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## 5. DOUBLE ENDED HEAVY DUTY MOTOR/BASE MODULE

### 5.1 DESCRIPTION (Figure 5.1)

The Double Ended Heavy Duty Motor/Base Module, hereafter referred to as the Motor/Base Module, is comprised of one motor to drive two Pump Modules, two bases to support the Pump Modules, two displacement adjustment mechanisms and one cable connector. The motor provides accurate control. The displacement adjustment mechanisms change the angle between the axis of the motor and the axis of the Pump Modules thus changing the pumped volume. The cable connector provides a connection point for the cable from the Controller Module.

#### WARNING

*Never remove a safety cover while the motor is running. Moving parts are located under these covers. Personal injury to individuals may result.*

### 5.2 OPERATION

The Motor/Base Module is used to operate two Pump Modules for several different applications.

*Same liquid pumped into both Pump Modules.*

Increase volume capacity by channeling the outputs of both pumps to one nozzle.  
Dispense from two different dispense tips with one Motor/Base Module.  
Reduce pulsations in metering applications.

*Different fluid pumped in each Pump Module.*

Accurate proportioning of two liquids.

The Motor/Base Module includes a thumbwheel for adjusting the calibration of each Pump Module, a spindle rotation sensor and a drive spindle to move each piston.

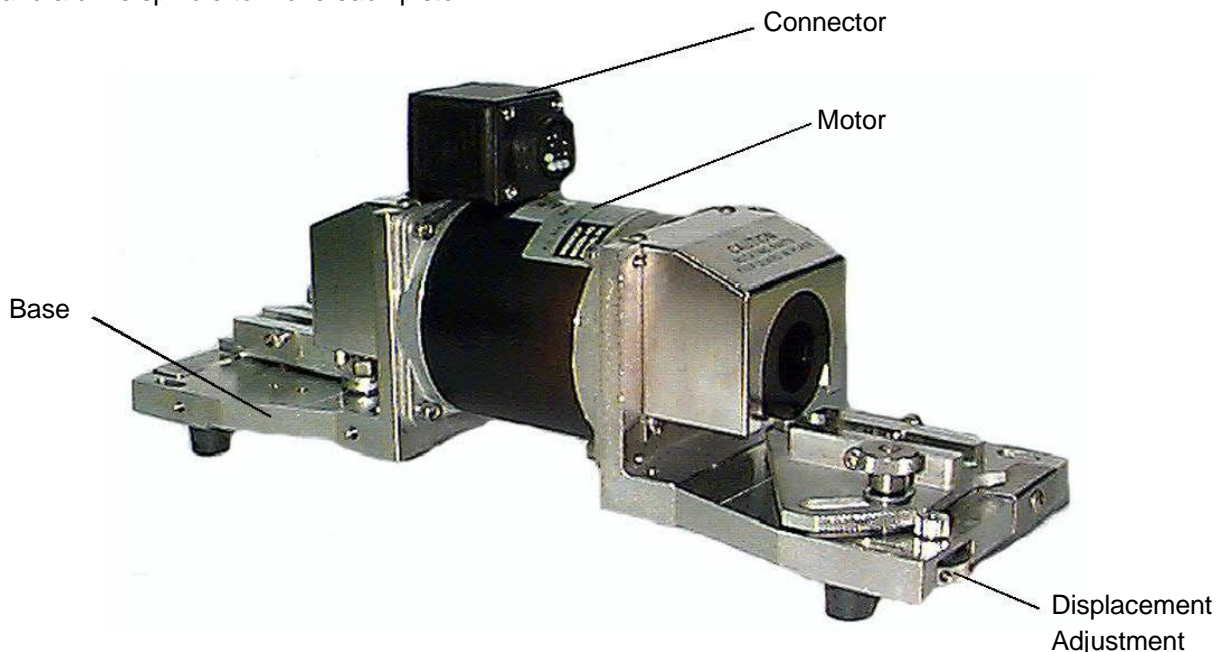


Figure 5.1 Double Ended Heavy Duty Motor/Base Module

### **5.2.1 Thumbwheel**

The thumbwheel is used to change the angular relationship of the Pump Module axis to the drive spindle axis. The greater the angle, the greater the volume of liquid displaced for each revolution. A vernier scale is located on the Motor/Base Module to provide a setting reference. Setting the angle to "0" provides minimum output and "20" provides maximum output. The thumbwheel contains 0.156" (3.9mm) holes for inserting a rod for fine adjustments.

