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5. LINEAR ACTUATOR MODULE

5.1 DESCRIPTION (Figure 5.1)

The Linear Actuator Module, hereafter referred to as the Actuator Module, contains the mechanism for controlling the rotary and linear motion of the piston. The Actuator Module is composed of the motor, lead screw (either 20-pitch or 40-pitch), pump coupling, clutch/brake assembly, sensors and the cable connector.

Either a 20-pitch or 40-pitch model has been supplied depending on the size of the Pump Module chosen for your application. The 20-pitch Actuator Module is used for the B, C and D size pumps and measures 266.7mm (10 1/2") high, 76.2mm (3") deep, 63.5mm (2 1/2") wide and weighs approximately 2.27 kg (5 pounds). The 40-pitch Actuator Module is used for the "A" series pumps and measures 228.6mm (9") high, 76.2mm (3") deep, 63.5mm (2 1/2") wide and weighs approximately 2.04kg (4.5 pounds). Both modules provide accurate control of the piston for precise dispensing volumes.

Minimum Chamber Volume (MCV) variants (032254 and 032255) are also available as 20-pitch or 40-pitch, respectively, and have been supplied depending on the size of the Pump Module chosen for your application. The 20-pitch Actuator Module is used for the B, C and D size pumps and measures 271mm (10.7") high, 76.2mm (3") deep, 63.5mm (2 1/2") wide and weighs approximately 2.3 kg (5 pounds). The 40-pitch Actuator Module is used for the "A" series pumps and measures 246mm (9.7") high, 76.2mm (3") deep, 63.5mm (2 1/2") wide and weighs approximately 2.3 kg (5 pounds). Both modules provide accurate control of the piston for precise dispensing volumes.

WARNING

Never remove a safety cover while the Actuator Module is running. Moving parts are located under these covers. Physical harm to individuals is possible.

5.2 OPERATION

The Actuator Module utilizes a permanent magnet stepper motor, a lead screw and an electromagnetic clutch and brake to produce a controllable linear and rotary motion. A linear displacement of the lead screw is produced by rotating a drive nut, internal to the stepper motor, while preventing the screw from rotating with the electromagnetic brake. Angular displacement steps of 1.8˚ produced by the stepping motor are thus converted to linear displacement steps at the screw. Angular displacement of the lead screw is accomplished by releasing the brake and coupling the lead screw to the motor drive nut through the electromagnetic clutch. The coupling of these members allows the stepper motor to impart a rotary motion to the lead screw.

Electronic control over these linear and rotary functions allows a mounted Pump Module to be driven so the linear motion is used to fill or empty the Pump Module and rotary motion is used to valve to the intake and discharge ports.

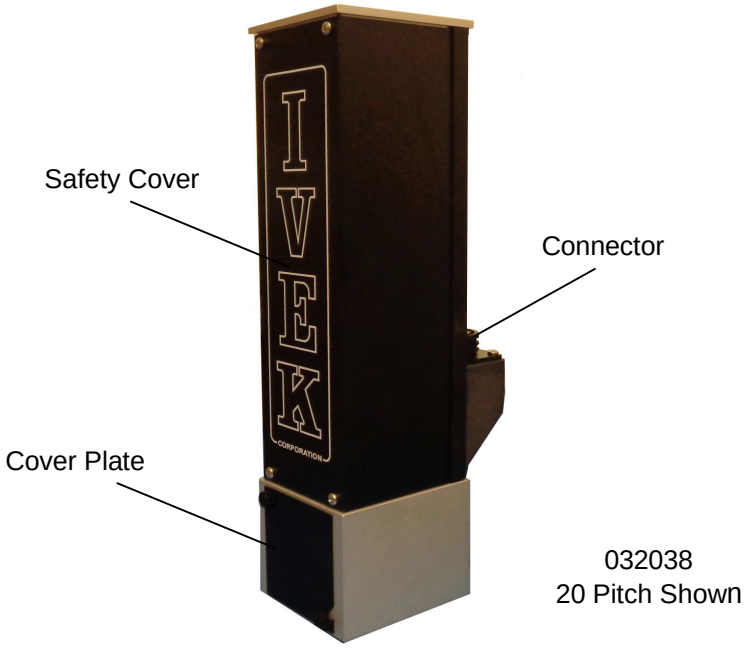

Figure 5.1 Actuator Module

5.2.1 Sensors

There are two sensors in the Actuator Module; both are used to control the stopping location of the lead screw. The linear sensor can either be magnetic or optical and is activated when the lead screw is in the linear home location. The rotary sensor is magnetic and is activated when the lead screw is in the rotary home location.

