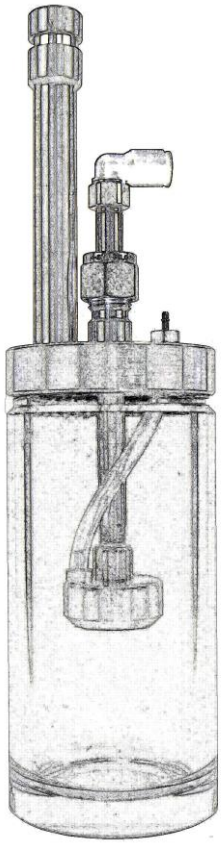
Blaustein Atomizer (BLAM)
Single-Jet Model



User's Manual

CH TECHNOLOGIES (USA)

CONTENTS

1. GENERAL DESCRIPTION AND SPECIFICATIONS

1.1. Introduction

The Blaustein Atomizer (BLAM) is a high output atomizer that uses the jet nebulization principle of the Collison Nebulizer, which has long been the recognized as the technique for the efficient aerosolization of various liquids. However, the BLAM relies on a new, patent pending design, which allows for a more efficient generation of aerosol than the Collison or other existing devices. This innovative design allows users to produce liquid aerosol at high particle concentrations and very narrow particle size distribution.

The BLAM is superbly suited to handle various liquid media, such as water based drug solutions, solvent based mixtures and biological test articles such as bacterial and viral suspensions. The single jet BLAM was specifically designed to provide bioaerosols with enhanced viability of pathogenic microorganisms for aerobiology research.

The particle size distribution of the aerosolized mist will depend on the nature of the liquid test article. However, for most solutions and suspensions, the BLAM will deliver a narrowly distributed mist that falls well within the respirable cutoff.

The BLAM features a modular design, composed of five interchangeable plates which enables it to perform the tasks of multiple nebulizers. By interchanging one or two parts, the atomizer can accommodate liquids of varying properties to produce aerosols in specific size ranges and output concentration.

The single-jet BLAM is used in one-pass mode, with the liquid feed being injected externally by a metering device. In Single Pass Atomization (SPA) mode the liquid medium is subjected to the sonic air jet only one time. The alternative design, a multi jet BLAM, can function in SPA mode or Multi Pass Atomization (MPA) mode where media is recirculated to the two or more sonic velocity air jets.

The BLAM is equipped with a vapor polished polycarbonate jar that is highly resistant to heat and mechanical stress, but at the same time allows a clear visual of the atomization process inside the device. As all other CH Technologies nebulizers, the BLAM outlet is equipped with a vertical Jaeger joint connector that is the standard connector of our inhalation systems. Other custom-designed connectors are available upon request.

The complete CHT BLAM is best used as an atomizer that interfaces directly to CH Technologies systems and equipment but with suitable modifications also adapts to other non-CHT equipment.

1.2. Specifications

- Particle diameter: Approximately 0.7-2.5 μm
- Models available: 1-jet
- Air flow rate: 1-4 L/min
- Operating Air Pressure: 20-100 psi
- Liquid Feed Rate: 0.1 – 6 ml/min
- Discharge: Vertical or Horizontal
- Material: Stainless Steel 316 (stem & plates) and Ploycarbonate (jar & head)

1.3. Mechanism of Operation

Knowledge of the mechanism of aerosol formation by the BLAM will help you in determining the aerosol characteristics as well as being useful for maintenance. The atomizing head at the end of the air supply stem is the key to aerosol formation. It is composed of two main parts: Nozzle Body and Expansion Plate (Figure 1).

