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7. LF MULTIPLEX PUMP MODULE

7.1 DESCRIPTION (Figure 7.1)

The LF Multiplex Pump Module, hereafter referred to as the Pump Module, is comprised of the following major components; a ceramic valve fabrication (hereafter referred to as the valve), a piston fabrication (hereafter referred to as the piston), a cylinder and a case. The Pump Module is within the liquid path and is designed to be detached from the Actuator Module and completely disassembled for ease of cleaning, decontamination and sterilization. The Pump Module is designed to be used in conjunction with the LF Multiplex Actuator Module.

7.2 OPERATION

The Pump Module is a piston/valve/cylinder arrangement providing positive displacement. The Pump Module contains a ceramic valve that is selectively rotated and a ceramic piston that is reciprocated by the Actuator Module. The valve and piston are connected to the Actuator Module through bearing balls located on each end of the Pump Module. The bearing balls compensate for angular misalignment. The valve incorporates a flat or slot on one end providing valving of the pump to either the intake or discharge ports.

The valve's normal dispensing position, after reference, is with the valve aligned with the discharge port. The piston's home position is retracted and ready for liquid dispensing. The piston is pushed forward forcing the specified amount of liquid through the discharge port. Depending on the Controller Module mode, the piston will either stop after completing a dispense and wait until requested to dispense again or the valve will rotate to the intake port, the piston will retract to fill the chamber and then the valve will rotate back to the discharge port.

The valve allows only one port to communicate with the pumping chamber at any time. This positive mechanical valving eliminates the need for check valves under normal operations.

7.2.1 Piston/Valve/Cylinder Set

The piston/valve/cylinder set is constructed of high density alumina or magnesium stabilized zirconia ceramic. The ceramics are compatible with most acids and bases. The valve/cylinder set has a clearance between the valve and cylinder wall of approximately .00005" (1.27 microns) which minimizes fluid slip.

The ceramic piston and valve operate 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.

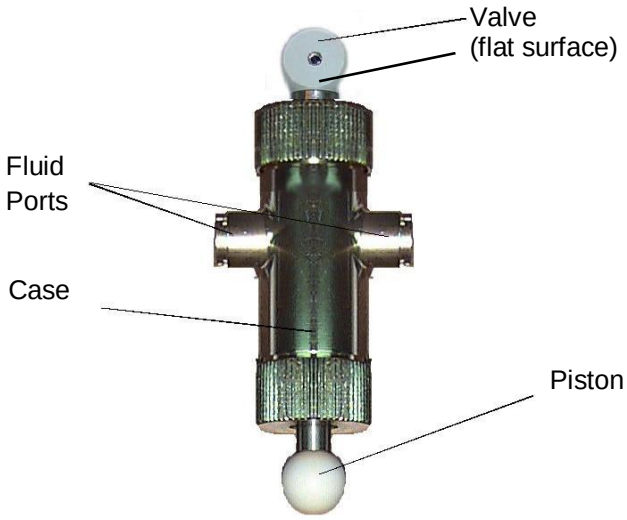


Figure 7.1 LF Multiplex Pump Module

The ceramic material's mechanical and thermal stability allows the valve to seal by virtue of a close running clearance between it 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

Installation of the Pump Module is required. Refer to section 7.5.2.1 for assembly and disassembly of the Pump Module to the Actuator Module. Refer to Chapter 2 for instructions on setting up the system for operation.

7.4 OPTIONS

IVEK Corporation offers a variety of options to best meet the customers' needs. Following is a list and description of available options for the Pump Module. Refer to the Title Section of this manual for the list of options provided with this system.

7.4.1 Special Piston/Cylinder Bore Clearances or Modifications

For certain applications, special clearances are required between the piston/valve and cylinder bore. IVEK Corporation determines these clearances by performing application tests using the application fluid. Contact IVEK Corporation Applications Department for more information.

7.4.2 Fitting Sets

Fitting sets are available with the Pump Module. Each fitting set is composed of a fitting, fitting seals and fitting retainers. The following types of fittings are available from IVEK Corporation.

