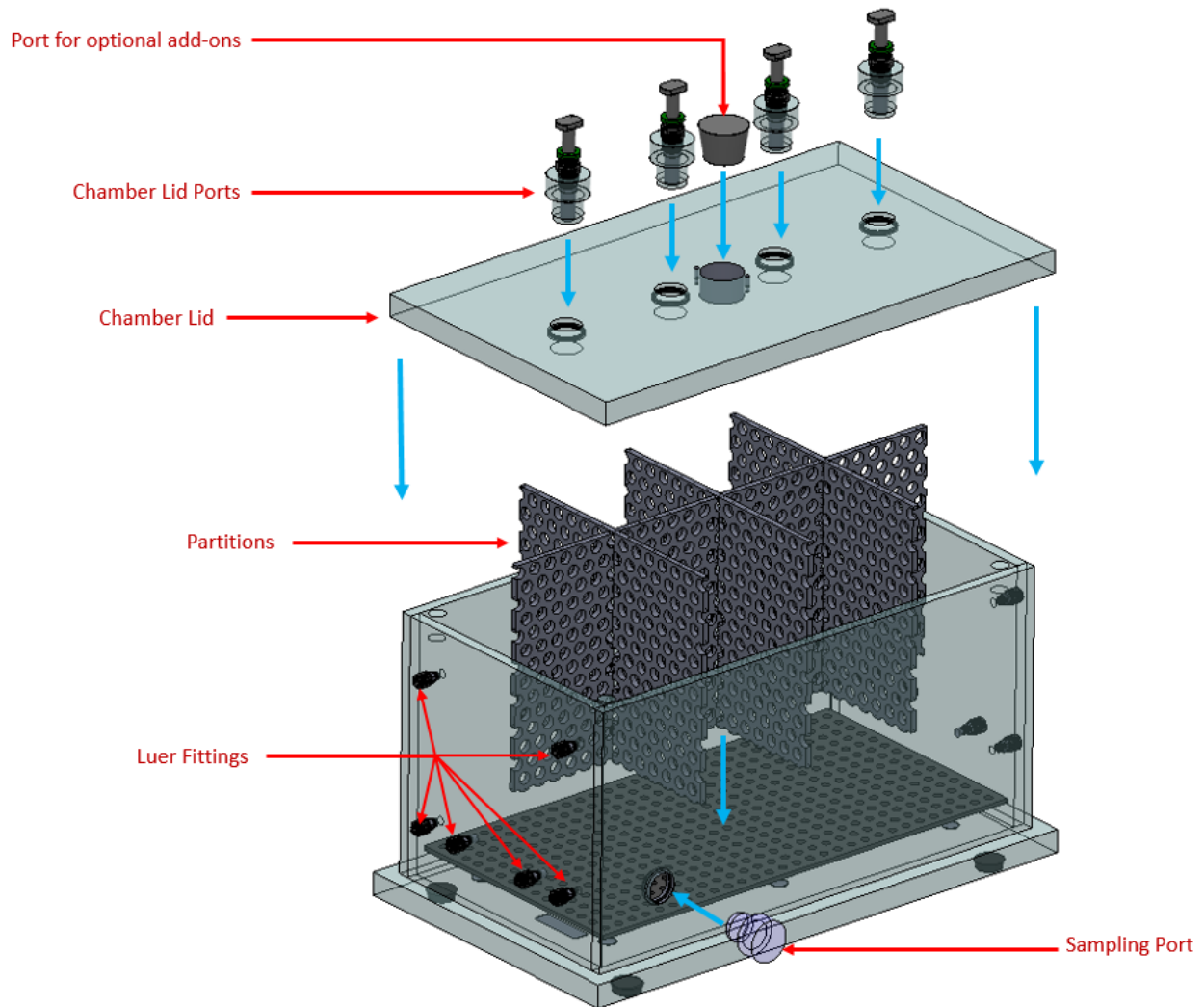
Figure 1. - Mass Dosing Chamber and Controller.

MASS DOSING CHAMBER COMPONENTS

DSI offers a Standard and Large Mass Dosing Chamber to accommodate the various numbers and sizes of subjects used for the exposure:

Chamber Type	Part Number	~Animal Capacity		
		Mouse	Rat	Guinea Pig
Standard	601-2039-001	15	6	2
Large	601-2036-001	25	10	4

