

Resodyn

ACOUSTIC MIXERS



LabRAM II*
Spray System
Installation and
Users' Manual

* Including LabRAM II, and PharmaRAM II Models

<i>Purchase and Installation Information</i>	

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1 Introduction

The LabRAM II Spray System integrates liquid metering components with an innovative, low-frequency, acoustic mixer, the LabRAM II. The patented, enabling technology, **ResonantAcoustic[®] Mixing (RAM)**, is a groundbreaking approach to multiple mixing applications.

RAM is distinctly different from conventional mixing methods such as impeller agitation and diffusion blending. Conventional methods work by producing bulk fluid flow in a mixture with restricted mixing zones. RAM mixing is based on using acoustic energy to mix liquids, slurries, and powders rapidly, efficiently, and thoroughly. Please refer to the Users' Manual provided with your LabRAM II or LabRAM II mixer for more detailed information about ResonantAcoustic[®] mixing or visit www.resodynmixers.com.

This manual will provide vital information to properly perform the following:

- Safely operate your LabRAM II Spray System
- Understand the major components of your LabRAM II Spray System
- Understand power requirements
- Set up the LabRAM II Spray System equipment
- Operate the LabRAM II Spray System equipment
- Clean and maintain the equipment
- Schedule equipment service and perform scheduled maintenance
- Obtain additional accessories or replacement parts

The LabRAM II Spray System is supplied with a fixture to hold either a 16 fl oz (0.47 liters) or a 32 fl oz (0.95 liters) mixing vessel that is 3.5" (8.9 cm) in diameter and 4" or 8" in height (10.2 cm). The system is equipped with an interlock safety switch to ensure that the LabRAM II's acrylic cover is in the correct position before and during operation.

The LabRAM II Spray System is designed for use in non-hazardous environments.

Not covered in this manual are:

- Use of RAMWare or **RAMware²**
- Repair of the LabRAM II mixer

2 Definitions

Acceleration:	A change in velocity with respect to time that is expressed in “g.” Different mix media mixes at different accelerations, based on the material and the expected results,
ATEX:	European Union (EU) directives describing what equipment and work environment is allowed in an area with an explosive atmosphere. LabRAM II Spray System is designed for non-hazardous environments.
Damping:	A term to quantify the instantaneous amount of energy absorbed by the mix media while mixing.
g:	A measure of acceleration expressed as a multiple of the gravitational acceleration applied to the vessel and mix media during mixing. For example, 10 g is 10 times the force of gravity. It may also be shown as g or g’s. Another term that may be used to describe the acceleration is “gravities.”
HMI:	Human Machine Interface control and input system screen used to operate the LabRAM II.
Headspace:	The volume of compressible air, gas, or void space above the fluid in the vessel that is not occupied by the Mix Media.
Mixing Media:	Defined as the material inside the mixing vessel.
Mixing Power:	The amount of power being delivered by the RAM system to perform mixing.
Mixing Regime:	This term identifies certain modes of mixing. For example, a fluid will change regimes as it undergoes changes in acceleration, from an incompressible liquid containing few headspace bubbles, to a fluid that is fully integrated with the compressible headspace such that the two are indistinguishable from each other.
RAM:	ResonantAcoustic® Mixing or ResonantAcoustic® Mixer.
RAMWare ² :	Control software that runs on a Personal Computer (PC) and provides control to, and feedback from, the mixing process
Resonance:	The frequency (nominally 60 Hz) at which the system operates in the most efficient manner.
Vacuum:	Internal vessel pressure that is less than atmospheric pressure.

3 Safety Information

Every effort has been made to assure that the LabRAM II Spray System is easy to use, reliable, and safe. This section outlines the general safety considerations and highlights important information with caution and warning symbols used throughout this document.

3.1 General Safety and Assembly Considerations

For safe operation, the LabRAM II Spray System should be operated only within the limits outlined in the system specifications. Specifically, the following classification defines acceptable use and conditions for the LabRAM II Spray System:

- Indoor use only.
- Main supply voltage fluctuations are not to exceed $\pm 10\%$ of the nominal supply voltage.
- Suitable for intermittent or continuous operation.
- For use in non-hazardous environments as classified by the United States National Electrical Code (NEC) Class and Division and **AT**mospheres **EX**plosibles (ATEX) directive for European Union countries.

For thorough and critical installation information, make sure to access, download, and carefully review the documents provided by the component manufactures of the LabRAM II Spray System.

For safe operation of the Spray System Components, carefully observe and follow these component instructions:

Ultrasonic Atomizer Nozzle Generator¹:

Read the instructions in the Ultrasonic Atomizer Nozzle Generator Operating Manual.

KDS Legato 100 Series syringe pump²:

Read the instructions in the KDS Legato 100 Series User's Manual.

Masterflex L/S 07528-20 Precision Variable Speed Console Drive³:

Read the instructions in the Masterflex L/S Operating Manual.

Masterflex L/S PTFE Tubing Pump, Model 77390-00⁴:

Read the instructions in the Masterflex L/S PTFE Tubing Pump, Model 77390-00 Operating Manual.

¹ See the Ultrasonic Atomizer Nozzle Generator information available at

http://www..com/Ultrasonic_Generator.html

² See the KDS Legato 100 Series User's Manual available at

<http://www.kdscientific.com/downloads/KDS%20Literature/Manuals/Legato%20100%20Manual%20Rev%200D%20.pdf>

³ See the Masterflex L/S Operating Manual available at




http://www.coleparmer.com/Assets/manual_pdfs/07528-10,%20-20,%20-30%20ENGLISH.pdf

⁴ See the Masterflex L/S PTFE Tubing Pump Operating Manual available at

http://www.coleparmer.com/Assets/manual_pdfs/77390-00.pdf

3.2 Warnings and Cautions

Throughout the manual, the following symbols are used to identify warnings and cautions:

	<p><i>The caution symbol indicates a potential hazardous situation which could result in minor injury or damage to the product.</i></p>
	<p><i>The high voltage symbol indicates the possibility of electrical shock.</i></p> <p><i>This symbol means <u>turn off</u> the electrical supply before removing any cover with the symbol attached. Failure to do so may cause exposure to electrical shock hazard.</i></p> <p><i>Access to electrical components should only be carried out by a licensed electrician or qualified electrical engineer.</i></p> <p><i>NEVER attempt to modify any electrical components or circuits as this may affect the safe operation of the machine.</i></p>
	<p><i>Electrostatic Discharge (ESD) sensitive components.</i></p>

3.3 Important Safety Notes



This equipment should only be operated by trained and qualified personnel with access to and knowledge of the equipment functions..

Mixing operations can generate heat and internal pressure depending on material and mixer accelerations. Always pre-test materials and processes. Do not mix materials longer than what has been characterized as safe.

Do not disable or tamper with any safety items, such as safety interlock switches located on the LabRAM II Spray System.

Note: Changes in noise level or frequency are common during mixing operations. If rattling, metal-on-metal, or obnoxious noises occur, turn off the LabRAM II Spray System and call or email the Resodyn Acoustic Mixers Technical Support line at 406-497-5333.



WARNINGS: Tubing breakage may result in fluid being sprayed from pump. Use appropriate measures to protect operator and equipment.


Turn Peristaltic Pump System off before removing or installing tubing. Avoid fingers or loose clothing getting caught in drive mechanism.

CAUTIONS: When changing flow direction, allow the peristaltic pump to come to a complete stop before starting again. Failure to do so could cause permanent damage to the motor. Replace the fuse only with one of the same type and rating. The fuse rating and type are stated on the rear panel.

Use only pre-formed Masterflex L/S PTFE tubing. Use of other tubing may result in premature or unknown failure modes.

Use recommended fittings only. Use of improper fittings and/or improper connection to fittings may result in leakage at the fittings.

A pressure relief/bypass valve must always be installed in a potentially high-pressure system to prevent the pump from exceeding the maximum rated pressure; i.e., 100 psig (6.8 bar) for the peristaltic pump system.

	<p>DANGER: Disconnect all power from the pump before any cleaning operation is started.</p> <p>WARNING: Disconnect all power from the pump before attempting any maintenance.</p> <p>CAUTION: To avoid electrical shock, the pump power cord protective grounding conductor must be connected to ground. Not for operation in wet locations as defined by EN61010-1.</p> <p>If the pump product is not used in a manner specified in the instructions, the protection provided by the equipment may be impaired.</p>
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3.3.1.1 Ultrasonic Nozzle

Avoid contact with the energized nozzle tip. This device will cut through tissue and damage cells when energized.

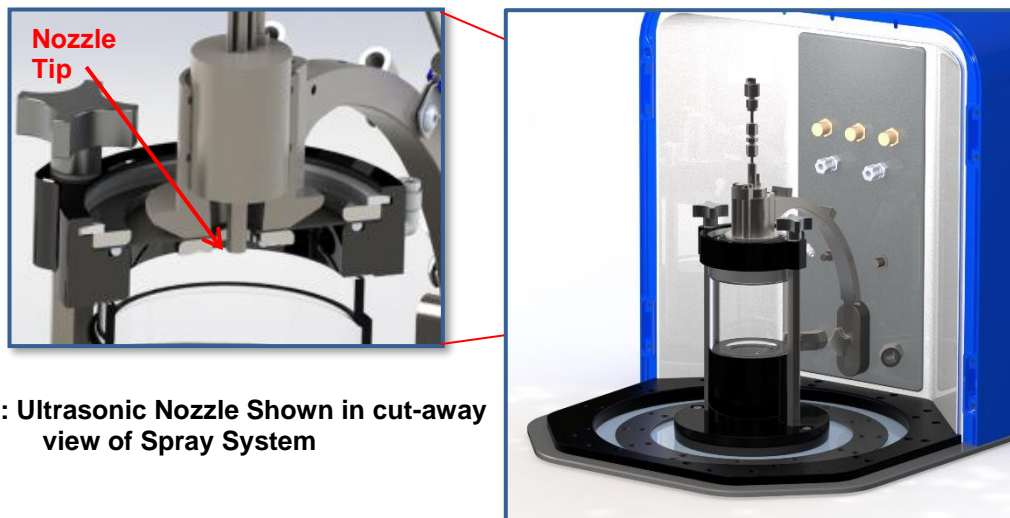


Figure 3-1: Ultrasonic Nozzle Shown in cut-away view of Spray System

3.3.2 Ultrasonic Atomizer Nozzle Generator

- 3.3.2.1 Before operating the ultrasonic atomizer, check for any damage that may be related to shipping.
- 3.3.2.2 Ensure that a properly grounded 110/120 VAC outlet is available.
- 3.3.2.3 Do not plug this unit into a 220/240 VAC outlet.
- 3.3.2.4 Alterations to unit without appropriate authorization will void warranty.
- 3.3.2.5 Disassembly of atomizer (i.e., generator) will void warranty.

