

PICARRO

Maintenance Guide

A2000 Pump Rebuild for Picarro Analyzers



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Table of Contents

Picarro Notices	2
Contact Information	3
Table of Contents	4
List of Figures	5
1. Introduction.....	6
1.1 Applicability	6
1.2 Symptoms Indicating Pump Rebuild is Required	6
1.3 Pump Service Overview.....	7
2. Safety.....	8
3. System Shutdown and Preparation	9
3.1 Shutdown Using the GUI	9
3.2 Shutdown from <i>Stop Instrument</i> in Diagnostics Folder	9
3.3 Disconnections Prior to Pump Servicing.....	10
4. Pump Service	11
4.1 Required Parts and Tools	11
4.2 Disassembly	12
4.3 Reassembly	17
4.4 Repeat Service for Lower Pump Head.....	21
4.5 Reassembly and Quick Test	22
4.6 Checking the Ultimate Vacuum.....	24

List of Figures

Figure 1: Pump Service Components (Housing Cover Removed)	7
Figure 2: Shutdown Confirmation Pop-Up Dialog.....	9
Figure 3: Shutting Down Analyzer from Stop Instrument Icon.....	10
Figure 4: Pump Rebuild Kit S2009	11
Figure 5: Loosen Transfer Tube Nut	12
Figure 6: Remove the Handle	12
Figure 7: Pump Cover Removal	13
Figure 8: Housing Cover and Valve Removal	13
Figure 9: Remove Head Covers from Housing.....	14
Figure 10: Signs of Wear on Diaphragms	14
Figure 11 Lift Edges of Diaphragm and Insert Removal Tool.....	15
Figure 12: Support all Diaphragm Assembly Parts During Removal.....	16
Figure 13: Separating Diaphragm Assembly.....	16
Figure 14: Clean Diaphragm Clamping Disc	17
Figure 15: Preparing for Reinstallation.....	17
Figure 16: Washer(s) Added – Ready for Installation.....	18
Figure 17: Aligning for Installation	18
Figure 18: Tighten Assembly Firmly	19
Figure 19: Press Around Diaphragm to Smooth Down.....	19
Figure 20: Install Head Covers.....	20
Figure 21: Valves Installed – Lobe Facing Lobe	20
Figure 22: Housing Cover Installation	21
Figure 23: Turn Pump Over and Service Lower Head	21
Figure 24: Install Handle	22
Figure 25: Tighten Transfer Tube Connections.....	22
Figure 26: Cap Vacuum Inlet for Operational Quick Check.....	23
Figure 27: Vacuum Measurement Meter	24

1. Introduction

1.1 Applicability

This Maintenance Guide (MG) provides a pump rebuild procedure for the A2000 series vacuum pump, used with most G2000, L2000, and PI2000 Picarro analyzers.

1.2 Symptoms Indicating Pump Rebuild is Required

The A2000 pump valves and diaphragms are parts that can wear out over time. The following symptoms may indicate the need to perform a pump maintenance by replacing the valves and diaphragms:

- The rated ultimate vacuum can no longer be achieved.
- Pump noise level has increased.

Troubleshooting: Before proceeding with a pump maintenance, check for the following situations:

- Check all vacuum hose connections, including the pump transfer tube. Make sure they are secure and leak-free.
- Ensure the voltage selection on the side of the pump is set for the same voltage as the local power source.
- Ensure pump placement is in an area with adequate ventilation. Poor air circulation around the pump can cause overheating and degraded performance or pump failure.
- Check for overpressure in the outlet line if one is attached (uncommon). Blockage on the outline can cause excessive pump noise and inefficiency.

In demanding circumstances, it may be efficient to check and clean the pump heads on a regular basis. With normal use, the lifetime of the diaphragms and valves is typically 15,000 operating hours.

Under normal operating conditions, the pump drive system (including bearings) is maintenance free.

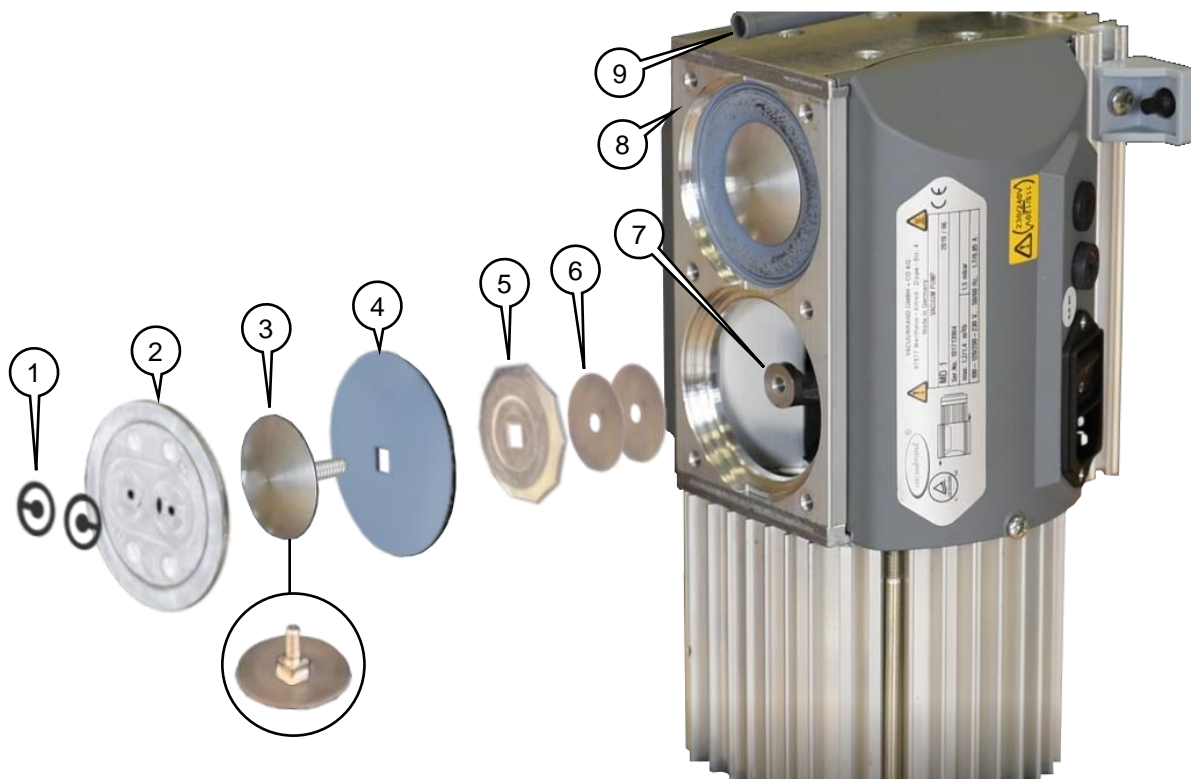
Preventive Measures: The following preventive actions can be taken to extend the pump maintenance interval.