- O-Ring Face Seal Fittings Compatible W/"Cajun" 2-VCO 7 4-VCO
- Barbed Tubing Adapters 1/8", 3/16", 1/4", 3/8", 1/2"
- Pipe Thread Adapters 1/8"&1/4" NPT
- 1/4 - 28 & 5/16 - 24 Adapters For "Upchurch Flangeless Tube Fittings"
- Sanitary Adapter Fittings
- Compression Fitting Adapter Compatible W/"JACO" 0 - 4, P6 - 4
- Compression Fitting Adapter Compatible W/"Swagelock 402 - 1, 404 - 1 & 403 - 1
- Compression Fittings Compatible W/"Swagelock 200 - 1, 204 - 1 & 203 - 1

7.5 MAINTENANCE

CAUTION

Never forcibly remove or install the piston or valve 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, valve and cylinder housing when they have been removed from the Pump Module. Always take great care when removing the piston or valve from the cylinder and replacing the piston or valve 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, valve and cylinder are serialized and must always be reassembled as a matched set. Never clean in such a way that the ceramics can vibrate against each other or chipping and scratching may result.

CAUTION

Ceramic piston/valve/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. Once the Pump Module has been emptied, 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.
5. Repeat step 4 using water and/or alcohol.

NOTE

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

7.5.2 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 Actuator Module.

CAUTION

If supplied, torque the castellated sleeves (5 and 6) on the Pump Module to 12 in lbs. (1.356 N m). The Pump Module may not operate properly if excessive pressure is placed on the valve. Refer to Figure 7.4.

NOTE

The lip seal(s) (7 and 9) must be replaced each time one is removed from the ceramic cylinder (8).

- Ceramic Piston Fabrication (1)
- End Caps (2 and 13)
- Washer (3)
- Case (4)
- Castellated or Knurled Sleeves (5 and 6)
- Lip Seals (7 and 9) (Optional)
- Ceramic Cylinder (8)
- Washer (10)
- Washer (11)
- Ceramic Valve Fabrication (12)

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.

7.5.2.1 Pump Module (Figure 7.3)

The following procedure is necessary if you received a new Pump Module or for removal and installation if removing the Pump Module for replacement, maintenance or repair.

Removal: (Figure 7.3)

View A

1. Remove all fittings from front and rear Ports (4) on Pump Module (5).

View B

2. Push slide door (7) down.

View C

3. Place a finger behind piston (6) and pull forward to remove the lower section of Pump Module (5) from the Actuator Module making sure you hold piston (6) to prevent it from falling out of Pump Module (5).

View D

4. Rotate Pump Module (5) 90^{O} and pull valve bearing ball (2) out of coupling assembly (1).

Installation:

View D

1. Position valve bearing ball (2) in coupling assembly (1) making sure the flat side faces up and the slots in valve bearing ball (2) align with locator pins in coupling assembly (1).
2. Slide valve bearing ball (2) into coupling (1) until it is fully seated.

CAUTION

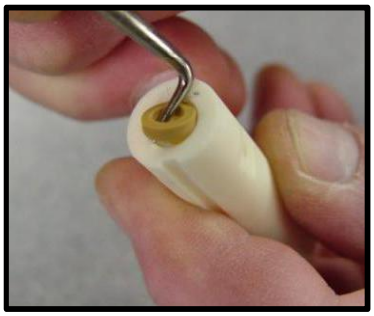
If pump module is rotated into position per step 3 without valve bearing ball being completely seated in the coupler, damage to the coupler and/or valve ball may result.

View C

3. Rotate Pump Module (5) 90^{O} making sure the alignment pin and rear port (4) fit into the holes on the rear panel.
4. Push piston bearing ball (8) into the slide assembly socket.

View B

5. Push slide door (7) up to secure piston ball in place.



Seal Removal

7.5.2.2 Piston/Cylinder/Valve (Figure 7.2 Items 1, 8 and 12)

NOTE

The piston, valve and cylinder are factory matched and serialized and cannot be sold individually or interchanged with other Pump Modules.

Disassembly

1. Remove the Pump Module from the Actuator Module as described in section 7.5.2.1.
2. Remove ceramic piston fabrication (1) from ceramic cylinder (8) by slowly pulling and turning ceramic piston fabrication (1) while holding case (4).
3. Remove end cap (2) from case (4) by turning in a counter clockwise direction.
4. Remove washer (3) if it did not come out with end cap (2).
5. Remove end cap (13) from case (4) by turning in a counter clockwise direction.
6. Remove ceramic valve fabrication (12) from ceramic cylinder (8) and washer (11) from case (4) by slowly pulling and turning ceramic valve fabrication (12) while holding case (4).
7. Remove washer (10) if it did not come off with ceramic valve fabrication (12).
8. Remove Sleeves (5 and 6) from case (4) by turning in a counter clockwise direction.