The sensor type is identified in the model number of the Actuator Module. The model number is located on the Actuator Module and in the Title Page section of the Operators Manual. A description of the Model Number is located in section 5.8 of this chapter.

5.2.1.1 Linear Sensor

The linear sensor sends a signal to the Controller Module when the lead screw is in the linear home position. When the pump chamber is filling, the lead screw is drawing the piston back. When the pump chamber is full, the lead screw activates the linear sensor stopping the piston. For a non-MCV actuator the linear home sensor detects a piston withdrawn to full chamber capacity. For an MCV actuator the linear sensor detects a piston that is in the empty chamber position. The Controller generates a fault if either the piston does not return to the home position within the expected motor movement distance (indicating a stall during load/reference), or it returns to the home position sooner than expected (indicating a stall during a previous discharge).

5.2.1.2 Rotary Sensor

The rotary sensor sends a signal to the Controller Module when the lead screw is in the rotary home position. The rotary sensor is used to detect problems during rotation of the piston (valving between the discharge port and intake port).).

The piston positions need to be referenced when power is first applied, and also after a fault has occurred. At the completion of the reference cycle, the piston is in the full chamber position with the port valved towards the discharge port (as determined by the mechanical position set by the factory and also the Controller setting).

5.2.2 Coupling (hub)

A coupling, located on the pump side of the Actuator Module, provides a mounting location for the piston. The piston drive pin slides into a slot on the coupling hub and is secured with two set screws. A heavy duty coupler is available for the 20-pitch actuator. This coupler provides greater longevity when dispensing viscous fluids at higher rates.

The coupling type is identified in the model number of the Actuator Module. The model number is located on the Actuator Module and in the Title Page section of the Operators Manual. A description of the Model Number is located in section 5.8 of this chapter.

CAUTION

The coupling is factory set to a precise location. Moving the coupling could cause damage to the Actuator Module or Pump Module or cause a leak.

WARNING

The linear actuator motor can generate a force capable of causing injury, especially during linear movement. The cover plate guards the operator from hand pinch hazards inside the coupler compartment. Do not remove the cover plate while the actuator is operating/powered. If the cover needs to be removed to view pump movement or coupler (e.g., for troubleshooting purposes), make sure it is performed by a trained operator and take precautions so that no fingers are placed within the compartment underneath the cover during operation.

5.2.3 Porting (Figure 5.2)

The porting position is mechanically preset at the factory based on the customer's installation requirements and must be specified upon purchase. There are 4 possible positions for the discharge port (outlet) and intake port (inlet). The "O'clock" option (e.g, 3 O'clock) refers to the desired position of the discharge port. The intake port is always in the position opposite of the discharge port.

Most Controllers also allow the inversion of the discharge port and intake port positions (e.g., Active Port A/B, or Invert Pump Ports Disabled/Enabled). While this provides some flexibility in the final installation, it is recommended to have the porting position mechanically preset by the factory.

The porting setup is identified in the model number of the Actuator Module. The model number is located on the Actuator Module and in the Title Page section of the Operators Manual. A description of the Model Number is located in section 5.8 of this chapter.

WARNING

Removing covers exposes pinch points; keep hands and foreign objects clear while operating with covers 12 and 13 removed.

In Forward, Port A is always the input and Port B is the output.