3.3.3 KDS Legato 100 Series Syringe Pump

- 3.3.3.1 Make sure all connections are made properly and securely. Any signal wire connections to the unit must be no longer than 9.8 feet (3 meters).
- 3.3.3.2 Review the operating manual to learn the ratings on all connections.
- 3.3.3.3 Do not touch any electronic circuitry inside of the product.
- 3.3.3.4 A pinch hazard may exist between the pusher block and end blocks. Avoid placing fingers between these points while the pump is running.
- 3.3.3.5 If damage is visible or suspected to the product do not operate the product. Contact qualified service personnel to perform inspection.
- 3.3.3.6 Do not orient the equipment so that it is difficult to operate the disconnection device.
- 3.3.3.7 Review the operating manual for guidelines for proper operating environments.
- 3.3.3.8 Read all labels on product to ensure proper usage.

3.3.4 Masterflex L/S Precision Variable Speed Console Drive

- 3.3.4.1 Observe safety precautions at all times, especially when pumping volatile, explosive, caustic, acidic, or reactive liquids. The LabRAM II Spray System is designed for use in non-hazardous environments.
- 3.3.4.2 If the pump makes unusual noises or if bunching of the tubing in the pump can be observed, make sure the tubing is clamped down tightly and/or replace it with a new piece of tubing.
- 3.3.4.3 The L/S Precision Variable-Speed Console Drive must be well-grounded at all times.
- 3.3.4.4 The L/S Precision Variable-Speed Console Drive is equipped with a current-limiting circuit that will shut the motor down if any of the following conditions exist:
 - 3.3.4.4.1 Tubing that is too hard is loaded in the pump.
 - 3.3.4.4.2 Incorrect tubing size or wall thickness is loaded in the pump.
 - 3.3.4.4.3 Tubing is improperly loaded into the Pump Head.
- 3.3.4.5 The unit is fused and grounded to protect the operator in the event of short circuits that could be caused by liquid entering the case.
- 3.3.4.6 For additional safety information relative to the Masterflex L/S Console Drive, please see the Masterflex L/S Operating Manual (see footnote on Page 6).

4 General Notes

The LabRAM II Spray System is an integrated mixing system designed to be used in laboratory and production environments. The spray system incorporates pump and spray components to expand the mixing capabilities of a LabRAM II mixer.

4.1 System Description

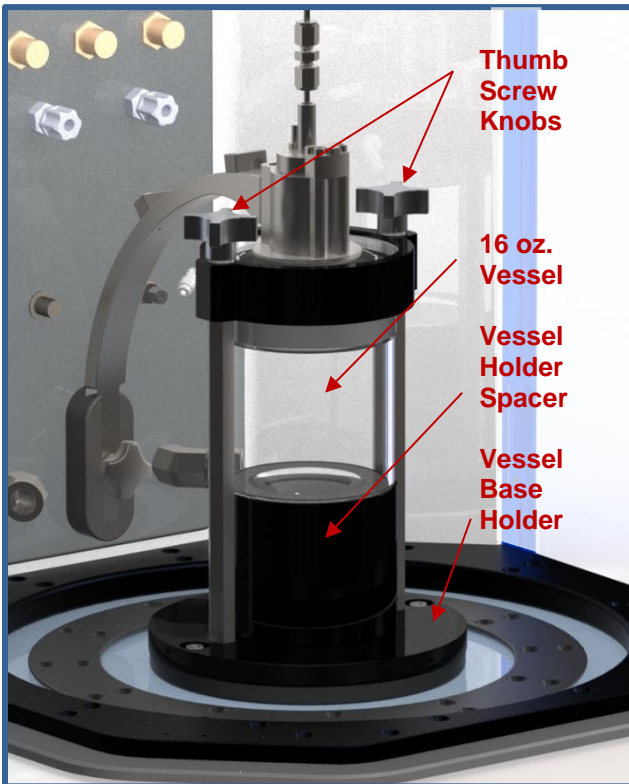
The LabRAM II Spray System consists of the following:

- LabRAM II spray system assembly
- Ultrasonic nozzle and controller
- OPTIONS: peristaltic and/or syringe pump

The LabRAM II Spray System's components are shown in Figures 4-1 through 4-4. *(A LabRAM II mixer is required for this accessory. If you do not have a LabRAM II Mixer, please contact Resodyn at 406-497-5333)*

4.1.1 LabRAM II Spray System

This unit, as shown fully assembled and installed on the front cover, is designed to be mounted on a LabRAM II mixer resonator plate.



4.1.2 Standard Vessel Fixture and Vessels

The vessel Hold-Down Fixture is designed to accommodate a 16 fl oz (0.47 liters) vessel as shown (Resodyn Part Number: 000539) with a spacer (Part Number 104210) that is 3.5 inches (8.9 cm) in diameter. The height of the vessel is 3.86 inches (9.8 cm). A 32 oz. vessel (Resodyn Part Number 002800) can also be used by removing the spacer.

4.1.3 Turning the Thumb Screw knobs clock-wise will clamp the vessel in place. Each knob is coupled to a threaded rod, which in turn is connected to a standoff

4.1.4 Vessel Holder Base

The vessel containing the mix material is positioned on the Vessel Holder Base (spacer shown with 16 oz. vessel).

4.1.5 Fluid Metering and Spray Components



Figure 4-2 : Ultra Sonic Atomizer Generator

The functions of the fluid metering and spray components are to dispense precise amounts of fluid of an atomized liquid onto the mix media.

The components consist of one or more of the following items:

- a. A 130 kHz, Wide Spray Atomizer Nozzle (Resodyn Part Number: 002041)
- b. An Ultra Sonic Atomizer Controller (Resodyn Part Number: 002891)
- c. Peristaltic Pump Option (Resodyn Part Number 900659):
Masterflex L/S PTFE-Tubing Peristaltic Pump System (model WU-77912-10) that includes a model 77390-00 Tubing Pump Head and Precision Variable Speed Console Drive from Cole-Palmer (model 07528-20).

Attachments include the following:

- 1) 4 mm PTFE Tubing pump with a 4 mm-to-male 1/8" NPT fitting
- 2) 1/8" Female NPT-to-female Luer fitting
- 3) Male Luer-to-1/16" OD tubing compression fitting
- 4) 1/16" OD, 1/32" ID PTFE tubing with a 1/16" OD compression tubing fitting
- 5) 4 mm PTFE coupler

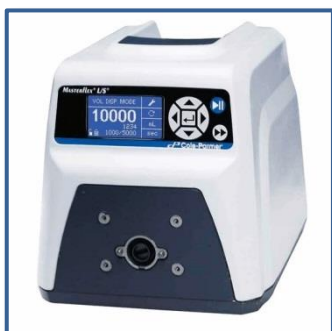


Figure 4-3: Optional Peristaltic Pump

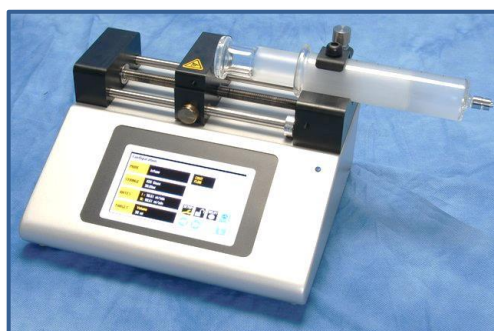


Figure 4-4: Optional Syringe Pump

Syringe Pump Option (Resodyn Part Number 900658):

- 1) KD Scientific Legato 100 Infuse Only Syringe Pump along with the following:
- 2) Luer fitting on the 20 mL stainless syringe
- 3) Stainless female-to-female Luer fitting
- 4) Male Luer-to-1/16" OD tubing compression fitting
- 5) 1/16" OD, 1/32" ID PTFE tubing with a 1/16" OD compression tubing fitting.

4.2 Voltage Level and Power Consumption

The mixer is designed to be very efficient by operating at a resonant condition. The LabRAM II is designed to utilize single phase 110-120 VAC @ 50Hz/60Hz supply voltages. Maximum power consumption is less than 1 kW.

4.2.1 Ultrasonic Atomizer

Utilizes single phase 110-120 VAC @ 50Hz/60Hz supply voltages. Voltage range must be between 114 to 126 VAC with no spike, EMI, or ESD issues. Maximum power consumption is 250 W when current draw is 2 A RMS at 115 VAC RMS.

4.2.2 KDS Legato 100 Series Syringe Pump

Utilizes single phase 100-240 VAC at 50Hz/60 Hz. The 8 W Universal Power Supply has a maximum current of 0.8 A RMS. Use Only a KD Scientific Approved Power Supply and Line Cord.

4.2.3 Masterflex L/S Precision Variable Speed Console Drive

Utilizes single phase 90-260 VAC at 50Hz/60Hz. Current draw is 2.2 A at 115 VAC, and 1.1 A at 230 VAC.

Maximum power consumption is associated with 2.2 A RMS current draw at 115 V RMS, or alternatively a 1.1 A RMS current draw at 230 V RMS.

5 Installation

5.1 Spray System Overall Assembly Pictures

If purchased with a LabRAM II ResonantAcoustic® Mixing (RAM) system, The LabRAM II Spray System will arrive packed in a separate box with the components packed in foam for protection against damage during shipping. The images of the key components in the following section are shown unpackaged and will be referred to throughout this manual.

