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7. MICRO ROTARY PUMP MODULE

7.1 DESCRIPTION (Figure 7.1)

The Micro Rotary Pump Module, hereafter referred to as the Pump Module, is comprised of the following major components; a ceramic piston fabrication and a cylinder pressed into a case having intake and discharge ports. The Pump Module is within the liquid path and is designed to be easily detached from the Motor/Base Module and disassembled for ease of cleaning, decontamination and sterilization. Depending on the model number ordered, the intake and discharge ports accept either 1/4-28 or 5/16-24 male threaded fittings. The Pump Module is designed to be used in conjunction with the Microspense AP and the Rotary Adjust Motor/Base Modules.

7.2 OPERATION

When the Pump Module is mounted on the Motor/Base Module, the piston is driven by a spherical bearing mounted within a rotating spindle. This drive arrangement imparts both reciprocating and rotary motion to the piston. The magnitude of the piston's stroke is adjustable by varying the angle of the axis of the pump head relative to the axis of the motor drive shaft. This displacement range is infinitely adjustable within the pump specifications (refer to Table 7.2). Repeatability of 0.1% is obtainable once the stroke length is established.

The end of the piston is never drawn back beyond the intake and discharge ports in normal operation. The piston flat allows only one port to communicate with the interior of the pump cylinder at any time. The effect of this is positive mechanical valving, eliminating the need for check valves under normal operations.

The pump, which cannot be driven by liquid pressure, essentially acts as a closed valve when the unit is not in operation.

7.2.1 Piston/Cylinder Set

The piston/cylinder set is constructed from a variety of ceramic materials. The ceramics are compatible with most acids and bases. The piston/cylinder set has a clearance between the piston and cylinder wall of approximately .00005" which minimizes fluid slip.

The ceramic piston operates within the ceramic cylinder with no lubrication other than the liquid being dispensed or metered. The natural crystalline structure of the ceramic displays zero porosity ensuring zero retention and carryover of one liquid to the next.

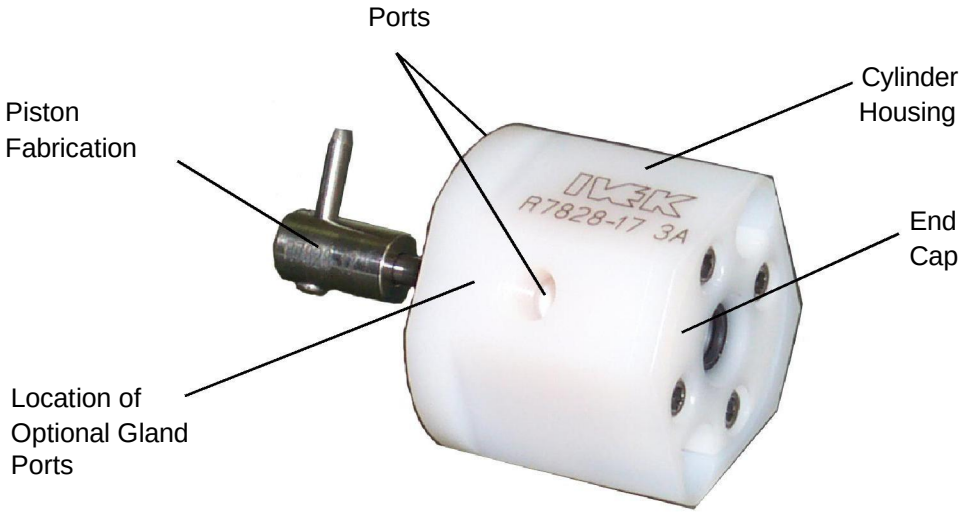


Figure 7.1 Micro Rotary Pump Module

The ceramic material's mechanical and thermal stability allows the Pump Module to be sealed by virtue of a close running clearance between the piston and the cylinder bore. This means that no compliant dynamic seals are used eliminating a part requiring frequent replacement in traditional pump designs.

7.3 INSTALLATION

No installation of the Pump Module is required. Refer to System Setup information in Chapter 2. Refer to section 7.5.3.1 for assembly and disassembly of the Pump Module to the Motor/Base Module.

7.4 OPTIONS

7.4.1 Internal Pump Modification

Modifications to the piston or cylinder can be made to provide improved pumping performance for certain liquids.

7.4.2 Fittings

Fittings are available with the Pump Module. Refer to Chapter 9 for a list of fittings and descriptions.

7.4.3 Teflon End Cap/Seal

The Teflon end cap/seal replaces the sight glass end cap and the inner O-ring. The Teflon provides the seal for the head end of the pump cylinder. The assembly disassembly procedures contain separate *italicized* instructions for this option and an illustrated parts breakdown provides a listing of the parts.

7.5 MAINTENANCE (Figure 7.2)

CAUTION

Never forcibly remove or install the piston into the cylinder housed within the Pump Module. Damage to the equipment may result.

7.5.1 Preventative Maintenance

The ceramic components for the Pump Module have been designed to last for millions of repetitions without wear. Preventative maintenance includes careful handling of the piston fabrication and cylinder housing when they have been removed from the Pump Module. Always take great care when removing the piston fabrication from the cylinder and replacing the piston fabrication into the cylinder. If the cleaning procedure includes removing the Pump Module and individually cleaning separate parts, always keep the Pump Module parts together, each piston fabrication with the cylinder housing to which it was originally mated. The number on the piston fabrication should match the number on the cylinder housing. To avoid damage or chipping, never clean in such a way that the ceramics can vibrate against each other.

CAUTION

Ceramic piston/cylinder sets are particularly sensitive to neglect and may seize if allowed to dry out without adequate cleaning.