- Avoid internal condensation, transfer of liquids or dust. The diaphragms and valves will be damaged if a significant amount of liquid is pumped through the A2000.

- If the pump is exposed to corrosive substances or accumulation of deposits, perform maintenance at more frequent intervals.
- Regular maintenance improves the lifetime of the pump and protects users and environment from exposure to potentially toxic substances.

1.3 Pump Service Overview

Below is an illustration of the parts of the pump encountered during service. As noted below, the valves and the diaphragm are the only replaceable parts. There are four heads, two on the top and two on the underside of the pump that receive the same service. Service only one side at a time to avoid mixing parts.



1. Valves (*Replaceable Part*)
2. Head Cover
3. Diaphragm Clamping Disc
(with square head screw)
4. Diaphragm (*Replaceable Part*)

5. Diaphragm Support Disc
6. Washer(s)
7. Connecting Rod
8. Pump Housing
9. Transfer Tube

Figure 1: Pump Service Components (Housing Cover Removed)

2. Safety

Read the following safety warnings prior to servicing the pump.



CAUTION

Follow the Shutdown and Disconnection procedures prior to servicing the pump. Ensure all power is disconnected.



CAUTION

Do not turn off the pump or disconnect the vacuum line while the instrument is still operating. Doing so could result in damage to the optics.



CAUTION

If you have trouble turning off the analyzer software, do NOT use the Windows Task Manager to kill the process(es). Instead, double-click on the “*Stop Instrument*” icon in the Diagnostics folder located on your desktop and select the option to “*Turn off analyzer in current state*”. See Section 3.2 and Figure 3.



CAUTION

HOT SURFACE: When disconnecting the pump line from the analyzer, remember that the area surrounding the sample inlet may be hot.



CAUTION

Never operate the pump if covers or other parts of the pump are disassembled. Never operate a defective or damaged pump.



WARNING

If the pump has been used where toxic substances may have contaminated the internal surfaces of the pump and may be released during disassembly, take appropriate precautions to use adequate personal protective equipment. This may involve the use of protective clothing, safety goggles, and gloves. Ensure that the person who will be servicing the pump is aware of the substances that may have been in contact with the pump.



CAUTION

Service only one side of the pump at a time to avoid mixing parts.

3. System Shutdown and Preparation

Complete this section before servicing the analyzer pump.

3.1 Shutdown Using the GUI

1. With the pump still running, switch to a source of clean, dry gas at the sample inlet and allow it to run until the water channel reading on the GUI falls below 0.2% (2000 ppm). This will prevent any damage from condensation to the cavity surfaces.
2. Click the **Shutdown** button located on the left side of the Data Viewer window.
3. A window will pop-up (Figure 2) asking the user to confirm the shutdown. (Note: If three options are given on an older instrument, choose the “**For Shipment**” option.)

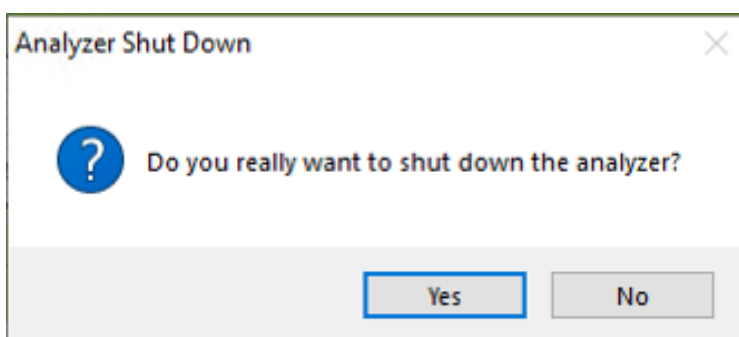


Figure 2: Shutdown Confirmation Pop-Up Dialog

- After clicking **Yes** to confirm shutdown, the analyzer software and then the computer OS will shut off after a few minutes. *Leave any dry gas or desiccant attached to the inlet during this process.*
4. When the instrument fans audibly turn off, and when the green power button light on the front of the instrument turns off, shut off the pumps manually from the rocker switch on the side of the pump.