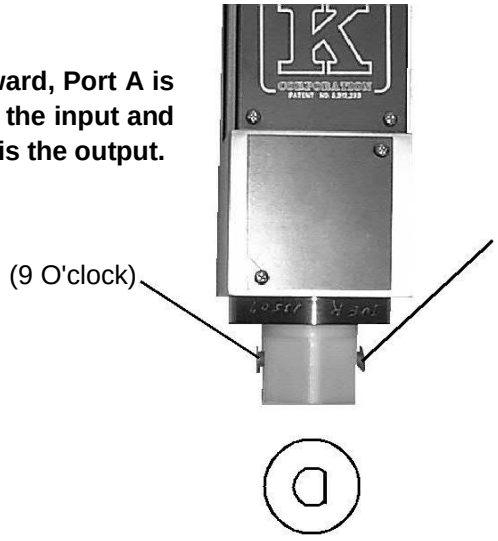

Figure 5.2A Example of a 3 O'clock discharge port position.

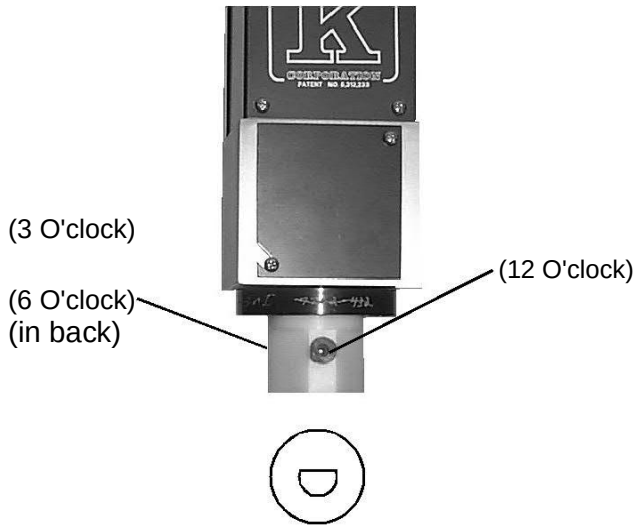

Figure 5.2B Example of a 12 O'clock discharge port position.

5.2.3.1 Operation

The Pump Module may be mounted to the Actuator Module with its intake and discharge ports positioned in one of two positions. This affects the internal setup of the Actuator Module and can be changed if required.

5.2.3.2 Porting Adjustment (Figure 5.3)

The following procedure describes changing the orientation of the porting.

Tools Required

1. Philips Head Screwdriver
2. 3/32 Hex Key
3. 5/32 Hex Key

Setup

1. Connect Controller Module to Actuator Module using the cable.
2. Turn power on and reference the system.
3. Change the Controller Module to Meter mode and Load mode to manual.
4. Press START to meter piston fully forward.
5. Remove covers (12) and (13).

WARNING

The linear actuator motor can generate a force capable of causing injury, especially during linear movement. The cover plate guards the operator from hand pinch hazards inside the coupler compartment. While performing the porting adjustment, it is important that the trained operator takes precautions so that the controller does not activate the actuator while fingers are in the compartment.

6. Use 5/32 hex key to remove Pump Module (refer to Chapter 7, leave the piston in place)
7. Use 3/32 hex key to loosen, do not remove, #4-40 socket head cap screw (19) (screw may be in a different position)
8. Rotate the piston so the flat lines up with the desired discharge port position (refer to figure 5.2). Do this by rotating the coupling that holds the piston. Use an edge of the coupling housing (1) as a visual reference.

NOTE

Be careful not to rotate the flag collar or you will have to repeat the adjustment in step 13. If you move the drive finger linearly there is a chance the spool bushing could interfere on one end of its linear movement.

9. Tighten #4-40 socket head cap screw (19).
10. Press the LOAD button on the Controller Module to fully retract the piston.
11. Press the START button to meter the piston fully forward.
12. Recheck piston flat to verify port alignment.
13. Repeat adjustments 7 through 9 if needed.
14. Insure there is approximately 1/32" gap between spool bushing (18) and drive hub (10) when pump is metered forward.
15. Replace Pump Module (refer to Chapter 7).
16. Replace covers (12) and (13).

5.3 INSTALLATION

The Actuator Module includes two 1/4-20 tapped mounting holes. These mounting holes can be used for mounting onto various apparatuses. The position of the Pump Module should be considered when mounting the Actuator Module. Plan to mount so the intake and discharge tubing and the end cap can be easily accessed. Additional consideration should be taken regarding the fluid flow. Always keep the discharge of the Pump Module even with or higher than the intake and never mount the Actuator Module so the pump end cap is above the ports.