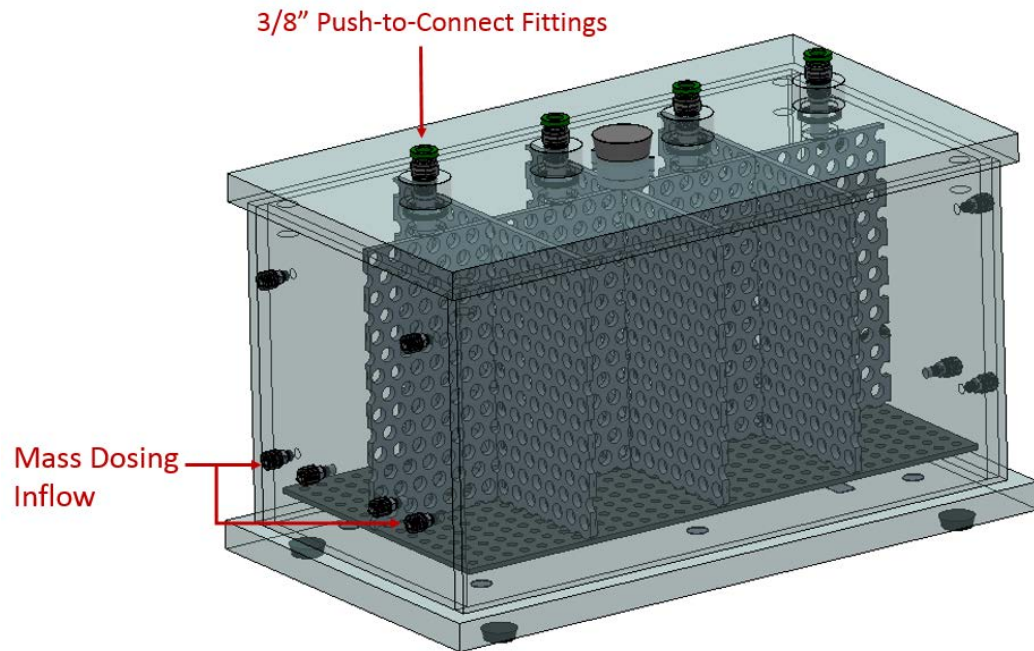
The following diagram outlines the various components and configurations of the chamber.



Mass Dosing Chamber with basic component labels.

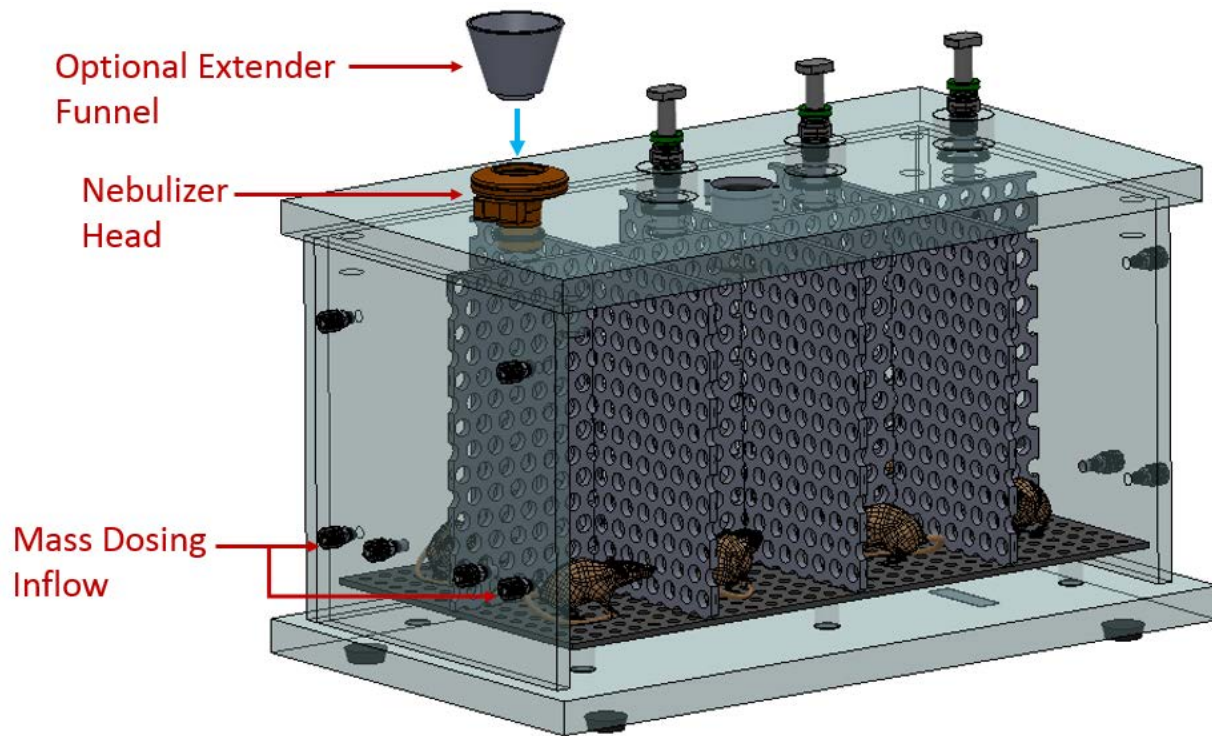
Component	Description
Chamber Lid Ports	The chamber lid ports can be plugged with the pieces seen here, which have push-to-connect fittings that accept 3/8 inch tubing, or nebulizer heads. See subsequent sections for more information on these configurations.
Chamber Lid	The chamber lid fits onto the chamber itself, and a gasket is supplied so that a tighter seal can be established. (Note: the Mass Dosing Chamber is not considered an airtight chamber, and is often used within a ventilation hood during exposures).
Partitions	The partitions are perforated plastic barriers that separate the animals. These can be removed if desired.
Luer Fittings	The luer fittings can be used for a variety of purposes. The chamber has six on either side for maximum flexibility. Most often, they are used to connect the Mass Dosing Controller for the purposes of providing fresh air to the chamber.
Sampling port	The sampling port is an optional piece that allows the user to connect a sampling device to one partition. Examples are a temperature/humidity probe or a photometer for in-line particle concentration. These configurations may require additional controllers or flow sources not described in this document.
Port for optional additions	This port at the top allows for optional components from DSI to be connected, such as the diffuser dryer, mixing plenum, or both. Subsequent sections will discuss these options.