3.2 Shutdown from *Stop Instrument* in Diagnostics Folder

To shut down instrument if analyzer software does not respond to a normal Shut down attempt from the UI:

1. Open the Diagnostics folder and double-click the *Stop Instrument* icon.
2. Select “Turn of analyzer in current state”.

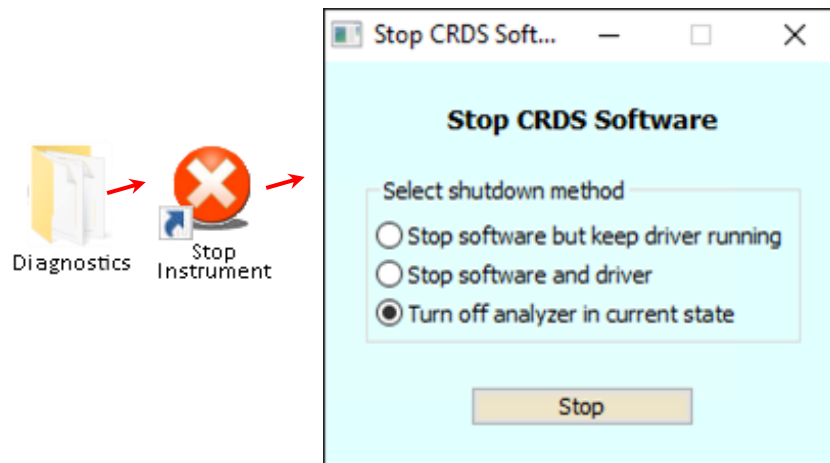


Figure 3: Shutting Down Analyzer from Stop Instrument Icon

3.3 Disconnections Prior to Pump Servicing

3. Disconnect the pump from the analyzer.
4. Disconnect the AC power cable from the pump.
5. Move the pump to an area appropriate for service.

4. Pump Service



WARNING

Ensure the pump is turned off and the power cord has been disconnected.

4.1 Required Parts and Tools

- Pump Rebuild Kit (part number S2009) This can be ordered directly from Picarro and includes 4 diaphragms, 8 valves, and a 46 mm diaphragm key. These parts may also come as part of a preventive maintenance kit.

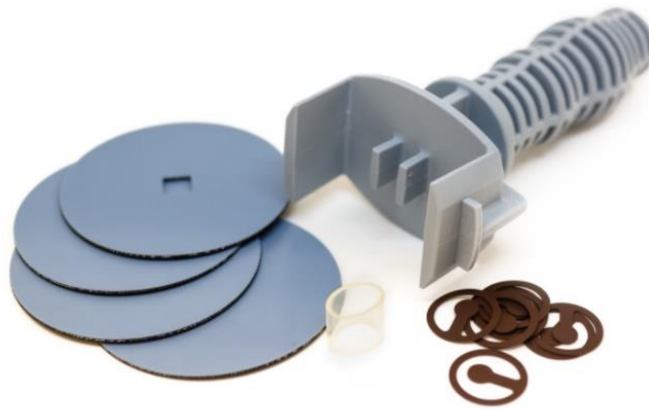


Figure 4: Pump Rebuild Kit S2009

- 13 mm open-end wrench
- 11/16" open-end wrench
- 4 mm Allen wrench
- 5 mm Allen wrench
- Small flat head screwdriver
- Isopropyl or Ethyl alcohol and towel for cleaning diaphragm clamping disc surfaces
- Vacuum gauge with adapter for connection to pump vacuum inlet
- Vacuum tubing of correct size to fit the vacuum gauge connection