### **5.2.2 Spindle Sensor**

A sensor detects the rotation of the spindle, and is used to count revolutions, stop the pump during the intake stroke and detect stalls.

#### **5.2.2.1 Volume Strokes**

The spindle sensor allows the Controller Module to count the revolutions of the spindle to ensure the requested number of revolutions (volume strokes) has been completed. Just prior to reaching the required count, the sensor signals the stepper motor drive circuitry to decelerate.

#### **5.2.2.2 Stopped Location**

The Controller Module decelerates the motor and stops the piston during the intake stroke of the pump. The sensor signals the stepper motor drive circuitry to decelerate, thereby ensuring the position at the end of the dispense is based on a sensed position, and not on the accumulation of motion commands to the motor drive circuitry.

If the piston is at a random position, such as after reassembly due to cleaning, the piston will be properly indexed to stop during the intake stroke following the completion of the first dispense cycle (with no faults). By stopping during the intake stroke, variations in the exact stopping position will not affect dispense accuracy.

#### **5.2.2.3 Stall Detect**

Motor stalls are detected if a signal from the spindle sensor is not detected for each revolution commanded to the motor. In a stepping motor system, a stall has occurred if more than the 200 required steps for a revolution have been commanded without a subsequent signal from the spindle sensor. A small margin above 200 steps is allowed to prevent minor variations from incorrectly signaling a fault. If an error is detected, the system can be designed to either inhibit further dispensing, alert the operator or provide a reject signal for integrated process control. (Refer to Chapter 3 for more information)

### **5.2.3 Spindle**

A spindle, containing a spherical bearing, is mounted on each motor shaft. When a Pump Module is mounted with its drive pin inserted into the spherical bearing, the spindle drives the piston in a motion that combines rotation and reciprocation.

When a Pump Module is mounted on the Motor/Base Module, the piston pin extends through the center bore of the spherical bearing. At zero pump displacement, the axis of the piston aligns with the axis of the spindle and motor shaft. As the motor turns, the spindle drives the piston in a purely rotational motion. Introducing an angle between the axis of the spindle and the axis of the piston adds a reciprocating motion to the rotation of the piston. The magnitude of the reciprocating motion is a function (sinusoidal) of the angle between the piston axis and the spindle axis.

### **5.2.4 Arrangement**

The two Pump Modules are mechanically coupled and will always operate together. For example, while the displacement calibration of one end is being adjusted, the liquid pumped from the other end must be recirculated or captured in a runoff container. To increase the flow rate, the two pumps will pump simultaneously. To reduce pulsations, the two pumps can pump alternately. Simultaneous or alternate operation of a Double Ended Motor/Base Module is determined during the manufacture of the system. The last digit in the model number specifies the operation; 1 for alternating and 2 for simultaneous.

**5.2.4.1 Simultaneous**

The intake and discharge cycles of the two Pump Modules coincide when the Motor/Base Module is configured for simultaneous operation. Both Pump Modules are intaking at the same time and discharging at the same time. Simultaneous operation is generally used for dispensing operations to either gain a second liquid path where separate control is not required or for extremely accurate proportioning of two different fluids.

