Table Of Contents

7. ROTARY ADJUST PUMP MODULE

7.1 DESCRIPTION (Figure 7.1)

The Rotary Adjust Pump Module, hereafter referred to as the Pump Module, is comprised of the following major components; a ceramic piston fabrication and a ceramic cylinder pressed into a fluorocarbon case. The Pump Module is available in low flow (1/4-28 Internal ports) and high flow (1/4 id compression nut) configurations. The Pump Module is available with either a low or high flow case. The Pump Module is within the liquid path and is designed to be detached from the Motor/Base Module for ease of cleaning, decontamination and sterilization.

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 Module specifications (refer to Table 7.2) and is the same for the low and high flow cases. The displacement adjustment is easily made and recorded as a setting taken from the Motor/Base Module's dial (refer to Chapter 5). Repeatability of 0.1% is obtainable once the stroke length is established.

On each rotation of the piston, the ports are opened alternately and exclusively, first to the inlet and then to the outlet. During the rotation, the piston flat creates the void that allows the flow from only one port at a time, positively displacing the liquid. The piston flat acts as a rotary valve, completing one pressure stroke and one suction stroke per revolution as the pump rotates and reciprocates synchronously.

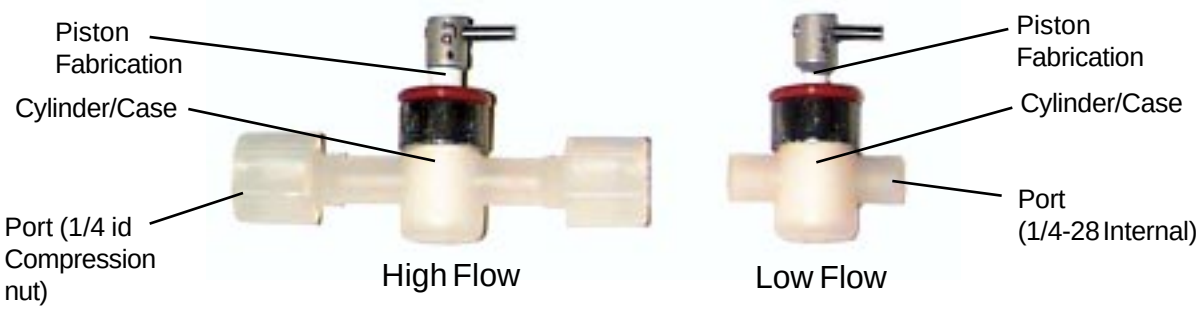


Figure 7.1 Rotary Adjust Pump Module

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

The Pump Module, which cannot be driven by either inlet or outlet pressure, essentially acts as a closed valve when the unit is not in operation.

The Pump Module can easily and accurately be set over the full displacement range. By changing the stroke length through the angular adjustment of the metering head, displacement is changed from zero to the maximum.

7.2.1 Piston/Cylinder Set

The piston/cylinder set is constructed of high density alumina or magnesium stabilized zirconia ceramic. The ceramics are compatible with most acids and bases.

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 ceramics display zero porosity ensuring zero retention and carry over of one liquid to the next.

7.2.2 Stabilized Pump Head

NOTE

When required, IVEK dispensing systems are preset with the pump heads stabilized before shipping. The following procedure is intended to aid the end user if, for example, the pump head is removed or there is a change in dispensing modes.

A stabilized pump head features the addition of two set screws placed 180° apart and centered in front of the inlet and outlet ports of the Pump Module. The purpose of this adjustment is to allow the user the ability to change certain fluidic performance characteristics of the dispense function.

The position of the pump case is adjusted with the set screws. Alternately and gently loosening and tightening these screws allows the user to move the pump case with precision. The adjustment needed to change dispensing modes is minimal. Do not overtighten the set screws.

NOTE

This stabilizing effect is not needed in all cases or in dispenses of more than 10 microliters.