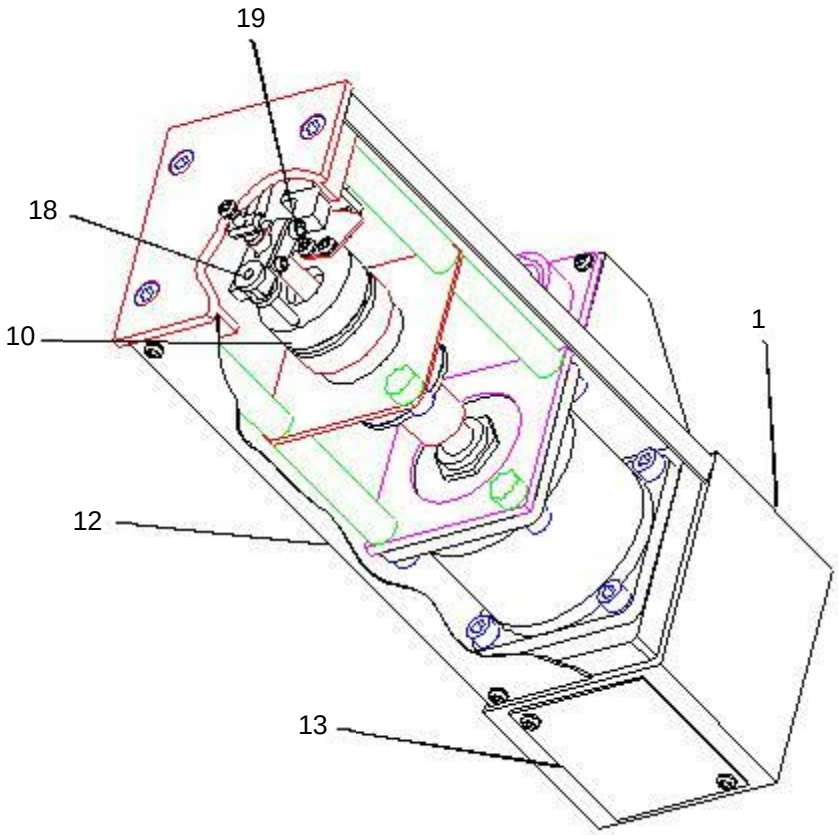

Figure 5.3 Actuator Module Port Change Illustration

CAUTION

The provided 1/4-20 stainless steel mounting screws should be tightened in the range of 7.9 Nm to 8.5 Nm (70 in-lb. to 75 in-lb.). Over torqueing may cause damage to the aluminum housing or mounting screws.

5.4 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 Actuator Module. Refer to the Title Section of this manual for the list of options provided with this system.

5.4.1 Encoder

The encoder option must be present in the channel card (in Controller Module), the interconnecting cable and in the corresponding Actuator Module.

This option adds an encoder to the Actuator Module which allows the channel card to verify all motions of the Actuator Module. Any stall during fluid displacement or valving will immediately be sensed using the encoder and will generate a fault condition. The encoder works in conjunction with the linear and rotary sensors.

The encoder option is identified in the model number of the Actuator Module. The model number is located on the Actuator Module and in the Title Page section of the Operators Manual. A description of the Model Number is located in section 5.8 of this chapter.

5.5 MAINTENANCE

CAUTION

Never connect or disconnect the cable from the Controller or Actuator Module connector while power is on. Damage to the equipment may result.

Minimal maintenance is necessary for this Actuator Module.

5.6 PROBLEM GUIDE

Table 5.1 contains a list of possible problems, causes and solutions for the Actuator Module.