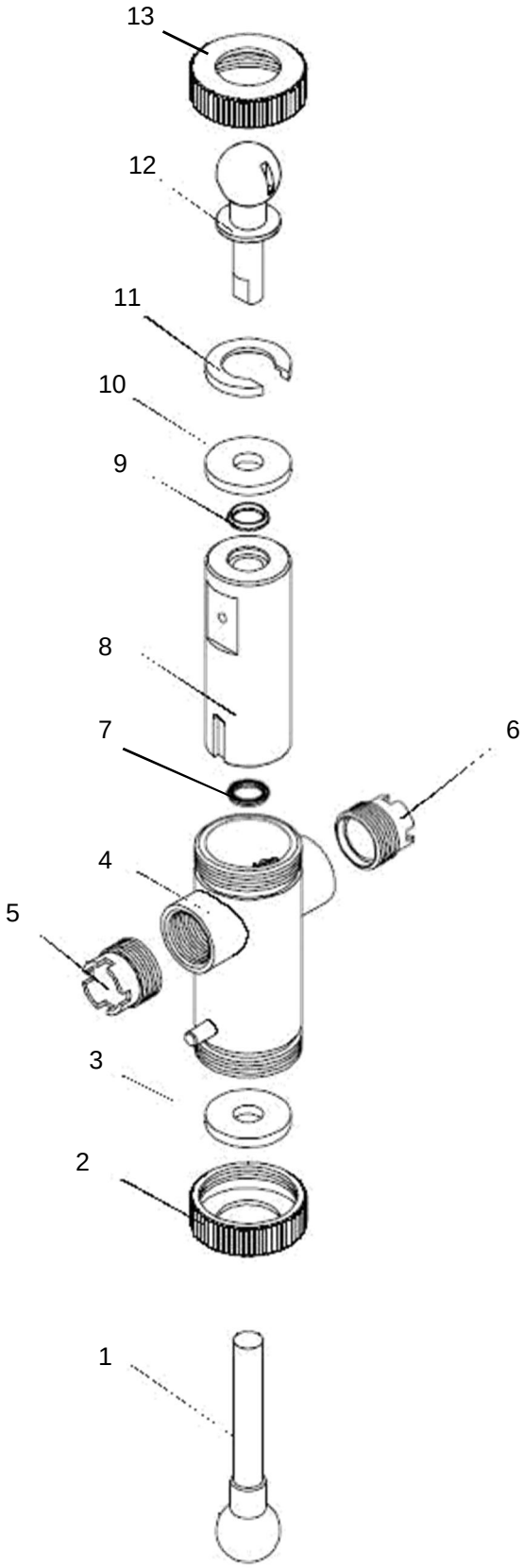
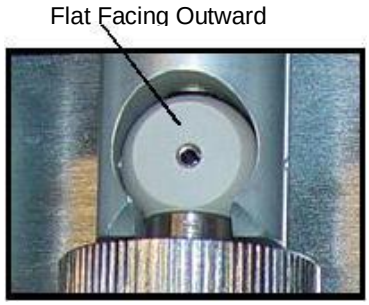