5.1.1 Figure 5-1 shows the Vessel Holder Base and Standoffs

5.1.2 Figure 5-2 shows the Nozzle Arm.

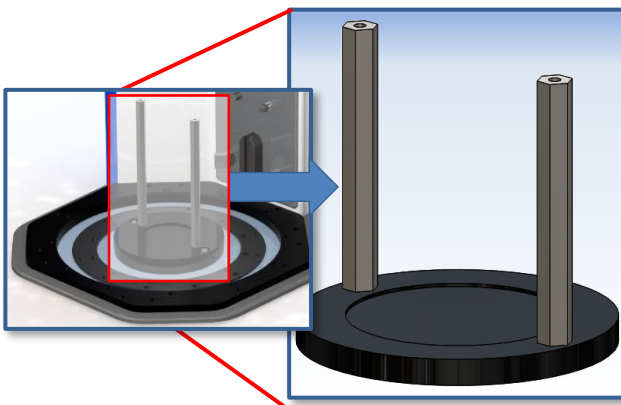


Figure 5-1: Vessel Holder Base and Standoffs

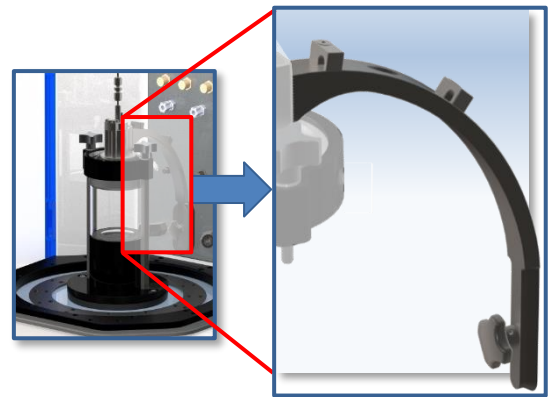


Figure 5-2: Spray Nozzle Arm

5.1.3 Figure 5-3 shows the Nozzle Vessel Top Holder and Nozzle Gasket.

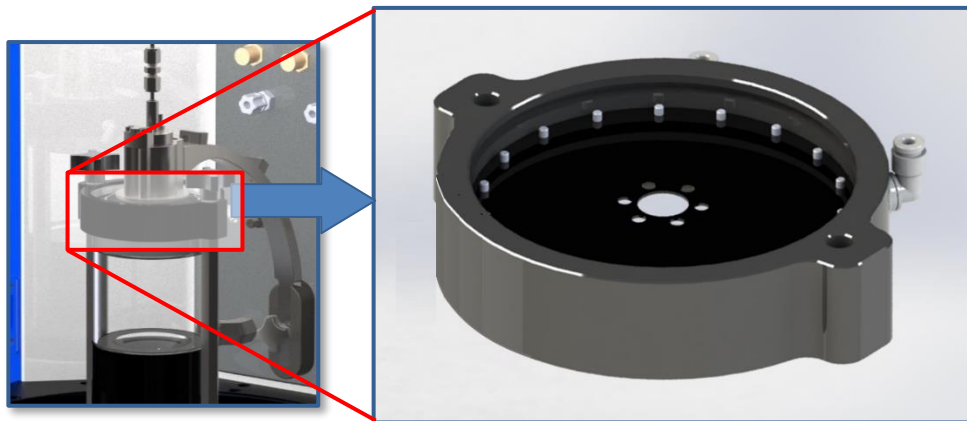


Figure 5-3: Vessel Top Holder and Nozzle Gasket

5.1.4 Figure 5-4 illustrates the Atomizer Nozzle and Atomizer Holder.

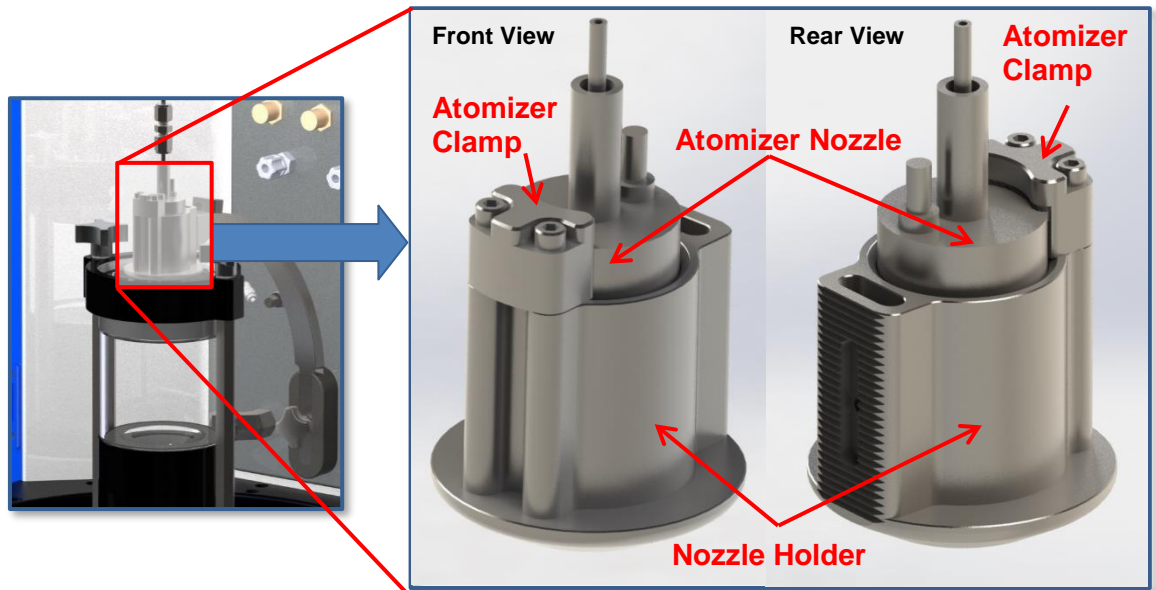


Figure 5-4: Ultrasonic Atomizer Nozzle and Atomizer Holder

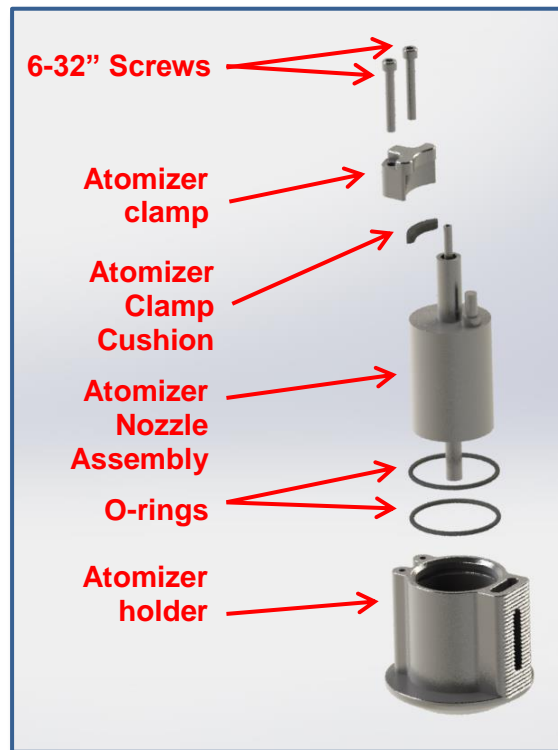


Figure 5-5: Nozzle Assembly

5.1.5 Figure 5-5 Shows an exploded view of the Atomizer Holder and Atomizer Nozzle Assembly

5.2 Spray System Installation

- 5.2.1 This section provides instructions on assembly of the spray system. A reverse procedure can be used to remove the spray system when changing vessel holders or accessories.
- 5.2.2 Before starting the assembly process, prepare a space to unpack, catalog, and stage the Spray System components. Placing a copy of the exploded view of the system nearby (Page 37) will be helpful in assembling the system in the future.
- 5.2.3 Locate and identify the Atomizer Base Vessel Holder baseplate as shown in Figure 5.2 (Resodyn Part Number: 104225), which will include the two vertical support standoffs attached, and position over the appropriate mounting holes in the resonator plate surface. Secure to the resonator plate

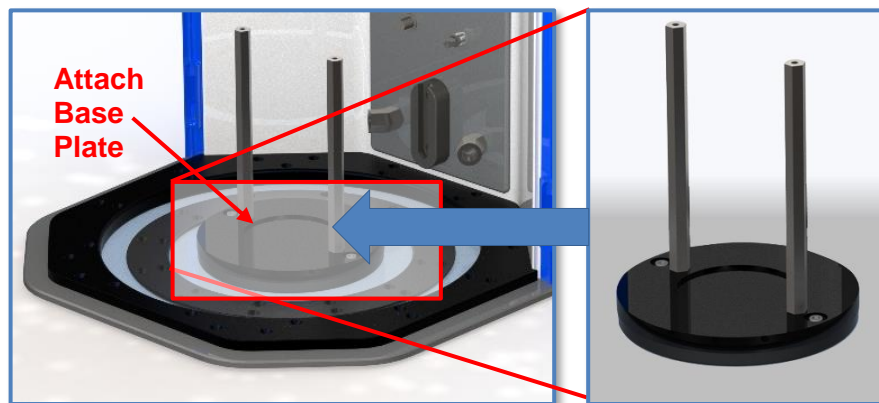


Figure 5-10: Base Plate Positioning

using two 1.25" long 1/4-20 cap screws taking note to include the accompanying washers. Torque until firmly seated using the provided Allen wrench.