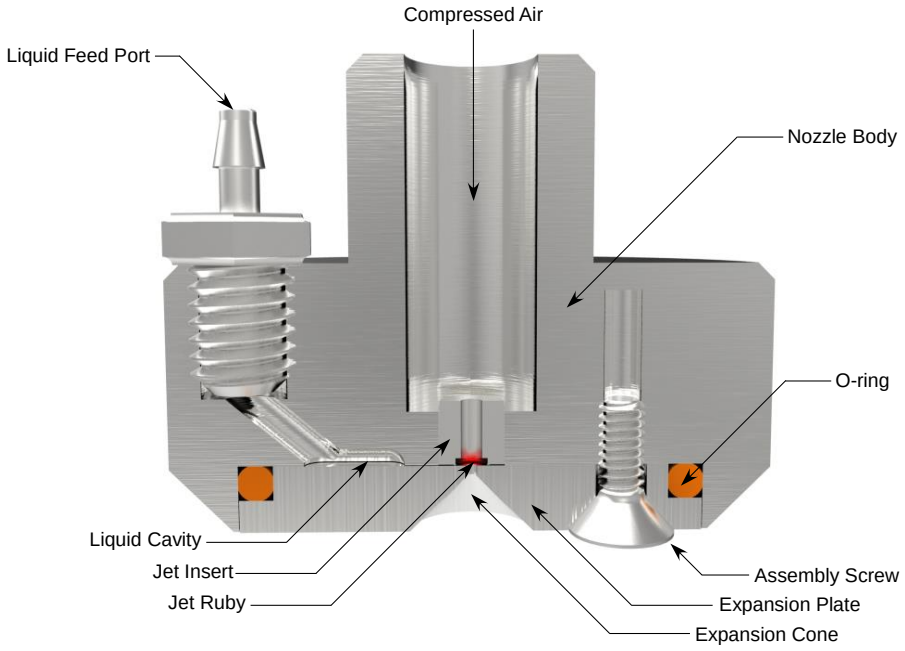


Figure 1. Components of Single Jet BLAM's Atomizing Nozzle

The atomization occurs when the pressurized air coming from the stem pushes at sonic velocity through a precisely laser cut ruby crystal pressed into the Nozzle Body. The jet is a 0.010" orifice through which pressurized air flows at a constant velocity. This process creates a powerful vacuum effect in the cavity (0.002" to 0.010" deep) between the Nozzle Body and Expansion Plate which drives the liquid from the liquid cavity to the

jets. The liquid then reaches a depression in the form of a well around the jet where is aspirated in and sheared into tiny droplets as the air expands after the jet. The liquid solution is pumped in at a controlled feed rate through the liquid feed port located on the rear of the Nozzle Body.

The aerosol generated by the atomization process is sprayed downwards and, after impacting the surface of the liquid inside the jar, it makes a 180° turn and it is forced up the outlet tube on top of the BLAM lid. During this process, larger droplets are collected on the liquid surface due to impaction as they cannot make the U-turn. The end result is a very fine mist, well within the respirable range and with narrow size distribution.

The properties of the aerosol generated by the single-jet BLAM are a function of the jet hole size, depth of the liquid cavity and expansion cone size. The standard single-jet BLAM is equipped with a fixed size 0.010" diameter laser cut ruby which guaranties long lasting precision in the atomization process. For specific applications, the BLAM can be fitted with other non-standard jet hole sizes.

The single-jet BLAM comes with a standard set of five Expansion Plates with the following liquid cavity depths and expansion cone diameters:

Plate ID	Cavity Depth (inch)	Cone Diameter (inch)
1-10	0.001	0.020
1-30	0.001	0.030
4-30	0.004	0.030
4-40	0.004	0.040
10-40	0.010	0.040

The cavity depth and cone diameter values are etched on each plate to singularly identify them. The various liquid film thickness controlled by the cavity depths of the plates allow for the use of mixtures having different viscosities and solid contents. Furthermore, shearing of thinner liquid films by the jet will result in finer aerosol droplets and vice versa. Various expansion cone diameters combined with various cavity depths provide a fine control on the output of the device and particle size distribution of the aerosol.

See Appendices 1 and 4 for an overview of parts and accessories of the single-jet BLAM.

2. BLAM OPERATION

2.1. Unpacking the BLAM

Your single-jet BLAM and accessories come in a convenient carrying case. When you receive your single-jet BLAM, you should unpack it carefully and check to make certain that the following parts are all present and in undamaged condition:

- The BLAM assembly as seen in Appendix 1

- Box of accessories containing:
  - 4 expansion plates (plate 1-10 is pre-assembled on the nozzle by default)
  - 6 spare expansion plate mounting screws
  - Allen wrench for the nozzle screws
  - 2 spare nozzle O-ring

- Black plastic case

Your BLAM may vary slightly in appearance depending upon the type of discharge (vertical vs. horizontal) and fittings you requested. Appendix 3 shows photographs of single-jet BLAMs with vertical and horizontal discharge configuration. An overview of all parts and accessories of the Single-jet BLAM complete kit is given in Appendix 4. Any changes from the standard pieces listed above will be noted on your shipping memo. PLEASE KEEP YOUR SHIPPING MEMO FOR FUTURE REFERENCE. If you find that anything has been damaged in transit, contact the carrier of the shipment immediately in addition to CH Technologies.