Figure 7.2 LF Multiplex Pump Module Component Assembly/Disassembly



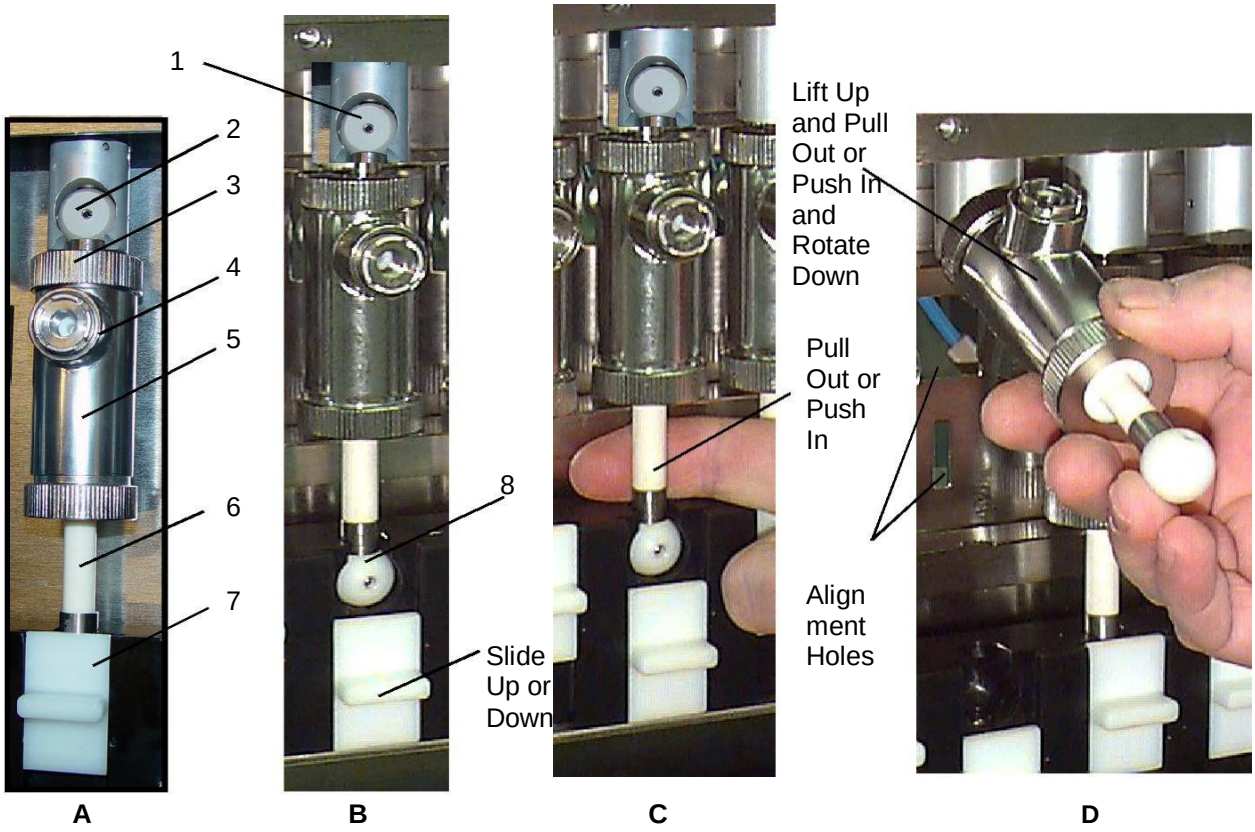


Figure 7.3 LF Multiplex Pump Module Assembly/Disassembly

9. Gently push ceramic cylinder (8) with seals (7 and 9) out of case (4).
10. Carefully remove seals (7 and 9) from ceramic cylinder (8) without damaging cylinder (8).

Assembly

NOTE

End caps (2) and (13) are identical and may be interchanged during assembly.

1. Insert seals (7 and 9) using tool provided* with exposed spring towards ceramic cylinder (8) into opening in ceramic cylinder (8). Make sure it sits flush with ceramic cylinder (8).
2. Slide ceramic cylinder (8) with seals (7 and 9) into case (4). Make sure the groove on ceramic cylinder (8) lines up with the pin on case (4).
3. Secure sleeves (5 and 6) to case (4) by turning in a clockwise direction, finger tighten.
4. Slide washer (10) onto valve fabrication (12).
5. Install ceramic valve fabrication (12) and washer (11) into ceramic cylinder (8) by slowly pushing and turning ceramic valve fabrication (12) while holding case (4).
6. Secure end cap (13) to case (4) by turning in a clockwise direction.
7. Position washer (3) on ceramic cylinder (8) so hole in washer (3) lines up with hole in ceramic cylinder (8).
8. Secure end cap (2) to case (4) by turning in a clockwise direction.
9. Install ceramic piston fabrication (1) into ceramic cylinder (8) by slowly pushing and turning ceramic piston fabrication (1) while holding case (4).
10. Install sleeves (5 and 6) into case (4).
11. If supplied, torque castellated sleeves (5 and 6) to 12 in lbs (1.356 N m) as shown in Figure 7.4.
12. Install the Pump Module onto the Actuator Module as described in section 7.5.2.1.