Table 5.1 Common Operational Problems and Solutions

PROBLEM	PROBABLE CAUSE	POSSIBLE SOLUTION
Controller Module power on and operational, but will not activate Actuator Module.	I/O Cable	Check connection of cable between Controller Module and Actuator Module. Inspect and repair faulty cable.
System is running but not pumping fluid.	Damaged Coupling	If piston not referenced to output, check coupling for damage.
	Loose fluid fitting	Tighten fluid fitting
Rotary or Linear Sensor Fault	Piston seized in cylinder	Remove and soak.
Piston home fault or linear sensor fault	Obstructed optical linear sensor	Inspect and clean optical linear sensor

5.7 SPECIFICATIONS

Motor:	23 Frame 1.8º Stepper
Lead Screw:	1/4-20 Acme or
	1/4-40 60º V Thread
Lead Accuracy:	.0001" / inch noncumulative
Maximum Stroke:	1/4-20 = 1/2" = 2000 steps or
	1/4-40 = 1/4" = 2000 steps
	1/4-20 with A-20 Option = 1/4" = 1000 Steps

5.8 MODEL NUMBER

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

40 Pitch Actuator **032037 -** ## # # #
20 Pitch Actuator **032038 -** ## # # #

Discharge Port Position
- **03** - 3 O'clock (standard)
- **06** - 6 O'clock
- **09** - 9 O'clock
- **12** - 12 O'clock

Encoder
- **1** - No Encoder
- **2** - Encoder

Sensors
- **1** – Magnetic Linear, Magnetic Rotary (Obsolete)
- **2** – Optical Linear, Magnetic Rotary

Coupler
- **1** - Standard
- **2** – Heavy Duty (20-Pitch Only)
- **3** – A20 (20-Pitch Only)

20 Pitch Actuator **032254 -** ## # # #
40 Pitch Actuator **032255 -** ## # # #

Dispense Port Position
- **03** - 3 O'clock
- **06** - 6 O'clock
- **09** - 9 O'clock
- **12** - 12 O'clock

Options
- **1** – No Encoder

Sensors
- **1** – N/A
- **2** – Optical Linear, Magnetic Rotary

Coupler
- **1** - Standard
- **2** – Heavy Duty (20-Pitch Only)
- **3** – A20 (20-Pitch Only)

5.9 ILLUSTRATED PARTS BREAKDOWN

The illustrated parts breakdown (Figure 5.4) contains replacement parts for the Actuator Module.

INDEX NO.	PART NUMBER	DESCRIPTION	UNITS PER ASSY
		Linear Actuator Module	**1**
032037-#####			
1	032133	Front Shell Fabrication	1
2	032083	Cover Plate	1
3	032128	Thumb Screw Fabrication	2
4	001576	Adaptor Ring	1
032038-#####			
1	032132	Front Shell Fabrication	1
2	032083	Cover Plate	1
3	032128	Thumb Screw Fabrication	2
4	032050	Adaptor Ring (supplied with 20 pitch macro pump module, not shown)	1
4	001576	Adaptor Ring (A20 only)	1
032254-#####			
1	032132	Front Shell Fabrication	1
2	032083	Cover Plate	1
3	032128	Thumb Screw Fabrication	2
4	032050	Adaptor Ring (supplied with 20 pitch macro pump module, not shown)	1
4	001576	Adaptor Ring (A20 only)	1
032255-#####			
1	032133	Front Shell Fabrication	1
2	032083	Cover Plate	1
3	032128	Thumb Screw Fabrication	2
4	001576	Adaptor Ring	1