2.2. Initial Testing

After unpacking, you should immediately check the operation of the device. Your BLAM comes fully assembled so it ready to be used for a performance check. Follow the steps outlined in Section 2.3.1. to set up and operate the device. Use ONLY distilled water for initial testing.

When the air source is turned on, mist should appear at the aerosol outlet as shown in Figure 2. If mist does not appear, recheck all your fittings and make sure that jar is screwed in tight. The operation of the BLAM depends upon it being a completely sealed unit.

Perform a visual inspection of the jet operation and make sure that none of them appears to be aerosolizing less than others or not at all. All the jets are identical and should perform exactly the same.

2.3. BLAM Operation Procedures

2.3.1. Running the BLAM

Your single-jet BLAM comes already preassembled and ready to run by simply connecting it to a regulated air source and liquid feed metering device.

Follow these steps to run the single-jet BLAM:

1. Remove the BLAM jar

2. Check the silicon tubing that connects the liquid feed port on the nozzle with the liquid feed bulkhead on the lid and make sure that is not loose

3. Fill the jar with about 20-30 ml of test solution and reassemble it into the lid. Make sure that the assembly is air tight.

   ATTENTION! DO NOT fill the jar excessively. The solution in it serves only the purpose of a soft impaction surface for the aerosol and it will not be used for atomization.

4. If you will use a syringe pump for feeding the BLAM, fill the syringe with the predetermined amount of test solution and place it in the pump. Use a syringe large enough so that the BLAM does not run out of liquid before the atomization session is up.

5. If you are using a low flow peristaltic pump instead, fill a glass beaker with the predetermined amount of liquid and dip the inlet end of the pump's tube in it. If your test article is a solution containing pathogens, make sure that the container is properly sealed (with a ventilation hole on the lid).

6. Using a piece of thin silicon tube, connect the outlet of the syringe or low flow peristaltic pump to the BLAM's liquid feed port

   ATTENTION! Make sure that all the connections between the liquid feed pump and the BLAM are air tight.

7. Using a ¼" OD tube, connect a compressed air line to the air inlet of the BLAM. Use polyurethane tubing or one that that can withstand the pressure used. BLAM's air inlet is equipped with a standard ¼" push-to-connect fitting so the air line can be connected by simply pushing the tubing in. If you BLAM comes with non-standard fittings, use appropriate couplers to connect the air line to the atomizer. If you are not using any of CH Technologies system control units, make sure that the compressed air line is equipped with appropriate pressure and flow controllers. An illustration of a standard setup of the single-jet BLAM is given in Figure 2.

8. Connect the BLAM outlet to your system or application using appropriate fittings. Make allowance for dilution of the aerosol outflow if desired.

9. Turn ON the liquid feed pump and adjust the feed rate as desired

10. When the liquid reaches the liquid feed port of the BLAM, turn ON compressed air supply to the device.

11. Using your flow controller, adjust the air flow at about 2 L/min. If you need more output, increase first the upstream pressure of the compressed air line and then increase air flow rate to the atomizer.

ATTENTION! DO NOT exceed 90 psi upstream pressure!

12. When the atomization process is up, turn OFF the liquid feed pump and, in quick sequence, shut down compressed air supply to the atomizer