- 5.2.4 Locate the Spray System Nozzle Arm and Atomizer Assembly and thumb screw. Position the Spray System Nozzle Arm and Atomizer Assembly above the Spray Arm Support Bracket (Resodyn Part Number 104215) on the LabRAM II back panel. To seat the Nozzle arm into the Support Bracket, slide the arm down into position (Figure 5-8). Tighten the Support Arm Tension Knob by turning in a clockwise direction until the Arm is secure in the Bracket (see 5.2.5 on Page 17).. Insert the thumb screw knobs just until the threads are engaged with the Spray Arm Support Bracket. Loosen the Thumb Screw knobs so that the

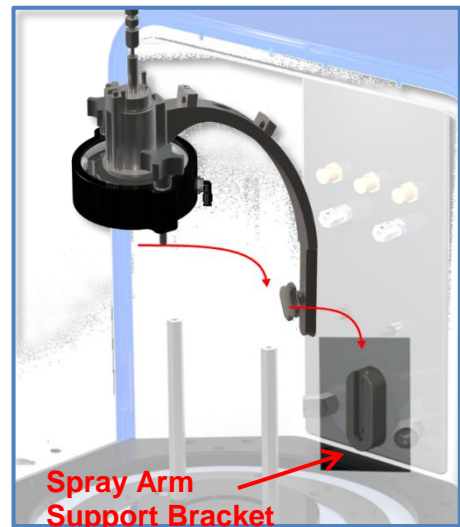


Figure 5-8: Atomizer Removal from LabRAM II Back Panel

Nozzle Vessel Top Holder (Resodyn Part No. 101825) can be lifted. Lifting the Nozzle Vessel Top Holder attached to the Spray System Nozzle Arm and Atomizer Assembly, slide the glass mixing vessel into position. *Tighten the thumb screw knobs by hand only.* Do not use mechanical devices to tighten. Over tightening may fracture or break the glass vessel. The vessel should not move in the fixture either side to side or front to back.

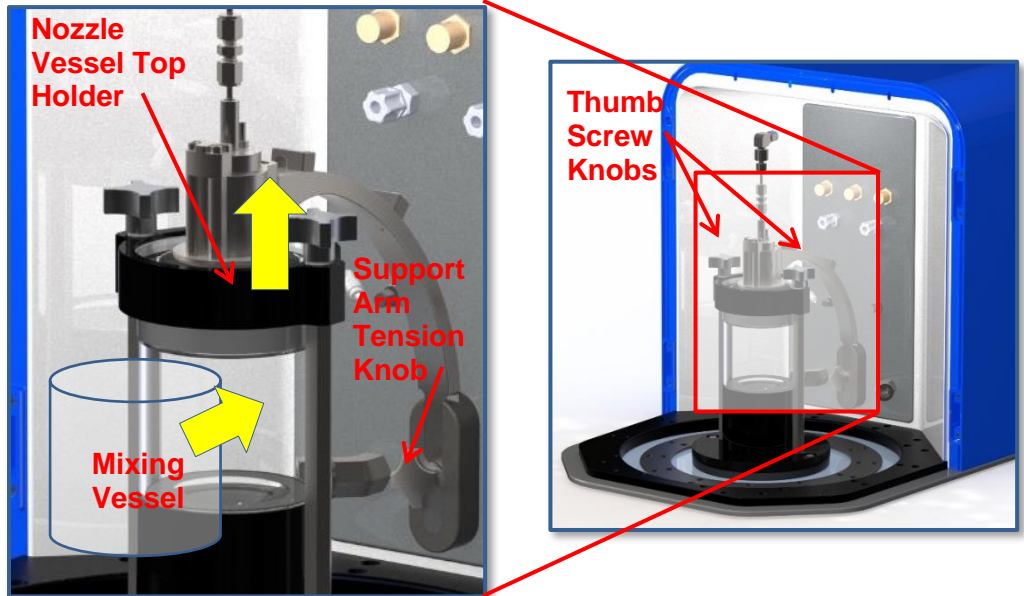


Figure 5-11: Vessel Installation

- 5.2.5 Connect the feedline shown in Fig. 5-6 to the back panel by unscrewing the compression nut with fingers, inserting the feedline and re-tightening the compression nut. Carefully connect the power and signal cable connected to the appropriate back panel connection port, pushing firmly but carefully directly into socket.

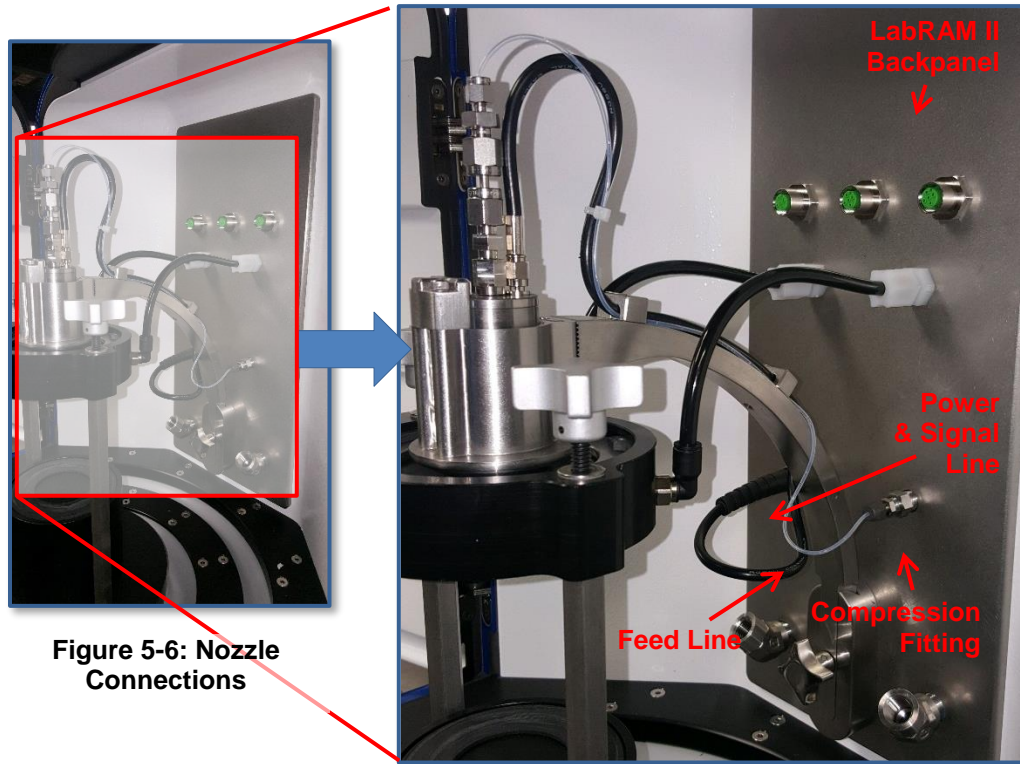


Figure 5-6: Nozzle Connections

- 5.2.6 Connect power supplies to the LabRAM II mixer, ultrasonic nozzle controller, and fluid pumps, if so equipped, after completing the following instructions as appropriate for your installation.
- 5.2.7 The reinstallation of the system is performed in reverse order. Please call 406-497-5401 if help is needed.



Do not attempt to override the DOOR SAFETY INTERLOCK SWITCH!
 During operation the Resonator top plate, fixture, and vessel travel 60 times per second, up to 3/4", creating up to 100 g's. Serious bodily injury may occur if contact is made with these moving surfaces.

Note: Doors must be positively engaged to activate the interlock switch and allow the machine to operate. If necessary, inspect the entire length of the door seal for any foreign

materials preventing proper closure

5.3 **Installing the Ultrasonic Atomizer Nozzle Generator**

The Ultrasonic Atomizer Nozzle Generator connection procedure is as follows:

- 5.3.1 Place the ultrasonic generator in reasonably close proximity to the LabRAM II.
- 5.3.2 Attach one end of the BNC cable assembly (supplied with the generator unit) to the back of the generator.
- 5.3.3 Attach the other end of the cable to the ultrasonic transducer/nozzle assembly.
- 5.3.4 Connect the generator to a 110/120 VAC power outlet using the power cord that came with the generator, but do not turn the unit on at this time.

5.4 **Connect Peristaltic Pump Options to Ultrasonic Nozzle**



Figure 5-13: Ultra Sonic Atomizer Generator

To connect the Masterflex L/S PTFE-Tubing Peristaltic Pump System (Resodyn Part Number 900659) from Cole-Palmer follow the instructions below.

Pump System model WU-77912-10 also includes Tubing Pump Head model 77390-00 Precision Variable Speed Console Drive model 07528-20.

- 5.4.1 Mount pump head and load tubing. (See pump head datasheets located on the CD supplied by the pump manufacturer).
- 5.4.2 Check to ensure that rollers are clean and free of defects.
- 5.4.3 See the pump manufacturer's Operating Manual for detailed instructions regarding setting up the peristaltic pump. (See Section 8 "Supplemental Information" section of this document.)
- 5.4.4 Place the peristaltic pump within reasonably close proximity to the LabRAM II.
- 5.4.5 Route the 4 mm PTFE tubing through the pump head.
- 5.4.6 Place one end of the tube in the vessel containing the spray solution.
- 5.4.7 The other end of the tube with the male NPT fitting should be connected to a female NPT-to-female Luer fitting.
- 5.4.8 The stainless female Luer connects to a male Luer-to-1/16" OD tubing compression fitting.
- 5.4.9 Attached to the compression fitting is a 1/16" OD, 1/32" ID PTFE tubing that must be attached to the spray nozzle via a 1.16" OD compression tubing fitting.

5.4.10 Connect the peristaltic pump to a 90 to 260 VAC power outlet. **Do not turn the pump on at this time.**



Figure 5-14: Peristaltic Pump Installation

5.5 **Connecting Syringe Pump to Ultrasonic Nozzle**

If you are using a KD Scientific Legato 100 Infuse Only Syringe Pump, connect the pump to the ultrasonic nozzle in the following manner: (Resodyn Part Number 900658)



Figure 5-15: Syringe Pump Installation

- 5.5.1 Follow the pump manufacturer's instructions regarding setting up the syringe pump. (See Section 8 "Supplemental Information" for details.)
- 5.5.2 Place the syringe pump within reasonably close proximity to the LabRAM II.
- 5.5.3 Attach the Luer fitting to the stainless steel, 20 mL syringe.
- 5.5.4 Place the syringe in the Legato 100 pump as per the pump manufacturer's instructions.
- 5.5.5 Connect a stainless female-to-female Luer fitting to the male Luer fitting that is attached to the syringe.
- 5.5.6 Connect a male Luer-to-1/16" OD tubing compression fitting to the female Luer fitting.
- 5.5.7 Connect the 1/16" OD, 1/32" ID PTFE tubing to the spray nozzle via a 1.16" OD compression tubing fitting.
- 5.5.8 Connect the syringe pump to a 110 to 240 VAC power outlet, but do not turn the pump on at this time.