7.5.1.1 General Applications; Routine Cleaning Procedure.

1. Disconnect intake tubing from process liquid supply container.
2. Cycle pump in continuous mode until remaining process liquid has been purged from the Pump Module liquid path.
3. Connect the intake tubing to the cleaning liquid supply container.
4. Cycle pump in continuous mode at a high prime rate to flush the cleaning liquid through the entire liquid path.

NOTE

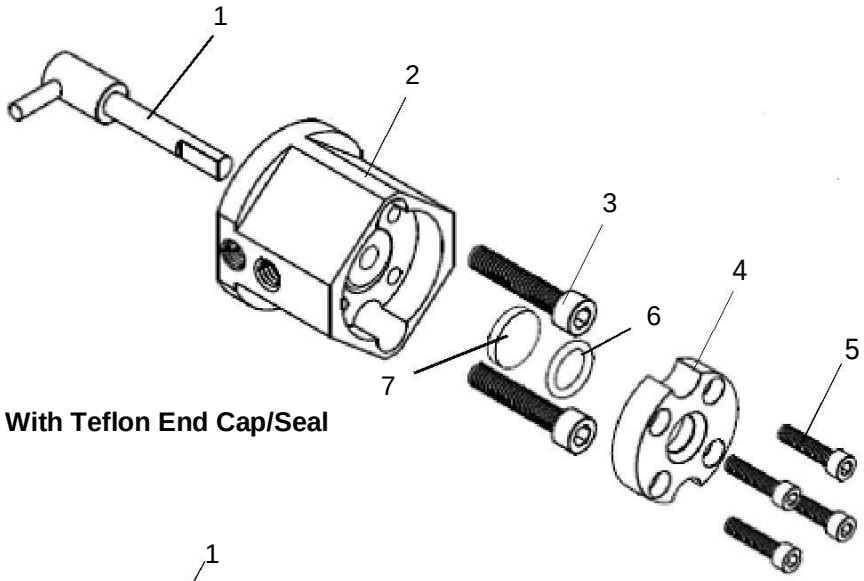
Routine flushing with a compatible liquid after shutdown may suffice for most applications.

7.5.2 O-Rings (Figure 7.2)

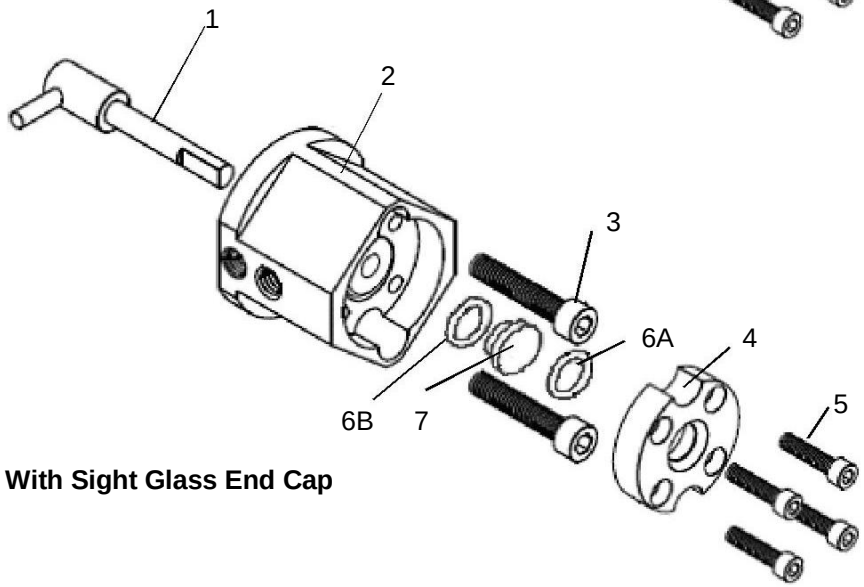
The inner O-ring (6B) serves to seal the head end of the pumping chamber.

Over time, O-rings may lose elasticity and become deformed. Periodic replacement of these O-rings is required. The replacement cycle is dependent on handling during assembly and disassembly in addition to the liquids being pumped.

Please contact technical support at IVEK Corporation with any questions or concerns you may have regarding the operation or maintenance of this module.



With Teflon End Cap/Seal



With Sight Glass End Cap

Figure 7.2 Micro Rotary Pump Module Components Assembly/Disassembly

7.5.3 Assembly/Disassembly Procedures (Figure 7.2)

The Pump Module contains the following replaceable parts. Also contained in this section are the procedures for assembling and disassembling the Pump Module from the Motor/Base Module.

- End Cap Retainer (4)
- Sight Glass End Cap (7) or *optional Teflon End Cap/Seal (7)*
- O-Rings (6, 6A and 6B)
- Cylinder/Case and Piston Assembly (1 and 2)

WARNING

Make sure the power is OFF and all hazardous liquids have been flushed from the system prior to performing any disassembly or assembly procedures.

7.5.3.1 Pump Module (Figures 7.2 & 7.3)

IVEK systems are shipped with the Pump Module assembled onto the Motor/Base Module. The following procedures are only necessary if you received a new Pump Module or for assembly after removing the Pump Module for cleaning, maintenance or repair.

Disassembly:

1. Loosen the two #8-32 socket head cap screws (3) securing the Pump Module to the face plate.
2. Pull the Pump Module away from the face plate until the piston fabrication is approximately 2/3 of the way out of the cylinder.
3. Determine the location of the spherical bearing and move the Pump Module laterally away from it until the pin in the piston fabrication slides out.

Assembly:

CAUTION

Lubricate the drive pin with Aqualube prior to assembly. Failure to lubricate the drive pin may result in damage to the Pump Module and Motor/Base Module.