CONFIGURATION FOR CONNECTION OF GAS OR SMOKE



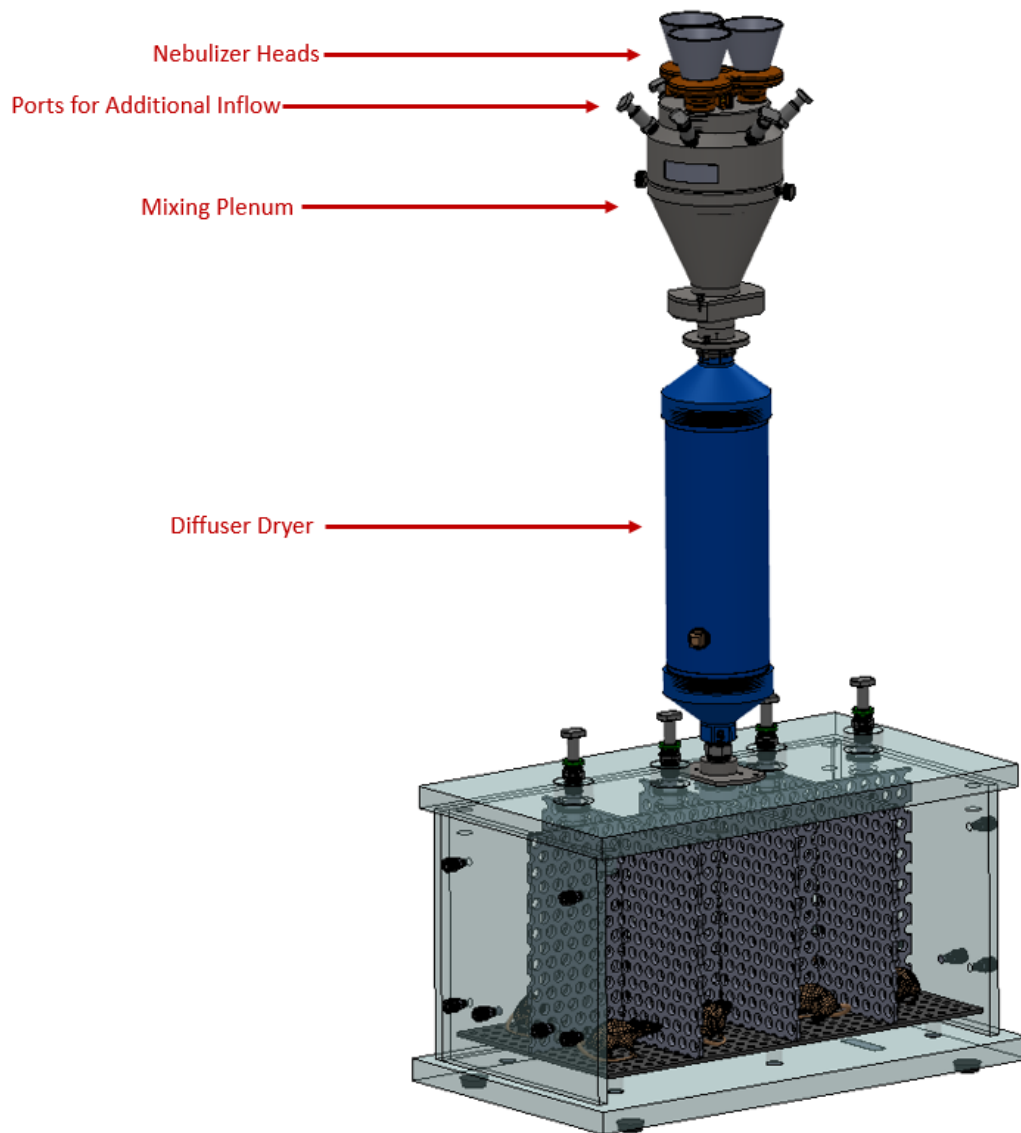
Component	Description
3/8" Push-to-Connect Fittings	These push-to-connect fittings accept 3/8 inch tubing which can connect to a variety of sources, such as the DSI Smoke Generator, Individual Cigarette Puff Generator, an external gas source, or others.
Mass Dosing Inflow	These four luer fittings are where the Mass Dosing Controller's Flow Output port connects. The opposite side of the chamber should have an equal number of these ports open for exhaust.