6 Operating Instructions

6.1 Power-up Equipment

- 6.1.1 LabRAM II Power-up
Ensure that power is applied to the LabRAM II. Turn on power switch on the rear panel of the LabRAM II. It will take a few seconds for the RAM operating system and HMI to boot. Once the full screen is displayed, the LabRAM II is ready for operation.
- 6.1.2 Ultrasonic Atomizer Nozzle Generator Power-up
Set-up the atomizer generator as described in the previous section.
 - 6.1.2.1 Turn the power switch located on the rear panel of the unit to the ON position.
 - 6.1.2.2 "Sonozap Atomizer" will be presented on the top line of the display, while "PWR: OFF" will be displayed on the second line.
 - 6.1.2.3 Important: make sure that the ultrasonic nozzle is not powered at this point. Running the nozzle in a dry state can damage the nozzle.
- 6.1.3 Power-up when using a Masterflex L/S PTFE-Tubing Peristaltic Pump:
Set up the peristaltic pump as described in the previous section, and activate power to the unit. Do not initiate the peristaltic pumping action at this time.
- 6.1.4 Power-up when using a KD Scientific Legato 100 Syringe Pump:
Set up the syringe pump as described in the previous section, and activate power to the unit. Do not initiate the pumping action at this time.

6.2 LabRAM II Spray System Operation

All operation of the LabRAM II is controlled through HMI screen located on the front of the machine. Refer to the LabRAM II Instruction Manual for details pertaining to the functions of the LabRAM II and its operating system. The instructions for using the Spray System coupled with the LabRAM II mixer are provided below.

6.2.1 Setup

The following describes the steps for preparing the machine for a mixing operation that incorporates atomized liquids.

6.2.1.1 If not already on, activate the power switch to the LabRAM II mixer as outlined in the LabRAM II manual, or see Section 6.1.1. above.

6.2.1.2 Ensure that the pump and nozzle generator have been powered-up as described in the section 6.1, above.

6.2.2 Spray System Operation using the Peristaltic Pump Option (Resodyn Part Number: 900659)

If the Spray System utilizes the Masterflex L/S PTFE-Tubing Peristaltic Pump option, the following start up and operating procedures apply:

6.2.2.1 Verify that the pump has been installed as described in Section 6.1.

6.2.2.2 Pump Priming

1. Prepare a reservoir containing the liquid to be pumped.
2. Insert one end of the peristaltic pump tubing into the liquid such that it touches the bottom of the reservoir. The other end should be connected to the ultrasonic nozzle. An empty vessel should be installed in the vessel holder to catch any primed fluid.
3. If the pump tube has been replaced or this is the initial instillation of the pump tube, please follow instructions outlined in the Masterflex L/S PTFE-tubing peristaltic pump instructions, pages 9-12.
4. Make sure the pump speed is set to a flow rate 1 mL/min or less.
5. To begin pumping, ensure the flow direction shows pumping in the direction of the nozzle.
6. Turn on the pump, and watch the fluid fill the line to the pump head. Note that the peristaltic pump is self-priming. If the fluid is not filling the tube, then please go back to step 3 and go through the pump head adjustment.
7. Once the fluid has reached the pump head, the pump speed can be increased as necessary to fill the lines to the ultrasonic nozzle.
8. Prime the tubing until you observe drops coming out of the ultrasonic nozzle.
9. Turn the pump off by pressing the play/pause button on the upper right of pump control panel once all the bubbles have been purged from the tubing.

6.2.2.3 Atomization Adjustments

These adjustments help you to identify your optimized spray characteristics.

1. Open the LabRAM II doors to install a 16 fl oz (0.47 liters), 3.5 inch diameter glass (or 32 fl oz) vessel into the LabRAM II as previously described in 5.3.2.
2. Close and fully engage the doors of the LabRAM II.
3. Connect the discharge end of the tubing to the ultrasonic nozzle.
4. Turn the pump on to have 1 mL/min of flow of the desired material through the nozzle (less than 1 mL/min of flow may be required with high viscosity when using the peristaltic pump).
5. **Important: the ultrasonic nozzle must not be powered-up until liquid is ready to flow through the nozzle. Running the ultrasonic nozzle in a dry state for an extended time will damage the nozzle.**
6. Once liquid is observed to be dripping from the nozzle, turn on the ultrasonic power to the nozzle at 50%.
7. At this point, a spray should be emitted from the nozzle. If a mist is not emitted and large droplets appear (> 500 um), increase the nozzle power until a mist is generated. The fluid flow and nozzle % power can be adjusted at this stage for final operating conditions.
8. Note: if vacuum application is planned during the subsequent mixing process, apply that same vacuum level at this step, while adjusting the spray parameters. Vacuum should be adjusted from ambient and slowly increased. Because of the ultra-high surface area of the atomized droplets, vacuum levels below 5 inches of Hg are typically required to dry most materials.
9. **Important: While adjusting the vacuum level, volatile materials may evaporate in the nozzle and stop the spray. If the spray stops, turn off the ultrasonic nozzle and reduce the vacuum. Once dripping of the spray material starts, the nozzle may be turned back on and vacuum can again be adjusted. If the nozzle is operating when there is no fluid being sprayed, the nozzle will be damaged. Depending on the elevation of your equipment, the maximum vacuum can be as low as 5 inches of Hg** when spraying volatile materials such as Acetone. For example, pulling 10 inches Hg of vacuum while spraying Acetone at low flow rates (<1mL/min) causes the Acetone to evaporate in the nozzle before it is atomized.
10. **Important:** If bubbles are observed at the pump and flowing down the PTFE feed line, the spray material is starting to evaporate in the feed tube and the vacuum is too great. Because of the increased surface area of the droplets from the ultrasonic nozzle, low vacuum levels can be used to dry volatile materials.
11. Adjust the pump flow rate and nozzle ultrasonic power level until the desired conditions are observed. The ultrasonic frequency should

be constant or dropping less than 100 Hz every 10 seconds in order to not damage the sonic nozzle.

12. Turn off the pump to stop the peristaltic pumping action.
 13. Then, quickly (less than 10 seconds) turn-off the power to the ultrasonic nozzle.
- 6.2.2.4 Remove the 16 fl oz (0.47 liters) or 32 fl oz glass vessel from the LabRAM II.
 - 6.2.2.5 The spray system is now ready to be operated at the determined conditions with your materials.
 - 6.2.2.6 Install a new 16 fl oz (0.47 liters) or 32 fl oz glass vessel that contains the powder materials to be mixed. It is recommended to fill the vessel from 30-80% full. ***If too little material is used in the vessel, most of the droplets will coat the vessel and not the powder. If the mixing vessel is too full of mixing media, the nozzle will spray the droplets onto a small area and it will form condensed droplets, negating the benefits of the system.*** Note that instead of using a different vessel, if desired, the previous vessel may be cleaned, dried, and reused for this step.
 - 6.2.2.7 Turn on the LabRAM II system.
 - 6.2.2.8 ***Important: the acceleration level should not exceed 30 g when mixing powder materials that incorporate atomized liquids.***
 - 6.2.2.9 Turn on the ultrasonic nozzle to atomize the liquid. The nozzle is turned on before the pump to ensure large droplets do not fall out of the ultrasonic nozzle
 - 6.2.2.10 Quickly turn on the pump to the desired flow rate.
 - 6.2.2.11 If vacuum is desired during the atomization, the previously determined vacuum level should be applied at this step.
 - 6.2.2.12 Once the materials have been sufficiently mixed and sprayed, turn off power to the various systems using this sequence:
 1. Turn off the vacuum.
 2. Discontinue the peristaltic pumping action. The pump flow may also be reversed at this stage to help ensure that no large droplets will fall into the vessel. The pump flow should be reversed if mixing under vacuum is required after all the materials are sprayed. If the pump is not reversed, then the vacuum will pump the materials into the mixing vessel, causing liquid saturated agglomerates, which negates the benefits of the atomized spray nozzle.
 3. Turn off the LabRAM II acceleration.
 4. Turn off the ultrasonic power supplied to the nozzle within 20 seconds of turning off or reversing the pump flow. This will ensure that the nozzle is not damaged and there are no drips

6.2.2.13 Remove the mixing vessel containing the materials from the LabRAM II.

6.2.3 If your Spray System utilizes the KD Scientific Legato 100 Infuse Syringe Pump Option (Resodyn Part Number: 900658), the following operating procedures apply:

6.2.3.1 Verify that the pump has been installed as described above.

6.2.3.2 **To fill and prime the syringe with the material to be dispensed, use the following procedure:**

1. Remove the stainless steel syringe from the pump.
2. Detach the tubing from the syringe by disconnecting the female-to-female Luer fitting from the syringe. The male Luer fitting will remain attached to the syringe.
3. Push the plunger into the syringe housing until it stops.
4. Insert the open end of the syringe into the liquid that will be metered by the syringe.
5. Retract the syringe until the desired amount of liquid has been drawn into the syringe.
6. Wipe-off the open end of the syringe to remove residual fluid.
7. Reattach the tubing to the syringe by reconnecting the female-to-female Luer fitting to the male Luer fitting attached to the syringe.
8. Hold the syringe in a vertical position such that the open end of the syringe is pointing upward. Wait for the air to come to the top of the syringe. Depress the plunger until all the air is out of the syringe and fluid is starting to flow out without bubbles.
9. Prime the syringe and tubing by pushing the plunger inward until a small amount of liquid is dispensed from the free end of the tube out of the nozzle.
10. Wipe-off the free end of the tubing to remove residual fluid.
11. Reinstall the stainless steel syringe into the pump.

6.2.3.3 Atomization Adjustments

These adjustments help you to identify your optimized spray characteristics.