The Pump Module is retained to the Motor/Base Module by an anodized aluminum end cap. The case can be seen through the 3/8" hole in the end cap. When the case and pump are centered in reference to this hole, reverse flow during dispensing is minimal to none. This condition is helpful for “touching off”.

When the case is moved towards the intake port, reverse flow becomes evident at a point preliminary to dispensing. This fluid movement aides in attaining a shearing effect at the end of the dispense cycle.

NOTE

When ever adjustments are made, reverify the Pump Module calibration.

7.2.2.1 Adjustment

Prime the Pump Module as specified in Chapter 2, using a transparent dispense tip (for viewing the liquid movement), for the system using maximum stroke length, making sure to clear all air.

Adjust calibration ring for zero displacement. (The user should observe a situation of no movement, forward or reverse, to the liquid in the outlet tubing or dispensing tip.)

If necessary, reset the position of the calibration ring scale so that the zero readings are aligned.

Continuing in the fill mode, reduce controller speed to a single digit rate. This will allow the user to observe what occurs during the dispense cycle.

Adjust calibration ring to a point of positive flow.

Hold dispense tip up so that the movement of the liquid can be seen and observe the liquid action and note whether the reverse flow is preliminary to or after the dispense.

7.2.2.2 Eject Stabilized

This type of adjustment is used when "Firing Off" dispenses of less than 10ul from the dispense tip.

Adjust set screws until liquid reverse flow in output tip is accomplished at the beginning of the dispense cycle.

Set the Controller Module to Dispense mode and the displacement to the approximate desired volume.

Properly set, the user should observe a shearing or “shooting off” of the discharge.

Calibrate to desired volume.

7.2.2.3 Neutral Stabilized

This type of adjustment is used when "Touching Off" dispenses of less than 10ul.

Adjust set screws until no reverse flow is observed before or after the dispense.

Set the Controller Module to dispense and the displacement to the approximate desired volume.

Properly set, the user should observe a situation in which the discharge is ideal for “touching off”.

Calibrate to desired volume.

7.3 INSTALLATION

The Pump Module comes installed on the Motor/Base Module. If it needs to be removed for any reason, refer to the assembly/disassembly procedures. Refer to Chapter 2 for instructions on setting up the system for operation. Refer to Section 7.5.5.1 for assembly/disassembly procedures.

7.4 OPTIONS

7.4.1 Special Piston/Cylinder Bore Clearances or Modifications

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

For certain applications, special machined modifications are required for the piston/cylinder. IVEK Corporation determines these modifications by performing application tests using the application fluid. Contact IVEK Corporation for more information.

7.4.2 Fittings

The following types of fittings are available from IVEK Corporation.

- Barb Fittings x 1/4-28
  1/16", 1/8" and 3/16" (barb size)
- Flangeless Compression Fittings
  1/4-28 (use with 1/16" or 1/8" OD plastic tubing)
  1/4" ID Compression Nuts (use w/1/4" OD plastic tubing)
- Adapters
  1/8" ID Tubing Adapter
  1/4" ID Tubing Adapter
  3/8" ID Tubing Adapter
  1/4"-28 Ferrule Fitting Adapter
  1/2" ID Tubing Adapter
  1/8" OD Tubing Adapter

7.5 MAINTENANCE

CAUTION

Never connect or disconnect the cable from the Motor/Base Module connector while power is on. 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 should include careful handling. Always take great care when removing the piston from the cylinder and replacing the piston into the cylinder. Never clean ceramic parts in such a way that they can vibrate against each other. This could cause chipping.

The piston and cylinder are a matched set and should always be kept together. Each piston and cylinder are identified with a number which match the parts as a set.

CAUTION

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

7.5.2 Gland Nut O-Ring

The O-ring (Figure 7.2 Item 4) serves as a compliant structure for holding the case.

When properly maintained in a clean condition, the original O-ring may be expected to last for a considerable amount of time. If removed for any reason, it should be carefully cleansed of all foreign particles and inspected prior to reassembly. The O-ring seat must also be free of particles.