CONFIGURATION FOR NEBULIZATION OF LIQUIDS



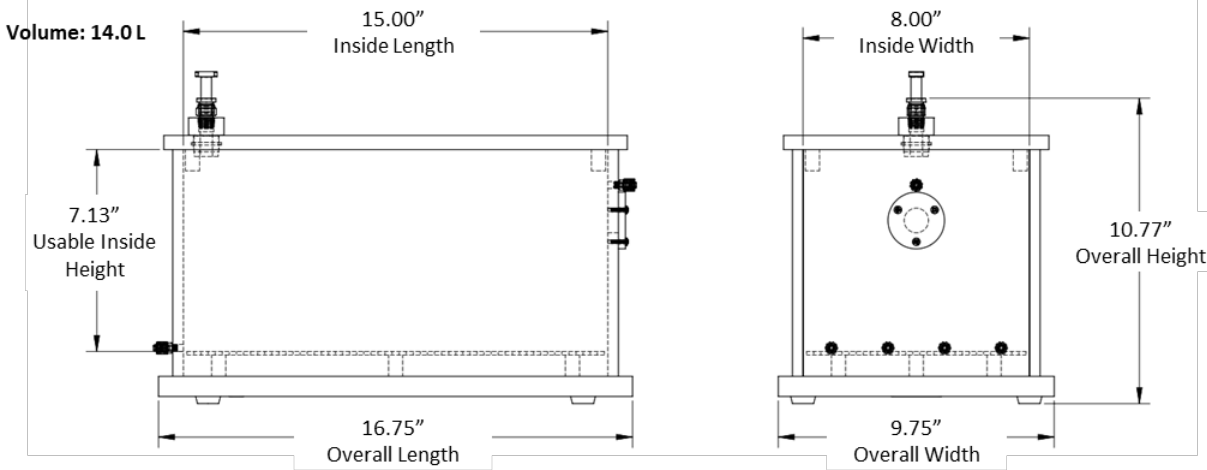
Component	Description
Nebulizer Head	DSI utilizes the Aerogen nebulizer head to generate liquid compound to a breathable aerosol. Up to four nebulizers can be connected to the chamber at a time, and each is connected to the Mass Dosing Controller's Nebulizer 1-4 jacks, or to their own Aerogen power supplies. Subsequent sections discuss these two options, as well as nebulizer head maintenance and care.
Optional Extender Funnel	This optional funnel piece can extend the total volume capacity of the nebulizer head from 10ml to 30ml.
Mass Dosing Inflow	These four luer fittings are where the Mass Dosing Controller's Flow Output port connects. The opposite side of the chamber should have an equal number of these ports open for exhaust.

CONFIGURATION FOR NEBULIZATION WITH MIXING AND DRYING

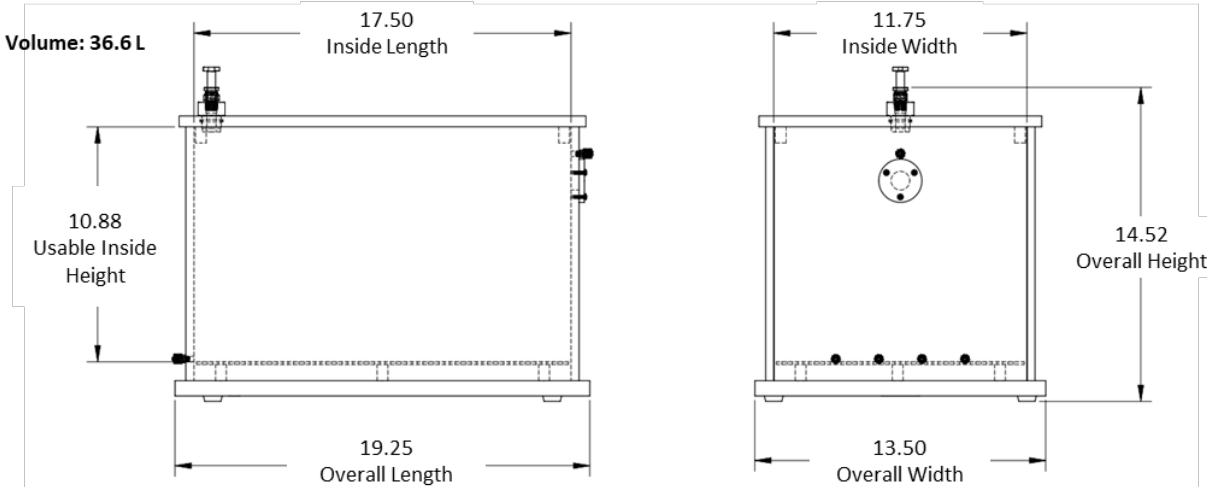


Component	Description
Nebulizer Head	DSI utilizes the Aerogen nebulizer head to generate liquid compound to a breathable aerosol.
Mixing Plenum	This optional piece provides space before the aerosol enters the mass dosing chamber, promoting mixing of the compound before dosing occurs.
Ports for additional inflow	The mixing plenum has six ports where inflow can be provided. This flow can be from the Mass Dosing Control, Inhalation Tower Controller, or any other source. This promotes mixing within the plenum and ensures that the compound flows into the chamber.
Diffuser Dryer	The diffuser dryer is filled with silica gel beads and dries the aerosol prior to it entering the mass dosing chamber. This creates smaller particle sizes and less humid conditions.

Standard Chamber Dimensions (inches):



Large Chamber Dimensions (inches):



MASS DOSING CONTROLLER OPTIONS

The DSI Mass Dosing Chambers may be used with either of the following options:

- DSI's Buxco Mass Dosing Controller
This option provides greater user control of the exposure as the controller provides a timer, rate control, and a bias flow source for long treatments.
- Aeroneb® Lab's Nebulizer System
This option nebulizes at 100% of the nebulizer head's capacity.

DSI'S MASS DOSING CONTROLLER (OPTION 1)

The Mass Dosing Controller provides a nebulization timer (0-99 minutes), nebulizer output rate control (0-100% of capacity), and a fresh air supply pump with an adjustable gauge. On the front panel is an LCD screen and a set of control buttons.