14. Open the LabRAM II doors to install a 16 fl oz (0.47 liters), 3.5 inch diameter glass (or 32 fl oz) vessel into the LabRAM II as previously described in 5.3.2.
15. Close and fully engage the doors of the LabRAM II.
16. Connect the discharge end of the tubing to the ultrasonic nozzle.
17. Turn the pump on to have 1 mL/min of flow of the desired material through the nozzle (less than 1 mL/min of flow may be required with high viscosity when using the syringe pump).
18. **Important: the ultrasonic nozzle must not be powered-up until liquid is ready to flow through the nozzle. Running the**

ultrasonic nozzle in a dry state for an extended time will damage the nozzle.

19. Once liquid is observed to be dripping from the nozzle, turn on the ultrasonic power to the nozzle at 50%.
20. At this point, a spray should be emitted from the nozzle. If a mist is not emitted and large droplets appear (> 500 um), increase the nozzle power until a mist is generated. The fluid flow and nozzle % power can be adjusted at this stage for final operating conditions.
21. Note: if vacuum is planned during subsequent mixing process, apply that same vacuum level at this step, while adjusting the spray parameters. The vacuum should be adjusted from ambient and slowly increased. Because of the ultra-high surface area of the atomized droplets, low vacuum levels below 5 inches of Hg are typically required to dry most materials.
22. **Important: While adjusting the vacuum level, volatile materials may evaporate in the nozzle and stop the spray. If the spray stops, turn off the ultrasonic nozzle and reduce the vacuum. Once dripping of the spray material starts, the nozzle may be turned back on and vacuum can again be adjusted. If the nozzle is operating when there is no fluid being sprayed, the nozzle will be damaged. Depending on the elevation of your equipment, the maximum vacuum can be as low as 5 inches of Hg when spraying a volatile material such as Acetone. For example, pulling 10 inches of Hg of vacuum while spraying Acetone at low flow rates (<1mL/min) causes the Acetone to evaporate in the nozzle before it is atomized.**
23. **Important:** If bubbles are observed at the pump and flowing down the PTFE feed line, or if the syringe pump plunger is moving faster than the feed mechanism the vacuum level is too great and should be reduced. Because of the increased surface area of the droplets from the ultrasonic nozzle, low vacuum levels can be used to dry volatile materials.
24. Adjust the pump flow rate and nozzle ultrasonic power level until the desired conditions are observed. The ultrasonic frequency should be constant or dropping less than 100 Hz every 10 seconds in order to not damage the sonic nozzle.
25. Turn off the pump to stop the peristaltic pumping action.
26. Quickly (less than 10 seconds after stopping the pump) turn-off the power to the ultrasonic nozzle.

- 6.2.3.4 Remove the 16 fl oz (0.47 liters) or 32 fl oz glass vessel from LabRAM II.
- 6.2.3.5 The spray system is now ready to be operated at the determined conditions with your materials.
- 6.2.3.6 Install a new 16 fl oz (0.47 liters) or 32 fl oz glass vessel containing your powder materials that are to be mixed. It is recommended to fill the vessel from 30-80% full. ***If too little material is used in the vessel, most of the droplets will coat the vessel and not the powder. If the mixing vessel is too full, the nozzle will spray the droplets onto a small area and it will form condensed droplets, negating the benefits of the nozzle.*** Note that instead of using a different vessel, if desired, the previous vessel may be cleaned, dried, and reused for this step.
- 6.2.3.7 Turn on the LabRAM II system.
- 6.2.3.8 **Important: the acceleration level should not exceed 30 g when mixing powder materials that incorporate atomized liquids.**
- 6.2.3.9 Turn on the ultrasonic nozzle to atomize the liquid. The nozzle is turned on before the pump to ensure large droplets do not fall out of the ultrasonic nozzle.
- 6.2.3.10 Quickly turn on the pump to the desired flow rate.
- 6.2.3.11 If vacuum is desired during the atomization, the previously determined vacuum level should be applied at this step.
- 6.2.3.12 Once the materials have been sufficiently mixed and sprayed, turn off power to the various systems using this sequence:
1. Turn off the vacuum.
 2. Discontinue the syringe pumping action. Note: Vacuum cannot be used with a syringe pump if flow is not controlled. If the vacuum level is, too great it will continue to flow materials into the vessel because a vacuum is pulled onto the syringe. The syringe is useful when metering an exact amount of fluid into the system, but is not ideal when the materials need to be dried after all the materials have been added.
 3. Turn off the LabRAM II acceleration.
 4. Turn off the ultrasonic power supplied to the nozzle within 20 seconds of turning off the pump flow. This will ensure that the nozzle is not damaged and that there are no drips.
- 6.2.3.13 Remove the mixing vessel containing the materials from the LabRAM II.

6.2.4 Spray System with vacuum and purge

The spray system lid, shown below, is equipped with 3 1/8" tube quick connections. These connections are used for the vacuum and vacuum sense lines.

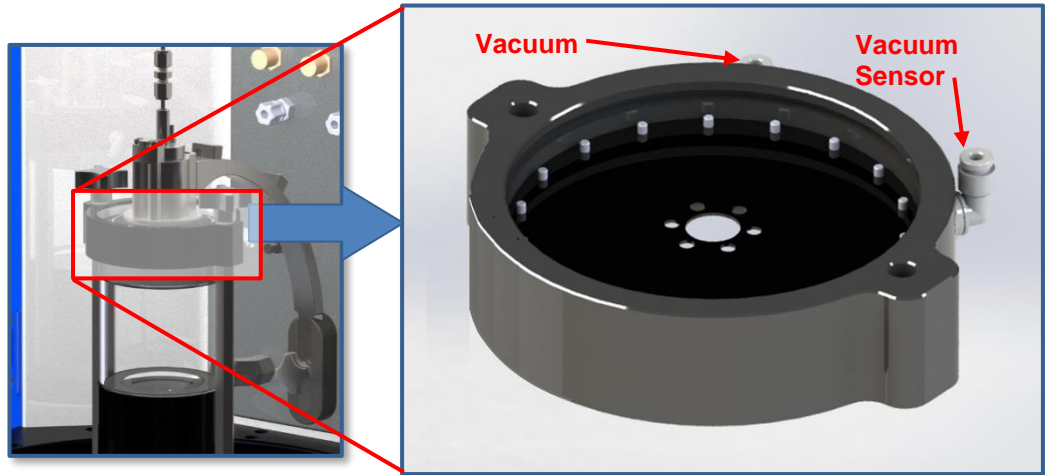


Figure 6-1: Vacuum Connections

6.3 Power-Down

Turn the LabRAM II power off the rear of the machine. Similarly, AC power to the pump and ultrasonic generator should just be switched off.

6.4 Maintenance and Cleaning

The LabRAM II Spray System is designed with few serviceable or replaceable parts.

6.4.1 Masterflex L/S Precision Variable Speed Console Drive:

- 6.4.1.1 Completely disconnect power from the pump before any maintenance operation is started.
- 6.4.1.2 See Masterflex L/S Precision Variable Speed Console Drive Operating Manual for maintenance instructions.

6.4.2 Masterflex L/S PTFE Tubing Pump:

- 6.4.2.1 Completely disconnect power and remove tubing pump from variable speed drive before any maintenance operation is started.
- 6.4.2.2 See Masterflex L/S PTFE Tubing Pump Operating Manual for maintenance instructions.

6.4.3 KDS Legato 100 Series Syringe Pump:

- 6.4.3.1 Completely disconnect power from the pump before any maintenance operation is started.
- 6.4.3.2 KDS Legato 100 Series pumps require no special maintenance other than keeping them clean by avoiding accidental spills of pumped material.
- 6.4.3.3 The two guide rods and the lead screw should be sparingly lubricated periodically. An automatic reminder is delivered by the pump every 100 hours of operation.
- 6.4.3.4 The guide rods and the lead screw should be lubricated with Super Lube Synthetic Grease provided with the pump.

6.4.4 Gasket Replacement Procedure:

The gasket between the moving lid and the nozzle holder is a *wear component* and will need to be replaced as needed. The Resodyn gasket part number is 102471 and replacements should only be ordered from Resodyn Acoustic mixers. Please contact your sales representative for a quote (406-497-5333).

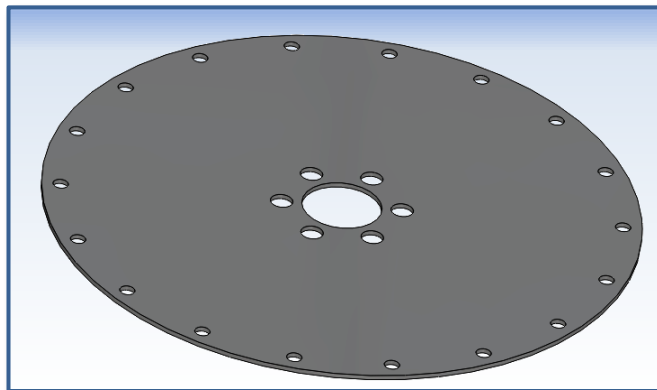


Figure 6-2: Nozzle Gasket (Resodyn Part Number 102471)

- 6.4.4.1 84 Remove snap ring on top of Nozzle Gasket / Vessel Holder with the snap ring pliers provided with your unit. Place tines of snap ring pliers in each hole of ring. Compress snap ring and pull up with the pliers. Note: the beveled edge of the snap ring is always installed facing up.