7.5.2.3 Case (Figure 7.2 Item 4)

Disassembly

1. Remove the Pump Module from the Actuator Module as described in section 7.5.2.1.
2. Remove ceramic piston fabrication (1) from ceramic cylinder (8) by slowly pulling and turning ceramic piston fabrication (1) while holding case (4).
3. Remove end cap (2) from case (4) by turning in a counter clockwise direction.
4. Remove washer (3) if it did not come out with end cap (2).
5. Remove end cap (13) from case (4) by turning in a counter clockwise direction.
6. Remove ceramic valve fabrication (12) from ceramic cylinder (8) and washer (11) from case (4) by slowly pulling and turning ceramic valve fabrication (12) while holding case (4).
7. Remove washer (10) if it did not come off with ceramic valve fabrication (12).
8. Remove Sleeves (5 and 6) from case (4) by turning in a counter clockwise direction.
9. Gently push ceramic cylinder (8) with seals (7 and 9) out of case (4).

Assembly

NOTE

End caps (2) and (13) are identical and may be interchanged during assembly.

1. Slide ceramic cylinder (8) with seals (7 and 9) into case (4). Make sure the groove on ceramic cylinder (8) lines up with the pin on case (4).
2. Secure sleeves (5 and 6) to case (4) by turning in a clockwise direction, finger tighten.
3. Slide washer (10) onto valve fabrication (12).
4. Install ceramic valve fabrication (12) and washer (11) into ceramic cylinder (8) by slowly pushing and turning ceramic valve fabrication (12) while holding case (4).
5. Secure end cap (13) to case (4) by turning in a clockwise direction.
6. Position washer (3) on ceramic cylinder (8) so hole in washer (3) lines up with hole in ceramic cylinder (8).

7. Secure end cap (2) to case (4) by turning in a clockwise direction.
8. Install ceramic piston fabrication (1) into ceramic cylinder (8) by slowly pushing and turning ceramic piston fabrication (1) while holding case (4).
9. Install sleeves (5 and 6) into case (4).
10. If supplied, torque castellated sleeves (5 and 6) to 12 in lbs. (1.356 N m) as shown in Figure 7.4.
11. Install the Pump Module onto the Actuator Module as described in section 7.5.2.1.

7.5.2.4 End Caps and Washer (Figure 7.2 Items 2, 13, and 3)

Disassembly

1. Remove the Pump Module from the Actuator Module as described in section 7.5.2.1.
2. Remove ceramic piston fabrication (1) from ceramic cylinder (8) by slowly pulling and turning ceramic piston fabrication (1) while holding case (4).
3. Remove end cap (2) from case (4) by turning in a counter clockwise direction.
4. Remove washer (3) if it did not come out with end cap (2).
5. Remove end cap (13) from case (4) by turning in a counter clockwise direction.

Assembly

NOTE

End caps (2) and (13) are identical and may be interchanged during assembly.

1. Secure end cap (13) to case (4) by turning in a clockwise direction.
2. Position washer (3) on ceramic cylinder (8) so hole in washer (3) lines up with hole in ceramic cylinder (8).
3. Secure end cap (2) to case (4) by turning in a clockwise direction.
4. Install ceramic piston fabrication (1) into ceramic cylinder (8) by slowly pushing and turning ceramic piston fabrication (1) while holding case (4).
5. Install the Pump Module onto the Actuator Module as described in section 7.5.2.1.

7.5.2.5 Washers (Figure 7.2 Items 10 and 11)

Disassembly

1. Remove the Pump Module from the Actuator Module as described in section 7.5.2.1.
2. Remove end cap (13) from case (4) by turning in a counter clockwise direction.
3. Remove ceramic valve fabrication (12) from ceramic cylinder (8) and washer (11) from case (4) by slowly pulling and turning ceramic valve fabrication (12) while holding case (4).
4. Remove washer (10) if it did not come off with ceramic valve fabrication (12).

