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7. SF MULTIPLEX PUMP MODULE

7.1 DESCRIPTION (Figure 7.1)

The SF Multiplex Pump Module, hereafter referred to as the Pump Module, is comprised of the following major components; a 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 SF 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 is connected to the Actuator Module through a valve bearing ball. The valve bearing ball compensates for angular misalignment. The valve incorporates a flat on one end that provides valving of the pump to either the intake or discharge ports.

The valve's normal dispensing position, after reference, is with the piston flat 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 will automatically rotate to the intake port, retract to fill the chamber and then rotate back to the discharge port.

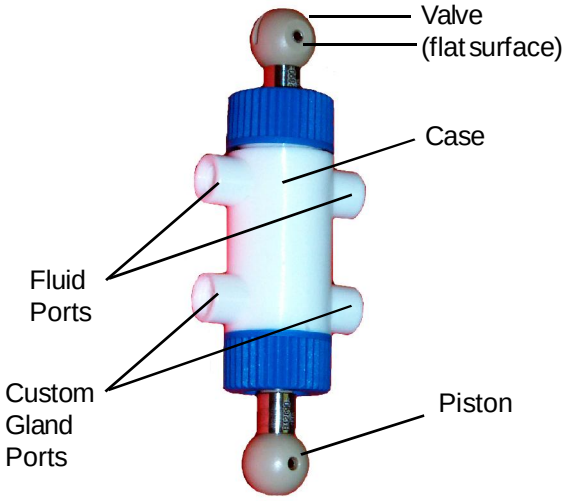

Figure 7.1 SF Multiplex Pump Module

The piston flat 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 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 carry over of one liquid to the next.

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.

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 customer's 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 for the valve/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 Spring Energized Lip Seal

This option provides an additional barrier in the fluid path. The seals, located at each end of the cylinder, prevent fluid from migrating beyond the ends of the cylinder. The model number indicates the presence or absence of the seal. (refer to section 7.8)

7.4.3 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.

- Barb Fittings x 1/4-28 or 5/16-24
  1/16", 1/8" and 3/16" (barb size)
- Flangeless Compression Fittings
  1/4-28 (use with 1/16" or 1/8" o.d. plastic tubing)
  5/16-24 (use with 1/16, 1/8, OR 3/16 o.d. plastic tubing)

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. Disconnect intake tubing from process liquid supply container.
2. Cycle pump in continuous mode until all 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.

NOTE

The spring energized seal, if provided, must be replaced each time it is removed from the cylinder. The assembly/disassembly procedures were written as if the seal was purchased as an option. If no seal is present, disregard the italic steps in the procedures.

- Case End Cap (1,6)
- Seal Retainer Washer (2)
- Spring Energized Lip Seal (4,9)
- Valve Retainer Washer (5)
- Valve/End Cap Fabrication (7)
- Piston/End Cap Fabrication (10)
- Cylinder (8)
- Pump Case (3)

WARNING

Make sure the power is OFF, air pressure is removed 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 7.2)

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

CAUTION

Make sure you hold piston (16) to prevent it from falling out of Pump Module (15). Damage to piston (16) could result if dropped.