**5.2.4.2 Alternate**

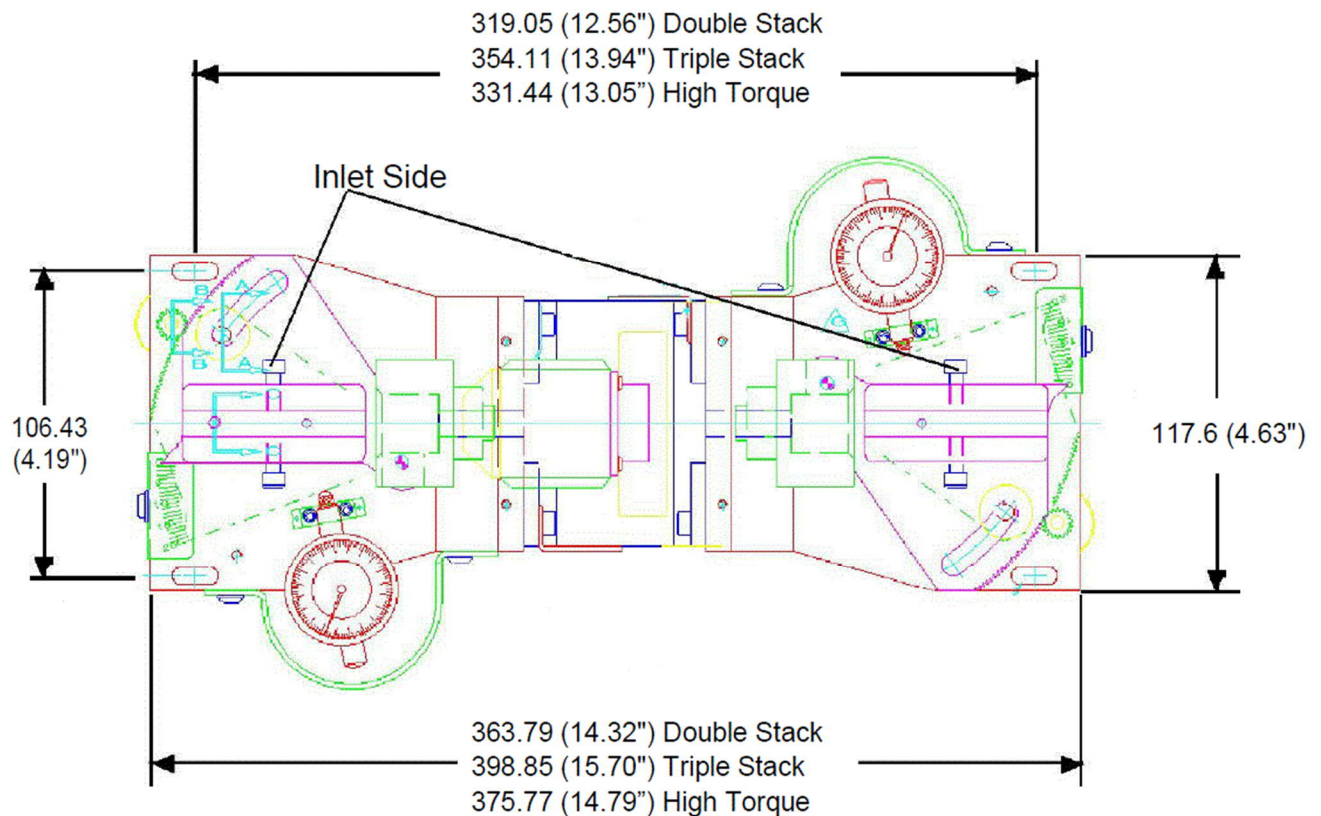
The intake and discharge cycles of the two Pump Modules are opposed when the Motor/Base Module is configured for alternate operation. While one Pump Module is intaking, the other Pump Module is discharging. Alternate operation is generally used for metering operations to reduce pulsations and if necessary, increase flow rate.

**5.3 INSTALLATION**

The Motor/Base Module includes four slotted mounting holes (Refer to Figure 5.2). These four mounting holes can be used for mounting onto various apparatuses.