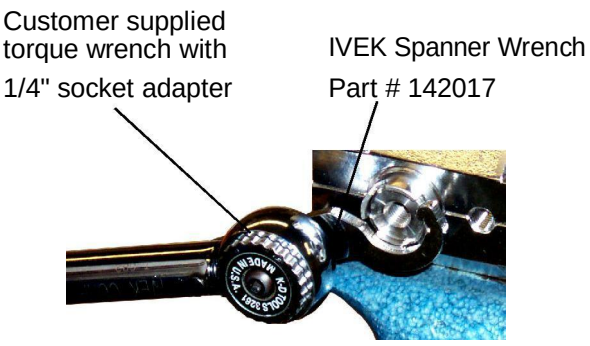


Figure 7.4 Torque Setup for Castellated Sleeves

Assembly

1. Slide washer (10) onto valve fabrication (12).
2. Install ceramic valve fabrication (12) from case (4) and washer (11) into ceramic cylinder (8) by slowly pushing and turning ceramic valve fabrication (12) while holding case (4).
3. Secure end cap (13) to case (4) by turning in a clockwise direction.
4. Install the Pump Module onto the Actuator Module as described in section 7.5.2.1.

7.5.2.6 Lip Seals (Figure 7.2 Items 7 and 9)

Disassembly

1. Remove the Pump Module from the Actuator Module as described in section 7.5.2.1.
2. Remove ceramic piston fabrication (1) from ceramic cylinder (8) by slowly pulling and turning ceramic piston fabrication (1) while holding case (4).
3. Remove end cap (2) from case (4) by turning in a counter clockwise direction.
4. Remove washer (3) if it did not come out with end cap (2).
5. Remove end cap (13) from case (4) by turning in a counter clockwise direction.
6. Remove ceramic valve fabrication (12) from ceramic cylinder (8) and washer (11) from case (4) by slowly pulling and turning ceramic valve fabrication (12) while holding case (4).
7. Remove washer (10) if it did not come off with ceramic valve fabrication (12).
8. Carefully remove seals (7 and 9) from ceramic cylinder (8) without damaging cylinder (8).

Assembly

NOTE

End caps (2) and (13) are identical and may be interchanged during assembly.

1. Insert seals (7 and 9) using tool provided* with exposed spring towards ceramic cylinder (8) into opening in ceramic cylinder (8). Make sure it sits flush with ceramic cylinder (8).
2. Slide washer (10) onto valve fabrication (12).
3. Install ceramic valve fabrication (12) from case (4) and washer (11) into ceramic cylinder (8) by slowly pushing and turning ceramic valve fabrication (12) while holding case (4).
4. Secure end cap (13) to case (4) by turning in a clockwise direction.
5. Position washer (3) on ceramic cylinder (8) so hole in washer (3) lines up with hole in ceramic cylinder (8).
6. Secure end cap (2) to case (4) by turning in a clockwise direction.
7. Install ceramic piston fabrication (1) into ceramic cylinder (8) by slowly pushing and turning ceramic piston fabrication (1) while holding case (4).
8. Install the Pump Module onto the Actuator Module as described in section 7.5.2.1.

* **Seal Insertion Tool - IVEK Part Number 202101**

7.6 PROBLEM GUIDE

7.6.1 Piston Seized In The Cylinder

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 Actuator Module may occur.

1. Remove the Pump Module from the Actuator Module as described in section 7.5.2.1.

2. Soak the Pump Module in a liquid compatible with the materials and process liquids.
3. 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 for assistance or an RMA number if the unit needs to be returned. It may be necessary to ship the Pump Module back to the factory. Provide a note describing, in detail, what conditions caused the seizure. It may also be necessary to return the Actuator Module along with the Pump Module should realignment of the Pump Module drive components be required.

Table 7.2 contains a list of possible problems, causes and solutions for the Pump Module.

7.7 SPECIFICATIONS

Table 7.3 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 7.3 Volumetric Output Of Multiplex Pump Modules

Pump Size	Chamber Capacity (µl)	Resolution (µl)
5000	5000	0.125
4000	4000	0.100
2000	2000	0.050

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.