PART NUMBERS:

601-2075-001

MASS DOSING CONTROLLER FRONT PANEL

The front panel of the Mass Dosing Controller contains the following user interface elements for controlled exposure:

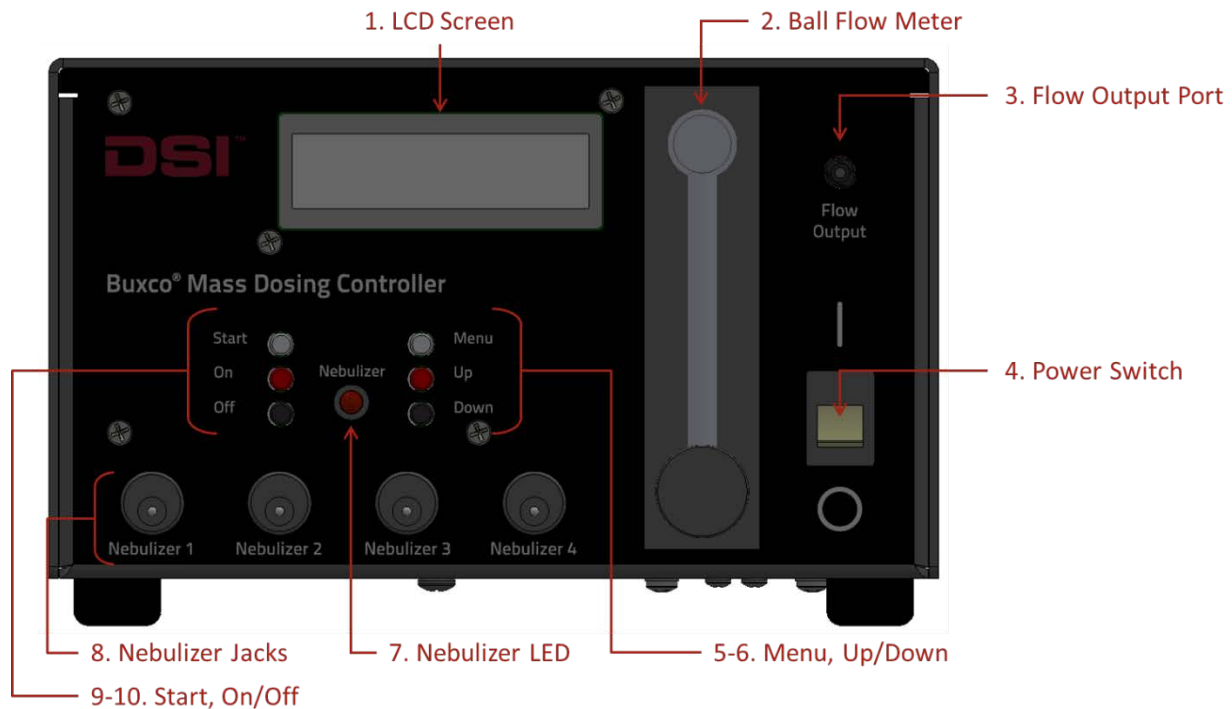


Figure 2. – DSI's Mass Dosing Controller with Front Panel labels.

1 – LCD Screen

Used to display menu items for Aerosol Duration and Duty Cycle percentage for user control of nebulization rate.

2 – Ball Flow Meter

Controls the flow rate of the fresh air pump.

3 – Flow Output Port

Provides bias flow air supply to the chamber. Connects to one of the Luer fittings on the chamber.

4 – Power Switch

Switches the Mass Dosing Controller power on and off.

5 – Menu Button

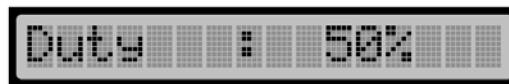
Cycles through the Aerosol and Duty menu selections.

- **Aerosol:** Sets the timing of the aerosolization period.



Aerosol duration range: 0 - 9.9 minutes (resolution of 0.1 minute), then 10 - 99 minutes (resolution of 1 minute).

- **Duty:** Controls the output of the aerosol by limiting the amount of time the nebulizer produces aerosol, per cycle. One cycle is 6 seconds or 0.1 minutes. 100% keeps the nebulizer on full time, all 6 seconds of each cycle. 50% will keep the nebulizer on 3 seconds, and then off 3 seconds during each cycle. In this way the flow is regulated.



Duty cycle percent range: 0-100% (resolution of 1%).

6 – Up/Down Buttons

Moves the currently displayed aerosol duration or duty cycle percentage up or down. Hold the buttons to get to the desired value more quickly.

7 – Nebulizer LED

Illuminated when the nebulizer is activated and producing aerosol.

8 – Nebulizer Jacks

The Aerogen Aeroneb Nebulizer Head gets connected to these jacks allowing the system to control the start, stop, and rate of nebulization based on the user defined Study protocol. Up to four Aerogen Aeroneb nebulizers may be attached to these ports to generate aerosol. The Mass Dosing Controller will run all four nebulizers for the same aerosol duration and at the same duty cycle percentage, as defined using the Controller's menu system.

9 – Start Button

Begins the aerosolization period, under timer control. The LCD display will provide a visual count down of time in 0.1 minute increments once the Start button is pressed.