**CAUTION**

*Only use the four slotted mounting holes. Using all eight holes may damage the Motor/Base Module.*



**Figure 5.2 Double Ended Heavy Duty Motor/Base Module Dimensions**

The orientation of the Pump Module should be considered when mounting the Motor/Base Module. Plan the mounting so the intake and discharge tubing and the end cap which holds the Pump Module's cylinder in place 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 Motor/Base Module so either Pump Module's cylinder end cap faces upward. Refer to Figure 5.2 for the mounting hole locations. If mounting to a solid surface, remove the rubber feet.

Some Motor/Base Modules are designed to work with certain Controller Modules. Make sure the Motor/Base Module is used with the Controller Module with which it was shipped or a comparable model. Please contact IVEK Corporation if there are any questions.

## 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 Motor/Base Module. Refer to the Title Section of this manual for the list of options provided with this system.

### 5.4.2 Calibration

IVEK provides two options for calibration. The two options are a digital indicator gauge or analog micrometer head. This option can be mounted on the front end, back end or both ends depending on the application.

#### 5.4.2.1 Calibration Gauge

The dial indicator option is used for precise pump calibration. A dial provides a precise reference for setting of the pump's displacement. If the pump displacement is changed, just return to the reference. Minor adjustments may still be necessary.

#### NOTE

*The Calibration Gauge does not operate over the full range of displacement. Set the position of the indicator for the approximate area of the required displacement.*

*One screw holding the indicator block in position is locked in place and should not be loosened or removed.*

*Do not over tighten the indicator block screws, the indicator shaft may not slide freely in the indicator.*

#### 5.4.2.2 Micrometer

The micrometer is mounted to the end of the base plate on the Motor/Base Module. This device is designed to aid in dispensing small volumes of material for applications requiring a high degree of accuracy and repeatability.

### 5.4.3 Motor Type

This Motor/Base is also available with a Double Stack Unipolar Stepper, Triple Stack Unipolar Stepper, DC Brushless or High Torque Bipolar Stepper motor.

These options provide reduced or increased motor torque needed to pump different density liquids or against elevated output pressure. The motor is determined based on the specific application.

IVEK Corporation provides application assistance in determining which motor works best for each application.

The Controller Module must be adjusted at the factory when changing between Unipolar, Bipolar and DC Brushless Motor/Base Modules.

### 5.4.4 **120° Counterclockwise Flag Adjustment**

This option changes the stopped location of the piston and is used for specific conditions or fluids as recommended

by our Applications Department.

### **NOTE**

*The 120° Counterclockwise Flag Adjustment can only be used on Multispense and 3009 Controller Modules.*

## **5.5 MAINTENANCE**

### **CAUTION**

*Never connect or disconnect the cable from the Motor/Base Module connector while power is on. Damage to the equipment may result.*

Minimal maintenance is necessary for this Motor/Base Module.

### **5.5.1 Assembly/Disassembly Procedures (Figure 5.3)**

This section contains assembly/disassembly procedures for the following parts.

- Vernier Scale (23) • Thumb Nut (18)
- Thumb Wheel (19) • Swing Plate Fabrication (2)
- Pinion Shaft (21) • Sensor End Shield (4)

#### **5.5.1.1 Vernier Scale (Figure 5.3 Items 23)**

Disassembly

1. Remove the #8 - 32 x .25" button head socket cap screw and #8 flat washer securing vernier scale (23) to base (1).
2. Remove vernier scale (23).