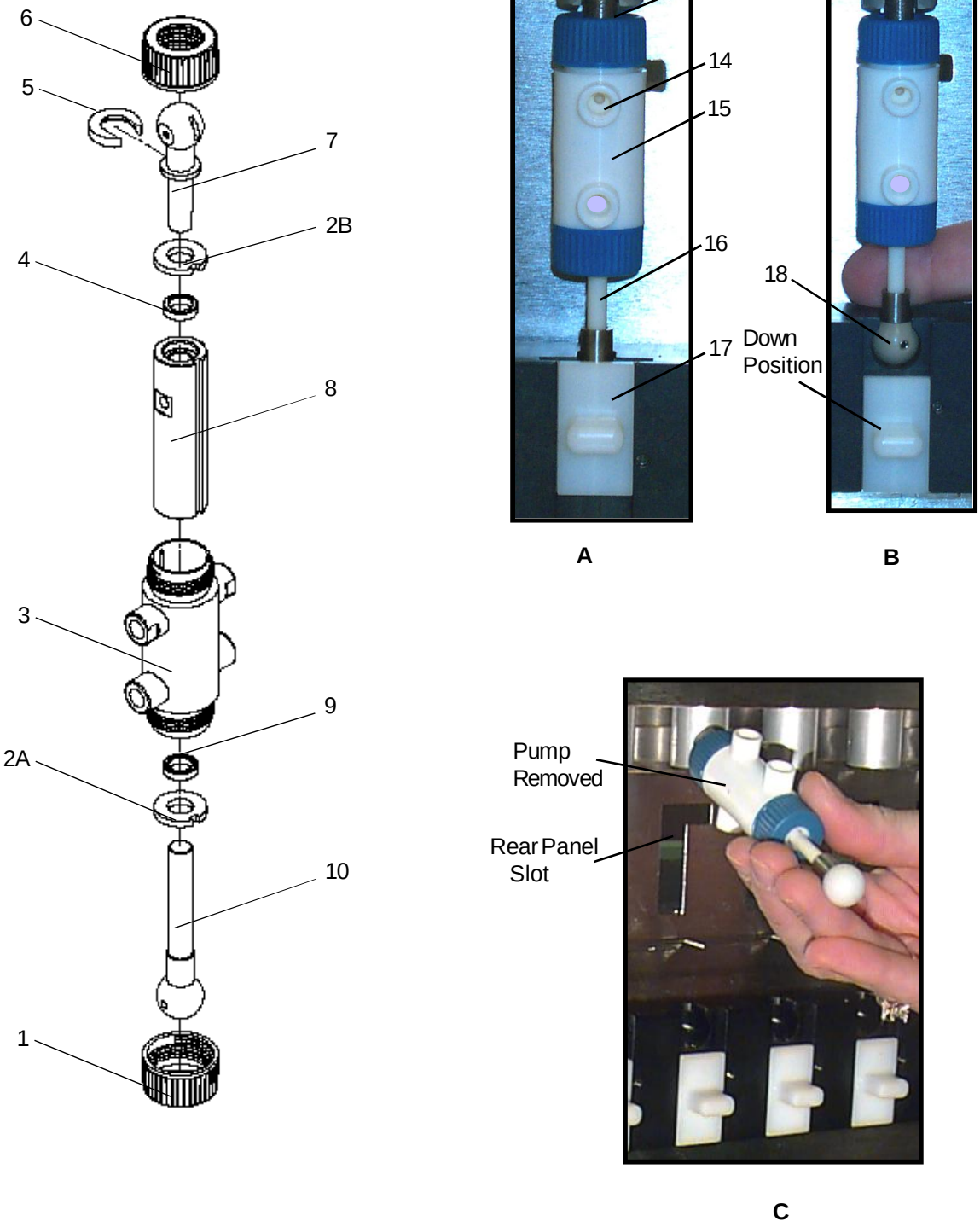

Figure 7.2 SF Multiplex Pump Module Assembly/Disassembly

Removal:

View A

1. Remove all fittings from front and rear Ports (14) on Pump Module (15).
2. Rotate coupler (11) to position the valve bearing ball (12) as shown in View A.

View B

3. Push slide door (17) down.
4. Place a finger behind piston (16) and pull forward to remove the piston (16) section of Pump Module (15) from the Actuator Module.

View C

5. Rotate Pump Module (15) 90° and pull valve bearing ball (12) out of the coupler (11).

Installation:

View C

1. Position valve bearing ball (12) into coupler (11) making sure the flat on the ball faces up and the slots in valve bearing ball (12) align with locator pins in coupler (11).
2. Slide valve bearing ball (12) into coupler (11) until it is fully seated.

CAUTION

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

View B

3. Rotate Module (15) 90° making sure the rear ports (14) fit into the slot on the rear panel. (See View C)

CAUTION

Make sure the rear ports (14) are properly seated in the slot. Damage to the Pump Module may result if not properly seated.

4. Push piston bearing ball (18) into the slide assembly.

View A

5. Push slide door (17) up to secure piston ball in place.

7.5.2.2 Assembly/Disassembly of Pump Module

NOTE

The piston, valve and cylinder are factory matched and serialized and can not 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 piston/end cap fabrication (10) from cylinder (8) by slowly pulling and turning piston/end cap fabrication (10) while holding pump case (3).
3. Remove case end cap (1) from pump case (3) by turning in a counter clockwise direction.
4. Remove seal retaining washer (2A).
5. Remove case end cap (6) from pump case (3) by turning in a counter clockwise direction.
6. Remove valve (7), valve retainer washer (5) and seal retainer washer (2B) from cylinder (8) by slowly pulling and turning valve/end cap fabrication (7) while holding pump case (3). If seal retainer washer (2) does not come out with valve/end cap fabrication (7), remove now.
7. Gently push cylinder (8) *with spring energized lip seals (4 and 9)* out of pump case (3).
8. *Carefully remove spring energized lip seals (4 and 9) from cylinder (8) without damaging cylinder (8). (Refer to Figure 7.3)*

Assembly

NOTE

Case end caps (1) and (6) are identical and may be interchanged during assembly.