4.2 Disassembly

1. Use the 13 mm open end wrench to loosen the transfer tube nut.

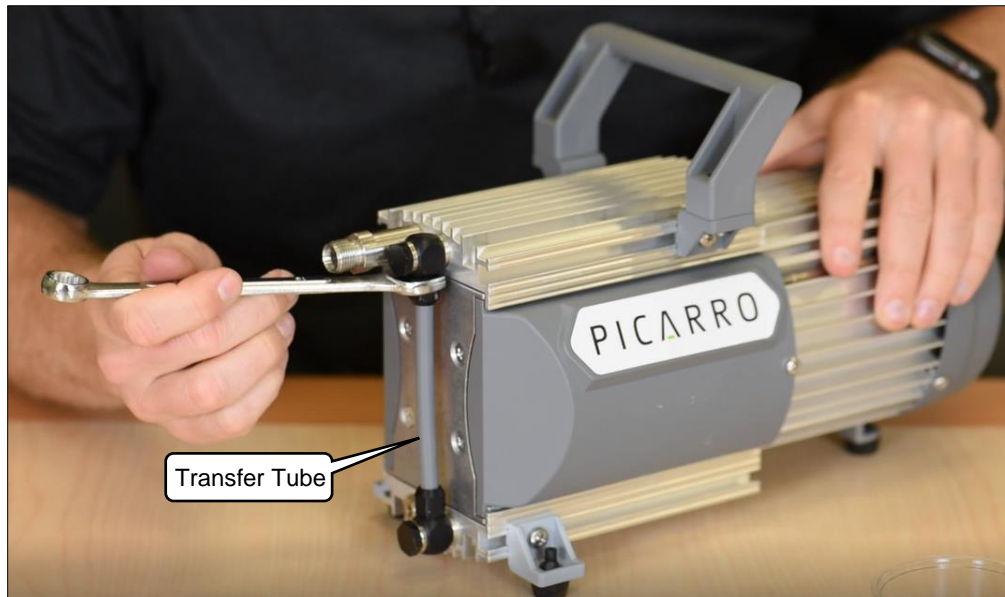


Figure 5: Loosen Transfer Tube Nut

2. Using the 5 mm Allen wrench, remove the two screws at the base of the pump handle and then remove the handle.

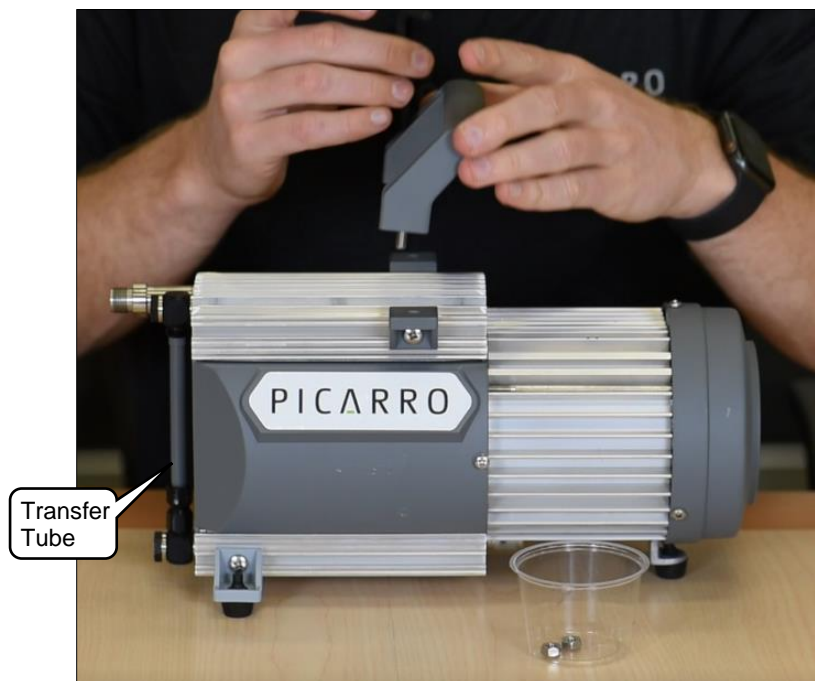


Figure 6: Remove the Handle

3. Using the 4 mm Allen wrench, loosen and remove the 6 screws from the housing cover.
4. Remove the pump housing cover and disconnect the transfer tube from the barb (this may require some force).

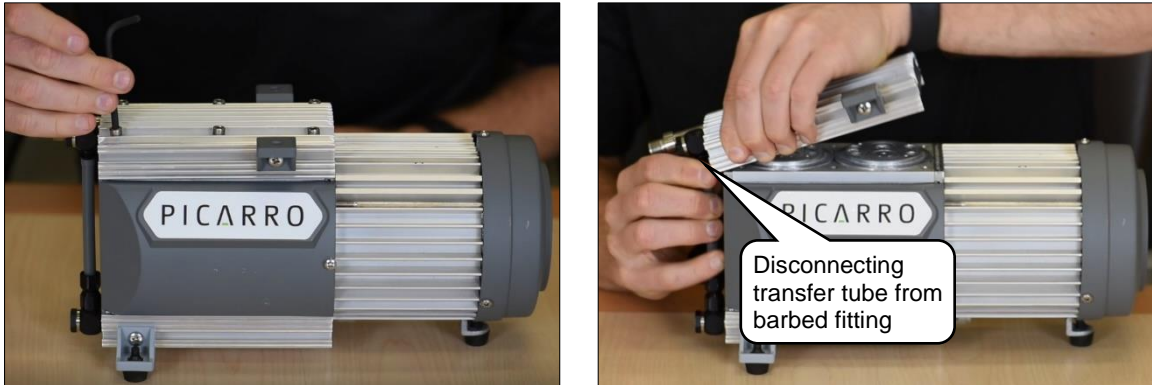


Figure 7: Pump Cover Removal

5. Note the location of the valves and take a picture to refer back to during reassembly.

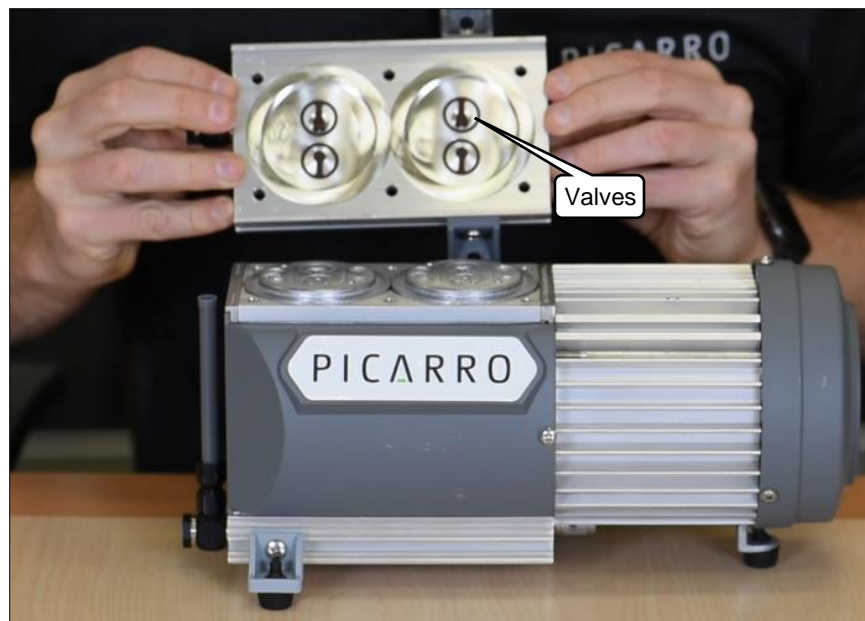


Figure 8: Housing Cover and Valve Removal

6. Remove the valves and dispose of them.
7. Remove the head covers, keeping their orientation on the bench consistent with their orientation in the pump.