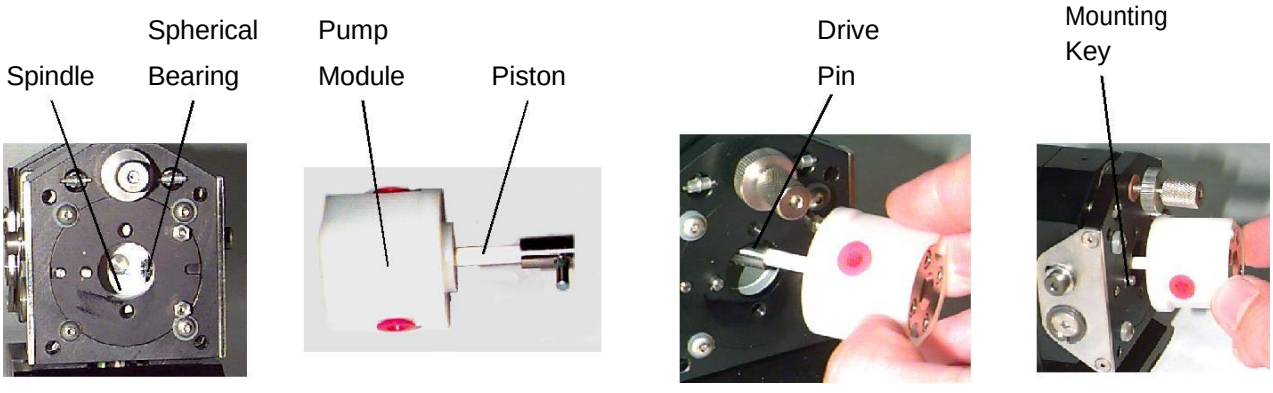


Figure 7.3 Micro Rotary Pump Module Assembly/Disassembly

1. (Image 1) Rotate the spindle on the Motor/Base Module so the spherical bearing is at the 3 O'clock position.
2. (Image 2) Extend the piston, which is housed in the Pump Module, approximately 2/3 of the way out of the cylinder.
3. (Image 3) Slide the drive pin, which is pressed into the piston end cap, into the center bore of the spherical bearing.
4. (Image 4) Position the Pump Module on the face plate aligning over the mounting key.
5. Secure the Pump Module to the swing plate by installing and tightening the two #8-32 socket head cap screws (3) torque to 5 in. lbs.

7.5.3.2 End Cap Retainer, End Cap and O-rings (Figure 7.2 items 4, 7, and 6)

Disassembly

1. Remove four #4-40 socket head cap screws (5) securing end cap retainer (4) to cylinder housing (2).
2. Remove end cap retainer (4).
3. Remove inner O-ring (6B), sight glass end cap (7) and outer O-ring (6A).
   OR if optional Teflon end cap/seal purchased.
3. *Remove Teflon end cap/seal (7) and O-ring (6).*

NOTE

Clean and inspect seals (6 or 7) prior to assembly. (Replace if necessary)

Assembly

1. Position outer O-ring (6A), sight glass end cap (7) and inner O-ring (6B) into the recessed diameter of end cap retainer
   (4).
   OR if optional Teflon end cap/seal purchased.
1. *Position O-ring (6) and Teflon end cap/seal (7) into the recessed diameter of end cap retainer (4).*

NOTE

Install sight glass end cap with the reduced diameter facing towards the cylinder housing.

2. Position end cap retainer (4), with installed components into the recessed diameter of cylinder housing (2).
3. Secure with four #4-40 socket head cap screws (5) torque to 5 in. lbs.

7.5.3.3 Cylinder/Case and Piston (Figure 7.2 Items 1 and 2)

NOTE

The piston and cylinder are a matched set. If either the cylinder/case or piston needs replacing, both parts must be replaced.

Disassembly

1. Remove the Pump Module from the Motor/Base Module as described in section 7.5.3.1.
2. Remove four screws (5) securing end cap retainer (4) to cylinder housing (2).
3. Remove end cap retainer (4).
4. Remove inner O-ring (6B), sight glass end cap (7) and outer O-ring (6A).
   OR if optional Teflon end cap/seal purchased.
4. *Remove Teflon end cap/seal (7) and O-ring (6).*

NOTE

Clean and inspect seals (6 and 7) prior to assembly. (Replace if necessary)

Assembly

1. Position outer O-ring (6A), sight glass end cap (7) and inner O-ring (6B) into the recessed diameter of end cap retainer
   (4).
   OR if optional Teflon end cap/seal purchased.
1. *Position O-ring (6) and Teflon end cap/seal (7) into the recessed diameter of end cap retainer (4).*

NOTE

Install sight glass end cap with the reduced diameter facing towards the cylinder housing.

2. Position end cap retainer (4), with installed components into the recessed diameter of cylinder/case fabrication (2).
3. Secure with four #4-40 socket head cap screws (5) and torque to 5 in. lbs.
4. Assemble the Pump Module onto the Motor/Base Module as described in section 7.5.3.1.

7.6 PROBLEM GUIDE

7.6.1 Piston Seized In The Cylinder (Figure 7.3)

7.6.1.1 Tool Required

Pump Extractor Tool Kit IVEK Part Number 072087
9/64" Allen Wrench
3/32" Allen Wrench

7.6.1.2 Procedure (Figures 7.2 & 7.3)

If the piston seizes in the cylinder perform the following steps.

CAUTION

DO NOT TRY TO FORCE THE PISTON FREE!
Damage to the piston/cylinder set or Motor/Base Module may occur.