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

7.5.3 Piston Seals and Washer (Figure 7.3)

The two Rulon lip seals and Teflon gland washer serve to minimize external contamination of the piston fabrication and not to contain liquid within the Pump Module.

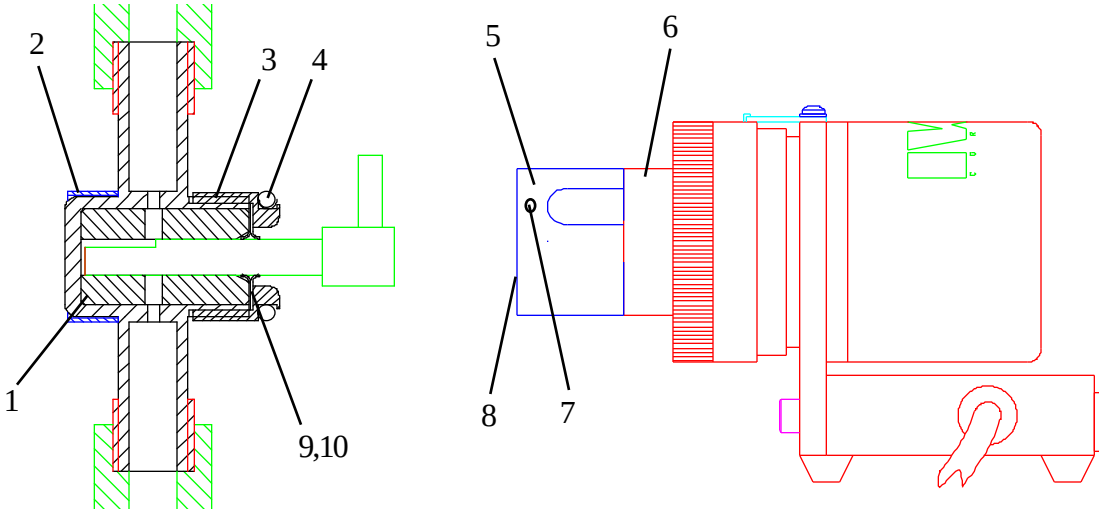


Figure 7.2 Rotary Adjust Pump Module

When properly maintained in a clean condition, the original seals may be expected to last for a considerable amount of time. If removed for any reason, they should be carefully cleansed of all foreign particles and inspected prior to reassembly. Figure 7.3 shows the proper mounting of the piston seals. Refer to Section 7.5.5.5 for assembly/disassembly procedures.

7.5.4 Stainless Steel Ring (Figure 7.2 Item 2)

The stainless steel ring, which slips onto the pump case, is there to protect the case itself from indentation caused by overtightening the stabilizing set screws. The adjustment screws for stabilizing the pump head should be used to maneuver the pump case into position. (Minimal adjustment and torque should be applied.)

CAUTION

Overtightening the stabilizing screws will damage the Pump Module.

7.5.5 Assembly/Disassembly Procedures

The Pump Module contains the following replaceable parts. (Refer to Figure 7.2)

- Ring (2)
- Gland Nut O-Ring (4)
- Gland Nut (3)
- Two Rulon Lip Seals (9)
- Teflon Gland Washer (10)
- Piston/Cylinder Fabrication (1)