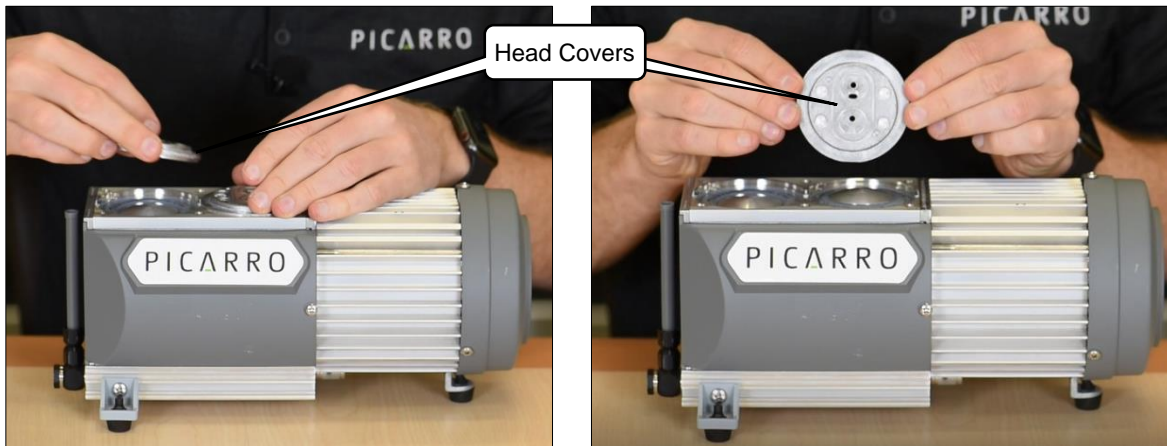


Figure 9: Remove Head Covers from Housing

8. The gray diaphragms are now visible. Some discoloration and deformation is expected due to age.



Figure 10: Signs of Wear on Diaphragms

9. Using a small flathead screw driver (shown in Figure 11), carefully fold in the edges of the diaphragm to reveal the diaphragm support disc below.



CAUTION

When using the screwdriver, be careful not to scratch the housing surfaces. Do not use any sharp tools as this can damage the diaphragm housing.

10. Place the diaphragm removal tool around the diaphragm, seating it against the flats of the diaphragm support disc located under the diaphragm.

11. Apply firm downward pressure on the tool, turning slightly if needed, until the tabs on the outer edge of the removal tool snap into place against the recessed lip of the housing (where the diaphragm seats).
12. Firmly turn the tool counter-clockwise to release the diaphragm assembly.