10 – On/Off Buttons

The On button turns nebulizer on for aerosolization. The nebulizer will remain on until either the Off button is pressed (manual control) or the aerosol duration is achieved. The Off button will also turn the nebulizer off to manually override the aerosol duration timer control.

MASS DOSING CONTROLLER BACK PANEL

The back panel of the Mass Dosing Controller has the following connections:

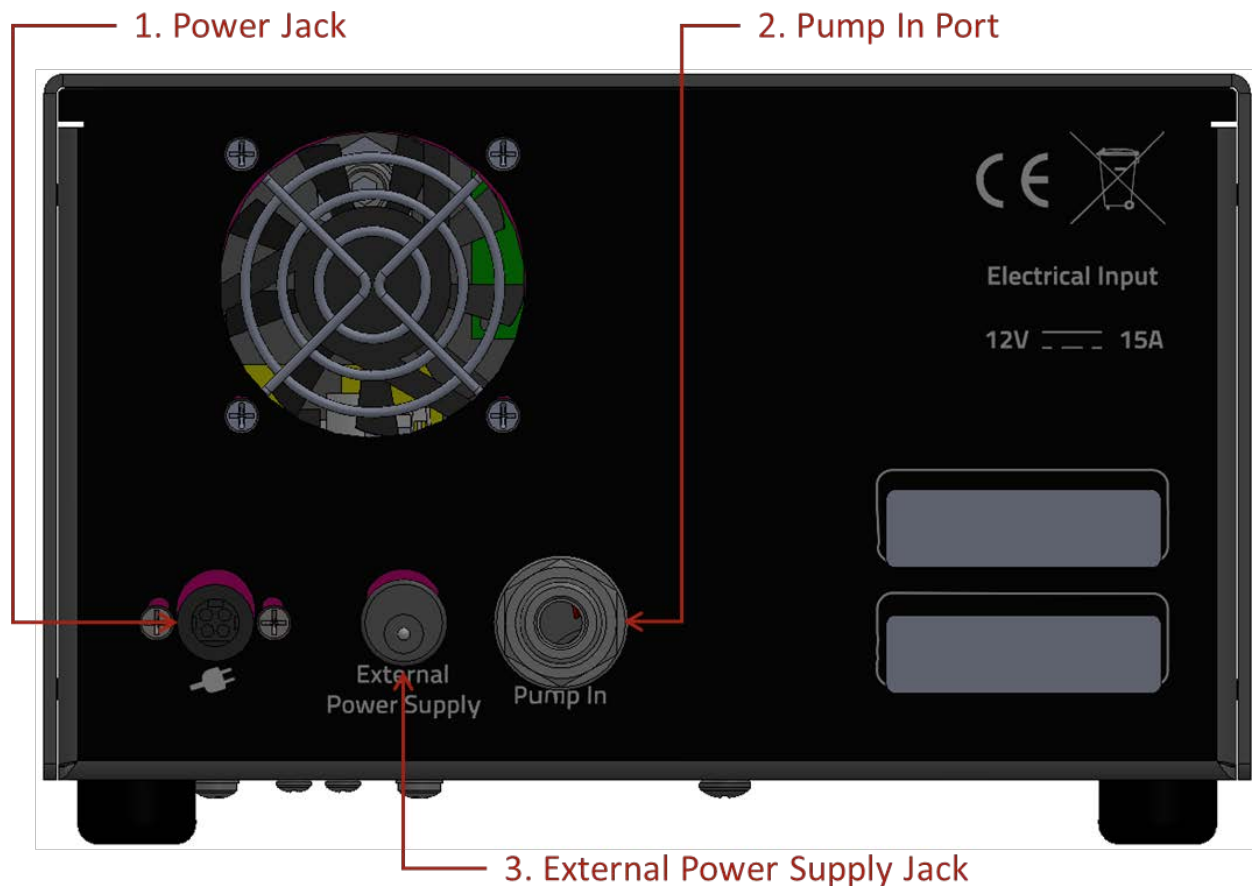


Figure 3. – DSI's Mass Dosing Controller with Rear Panel labels.

1 – Power Jack

This jack receives a plug from a 12V external power transformer.

2 – Pump In

Open to fresh air. This port must be kept open and unobstructed. Serves as the bias flow source for long treatments.

3 – External Power Supply

The power supply for (applicable) Aerogen Control Module. Earlier versions of the Aerogen Control Module (Rev B and earlier) can be plugged into the power supply connection. Newer versions of the Aerogen Control Module (Rev C and beyond) are not compatible and should not be used.

AERONEB LAB NEBULIZER SYSTEM (OPTION 2)

The Aeroneb Lab Nebulizer System includes the following components:

Nebulizer Head

The nebulizer head has a 10mL capacity. The nebulizer head is translucent to allow visual monitoring of nebulate levels and aerosolization. It consists of a cup, a piezoelectric element, and an aperture plate with holes. When energy is applied, the plate vibrates rapidly, creating a micro-pumping action that generates a fine particle aerosol.

Nebulizer Control Module (601-2308-001)

The nebulizer control module operates on a DC power source from a transformer plug. The module includes a cable that attaches to the nebulizer head and a receptacle for the DC adapter. On the module is an LED that indicates when the nebulizer is on. Newer modules also have an amber “fault light” that indicates a bad cord or other controller problem.