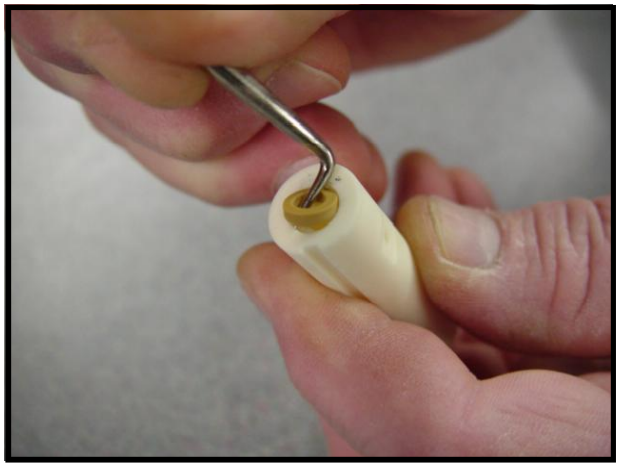

Figure 7.3 Spring Energized Lip Seal Removal

1. *Insert spring energized lip seals (4 and 9) using seal insertion tool* with exposed spring towards cylinder (8) into opening in cylinder (8). Make sure it sits flush with cylinder (8).*
2. Slide cylinder (8) *with spring energized lip seals (4 and 9)* into pump case (3). Make sure the groove on cylinder (8) lines up with the key on pump case (3).
3. Place seal retainer washer (2B) over cylinder (8) aligning notch in washer with keyway in case.
4. Slide valve retainer washer (5) over valve/end cap fabrication (7).
5. Install valve/end cap fabrication (7) into cylinder (8) by slowly pushing and turning valve/end cap fabrication (7) while holding pump case (3).
6. Place case end cap (6) over valve/end cap fabrication (7) and secure case end cap (6) to pump case (3) by turning in a clockwise direction.
7. Position seal retaining washer (2A) on cylinder (8).
8. Secure case end cap (1) to pump case (3) by turning in a clockwise direction.
9. Install piston/end cap fabrication (10) into cylinder (8) by slowly pushing and turning piston/end cap fabrication (10) while holding pump case (3).
10. Be sure the port hole in the cylinder is centered in the port hole in the case, by loosening and tightening each end cap.
11. Install the Pump Module onto the Actuator Module as described in section 7.5.2.1.

*** Seal Insertion Tool - IVEK Part Number**
202101-02 - 200
202101-04 - 400

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 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 procedure fails, 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.

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 SF Multiplex Pump Modules

Size	Chamber Capacity (µl)	Resolution (µl)
400	400	0.010
200	200	0.005

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.

202304 - ### # #

Pump Size
20N - 200µL W/Out Lip Seal
20S - 200µL With Lip Seal
40N - 400µL W/Out Lip Seal
40S - 400µL With Lip Seal

Seal
0 - No Seal
2 - EGC Ø4.22mm Seal
4 - EGC Ø6.07mm Seal

Port Size
1 - 1/4 - 28
2 - 5/16 - 24

7.9 ILLUSTRATED PARTS BREAKDOWN

The illustrated parts breakdown (Figures 7.4) contains replacement parts for the 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.
	Cavitation.	Increase inlet tubing size, reduce Pump Module speed or increase feed pressure. If the reservoir is not pressurized, be sure it is properly vented to prevent a build up of vacuum.
Piston or valve seizing	Suspended or particulate materials in liquid entrapped between piston and cylinder.	Disassemble Pump Module and clean all wetted surfaces.
	Improper pump assembly	Reference section 7.5.2.1 and be sure the piston and valve move freely once the assembly has been completed.
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.
	Excessive back pressure caused by a blocked discharge tubing assembly	Remove the nozzle from the tubing assembly and inspect tubing for damage such as kinks.
Pump will not pull fluid from the reservoir	Loose or damaged inlet seal	Tighten/replace fitting
	Blocked discharge line	Remove nozzle from the discharge tube assembly and inspect tubing assembly for damage Insure cylinder port holes are aligned witht the input/output bosses on the case.
	Valve improperly assembled into the coupler	Reference section 7.5.2.2 and be sure the flat portion of the valve ball is pointed in the up position.