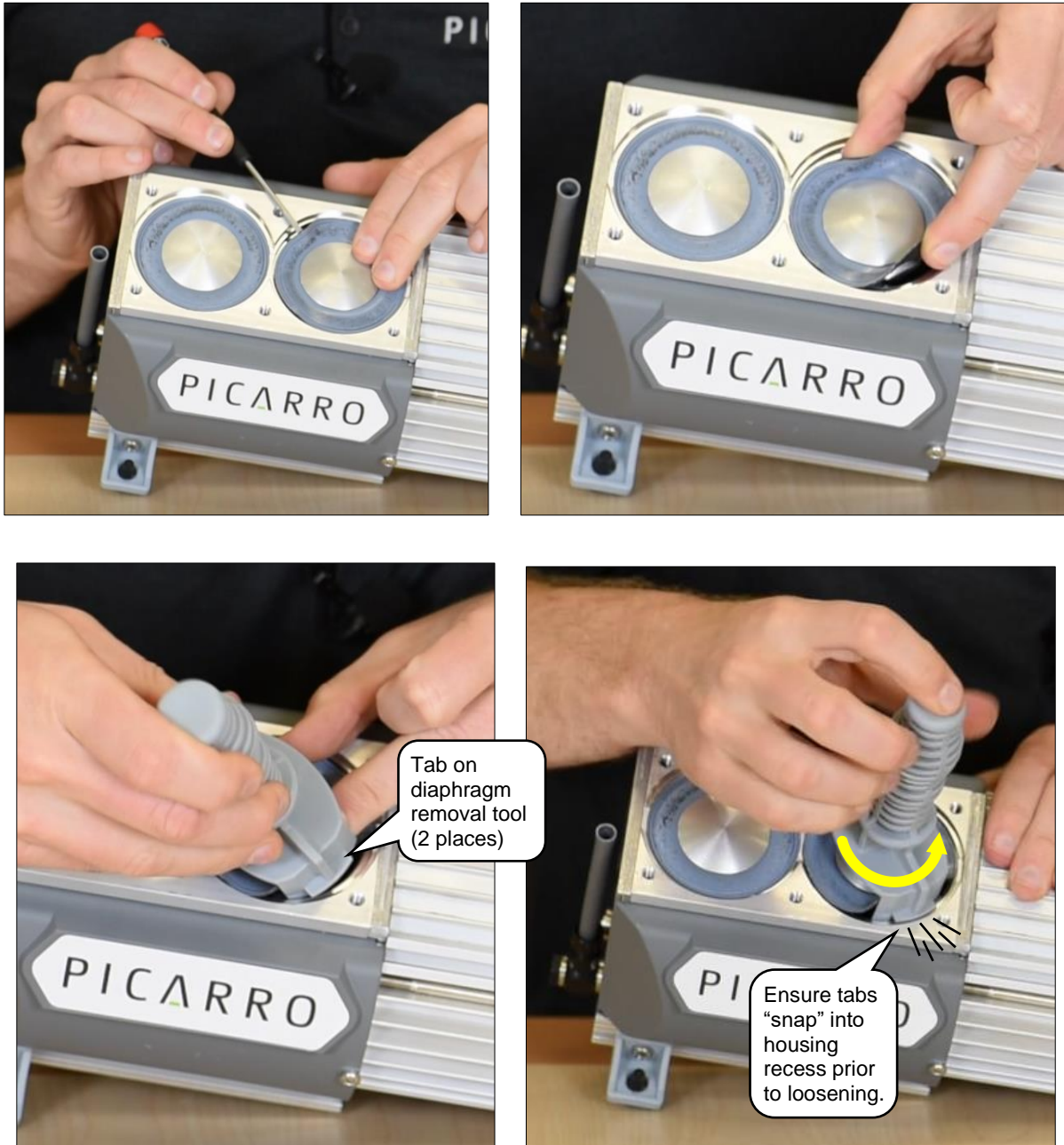


Figure 11 Lift Edges of Diaphragm and Insert Removal Tool



WARNING

Before removing the diaphragm assembly: To prevent the washers from dropping down into the pump housing, slip a finger under the diaphragm assembly and washers, then carefully lift the whole assembly out.

13. Place a finger under the diaphragm (Figure 12) to support the spacer washers as you remove the diaphragm assembly. As you remove the components be sure to note the order in which they are removed and the number of washers.



Figure 12: Support all Diaphragm Assembly Parts During Removal

14. Disassemble the Clamping Disc, Diaphragm, Support Disc, and Washer(s). (You may have to pry the Support Disc from the diaphragm underside.)

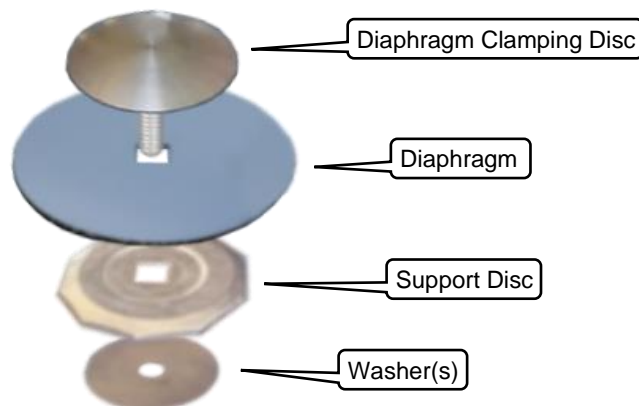


Figure 13: Separating Diaphragm Assembly

15. Clean the Diaphragm Clamping Disc top and underside with ethyl or isopropyl alcohol, then add the new diaphragm. (Black side down, gray side up).



Figure 14: Clean Diaphragm Clamping Disc

4.3 Reassembly

1. Install the new diaphragm onto the diaphragm clamping disc. Ensure the gray side is facing the rounded top of the disc and the square center hole is aligned with the squared section of the disc.
2. Install the diaphragm support disc against the black underside of the diaphragm, aligning the flat sides with the gray plastic of the removal tool.
3. Push the assembly into the diaphragm removal tool, keeping all square holes aligned. This may take some practice.



Figure 15: Preparing for Reinstallation

4. Place the washer(s) onto the assembly.



Figure 16: Washer(s) Added – Ready for Installation

5. Place the pump on its end and prepare to install the diaphragm assembly. This orientation will aid in preventing parts from falling into the housing during diaphragm installation.

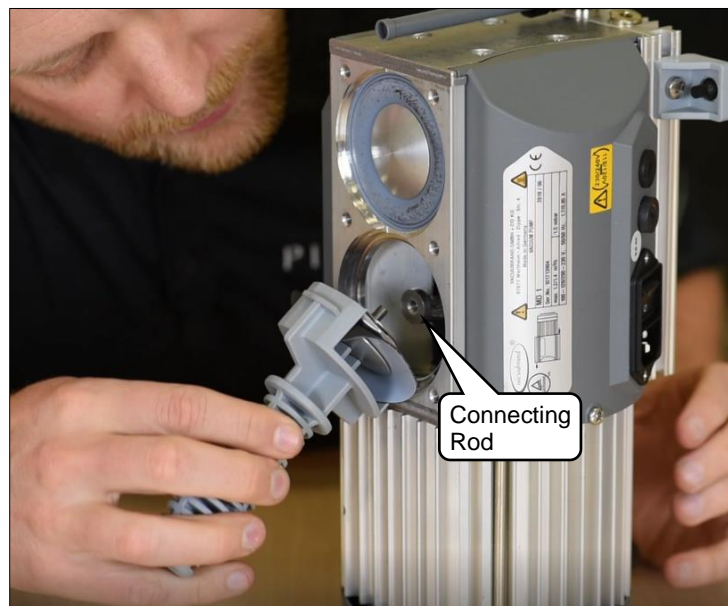


Figure 17: Aligning for Installation

6. Carefully rethread the assembly into the pump connecting rod.
7. Once fully seated, firmly tighten the diaphragm assembly, then remove the tool.