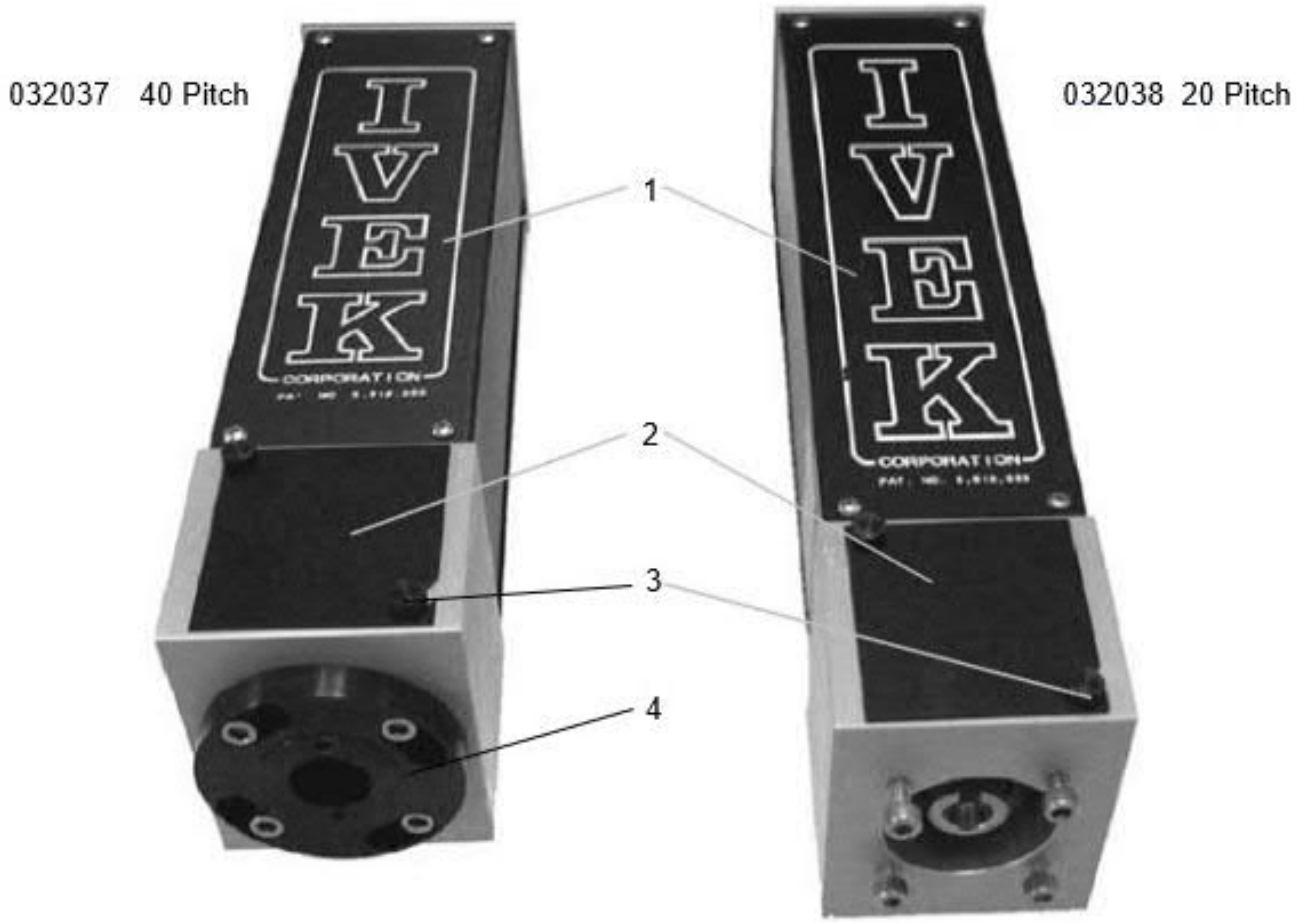

Figure 5.4 Linear Actuator Modules shown (Sheet 1 of 1)

CHAPTER REVISIONS

K	12/13/24	Per DCR/N 22477 & 22450
J	Unknown	Per DCR/N Unknown
I	2/25/21	Per DCR/N 20383 Improvements
H	2/4/20	Per DCR/N 19526 Added ¼-20 with A-20 option spec
G	4/9/19	Per DCR/N 19189 Corrected Encoder tab 1 = No Encoder 2 = Encoder.
F	10/30/18	Per DCR/N 18913 added 4th tab for Sensors and 5th tab for Couplers.
E	4/14/16	Per DCR/N 17165 added torque note in section 5.3.
D	12/01/09	Per DCR/N 12810 added port position to 5.2.3, corrected black and white conversion for figure 5.3, and added warning to section 5.2.3.2. Per DCR/N 15805 added additional tabs for Encoder Type.
C	7/20/07	Replaced Photo in Figure 5.4 to show Adaptor Ring per DCR/N 11377
B	4/8/04	Add Adaptor Ring to part list per DCR/N 9941
A	1/31/03	Added Model Numbers and changed porting section.
-	4/21/97	Original release

DRAFT DOCUMENT CARRIER SHEET

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