1-2. Power, Warning LEDs

Figure 4. – Aeroneb Lab Nebulizer and Controller.

1 – Green Power LED

When illuminated, indicates that power is supplied and that the unit is running.

2 – Amber Warning LED

When illuminated, indicates nebulizer is disconnected or faulty connection.

Note: Please see the Aeroneb Lab user manual for further information on this nebulizer and controller.

OPERATING INSTRUCTIONS

MASS DOSING CONTROLLER (OPTION 1)

This unit provides air flow to the Mass Dosing Chamber. Fresh air flow is controlled by a ball flow meter on the front panel of the Mass Dosing Controller. The front panel has an LCD screen and a set of control buttons. The controller provides a timer (0-99 minutes) and nebulizer output rate control (0-100% of capacity).



Figure 5. – DSI's Mass Dosing Controller

To operate:

1. Place Mass Dosing Chamber into a ventilation hood.
Note: The Mass Dosing Chamber is not a sealed box. It should always be used in a ventilated hood.
2. Insert the nebulizer head into the Mass Dosing Chamber's lid nebulizer port.
3. Attach the nebulizer cable to the nebulizer head and to one of the Nebulizer jacks on the front panel of the mass dosing controller.
4. Attach tubing from the Flow Output port on the front panel of the Mass Dosing Controller to one of the Luer fittings on the front of the Mass Dosing Chamber.
5. Connect the power source to the back panel of the Mass Dosing Controller.
6. Turn on the Mass Dosing Controller.
7. Set the desired Flow Rate using the Ball Flow Meter on the front panel of the Mass Dosing Controller.
8. Set the desired Aerosol Duration and Duty Cycle Percentage using the Menu button on the front panel of the Mass Dosing Controller.
9. Place animal(s) in the chamber and replace chamber lid.
10. Load compound into the Nebulizer.
See the **Delivering Aerosol** section for detailed information.
11. Press the Start button on the front panel of the Mass Dosing Controller.

Please see the **Care and Cleaning** section for instructions once exposure is complete.

AERONEB LAB NEBULIZER SYSTEM (OPTION 2)

The Aeroneb Lab Nebulizer System may be used for aerosol delivery instead of the DSI Mass Dosing Controller. When using the Aeroneb Lab's Nebulizer Controller, the nebulizer is either turned ON or OFF. When ON, it will nebulize at 100% of capacity.

Note: this set up does not provide a bias flow supply to the chambers.

If animals will be placed in the chamber for extended periods, a bias flow supply (available separately) should be provided for fresh air and cooling. One or more bias flow pumps can be connected to the Chamber's Luer fittings.

DSI offers the following Bias Flow options:

	DSI Part Number	Flow Rate Max per Bias Flow Port (LPM)
Small Animal	601-2001-001	2.5
Large Animal	601-2200-001 (200VAC)	20
	601-2200-002 (110VAC)	

To operate:

1. Place Mass Dosing Chamber into a ventilation hood.
Note: The Mass Dosing Chamber is not a sealed box. It should always be used in a ventilated hood.
2. Insert the nebulizer head into the Mass Dosing Chamber's lid nebulizer port.
3. Attach the nebulizer cable to the nebulizer head and to the Aerogen Control Module.
4. Connect the transformer plug to the Aerogen control module.
5. Attach tubing from the bias flow to one of the Luer fittings on the front of the Mass Dosing Chamber.
6. Open an unused port or Luer fitting for exhaust, when using a nebulizer and/or bias flow.
7. Load compound into the Nebulizer.
See the **Delivering Aerosol** section for detailed information.
8. Place animal(s) in the chamber and replace chamber lid.
9. When ready to begin nebulization, plug transformer into DC power source.
Note: When using the Aeroneb Lab Controller, the nebulizer is either turned ON at 100% capacity or OFF.
10. Unplug transformer to stop nebulization.

Please see the **Care and Cleaning** section for instructions once exposure is complete.

NEBULIZATION SUGGESTIONS

The nebulizer head has a 10mL capacity. Since this nebulizer uses every bit of compound, you can change the dosage by changing the volume of compound.

Nebulizer head output rate declines as the viscosity of a solution increases. DSI recommends using saline vehicle. Other compounds are used at your own risk. Contact DSI or Aerogen if you have any questions about viscosity.

NEBULIZER HEAD

The nebulizer head may be autoclaved and should be cleaned between each use. It consists of a cup, a piezoelectric element, and an aperture plate with holes. When energy is applied, the plate vibrates rapidly, creating a micro-pumping action that generates a fine particle aerosol. It is capable of aerosolizing a broad range of formulations, including solutions, suspensions, small molecules, and macromolecules.

DSI offers two different versions of nebulizer heads, one purple and one gold, pictured here.



Replacement part numbers:

- 601-2306-001: 2.5 to 4 μ m (purple) has a smaller particle size and a rate of approximately 100 μ L/min.
- 601-2307-001: 4 to 6 μ m (gold) has a larger particle size and a rate of approximately 300 μ L/min.

DELIVERING AEROSOL

DOSING

When loading the dose, carefully and slowly inject up to 10mL of the solution in the center of the nebulizer head. Do not touch the membrane with the pipette. Pipette or inject compound in. Use the white insert cap for larger doses.