Assembly

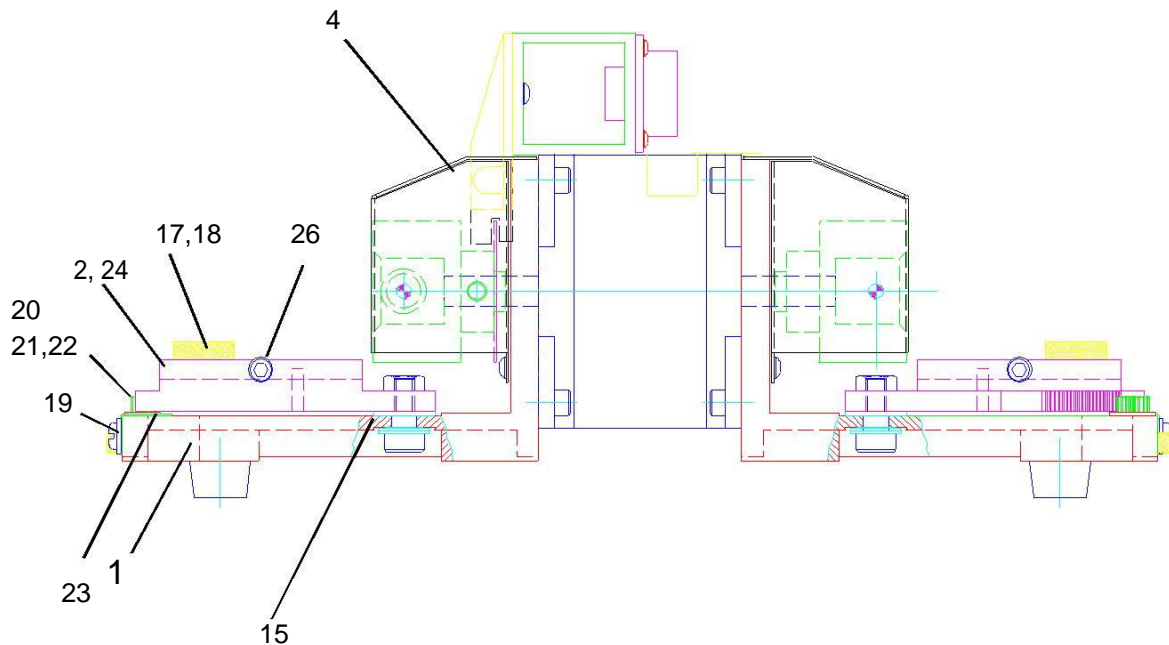
1. Position vernier scale (23) on base (1).
2. Secure using #8 - 32 x .25" button head socket cap screw and #8 flat washer.

Set the vernier scale position (calibrate) fluidically by setting the pump for zero liquid displacement and position the vernier scale "0" under the pointer.

#### **5.5.1.2 Thumb Wheel (Figure 5.3 Item 19) and Pinion Gear (Item 21) and Bearings**

Disassembly

1. Remove the #10 - 32 x .25" socket set screw securing thumb wheel (19) to pinion gear (21) and remove pinion gear (21).
2. Remove thumb wheel (19), pinion gear (21) and plain bearing (20).
3. Using a 1/4" (6.35mm) diameter drift punch, push flange bearing (22) out of base (1).



**Figure 5.3 Double Ended Heavy Duty Motor/Base Module**

#### Assembly

1. Position flange bearing (22) over bore in base (1) with the flange end up and press into position.
2. Insert pinion gear (21) with the gear on top into flange bearing (22).
3. Install plain bearing (20) around bottom end of flange bearing (22).
4. Install thumb wheel (19) over bottom of pinion gear (21).
5. Align the set screw in the thumb wheel (19) with the flat on the side of pinion gear (21).
6. Secure thumb wheel (19) to pinion gear (21) using the #10 - 32 x .25" socket set screw.

#### 5.5.1.3 Thumb Nut (Figure 5.3 Item 18) and Bearings

##### Disassembly

1. Remove thumb nut (18) by turning in a counterclockwise direction.
2. Remove .25" ID flat washer.
3. Pivot swing plate fabrication (2) to gain access to .06" thick plain bearing (17).
4. Remove .06" thick plain bearing (17).