13. Remove the liquid feed tube from the liquid feed port on the lid

14. Remove the compressed air line from the BLAM's air inlet

15. Take the atomizer for cleaning/decontamination

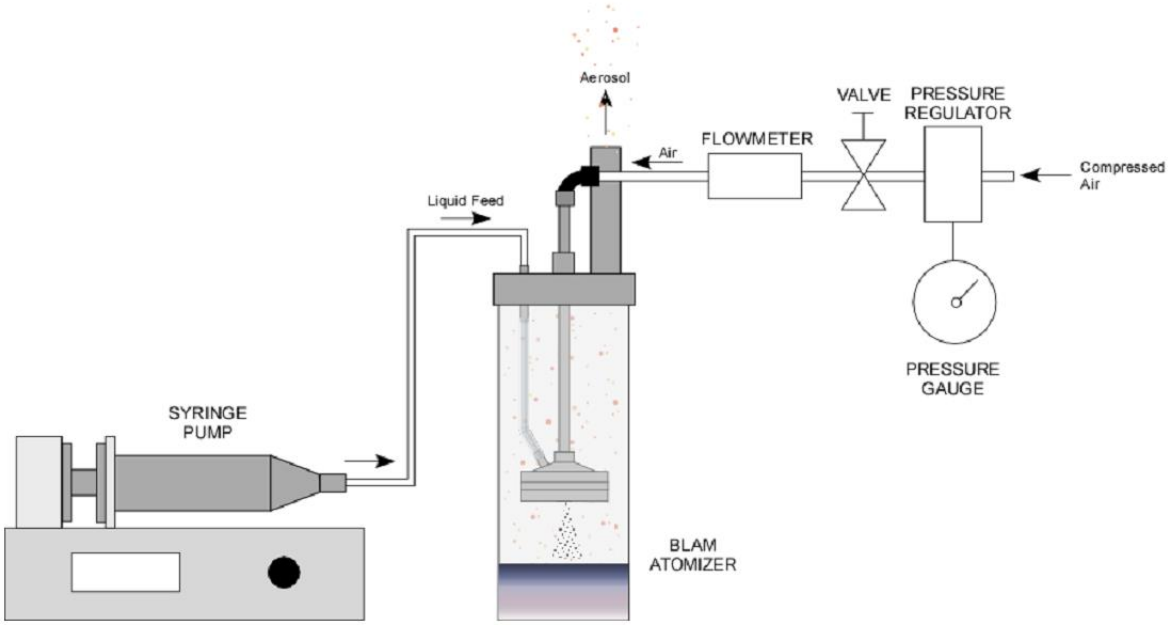


Figure 2. Schematic of Single-Jet BLAM's Setup

2.3.2. Changing BLAM's Expansion Plates

Your single-jet BLAM comes preassembled with a 1-10 plate. Depending on the nature of liquid to be aerosolized and desired characteristics of the aerosol, you might need to replace the default plate with another one from the accessories kit. As a general guidance, use plates with a larger cavity depth and expansion cone diameter to handle more viscous liquid and/or to obtain larger droplet size.

Follow these steps to change BLAM plates:

1. Remove the jar from the BLAM lid

2. Flip the stem so that the expansion plate of the nozzle faces up

3. Using the provided allen wrench, remove the three assembly screws

4. Remove the expansion plate

5. Select the appropriate expansion plate from the accessories kit and place it onto the O-ring so that the ID numbers etched on the face of the plate are opposite the liquid feed channel (Figure 3). This will confirm the liquid feed channels of the two parts are aligned.

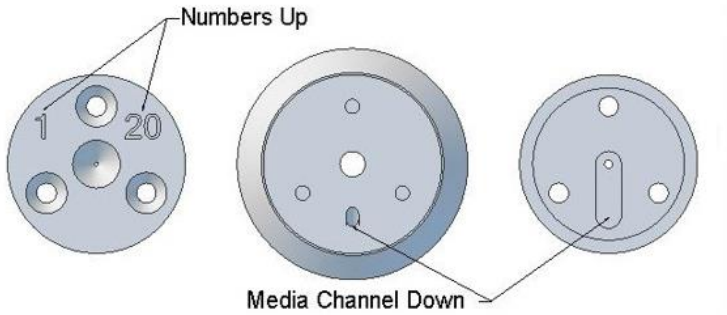


Figure 3. Positioning of the Expansion Plate on Nozzle Body

6. Secure the plate on the nozzle body using the three assembly screws. If necessary, use a tiny rod to align the holes. Tighten the screws with the supplied allen wrench in a circular pattern.

ATTENTION! Tighten the screws in two stages, first slightly tight and then snug. Make it leak free but do not over tighten.

7. Re-assemble the jar into the lid. Your BLAM is ready to be used the newly assembled expansion plate

2.4. Cleaning/Decontaminating Procedures

Your BLAM should perform indefinitely if it is cleaned and maintained properly. The device should be cleaned after each use.