1. Remove four #4-40 socket head cap screws (5).
2. Remove end cap retainer, sight glass/Teflon seal and O-ring/s.
3. Remove two #8-32 socket head cap screws (3).
4. Install end cap extractor with countersink out using the four #4-40 socket head cap screws (5).
5. Insert correct size extractor tip into the thumb screw knob.
6. Turn (by hand) the thumb screw knob (clockwise) into the end cap extractor until cylinder housing (2) becomes loose from piston fabrication (1).
7. Remove cylinder housing (2).

If step 7 cannot be performed, move the cylinder housing (2) laterally until the pin in the piston fabrication slides out of the spherical bearing then perform steps 8 and 9.

8. Soak the whole assembly in a liquid compatible with the materials and process liquids.
9. After soaking, try removing the piston from the cylinder by applying a light torque to the piston using only your fingers (no tools).

If the aforementioned procedures fail, contact IVEK Technical Support Department. It may be necessary to ship the Pump and Motor/Base Modules back to the factory. Provide a note describing, in detail, what conditions caused the seizure.

7.6.2 Additional Problems

Table 7.1 contains a list of possible problems, causes and solutions for the Pump Module.

7.7 SPECIFICATIONS

Table 7.2 lists the volumetric output of the different size Pump Modules. Refer to the Title Page section of this manual for the Pump Module size provided with your system.

Table 7.2 Maximum Volumetric Output Per Rotation Of Micro Rotary Pump Modules

Size	Max Displacement Per Stroke (µl)	Recommended Min Displacement Per Stroke (µl)
3A	25	1
2A	50	5
1A	100	10

7.8 MODEL NUMBER

The model number provides important information about the specifics of your Pump Module. Refer to this number when calling IVEK Technical support. The model number for your Pump Module is located in the Title Page section of this manual.

W/Teflon End Cap **102103 -** **# # ##**
W/Sight Glass End Cap **102109 -** **# # ##**

End Cap Retainer Material

- **1** - White Delrin
- **2** - 303 Stainless Steel

O-Ring Material

- **1** - Buna-N
- **2** - Ethylene Propylene
- **3** - Kalrez
- **4** - Polyurethane
- **5** - Silicone
- **6** - Teflon
- **7** - Teflon Encapsulated Silicone
- **8** - Viton
- **9** - Teflon Encapsulated Viton

Pump Case / Ceramics

- **11** - 1/4 - 28, 3A Hip/YTZP
- **21** - 5/16 - 24, 3A Hip/YTZP
- **1A** - 1/4 - 28, 3A Hip/YTZP, W/Gland
- **2A** - 5/16 - 24, 3A Hip/YTZP, W/Gland
- **31** - 1/4 - 28, 3A Hip/YTZP/Alumina
- **42** - 5/16 - 24, 3A Hip/YTZP/Alumina
- **3A** - 1/4 - 28, 3A Hip/YTZP/Alumina, W/Gland
- **4A** - 5/16 - 24, 3A Hip/YTZP/Alumina, W/Gland
- **12** - 1/4 - 28, 3A Mag Zirc
- **22** - 5/16 - 24, 3A Mag Zirc
- **1B** - 1/4 - 28, 3A Mag Zirc, W/Gland
- **2B** - 5/16 - 24, 3A Mag Zirc, W/Gland
- **13** - 1/4 - 28, 2A Mag Zirc
- **23** - 5/16 - 24, 2A Mag Zirc
- **1C** - 1/4 - 28, 2A Mag Zirc, W/Gland
- **2C** - 5/16 - 24, 2A Mag Zirc, W/Gland
- **14** - 1/4 - 28, 2A Alumina
- **24** - 5/16 - 24, 2A Alumina
- **1D** - 1/4 - 28, 2A Alumina, W/Gland
- **2D** - 5/16 - 24, 2A Alumina, W/Gland
- **15** - 1/4 - 28, 1A Mag Zirc
- **25** - 5/16 - 24, 1A Mag Zirc
- **1E** - 1/4 - 28, 1A Mag Zirc, W/Gland
- **2E** - 5/16 - 24, 1A Mag Zirc, W/Gland
- **16** - 1/4 - 28, 1A Alumina
- **26** - 5/16 - 24, 1A Alumina
- **1F** - 1/4 - 28, 1A Alumina, W/Gland
- **2F** - 5/16 - 24, 1A Alumina, W/Gland
- **17** - 1/4 - 28, 1A HEX SA SIC
- **27** - 5/16 - 24, 1A HEX SA SIC
- **1G** - 1/4 - 28, 1A HEX SA SIC, W/Gland
- **2G** - 5/16 - 24, 1A HEX SA SIC, W/Gland

7.9 ILLUSTRATED PARTS BREAKDOWN

The illustrated parts breakdown (Figures 7.4) contains replacement parts for the Micro Rotary Pump Module.

Table 7.1 Common Operational Problems And Solutions

PROBLEM	PROBABLE CAUSE	POSSIBLE SOLUTION
Air evident in discharge line.	Loose/Damaged Ferrules.	Tighten/replace ferrules.
	Loose or damaged intake tubing.	Tighten/replace intake tubing.
	Loose/Damaged End Cap Seals.	Clean, inspect and replace if necessary.
	Cavitation	
	Particulate materials entrapped between piston and cylinder or liquid has polymerized.	Increase feed pressure, inlet tubing size or reduce Pump Module speed.
Piston seizing	Improperly seated or worn end cap retainer, sight glass, end cap or O-ring.	Disassemble Pump Module and clean all wetted surfaces.
Fluid leaks	Loose/damaged ferrule or tubing.	Disassemble Pump Module and clean all wetted surfaces, inspect components and replace if necessary.
		Inspect and replace ferrule or tubing if necessary.