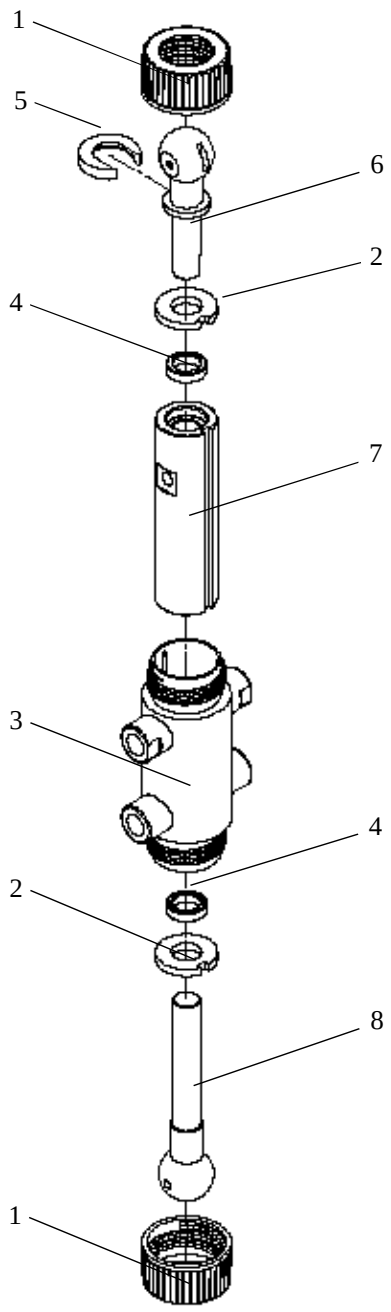

Figure 7.4 SF Multiplex Pump Module (Sheet 1 of 2)

INDEX NO.	PART NUMBER	DESCRIPTION	UNITS PER ASSY
	202304	**SF Multiplex Pump Module**	**1**
Common Parts For All Model #'s			
1	202002	End Cap, Case, SF M'plex	2
5	202195	Washer, Valve Retainer, PEEK, SF Multiplex Pump	1
Model # 202304-20N## Additional Parts			
2	202026-002	Washer, Seal Retainer SF Multiplex Pump; Ø6.15	2
6	022194-200N	Ceramic Valve, SF Multiplex, Alumina	1
7		Ceramic Cylinder, SF Multiplex, Alumina	1
8		Ceramic Piston, SF Multiplex, Alumina	1
Model # 202304-20S## Additional Parts			
2	202026-002	Washer, Seal Retainer SF Multiplex Pump; Ø6.15	2
6	022194-200S	Ceramic Valve, SF Multiplex, Alumina	1
7		Ceramic Cylinder, SF Multiplex, Alumina	1
8		Ceramic Piston, SF Multiplex, Alumina	1
Model # 202304-40N## Additional Parts			
2	202026-001	Washer, Seal Retainer SF Multiplex Pump; Ø8.00	2
6	022194-400N	Ceramic Valve, SF Multiplex, Alumina	1
7		Ceramic Cylinder, SF Multiplex, Alumina	1
8		Ceramic Piston, SF Multiplex, Alumina	1
Model # 202304-40S## Additional Parts			
2	202026-001	Washer, Seal Retainer SF Multiplex Pump; Ø8.00	2
6	022194-400S	Ceramic Valve, SF Multiplex, Alumina	1
7		Ceramic Cylinder, SF Multiplex, Alumina	1
8		Ceramic Piston, SF Multiplex, Alumina	1
Model # 202304-###2# Additional Parts			
4	142378-001	Seal, Lip, Spring Energized	2
Model # 202304-###4# Additional Parts			
4	142378-007	Seal, Lip, Spring Energized	2
Model # 202304-#### 1 Additional Parts			
3	202001-01	Pump Case, SF Multiplex; 1/4 - 28 Port	1
Model # 202304-#### 2 Additional Parts			
3	202001-02	Pump Case, SF Multiplex; 5/16 - 24 Port	1

Figure 7.4 SF Multiplex Pump Module (Sheet 2)