202122 - ##### # #

Pump Size

- **2000N** - 2000µL No Seal
- **2000S** - 2000µL With Seal
- **4000N** - 4000µL No Seal
- **4000S** - 4000µL With Seal
- **5000N** - 5000µL No Seal
- **5000S** - 5000µL With Seal

Seal

- **0** - No Seal
- **2** - 9.75mm Diameter Seal
- **4** - 13.92mm Diameter Seal
- **5** - 16.85mm Diameter Seal

Threaded Sleeve

- **1** - Castellated
- **2** - Knurled

7.9 ILLUSTRATED PARTS BREAKDOWN

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

Table 7.2 Common Operational Problems And Solutions

PROBLEM	PROBABLE CAUSE	POSSIBLE SOLUTION
Air evident in discharge line.	Loose tubing connection at intake fitting.	Tighten/replace fittings.
	Loose/Damaged intake port seals.	Tighten/replace port seals.
	Loose/Damaged End Cap Seals or damaged intake fitting.	Clean, inspect and replace if necessary.
	Cavitation.	Increase inlet tubing size, reduce Pump Module speed or increase feed pressure.
Piston or valve seizing	Suspended or particulate materials in liquid entrapped between piston and cylinder.	Disassemble Pump Module and clean all wetted surfaces.
Fluid leaks	Improperly seated or worn spring energized seal.	Disassemble Pump Module and clean all wetted surfaces, inspect components and replace if necessary.
	Loose/damaged output port seal, output tubing, or damaged fitting.	Inspect, tighten or replace if necessary.
Fluid not moving in tubing when priming, dispensing or metering.	Pump Module not properly oriented on Actuator Module.	Make certain that port holes in Pump Module line up with flat on piston.