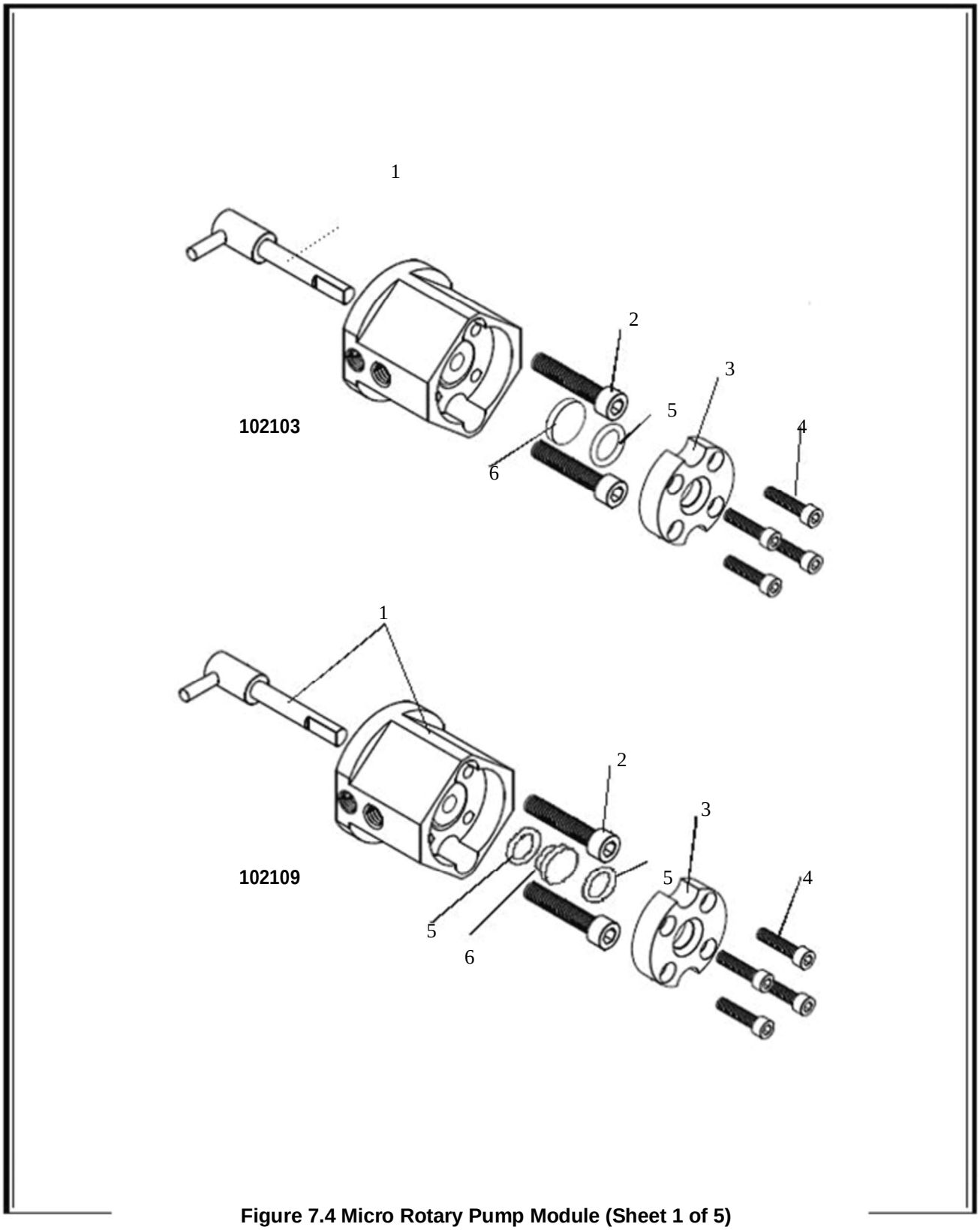


Figure 7.4 Micro Rotary Pump Module (Sheet 1 of 5)

	PART NUMBER	DESCRIPTION	UNITS PER ASSY
	102103-####	**Micro Rotary Pump Module W/Teflon End Cap**	**1**