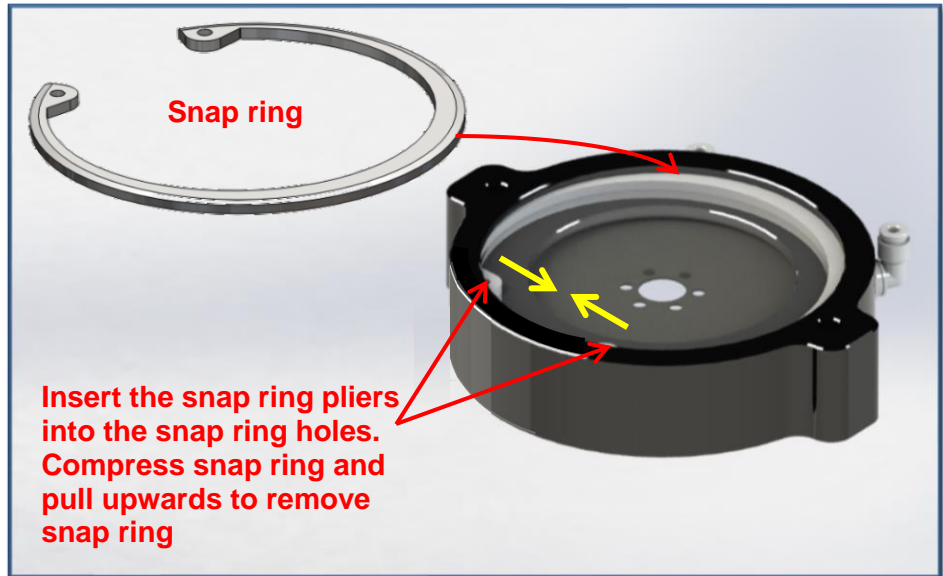


Figure 6-3: Snap Ring Removal (See Page 37 and 38 for Part Number listing)



Figure 6-4: Lid Assembly Explosion (See Page 37 and 38 for Part Number listing)

- 6.4.4.2 The gasket can now be pulled off the lid assembly as shown above and replaced.
- 6.4.4.3 The spray system is assembled in the reverse order of this section.

6.4.5 Atomizer Nozzle External Cleaning Procedure:

The Atomizer Nozzle (Resodyn Part Number 002041) can be taken out of the nozzle holder for cleaning and replacement of the sealing O-rings holding the nozzle in place.

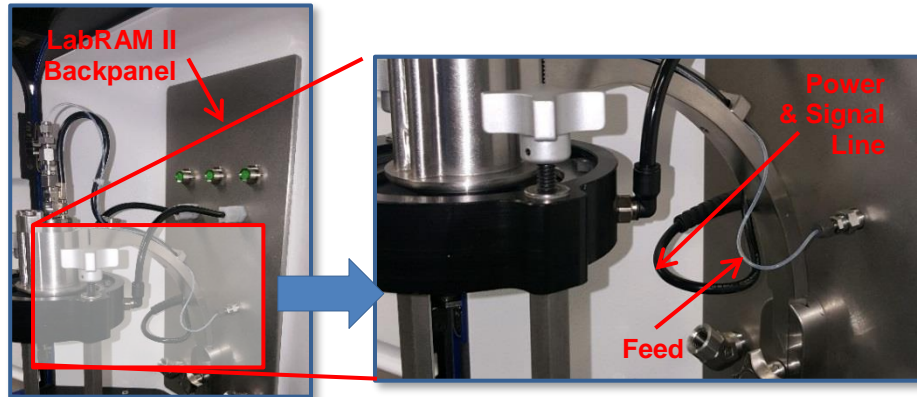


Figure 6-5: Nozzle Cleaning

- 6.4.5.1 Disconnect feedline from the backpanel by unscrewing the compression nut with fingers. Remove the power and signal cable connected to the backpanel pulling directly out of the socket. To take out the nozzle, unscrew the top tube compression nut using a 7/16" wrench, freeing the tube.

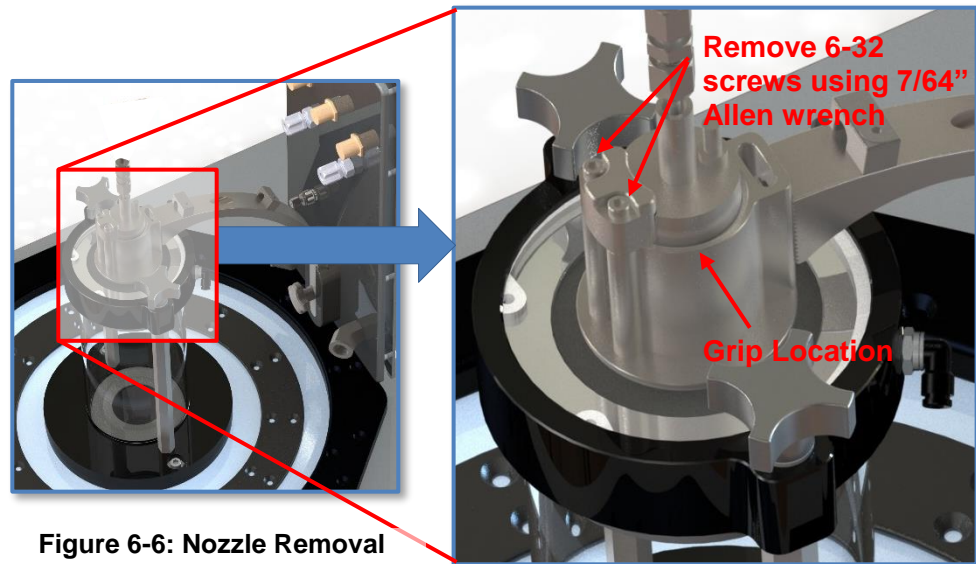


Figure 6-6: Nozzle Removal

- 6.4.5.2 Remove nozzle head. The nozzle may be removed by unscrewing the two 6-32" socket head cap screws using a 7/64" Allen wrench. The nozzle should be gripped at the top of the body with a non-marring tool such as channel locks with a soft grip (rubber and not metallic). By turning and pulling, the nozzle will release easily. **Note: Do not pull on the feed tube. It is easily damaged.**

6.5 General Cleaning Instructions

6.5.1 Masterflex L/S Precision Variable Speed Console Drive:

- 6.5.1.1 Disconnect all power from the pump before any cleaning operation is started.
- 6.5.1.2 Clean the drive enclosure using mild detergents.
- 6.5.1.3 Do not immerse or use excessive fluid when cleaning.

6.5.2 KDS Legato 100 Series Syringe Pump:

- 6.5.2.1 Disconnect all power from the pump before any cleaning operation is started.
- 6.5.2.2 To clean the exterior surfaces, use a lint-free cloth to remove loose dust.
- 6.5.2.3 Use care to avoid scratching the clear display window.
- 6.5.2.4 For more efficient cleaning, use a soft cloth dampened [not soaked] with water, an aqueous solution of 75% isopropyl alcohol, or a mild detergent.

6.5.3 Feedlines:

- 6.5.3.1 Install clean 16 fl oz glass vessel.
- 6.5.3.2 Pump cleaning liquid through system until clear.

6.5.4 Nozzle and Nozzle Gasket:

- 6.5.4.1 Place additional cleaning liquid in 16 fl oz glass vessel if needed.
- 6.5.4.2 Run LabRAM II at 30 g until gasket and nozzle surfaces are clean.
- 6.5.4.3 Remove vessel.
- 6.5.4.4 Wipe gasket and nozzle gently to dry.

7 Warranty and Service

7.1 Limited Warranty

Seller warrants that for a period of one (1) year from the date of Seller's shipment of Product to Purchaser its Product is free from defects in material and workmanship. Some newly manufactured Seller Products may contain, and Seller Service may use, remanufactured parts, which are equivalent to new in performance. The warranty period for the Product is a specified, fixed period commencing on its date of shipment, or the date of installation if installed by Seller. Seller does not warrant that the operation of Products will be uninterrupted, or error free.

If Seller receives written notice of defects from Purchaser during the warranty period, Seller will, at its option, repair or replace the affected Products.

The warranties provided herein will apply only to those Products and integral components thereof that are identified by a unique LabRAM II Spray System part number and for any Service provided by Aero Spec, Inc. employees or their authorized agents. Seller does not warrant any third party Products or Service even if included with other LabRAM II Spray System Branded Products or Service. Furthermore, Seller provides all such third party Products and Service AS IS. However, the original manufacturers or suppliers may provide their own warranties as specified in the documentation accompanying such third party Products and Service.

The above warranties do not apply to defects resulting from:

- a.) Improper or inadequate maintenance by Purchaser
- b.) Unauthorized modification
- c.) Improper use or operation outside of the Specifications for the Product
- d.) Abuse, negligence, accident, loss, or damage in transit
- e.) Improper site preparation
- f.) Unauthorized maintenance or repair

THE ABOVE WARRANTIES ARE EXCLUSIVE AND NO OTHER WARRANTY, WHETHER WRITTEN OR ORAL, IS EXPRESSED OR IMPLIED. TO THE EXTENT PERMITTED BY LAW, SELLER SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, AND NONINFRINGEMENT.

In no event shall Seller be liable for any consequential damages, or damages of any kind, or nature alleged to have resulted from any breach of warranty.

7.2 Maintenance and Service

The LabRAM II Spray System should only be operated when it is in good working condition. If the system shows any signs of visible damage or fails to operate as outlined in this manual, the system should not be operated.

If necessary, contact your Resodyn Acoustic Mixers customer service representative for questions or additional technical support related to the mixer.

Technical Support for Mixer and Spray System Operation and Maintenance:

Phone: (406) 497-5333 Fax: (406) 497-5206 e-mail: service@resodynmixers.com	Resodyn Acoustic Mixers 130 North Main, Suite 630 Butte, Montana 59701
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8 Supplemental Information

8.1 *Other Operating Manuals*

Supplemental information is provided in the following PDF links.