Figure 18: Tighten Assembly Firmly

8. Press around the new diaphragm to help seat it (Figure 19). (The diaphragm won't sit perfectly flat until after the head cover is installed – just ensure the diaphragm is properly centered and seated.)

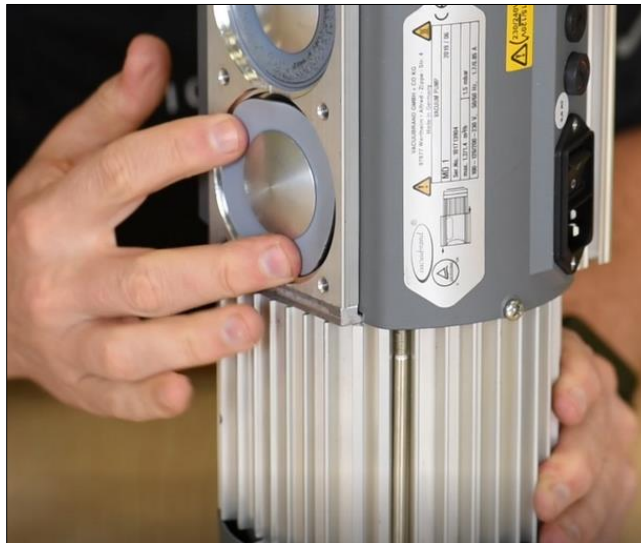


Figure 19: Press Around Diaphragm to Smooth Down

9. Repeat all the above steps for the second diaphragm.
10. Install the head covers over the two diaphragms.



Figure 20: Install Head Covers

11. Place new valves on the head covers, making sure the lobes are oriented facing toward each other as shown.

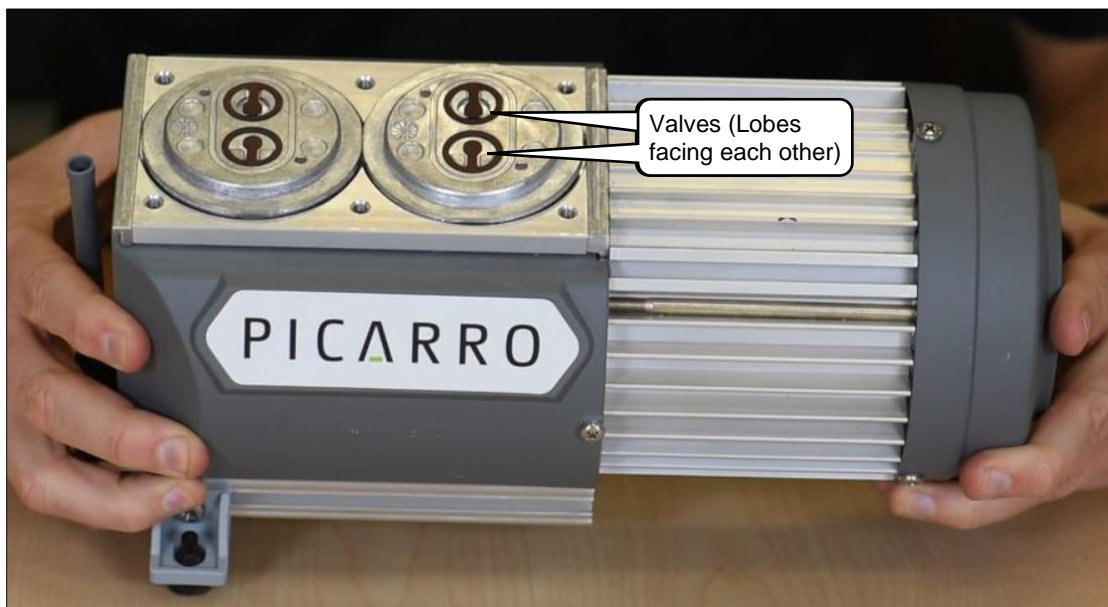


Figure 21: Valves Installed – Lobe Facing Lobe

12. Install the housing cover, reconnecting the transfer hose onto its barbed fitting, then install and tighten the six screws.