Model # Tab	Dwg Index #	Part #	Description	Qty
	2	182011-C08088	Scr, Soc Hd Cap, 18-8; 8-32 x 0.88	2
	4	182011-C04088	Scr, Soc Hd Cap, 18-8; 4-40 x 0.88	4
	6	102104	End Cap, Teflon	1
102103 - #### END CAP RETAINER MATERIAL Contains 1 of the Following:				
1	3	102171-001	End Cap Retainer; White Delrin	1
2	3	102171-003	" ; 303 Stainless Steel	1
102103 - #### O-RING MATERIAL Contains 1 of the Following:				
1	5	142294-01101	O-Ring; -011 Buna-N	1
2	5	142294-01102	" ; -011 Ethylene Propylene	1
3	5	142294-01103	" ; -011 Kalrez	1
4	5	142294-01104	" ; -011 Polyurethane	1
5	5	142294-01105	" ; -011 Silicone	1
6	5	142294-01106	" ; -011 Teflon	1
7	5	142294-01107	" ; -011 Teflon Encapsulated Silicone	1
8	5	142294-01108	" ; -011 Viton	1
9	5	142294-01109	" ; -011 Teflon Encapsulated Viton	1
102103 - #### PUMP CASE / CERAMICS Contains 1 of the Following:				
11	1	102105-110	Micro Rotary Pump Case Fab; 1/4-28, 3A Hip/YTZP	1
21	1	102105-210	" ; 5/16-24, 3A Hip/YTZP	1
1A	1	102105-3A0	" ; 1/4-28, 3A Hip/YTZP W/Gland	1
2A	1	102105-4A0	" ; 5/16-24, 3A Hip/YTZP W/Gland	1
31	1	102105-110	" ; 1/4-28, 3A Hip/YTZP/Alumina	1
42	1	102105-210	" ; 5/16-24, 3A Hip/YTZP/Alumina	1
3A	1	102105-3A0	" ; 1/4-28, 3A Hip/YTZP/Alumina W/Gland	1
4A	1	102105-4A0	" ; 5/16-24, 3A Hip/YTZP/Alumina W/Gland	1
12	1	102105-120	" ; 1/4-28, 3A Mag Zirc	1
22	1	102105-220	" ; 5/16-24, 3A Mag Zirc	1
1B	1	102105-3B0	" ; 1/4-28, 3A Mag Zirc W/Gland	1
2B	1	102105-4B0	" ; 5/16-24, 3A Mag Zirc W/Gland	1
13	1	102105-130	" ; 1/4-28, 2A Mag Zirc	1
23	1	102105-230	" ; 5/16-24, 2A Mag Zirc	1
1C	1	102105-3C0	" ; 1/4-28, 2A Mag Zirc W/Gland	1
2C	1	102105-4C0	" ; 5/16-24, 2A Mag Zirc W/Gland	1
14	1	102105-140	" ; 1/4-28, 2A Alumina	1
24	1	102105-240	" ; 5/16-24, 2A Alumina	1
1D	1	102105-3D0	" ; 1/4-28, 2A Alumina W/Gland	1
2D	1	102105-4D0	" ; 5/16-24, 2A Alumina W/Gland	1
15	1	102105-150	" ; 1/4-28, 1A Mag Zirc	1
25	1	102105-250	" ; 5/16-24, 1A Mag Zirc	1
1E	1	102105-3E0	" ; 1/4-28, 1A Mag Zirc W/Gland	1
2E	1	102105-4E0	" ; 5/16-24, 1A Mag Zirc W/Gland	1

Figure 7.4 Micro Rotary Pump Module (Sheet 2 of 5)

		PART NUMBER	DESCRIPTION	UNITS PER ASSY
		102103-####	**Micro Rotary Pump Module W/Teflon End Cap**	**1**

Model # Tab	Dwg Index #	Part #	Description	Qty
102103 - # # #			**PUMP CASE / CERAMICS Contains 1 of the Following:**	
16	1	102105-160	" ; 1/4-28, 1A Alumina	1
26	1	102105-260	" ; 5/16-24, 1A Alumina	1
1F	1	102105-3F0	" ; 1/4-28, 1A Alumina W/Gland	1
2F	1	102105-4F0	" ; 5/16-24, 1A Alumina W/Gland	1
17	1	102105-170	" ; 1/4-28, 1A HEX SA SIC	1
27	1	102105-270	" ; 5/16-24, 1A HEX SA SIC	1
1G	1	102105-3G0	" ; 1/4-28, 1A HEX SA SIC W/Gland	1
2G	1	102105-4G0	" ; 5/16-24, 1A HEX SA SIC W/Gland	1

Figure 7.4 Micro Rotary Pump Module (Sheet 3 of 5)

	PART NUMBER	DESCRIPTION	UNITS PER ASSY
	102109-####	**Micro Rotary Pump Module W/Sight Glass End Cap**	**1**

Model # Tab	Dwg Index #	Part #	Description	Qty
	2	182011-C08088	Scr, Soc Hd Cap, 18-8; 8-32 x 0.88	2
	4	182011-C04088	Scr, Soc Hd Cap, 18-8; 4-40 x 0.88	4
	6	022044	End Cap, Sight Glass	1
102109 -#	**# ## END CAP RETAINER MATERIAL Contains 1 of the Following:**			
1	3	102171-001	End Cap Retainer; White Delrin	1
2	3	102171-003	" ; 303 Stainless Steel	1
102109 - #	**### O-RING MATERIAL Contains 1 of the Following:**			
1	5	142294-01101	O-Ring; -011 Buna-N	2
2	5	142294-01102	" ; -011 Ethylene Propylene	2
3	5	142294-01103	" ; -011 Kalrez	2
4	5	142294-01104	" ; -011 Polyurethane	2
5	5	142294-01105	" ; -011 Silicone	2
6	5	142294-01106	" ; -011 Teflon	2
7	5	142294-01107	" ; -011 Teflon Encapsulated Silicone	2
8	5	142294-01108	" ; -011 Viton	2
9	5	142294-01109	" ; -011 Teflon Encapsulated Viton	2
102109 - #	**## PUMP CASE / CERAMICS Contains 1 of the Following:**			
11	1	102105-110	Micro Rotary Pump Case Fab; 1/4-28, 3A Hip/YTZP	1
21	1	102105-210	" ; 5/16-24, 3A Hip/YTZP	1
1A	1	102105-3A0	" ; 1/4-28, 3A Hip/YTZP W/Gland	1
2A	1	102105-4A0	" ; 5/16-24, 3A Hip/YTZP W/Gland	1
31	1	102105-110	" ; 1/4-28, 3A Hip/YTZP/Alumina	1
42	1	102105-210	" ; 5/16-24, 3A Hip/YTZP/Alumina	1
3A	1	102105-3A0	" ; 1/4-28, 3A Hip/YTZP/Alumina W/Gland	1
4A	1	102105-4A0	" ; 5/16-24, 3A Hip/YTZP/Alumina W/Gland	1
12	1	102105-120	" ; 1/4-28, 3A Mag Zirc	1
22	1	102105-220	" ; 5/16-24, 3A Mag Zirc	1
1B	1	102105-3B0	" ; 1/4-28, 3A Mag Zirc W/Gland	1
2B	1	102105-4B0	" ; 5/16-24, 3A Mag Zirc W/Gland	1
13	1	102105-130	" ; 1/4-28, 2A Mag Zirc	1
23	1	102105-230	" ; 5/16-24, 2A Mag Zirc	1
1C	1	102105-3C0	" ; 1/4-28, 2A Mag Zirc W/Gland	1
2C	1	102105-4C0	" ; 5/16-24, 2A Mag Zirc W/Gland	1
14	1	102105-140	" ; 1/4-28, 2A Alumina	1
24	1	102105-240	" ; 5/16-24, 2A Alumina	1
1D	1	102105-3D0	" ; 1/4-28, 2A Alumina W/Gland	1
2D	1	102105-4D0	" ; 5/16-24, 2A Alumina W/Gland	1
15	1	102105-150	" ; 1/4-28, 1A Mag Zirc	1
25	1	102105-250	" ; 5/16-24, 1A Mag Zirc	1
1E	1	102105-3E0	" ; 1/4-28, 1A Mag Zirc W/Gland	1
2E	1	102105-4E0	" ; 5/16-24, 1A Mag Zirc W/Gland	1
16	1	102105-160	" ; 1/4-28, 1A Alumina	1
26	1	102105-260	" ; 5/16-24, 1A Alumina	1