Operating Manual for Masterflex L/S PTFE Tubing Pump, Model 77390-00

http://www.coleparmer.com/Assets/manual_pdfs/77390-00.pdf

Operating Manual for Masterflex L/S Precision Variable Speed Console Drives, Models 07528-10, 07528-20 and 07528-30

http://www.coleparmer.com/Assets/manual_pdfs/07528-10,%20-20,%20-30%20ENGLISH.pdf

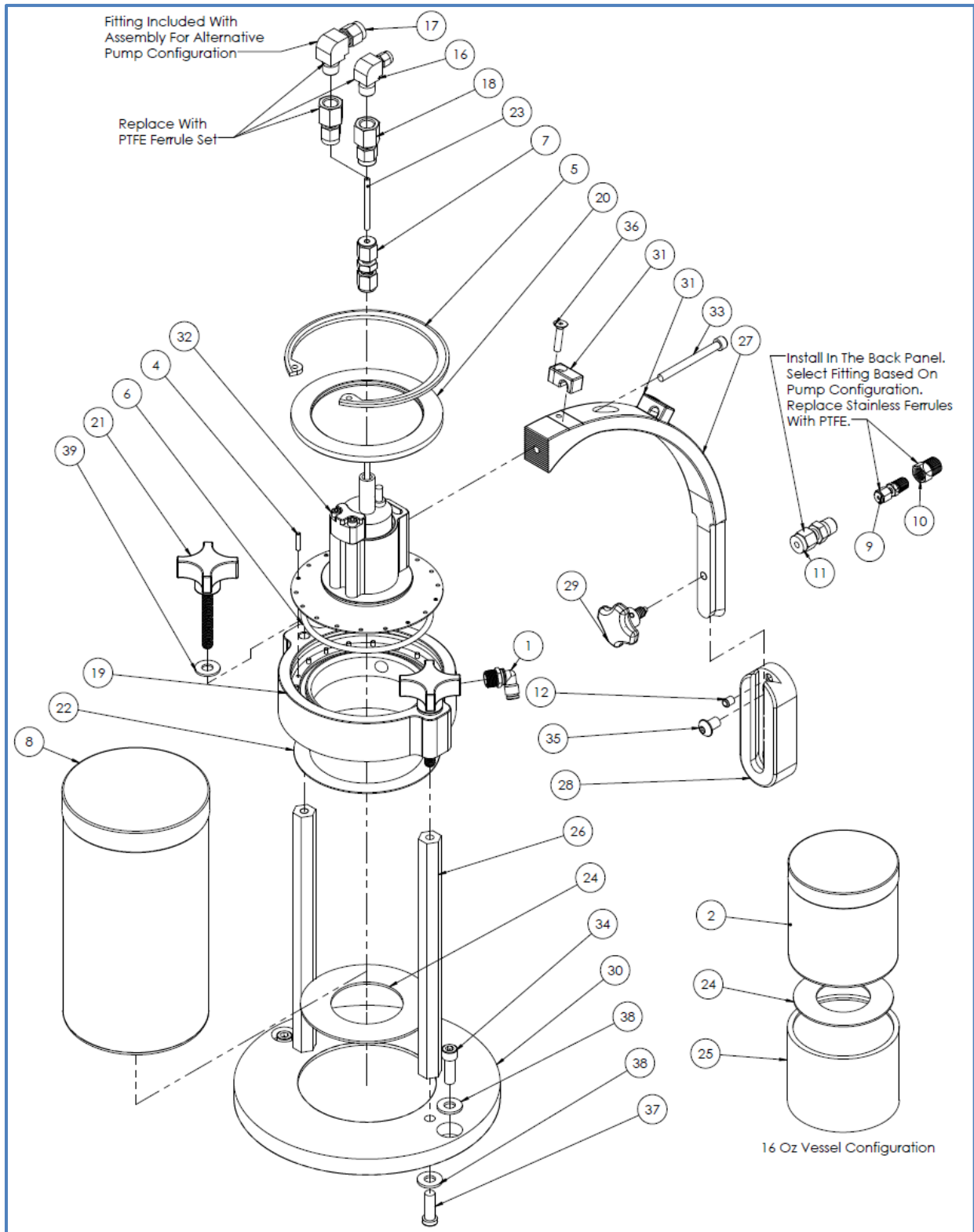
KDS Legato 100 Series User's Manual

<http://www.kdscientific.com/downloads/KDS%20Literature/Manuals/Legato%20100%20Manual%20Rev%20D%20.pdf>

Sonaer Bench-top Ultrasonic Atomizer Nozzle Generator

http://www..com/Ultrasonic_Generator.html

8.2 Replacement Parts



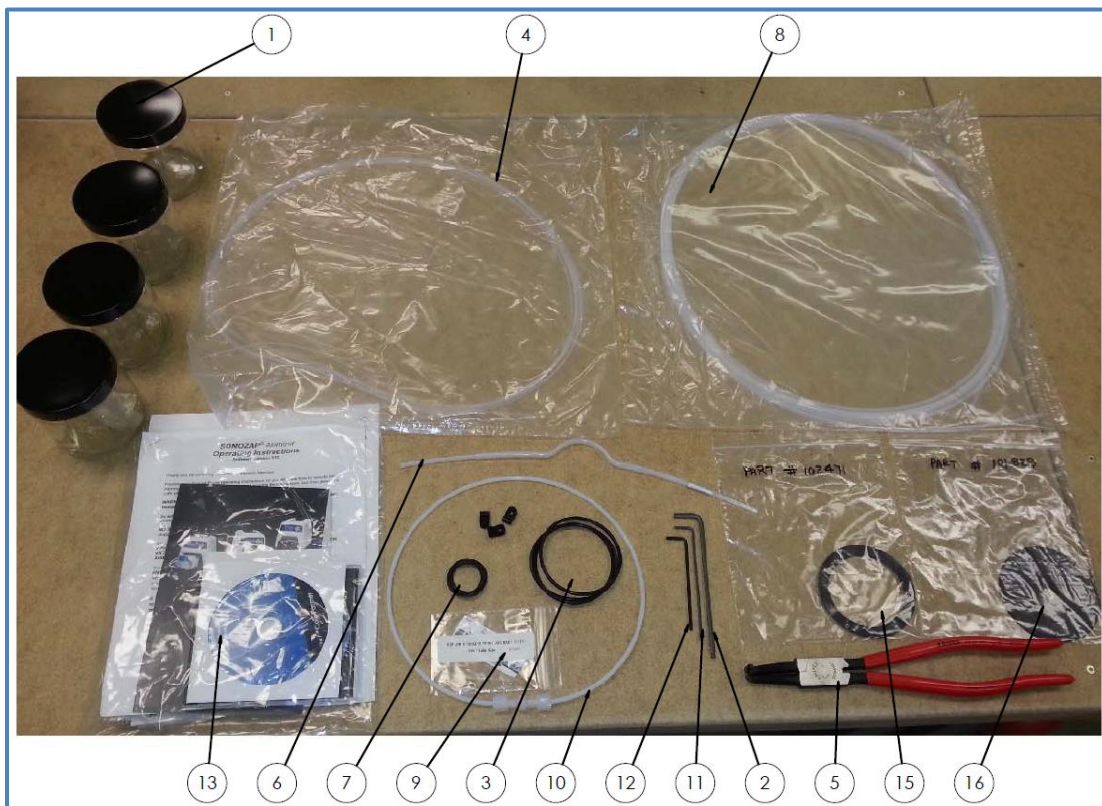
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Figure 8-1: LabRAM II Spray System Components

Item	Quantity	Part No.	Description
1	2	000310	Elbow 1/8" Tube, 1/8" NPT
2	1	000539	16oz Glass Vessel w/ Lid
3	2	002127	Ferrule Set, PTFE
4	18	002543	Dowel Pin, 3/32" x 0.5"
5	1	002544	Retaining Ring, Internal
6	1	002545	O-ring, EPDM
7	1	002714	Tube Fitting, Straight, 1/8"
8	1	002800	32 oz Glass Vessel w/ Lid
9	1	003757	Straight Fitting, 1/16 Tube x 1/16 MNPT
10	1	003758	Straight Fitting, 1/8 MNPT x 1/16 FNPT
11	1	003760	Fitting, 4mm Tube to 1/8 MNPT
12	2	004116	Press Fit Plunger
13	2	004130	PTFE Back Ferrule for 4mm Tube
14	2	004131	PTFE Front Ferrule for 4mm Tube
15	2	004132	PTFE Ferrule Set, 1/6" Tube Fitting
16	1	004133	Elbow, 1/16 Tube x 1/8 MNPT
17	1	004134	Elbow, 4mm Tube x 1/8 MNPT (provided for different configuration)
18	2	004135	Union Fitting, 1/8 FNPT x 1/8 Tube
19	1	101825	Nozzle Vessel Top Holder
20	1	101826	Vessel Top Gasket Ring
21	2	101828	Knob
22	1	102471	Gasket
23	1	102652	Tube Stub, 1/8"
24	2	104209	Gasket
25	1	104210	Spacer for 16 Oz Spray Jar
26	2	104211	Standoff Nozzle Vessel Holder
27	1	104214	Spray Arm
28	1	104215	Spray Arm Support Bracket
29	1	104216	Support Arm Tension Screw
30	1	104225	Base Vessel Holder, Atomizer
31	2	104226	Clamping Block
32	1	900656	Atomizer Assembly
33	1	B01A-0190-32-02000-ABB	SHCS, #10 x 2.00 L
34	2	B01A-0250-20-00750-ABB	SHCS, 1/4 x 0.750 L
35	2	B02A-0250-20-00375-ABB	BHCS, 1/4 x 0.375 L
36	2	B03A-0164-32-00750-ABB	FHCS, #8 x 0.750 L
37	2	B07-0250-20-00750-ABB	Low Head SHCS, 1/4 x .750 L
38	4	J01-0250-00-00063-ABB	Washer, Narrow, 1/4
39	2	J02-0250-00-00063-ABB	Washer, Regular, 1/4

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Figure 8-2: LabRAM II Supplied Parts and Tools



Item	Quantity	Part No.	Description
1	4	000539	16oz Glass Vessel w/ Lid
2	1	001446	5/32" Allen Wrench
3	3	002545	O-ring, -234, EPDM
4	1	002560	Tubing, PTFE, 1/16" (25 ft)
5	1	002561	Retaining Ring Pliers
6	1	002564	Peristaltic Pump Tubing, 4mm, PTFE
7	7	002686	O-ring, EPDM
8	1	002687	Tubing, PTFE, 4mm x 25ft
9	1	002721	1/16" Stainless Compression Fitting Sleeve Set
10	1	002722	4mm PTFE Tube & 4mm PTFE Coupler (PFA) 1.5 ft ea
11	1	002723	7/64" Allen Wrench
12	1	002724	3/32" Allen Wrench
13	1	002725	Spray System Manual & Calibration Certificates
14	4	002800	32 oz. Straight-Sided Glass Jar w/Plastic Lid
15	2	101829	Nozzle Gasket
16	2	102471	Gasket
17	2	104209	Gasket

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