If you are using your BLAM with any aqueous solutions that contain no pathogens, cleaning with a mild soap solution in warm water is generally adequate. Depending on the test article used, special solvents may be used in certain cases. Be sure that the O-rings are compatible with any solvents used. Special chemical resistant O-rings are available from CH Technologies if needed. Distilled water is a good choice for the final rinse; warm tap water may work also. You must judge the success of your cleaning/rinsing with your own QA/QC wipe tests or similar assessments. The cleaned BLAM parts should be allowed to air dry or they may be dried with warm forced air.

If your tests involve atomization of viscous suspensions or you are switching from one test article to another, an additional step is needed to make sure that the jets are freed from any occlusion from solids that may dry inside the nozzle and/or the nozzle is free from any residuals that may cause cross contamination. To do this, after cleaning the parts externally, feel the jar with few milliliters of water and run the BLAM for a few minutes in MPA mode. As clean water is atomized, it washes the cavities inside the nozzle and the jet holes.

WARNING! Whether you are using the BLAM in SPA or MPA mode, always replace the internal liquid aspiration/feeding tube during the cleaning/decontamination process when you switch from one test article to another to avoid potential cross-contamination.

Autoclaving can be used to decontaminate the BLAM parts if the device is used with pathogenic test articles. If you opt for autoclaving, you should first contact CH Technologies in order to establish appropriate guidelines for cleaning under high temperature and pressure.

WARNING! If autoclaving or decontamination with corrosive chemicals is not carried out properly, it may cause mechanical damage and/or chemical corrosion to various BLAM parts.

The O-ring in the BLAM's lid should be inspected during each cleaning. The slightest tear or cut on the O-ring will result in an inappropriate sealing of the device and may result in leaking of the test article into the air. The O-ring should be changed at frequent intervals because it may deteriorate with time.

2.5. Nozzle Maintenance and Adjustment

To make sure that the BLAM performs consistently over long periods of time, the nozzle should be serviced periodically. The frequency of the service will depend on the usage intensity and type of test articles utilized. The maintenance procedure of the nozzle is the following:

1. Remove the nozzle from the air stem using appropriate wrenches
2. Remove the liquid feed barb fitting from the nozzle body
3. Use the provided allen wrench to remove the three screws that hold the expansion plate
4. Remove the expansion plate and lay it down on a clean work surface
5. Remove and carefully inspect the O-ring that seal the expansion plate against the nozzle body (refer to Figure 1 for details). If it show signs of damage, replace it a spare O-ring from the accessories kit supplied with the BLAM.
6. Visually inspect the jet hole against a light source and observe if there is any visible occlusion present in it. If the jet hole is clogged, place the nozzle body in an ultrasonic bath with distilled water for about 30 minutes.
7. Wash the expansion plate and nozzle body with a mild soap solutions and rinse them well with tap or distilled water
8. After the parts have dried, place the O-ring back on the nozzle body and reassemble the nozzle
9. Apply some Teflon tape on the threads of the air stem and thread the nozzle using appropriate wrenches

WARNING! If the BLAM has been used with pathogenic test articles, any servicing of the nozzle should take place after the device has been properly decontaminated or autoclaved.

3. DISCLAIMER

The BLAM Atomizer is subject to all the terms of CH Technologies (USA) standard limited warranty. The BLAM is a specialized article of research equipment intended for use by trained professionals. No liability is accepted by CH Technologies (USA) on account of misuse, misapplication or mishandling. CH Technologies (USA) specifically does not condone nor endorse any application or use which involves restricting emissions from the device and thus causing pressurizing of the jar. Further, CH Technologies (USA) accepts no liability for exposure to toxic, infectious or harmful substances resulting from the use of this apparatus.