BETWEEN DOSES

At the completion of aerosol doses, you may see one or several puffs of aerosol coming out of the nebulizer head. These final puffs usually indicate that aerosolization is complete. There is nothing wrong with this; it is the action of the membrane in the nebulizer head.

BETWEEN SUBJECTS

Between subjects, rinse the apparatus with water and dry it thoroughly.

If you are running several experiments a day, DSI recommends that you purchase an additional nebulizer head so that you can wash one set while running another experiment. A replacement nebulizer head may have different efficiency (flow rate) compared to the previous head.

CARE AND CLEANING

CLEANING THE CHAMBER

Clean animal chamber of debris as needed by wiping with a cloth or rinsing with warm water. For a more thorough cleaning, use warm water and a mild dish detergent. It is best to let the chambers thoroughly air dry. Be certain that no water remains in any ports or tubing. If required, dry with a cloth towel.

- **DO NOT USE WINDEX** or window cleaner to clean the chamber. Continued use of Windex will eventually crack the lucite material.
- **DO NOT** put the chamber in the dishwasher.
- **DO NOT** use alcohol-based cleansers.

CLEANING THE NEBULIZER HEAD

Clean the nebulizing equipment after each use. To clean the nebulizer head, remove it from the plethysmograph or aerosol block and rinse it in warm, soapy water. Let it soak for a few minutes. It can be submerged.

- **DO NOT** use a high-pressure water stream; let it run gently into the device.
- **DO NOT** touch the metal membrane or attempt to brush it, as this may cause damage, but do rinse it from both the top and the bottom
- **DO NOT** clean the head with alcohol. Alcohol will damage the metal membrane. It is best to use soapy water for all general cleaning.
- **DO NOT** leave the head attached to the chamber overnight after use.

CORRECT DRYING POSITION

To dry, shake off the excess water and wipe gently with a paper towel or Kimwipes®. Set the head on its **SIDE** in a dry place.



INCORRECT DRYING POSITION

Do **NOT** stand the head up or place it in any inline circuit while not in use. Trapped humidity may cause the metal membrane to discolor.



If stubborn proteins build up on the head, dissolve an Efferdent tablet in a glass of water. Filter the solution with a syringe filter. Nebulize for 10 minutes. Rinse thoroughly, pat gently with paper towels, and air dry.

If you have been using a pathogen and wish to decontaminate, disconnect the head from the power cord and autoclave it using the “flash” steam sterilization cycle, 134C for 4 minutes.

CAUTIONS

- To ensure uninterrupted operation of the Nebulizer, secure power and control module cables so they cannot become disconnected during treatment. Ensure all cables are routed safely.
- To ensure proper nebulization, maintain the nebulizer head in an upright position.
- To avoid mechanical or electrical damage, do not drop the nebulizer head or the control module.
- Do not use in the presence of devices generating high electromagnetic fields such as magnetic resonance imaging (MRI) equipment.
- Disconnect the nebulizer head from control module before cleaning.
- Do not immerse or autoclave the nebulizer control unit.
- Use only with components specified by Aerogen or DSI.
- Inspect all parts before use, and do not use if any parts are missing, cracked or damaged. In case of missing parts, malfunction or damage, contact your DSI representative.
- Do not use or store outside of specified environmental conditions.

TROUBLESHOOTING

TROUBLESHOOTING THE NEBULIZER HEAD

If an aerosol is not being produced, and the unit has been on for at least 1 minute, there may be a problem.

If a drop of liquid forms on the **bottom** of the micro-pump surface (the tiny dome shaped membrane in the center of the aerosol side of the nebulizer head), then it may fail to nebulize. Carefully dry the bottom surface with a paper towel by dabbing it.

Test the efficiency of the nebulizer head as follows:

1. Set the duty cycle to 100%.
2. Put 1 mL of H₂O in the nebulizer head. Do NOT use distilled water. Use water with ions such as tap water.
3. Start the aerosol manually and time how long it takes to nebulize.
 - a. For the gold neb heads, the rate should be close to 300 µL/min.
 - b. For the purple neb heads the rate should be close to 100 µL/min.
4. Proper care and cleaning of the nebulizer head may help extend the life of this consumable product.

If the pores in the Nebulizer are clogged, perform the following:

1. Remove the nebulizer head from the dosing chamber, but do not disconnect the cable (i.e., leave it in the operating condition).
2. Empty the nebulizer head and position it upside down so that the output is pointing upward.
3. With the duty cycle set to 100%, place 1 drop of water on the surface of the micropump membrane.
4. Turn on the Nebulizer and observe the drop of water. It should “sizzle” and eventually evaporate into the nebulizer head and get pushed back out as a puff of aerosol. This may take 20-25 seconds.
5. Repeat steps 3 and 4 several times.

Please call DSI Technical Support for further assistance.

TECHNICAL SUPPORT

DSI™ is available to help you with your questions and concerns. Should you hit a roadblock or need some additional training, please feel free to contact us. We are happy to help!

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DSI SUPPORT CENTER

<https://support.datasci.com/>

SCHEDULE A MEETING WITH SUPPORT

<https://go.oncehub.com/DSIScientificServices>

REFERENCES

Eckard Hamelmann and Erwin W. Gelfand, “Animal Models of Airway Sensitization,” from the Animal Models for Autoimmune and Inflammatory Disease chapter of Current Protocols in Immunology (1999) 15.18.1 - 15.18.13.

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