Figure 7.4 Micro Rotary Pump Module (Sheet 4 of 5)

	PART NUMBER	DESCRIPTION	UNITS PER ASSY
	102109-####	**Micro Rotary Pump Module W/Sight Glass End Cap**	**1**

Model # Tab	Dwg # Index #	Part #	Description	Qty
102109 - # # ## PUMP CASE / CERAMICS Contains 1 of the Following:				
1F	1	102105-3F0	Micro Rotary Pump Case Fab; 1/4-28, 1A Alumina W/Gland	1
2F	1	102105-4F0	" ; 5/16-24, 1A Alumina W/Gland	1
17	1	102105-170	" ; 1/4-28, 1A HEX SA SIC	1
27	1	102105-270	" ; 5/16-24, 1A HEX SA SIC	1
1G	1	102105-3G0	" ; 1/4-28, 1A HEX SA SIC W/Gland	1
2G	1	102105-4G0	" ; 5/16-24, 1A HEX SA SIC W/Gland	1

Figure 7.4 Micro Rotary Pump Module (Sheet 5 of 5)

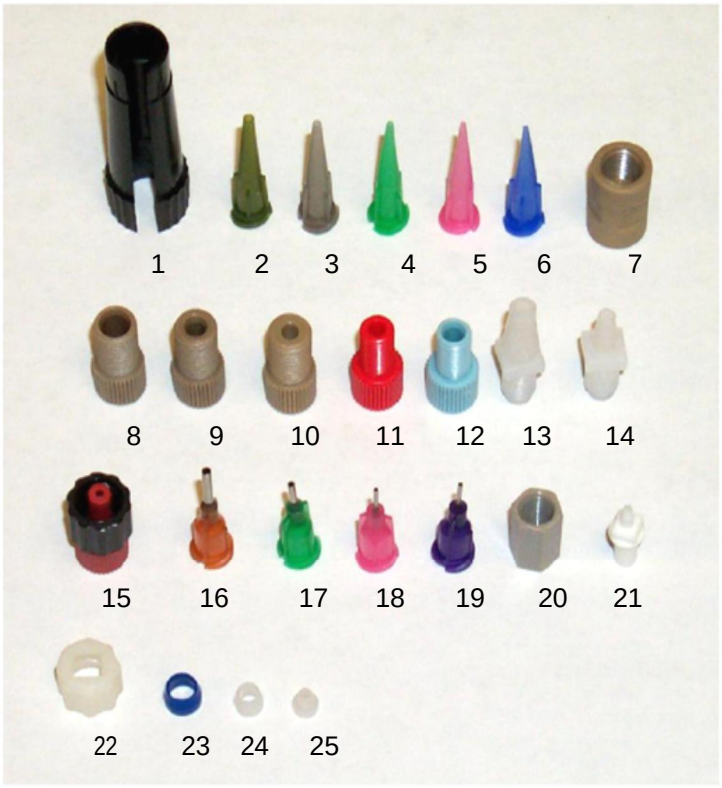


Figure 7.5 Fittings (Sheet 1 of 4)