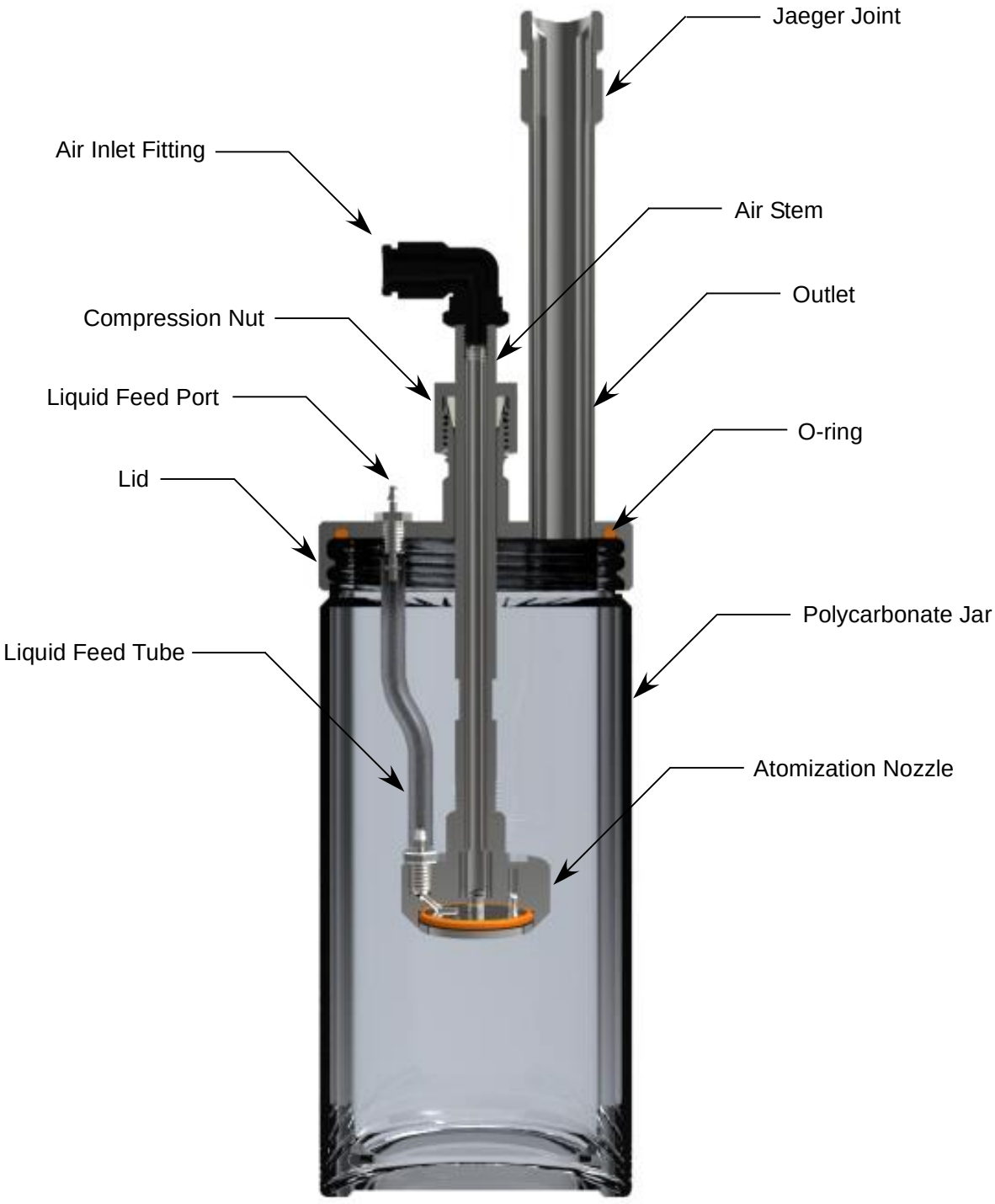
4. LIMITED WARRANTY

CH Technologies (USA) warrants equipment of its manufacture to be free from defects in workmanship and material. We make no warranty, express or implied, except as set forth herein.
CH Technologies (USA)'s liability under this warranty extends for a period of one (1) year from the date of shipment. It is expressly limited to repairing or replacing at the factory during this period and at CH Technologies (USA)'s option, any device or part which shall within one year of delivery to the original purchaser, be returned to the factory, transportation prepaid and which on examination shall in fact be proved defecting. CH Technologies (USA) assumes no liability for consequential damages of any kind. The purchaser, by acceptance of this equipment, shall assume all liability for consequences of its misuse by the purchaser, his employees or others. This warranty will be void if the equipment is not handled, installed, or operated in accordance with our instructions. If damage occurs during transportation to the purchaser, CH Technologies (USA) must be notified immediately upon arrival of the equipment.