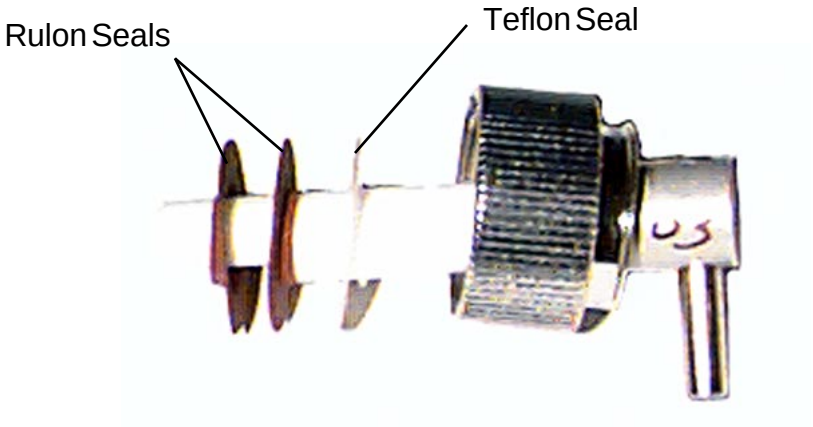


Figure 7.3 Rotary Adjust Pump Module Seal Locations

WARNING

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

7.5.5.1 Pump Module

Disassembly

Refer To Figure 7.2

1. Remove two socket head cap screws (8) securing end cap (5) to half collar (6) and remove end cap (5).
2. Loosen two stabilizing set screws (7).

Refer To Figure 7.4

3. Pull the Pump Module straight away from the Motor/Base Module until you can see the gland nut O-ring and piston. Tilt the Pump Module at a 45^{O} angle (axis of piston to axis of pump) and remove from the Motor/Base Module by pulling the pin out of the spherical bearing.

Assembly

CAUTION

Apply Aqualube lubricant to the drive pin prior to assembly. Apply enough to cover the surface. (see below) Failure to lubricate the drive pin may result in damage to the Pump Module and Motor/Base Module.

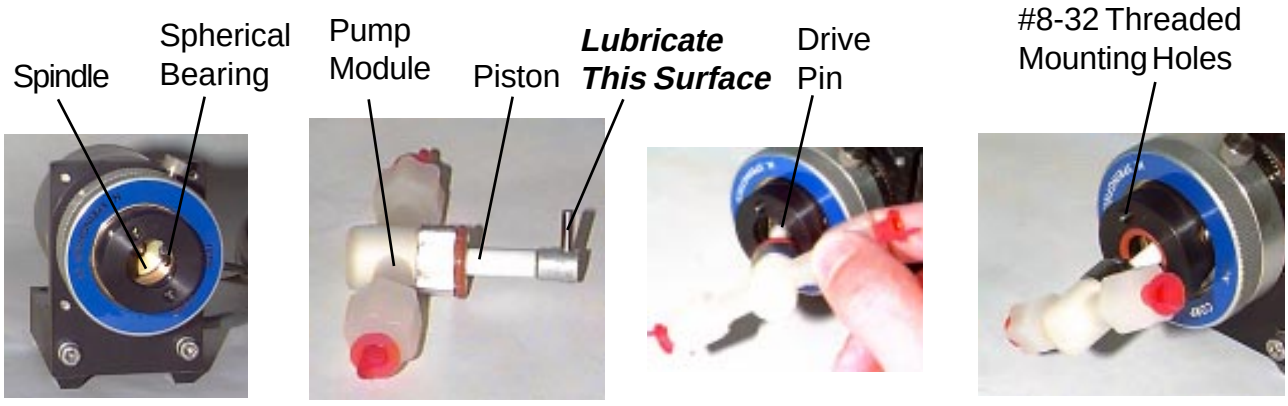


Figure 7.4 Rotary Adjust Pump Module Installation

Refer To Figure 7.4

1. Locate the position of the spherical bearing located on the spindle of the Motor/Base Module.
2. Extend the piston, which is housed in the Pump Module, approximately 2/3 of the way out of the module.
3. Holding the pump at a 45^{O} angle (axis of piston to axis of pump), slide the piston fabrication's drive pin into the center bore of the spherical bearing.

Refer To Figure 7.2

4. Push the Pump Module toward the rotary assembly so gland nut O-ring (4) seats into half collar (6).
5. Place stainless steel band (2) around the pump case.
6. Place end cap (5) over the Pump Module and secure to half collar (6) using the two socket head cap screws (8).
7. Readjust stabilization set screws (7).