	PART NUMBER	DESCRIPTION	UNITS PER ASSY
	142092	**Tubing Accessory Kit, A-Size Hi-Flo, 2A-Size Hi-Flo**	**1**
1	142220	Tool, Extender	1
2	142243-006	Dispense Tip, Tapered, Poly; 14 Ga, Olive	2
3	142243-005	Dispense Tip, Tapered, Poly; 16 Ga, Grey	2
4	142243-004	Dispense Tip, Tapered, Poly; 18 Ga, Green	2
5	142243-003	Dispense Tip, Tapered, Poly; 20 Ga, Pink	2
6	142243-002	Dispense Tip, Tapered, Poly; 22 Ga, Blue	2
7	142232	Fitting, Adapter, 1/4-28 x 5/16-24	1
8	142235	Nut, Flgless Ftg, 5/16-24, 3/16 Tube, Peek	4
9	142489	Nut, Flgless Ftg, 5/16-24, Natural Peek, 1/8 Tub	2
10	142444	Nut, Flgless Ftg, 5/16-24, 1/16 Tube, Peek	2
11	142046	Nut, Flgless Ftg, 1/4-28, 1/16 Tube, Red Delrin	4
12	142218	Nut, Flgless Ftg, 1/4-28, 1/8 Tube, Blue Delrin	4
13	142186	Fitting, Adapter, 1/4-28 X 3/16 Barb, Tefzel	1
14	142185	Fitting, Adapter, 1/4-28 X 1/8 Barb, Tefzel, P647	2
15	142527	Adapter, 1/4-28 To Male Luer, 1/16 Tube, Peek	1
16	142528-0515	Tips, 1/2 To 1 1/2, Presision Dispensing, SS; 1/2" 15 Gage	2
17	142222-003	Dispense Tip, SS X Fem Luer; 18 Ga, .25"Lg	2
18	142222-002	Dispense Tip, SS X Fem Luer; 20 Ga, .25"Lg	2
19	142222-001	Dispense Tip, SS X Fem Luer; 21 Ga, .25"Lg	2
20	142285	Union, 1/4-28, Peek	1
21	142115	Fitting, Conn, Luer X 1/16 Brb	5
22	142141	Luer Lock, Rotating Ring, Nylon	2
23	142234	Ferrule, Flgless, Ftg 3/16 Tube, Blue Tefzel	4
24	142106	Fitting, Flangeless Ferrule, 1/8 Tubing	4
25	142047	Ferrule, Flgless, Ftg 1/16 Tubing	4
NS	142246	Tubing, Polyurethane 3/16" 00 X 1/8" ID	1
NS	142119-914	1/16" OD Tubing, & Flangeless Fitting Fabrication	1
NS	142118-914	1/8" OD Tubing, & Flangeless Fitting Fabrication	1
NS	142121	Tubing, Polyethylene, 1/8" OD X 1/16" ID 3 ft.	1
NS	142048	Tubing, Teflon 1/16" OD X .031" ID 3ft.	2
NS	142441	Box, Compartmented Styrene, 9 Compartments	1
NS	142219-914	3/16" OD Tubing, & Flangless Fitting Fabrication	1
NS	142217	Tubing, Polyurethane 5/16" OD X 3/16" ID 3ft.	2

Figure 7.5 Fittings (Sheet 2 of 4)

Figure 7.5 Fittings (Sheet 3 of 4)

	PART NUMBER	DESCRIPTION	UNITS PER ASSY
	142093	**Tubing Accessory Kit, 2A, 3A, 4A-Size Lo-Flo**	**1**
1	142220	Tool, Extender	1
2	142528-1520	Tips, 1/2 To 1-1/2, Precision Dispensing, SS; 1-1/2" 20 Gage	2
3	142528-1521	Tips, 1/2 To 1-1/2, Precision Dispensing, SS; 1-1/2" 21 Gage	2
4	142528-1522	Tips, 1/2 To 1-1/2, Precision Dispensing, SS; 1-1/2" 22 Gage	2
5	142528-1523	Tips, 1/2 To 1-1/2, Precision Dispensing, SS; 1-1/2" 23 Gage	2
6	142528-1525	Tips, 1/2 To 1-1/2, Precision Dispensing, SS; 1-1/2" 25 Gage	2
7	142243-002	Dispense Tip, Tapered, Poly; 22 Ga, Blue	2
8	142243-003	Dispense Tip, Tapered, Poly; 20 Ga, Pink	2
9	142243-001	Dispense Tip, Tapered, Poly; 25 Ga, Red	2
10	142528-0520	Tips, 1/2 To 1-1/2, Precision Dispensing, SS; 1/2" 20 Gage	2
11	142528-0521	Tips, 1/2 To 1-1/2, Precision Dispensing, SS; 1/2" 21 Gage	2
12	142528-0522	Tips, 1/2 To 1-1/2, Precision Dispensing, SS; 1/2" 22 Gage	2
13	142528-0523	Tips, 1/2 To 1-1/2, Precision Dispensing, SS; 1/2" 23 Gage	2
14	142528-0525	Tips, 1/2 To 1-1/2, Precision Dispensing, SS; 1/2" 25 Gage	2
15	142528-0527	Tips, 1/2 To 1/1/2, Precision Dispensing, SS; 1/2" 27 Gage	2
16	142528-0530	Tips, 1/2 To 1-1/2, Precision Dispensing, SS; 1/2" 30 Gage	2
17	142222-001	Dispense Tip, SS X Fem Luer; 21 Ga, .25"Lg	2
18	142222-002	Dispense Tip, SS X Fem Luer; 20 Ga, .25"Lg	2
19	142218	Nut, Flgless Ftg, 1/4-28, 1/8 Tube, Blue Delrin	4
20	142046	Nut, Flgless Ftg, 1/4-28, 1/16 Tube, Red Delrin	4
21	142527	Adapter, 1/4-28 To Male Luer, 1/16 Tube, Peek	1
22	142285	Union, 1/4-28, Peek	1
23	142115	Fitting, Conn, Luer X 1/16 Brb	5
24	142141	Luer Lock, Rotating Ring, Nylon	2
25	142106	Fitting, Flangeless Ferrule, 1/8 Tubing	4
26	142047	Ferrule, Flgless, Ftg 1/16 Tubing	4
NS	142121	Tubing, Polyethylene, 1/8" OD X 1/16" ID 3 ft.	1
NS	142121	Tubing, Teflon 1/16" OD X .031" ID 3 ft.	2
NS	142441	Box, Compartmented Styrene, 9 Compartments	1
NS	142119-914	1/16" OD Tubing, & Flangeless Fitting Fabrication	1
NS	142118-914	1/8" OD Tubing, & Flangeless Fitting Fabrication	1

Figure 7.5 Fittings (Sheet 4 of 4)