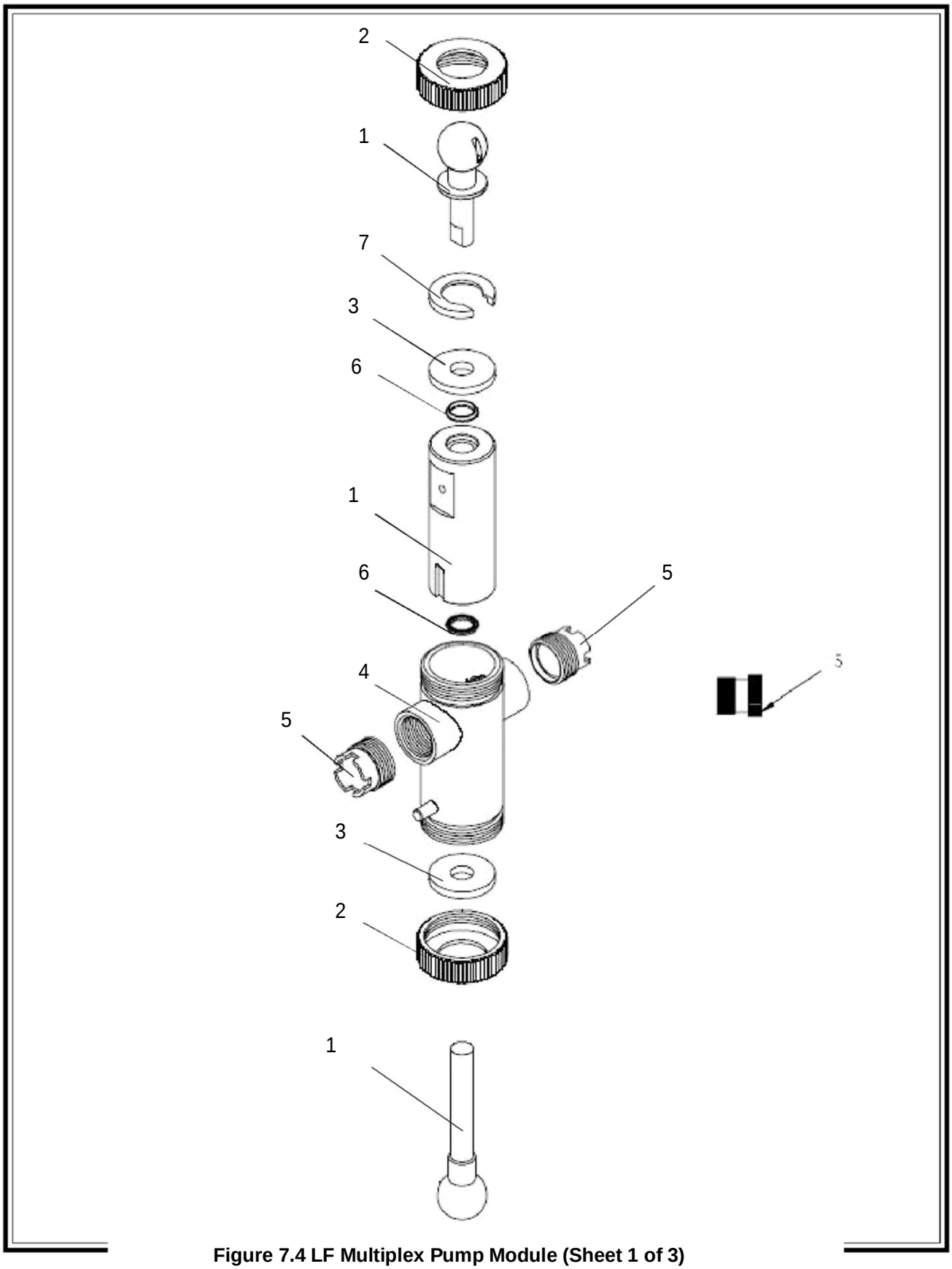


Figure 7.4 LF Multiplex Pump Module (Sheet 1 of 3)

INDEX NO.	PART NUMBER	DESCRIPTION	UNITS PER ASSY
	202122-#######	**LF Multiplex Pump Module**	**1**
Common Parts For All Model #'s			
2	202124	Cap, Case End, LF Multiplex Pump	2
4	202123	Machining/Fab, Case, LF Multiplex Pump	1
7	202211	Washer, Valve Retainer, Peek, LF Multiplex Pump	1
Model #202122-2000N## Additional Parts			
1	022186-2000N	Piston/Valve/Cyl Set, LF Multiplex Pump;2000ul, w/O Seal Bore	1
3	202125-2000	Washer, Seal Retainer, LF Multiplex Pump; Ø10.20	2
Model #202122-2000S## Additional Parts			
1	022186-2000S	Piston/Valve/Cyl Set, LF Multiplex Pump;2000ul, w/ Seal Bore	1
3	202125-2000	Washer, Seal Retainer, LF Multiplex Pump; Ø10.20	2
Model #202122-4000N## Additional Parts			
1	022186-4000N	Piston/Valve/Cyl Set, LF Multiplex Pump;4000ul, w/O Seal Bore	1
3	202125-4000	Washer, Seal Retainer, LF Multiplex Pump; Ø14.35	2
Model #202122-4000S## Additional Parts			
1	022186-4000S	Piston/Valve/Cyl Set, LF Multiplex Pump;4000ul, w/ Seal Bore	1
3	202125-4000	Washer, Seal Retainer, LF Multiplex Pump; Ø14.35	2
Model #202122-5000N## Additional Parts			
1	022186-5000N	Piston/Valve/Cyl Set, LF Multiplex Pump;4000ul, w/O Seal Bore	1
3	202125-5000	Washer, Seal Retainer, LF Multiplex Pump; Ø16.85	2
Model #202122-5000S## Additional Parts			
1	022186-5000S	Piston/Valve/Cyl Set, LF Multiplex Pump;4000ul, w/ Seal Bore	1
3	202125-5000	Washer, Seal Retainer, LF Multiplex Pump; Ø16.85	2
Model #202122-#####0# Additional Parts			
None			

Figure 7.4 LF Multiplex Pump Module (Sheet 2 of 3)

INDEX NO.	PART NUMBER	DESCRIPTION	UNITS PER ASSY
	202122-#######	**LF Multiplex Pump Module**	**1**
		Model #202122-#####2# Additional Parts	
6	142378-003	Seal, Lip, Spring Energized; Ø9.75	2
		Model #202122-#####4# Additional Parts	
6	142378-004	Seal, Lip, Spring Energized; Ø13.92	2
		Model #202122-#####5# Additional Parts	
6	142378-008	Seal, Lip, Spring Energized; Ø15.76	2
		Model #202122-######1 Additional Parts	
5	142084	Threaded Sleeve, Castellated	2
		Model #202122-######2 Additional Parts	
5	142648	Threaded Sleeve, Knurled	2

NOTE

** The piston fabrication, cylinder and valve fabrication are factory matched and cannot be sold individually.*

Figure 7.4 LF Multiplex Pump Module (Sheet 3 of 3)