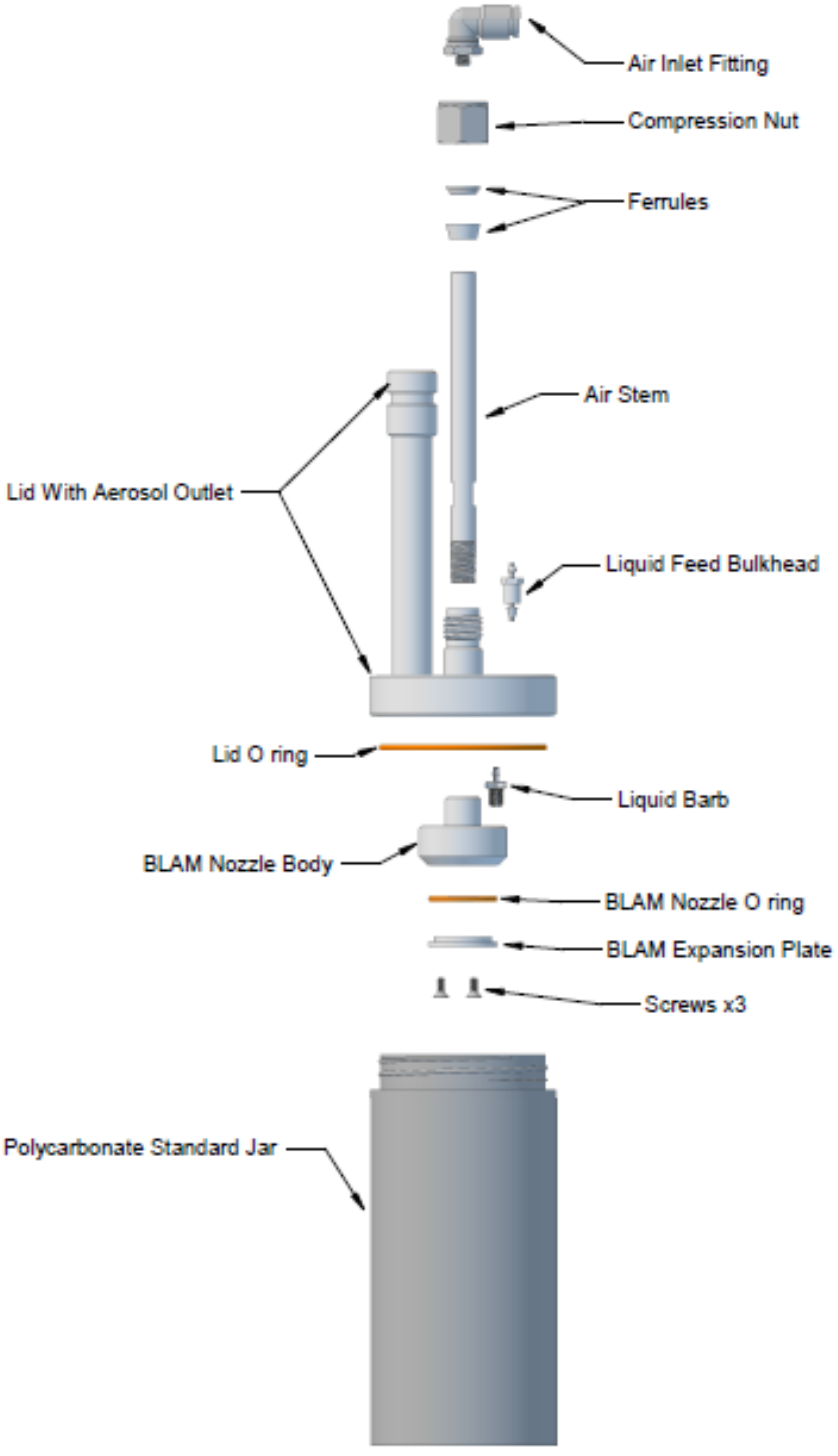
A defective part in the meaning of this warranty shall not, when such part is capable of being repaired or replaced, constitute a reason for considering the complete equipment defective. Acknowledgment and approval must be received from CH Technologies (USA) prior to returning parts or equipment for credit.

No representative of ours has authority to change or modify this warranty in any respect.

Appendix 1. Overview of the Single-Jet BLAM Assembly



Appendix 2. Single-Jet BLAM's Exploded Diagram



Appendix 3. Views of the Single-Jet BLAM

Vertical Discharge BLAM

Horizontal Discharge BLAM

Appendix 4. View of the Single-Jet BLAM Complete Kit

Appendix 5. Single-Jet BLAM's Air Flow Rate Calibration Chart