NOTE

There will be some compression of the O-ring when attaching the end cap. ***Excessive force should not be used. If the end cap does not seat easily, remove it and be sure that the Pump Module is in place.***

Make sure inlet and outlet ports are properly aligned.

7.5.5.2 Ring (Figure 7.2 Item 2)

Disassembly

1. Remove two socket head cap screws (8) securing end cap (5) to half collar (6) and remove end cap (5).
2. Loosen two stabilizing set screws (7).
3. Remove ring (2).

Assembly

1. Position ring (2) on the Pump Module.
2. Position end cap (5) over the Pump Module.
3. Secure with two socket head cap screws (8).
4. Readjust stabilization set screws (7).

7.5.5.3 Gland Nut O-Ring (Figure 7.2 Item 4)

Disassembly

1. Remove the Pump Module.
2. Remove gland nut O-ring (4) from gland nut (3).
3. Inspect gland nut O-ring (4) for damage, replace if necessary.

Assembly

1. Position gland nut O-ring (4) on gland nut (3).
2. Install the Pump Module.

7.5.5.4 Gland Nut (Figure 7.2 Item 3)

Disassembly

1. Remove the Pump Module.
2. Remove O-ring (4) from gland nut (3).
3. Unscrew gland nut (3) from the Pump Module.
4. Remove the lip seals (9) and washer (10) from inside of gland nut (3).

Assembly

1. Install the lip seals (9) and washer (10) inside of gland nut (3). (Refer to Figure 7.2)
2. Screw gland nut (3) onto Pump Module.
3. Install O-ring (4) on gland nut (3).
4. Install the Pump Module.

7.5.5.5 Lip Seal and Washer (Figure 7.2 Items 9 and 10)

CAUTION

The Rulon lip seals are fragile. Remove and install carefully to prevent tearing.

Disassembly

1. Remove the Pump Module.
2. Unscrew gland nut (3) from the Pump Module.
3. Remove the lip seals (9) and washer (10) from inside of gland nut (3).

Assembly

1. Install the lip seals (9) and washer (10) inside of gland nut (3). (Refer to Figure 7.2)
2. Screw gland nut (3) onto Pump Module.
3. Install the Pump Module.

7.5.5.6 Ceramics/Cylinder Housing (Figure 7.2 Item 1)

NOTE

The ceramics/cylinder housing is made up of the piston fabrication, cylinder, and cylinder housing. If any of these parts needs replacing, they must all be replaced.

Disassembly

1. Remove the Pump Module.
2. Remove the piston from the cylinder housing.
3. Unscrew and remove gland nut (3) from the Pump Module.

Assembly

1. Screw gland nut (3) onto the Pump Module.
2. Carefully slide the cylinder into the cylinder housing.
3. Install the Pump Module.

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 may occur.

1. Remove the end cap from the Motor/Base Module and loosen the two stabilizing set screws. Carefully remove the Pump Module and soak in a compatible liquid.

2. If the aforementioned procedures fail, contact IVEK for technical help. It may be necessary to ship the Pump Module back to the factory. Provide a note describing, in detail, what conditions caused the seizure and what liquids are being pumped.

It may also be necessary to return the Motor/Base Module along with the Pump Module.

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

Table 7.1 Common Operational Problems And Solutions

PROBLEM	PROBABLE CAUSE	POSSIBLE SOLUTION
Air evident in discharge line.	Loose/Damaged Fitting	Tighten/replace fittings.
	Cavitation	Increase inlet tubing size or reduce motor speed.
Piston seizing	Particulate materials entrapped between piston and cylinder.	Disassemble Pump Module and clean all wetted surfaces.
Fluid leaks	Loose/damaged fitting or tubing.	Inspect and replace if necessary.
Fluid not moving in tubing when priming, dispensing or metering.	Bad seals.	Make certain that port seals in Pump Module are tight and in good condition.
	Bad input tubing connection.	Check reservoir and port tubing connections.
	Broken piston or loose piston cap.	Remove Pump Module and inspect, replace if necessary.
Inconsistent low volume dispenses.	Pump Module not stabilized.	Stabilize Pump Module.
	Pump Module case damaged.	Inspect for damage caused by the stabilization screws, replace if necessary.
Fluid trapped between case and cylinder.	Improper seal.	Return to IVEK for new case.