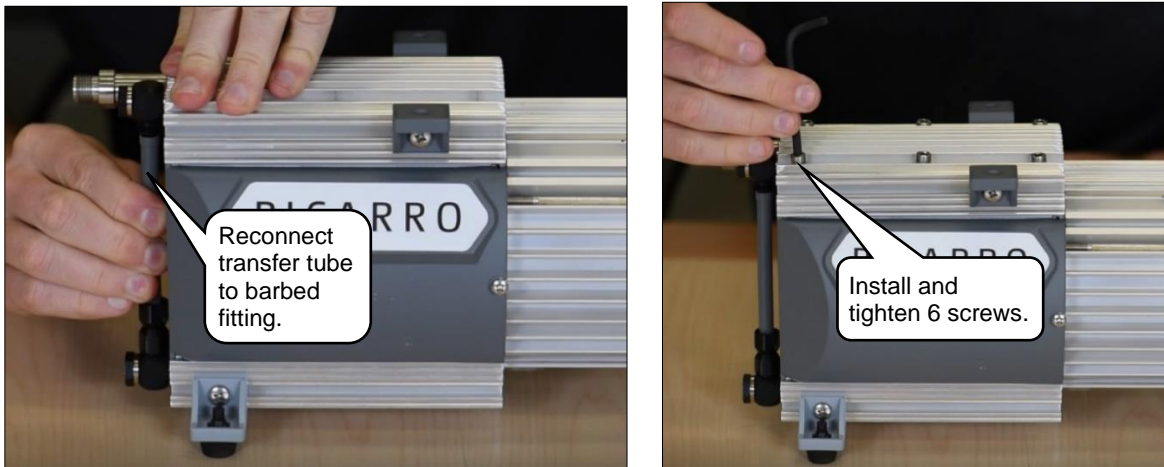


Figure 22: Housing Cover Installation

4.4 Repeat Service for Lower Pump Head

1. Flip the pump over and repeat the same service steps for the lower pump head.



Figure 23: Turn Pump Over and Service Lower Head

2. Once the lower head diaphragms and valves are replaced perform reassembly and testing in the next section.

4.5 Reassembly and Quick Test

1. Reinstall the handle (facing away from the inlet connection).



Figure 24: Install Handle

2. Using 13 mm wrench, tighten the transfer tube nuts. Do not overtighten; the nuts are plastic.



Figure 25: Tighten Transfer Tube Connections

3. To perform a quick test, cap the inlet, and confirm the pump turns on successfully and sounds like it did before. (Some hissing may occur at the inlet if the cap makes an imperfect seal; this is normal.)
4. In case of an unusual noise, switch off pump immediately and check clamping disc positions.

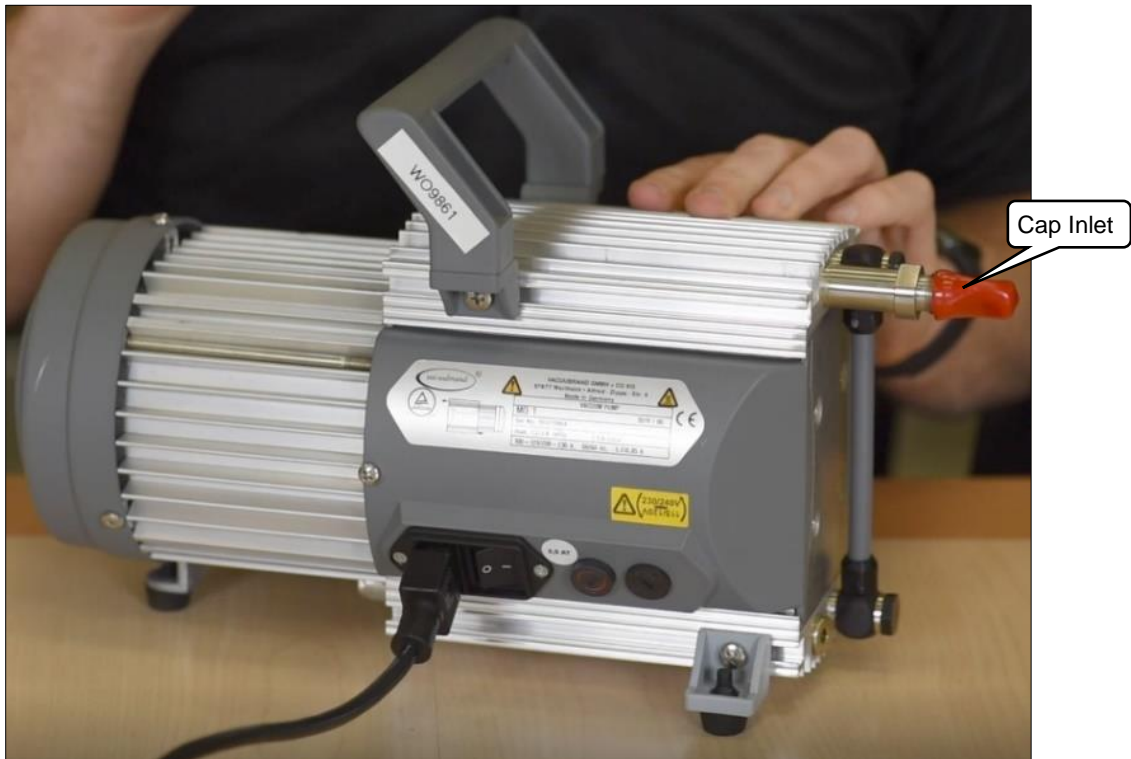


Figure 26: Cap Vacuum Inlet for Operational Quick Check

4.6 Checking the Ultimate Vacuum

After service, the ultimate vacuum of the pump should be checked to ensure the pump will achieve the correct vacuum for the instrument. Only if the pump achieves its specified ultimate vacuum.

1. Using a proper adapter, connect a vacuum pressure meter (Figure 27) to the inlet line, turn on the pump and ensure the pump is able to pull a vacuum of <math><15\text{ torr}</math> (20 mbar).



Figure 27: Vacuum Measurement Meter

If the pump does not achieve ultimate vacuum:

2. A break-in period of several hours may be required before the pump achieves its ultimate vacuum whenever the diaphragms and valves have been replaced.
3. If the ultimate vacuum is not achieved after the break-in period, check transfer tube connectors at pump heads for leaks.
4. If necessary, recheck valve seats and pump chambers.