7.7 SPECIFICATIONS

7.7.1 Volume

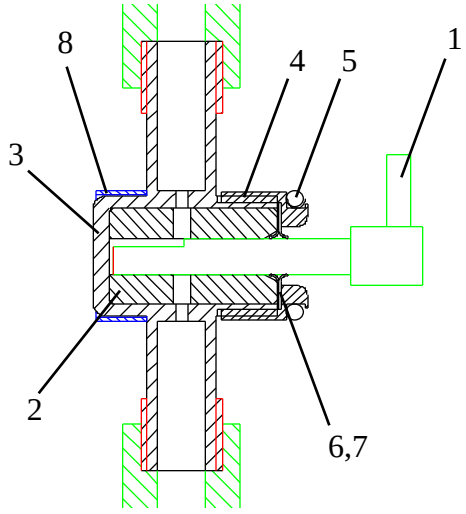
Table 7.2 lists the volumetric output of the different size Pump Modules. Refer to the Title Page section of this manual for the Pump Module size provided with your system.

Table 7.2 Volumetric Output Of Rotary Adjust Pump Modules

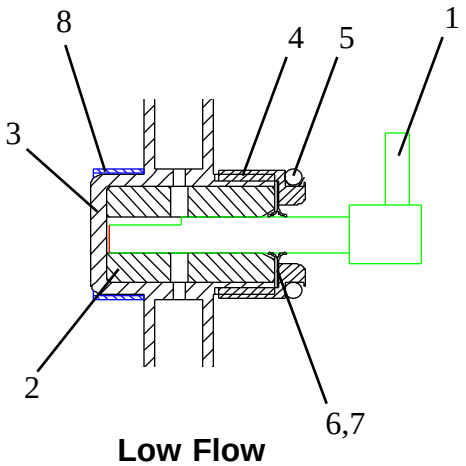
Size	Max Displacement Per Stroke (µl)	Recommended Min Displacement Per Stroke (µl)
3A	25	1
2A	50	5
1A	100	10

7.8 ILLUSTRATED PARTS BREAKDOWN

The illustrated parts breakdowns (Figure 7.5) contains the information required for identifying and ordering parts for the Rotary Adjust Pump Module.



High Flow



Low Flow

Figure 7.5 Rotary Adjust Pump Module (Sheet 1 of 2)

INDEX NO.	PART NUMBER	DESCRIPTION	UNITS PER ASSY
	See Chart	**Rotary Adjust Pump Module**	**1**
1	*	Piston Fabrication	1
2	*	Cylinder Liner	1
3	*	Pump Case	1
4	102045	Gland Nut	1
5	102044	O-Ring	1
6	**	Rulon Lip Seal	2
7	**	Teflon Gland Washer	1
8	102001	Ring	1

Part Number	Description
102032	Low Flow Kynar Case
102033	High Flow Kynar Case
102036	Low Flow Tefzel Case
102037	High Flow Tefzel Case

NOTE

***** *The Pump Case, Piston Fabrication and Cylinder Liner are factory matched and can not be sold individually. The number for this assembly is located on the side of the pump case, (look closely) refer to this number when ordering or inquiring about ceramic components.*

****** *These parts are different depending on the size of the pump. Refer to the following chart for the correct part numbers.*

Pump Size	Hole or Piston Diameter (approx)	Lip Seal (red)	Gland Washer (White)
3A	1/8"	102038	102041
2A	3/16"	102039	102042
1A	1/4"	102040	102043

Figure 7.5 Rotary Adjust Pump Module (Sheet 2)

CHAPTER REVISIONS

B	8/18/97	Reformatted and Edited
A	3/6/96	Minor changes in text.
-	1/18/96	Original release