##### Assembly

1. Position .06" thick plain bearing (17) over threaded hole on base (1).
2. Position 18 - 8 x .25" ID flat washer on top of swing plate fabrication (2) and align holes with .06" thick plain bearing (17) and threaded hole in base (1).
3. Install thumb nut (18) through 18 - 8 x .25" ID flat washer, swing plate fabrication (2) and .06" thick plain bearing (17) and secure to base (1).

### 5.5.1.4 Swing Plate (Figure 5.3 Item 2) and Bearings

#### Disassembly

1. Remove the Pump Module (Refer to Chapter 7) and two mounting screws (26).
2. Remove thumb nut (18) by turning in a counterclockwise direction.
3. Remove .25" ID flat washer.
4. Slide swing plate fabrication (2) to gain access to .06" thick plain bearing (17).
5. Remove the 1/4 - 20 hex nut, shoulder screw and two belleville washers securing swing plate (2) to base (1).
6. Remove .06" thick plain bearing (17).
7. Remove #10 - 32 x .25" flat head socket cap screw, on swing plate bottom, securing C'sink plain bearing (24) to swing plate (2).

#### Assembly

1. Position C'sink plain bearing (24) on bottom of swing plate (2) and secure with #10 - 32 x .25" flat head socket cap screw.
2. Position .06" thick plain bearing (17) on top of base (1).
3. Align threaded pivot hole on swing plate (2), inside diameter of .06" thick plain bearing (17) and pivot hole in base.
4. Place two belleville washers on the shoulder screw in series, insert screw from bottom through pivot hole in base machining (1), .06" thick plain bearing (15), and thread into swing plate (2).
5. Tighten shoulder screw to flatten belleville washers then back off 1/4 turn. (Swing plate should slide, but with some resistance. Lock in place with 1/4-20 hex nut.
6. Position .06" thick plain bearing (17) over hole on base machining (1).
7. Position 18 - 8 x .25" ID flat washer on top of swing plate fabrication (2) and align holes with .06" thick plain bearing (17) and hole in base (1).
8. Install thumb nut (18) through 18 - 8 x .25" ID flat washer, plain bearing (17), swing plate fabrication (2) and .06" thick plain bearing (17) and secure to base (1).
9. Install Pump Module and secure with two mounting screws.

### 5.5.1.5 Sensor End Shield (Figure 5.3 Item 4)

#### Disassembly

1. Remove the top two #6 - 32 x .25" button head socket cap screw securing sensor end shield (4) to base (1).

#### NOTE

*The lower two screws are assembled with a liquid thread lock and should not be removed.*

2. Lift sensor end shield (4) straight up and remove.

#### Assembly

1. Slide lower tabs of sensor end shield (4) over screws mounted in base (1).
2. Secure using two #6 - 32 x .25" button head socket cap screw.

## 5.6 PROBLEM GUIDE

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



**5.7 SPECIFICATIONS**

Hall Effect Sensor: Supply Voltage 6-24 VDC  
Supply Current 13mA  
Output Voltage 0.4 VDC  
Open Collector  
Output Signal  
Output Current 20mA

Double Motor: General:  
Step Motor, Size 34  
Insulation: UL Recognized Class B, 130° C  
Protection Class: IP40  
Step Angle: 1.8°

Electrical:  
Unipolar, 6-wire  
Per Phase:  
Rated Voltage: 2.5 VDC  
Current: 4.55 AMPS  
Resistance: 0.55 OHMS  
Inductance: 2.5 mH  
Voltage Constant: 31.77 V/KRPM

Triple Motor: General:  
Step Motor, Size 34  
Insulation: UL Recognized Class B, 130° C  
Protection Class: IP40  
Step Angle: 1.8°

Electrical:  
Unipolar, 6-wire  
Per Phase:  
Rated Voltage: 2.5 VDC  
Current: 7.1 AMPS  
Resistance: 0.35 OHMS  
Inductance: 2.5 mH  
Voltage Constant: 31 V/KRPM

Brushless DC Motor: General:  
Housing: Aluminum Extrusion  
Endcap Material: Machined Aluminum  
Finish: Black Anodized

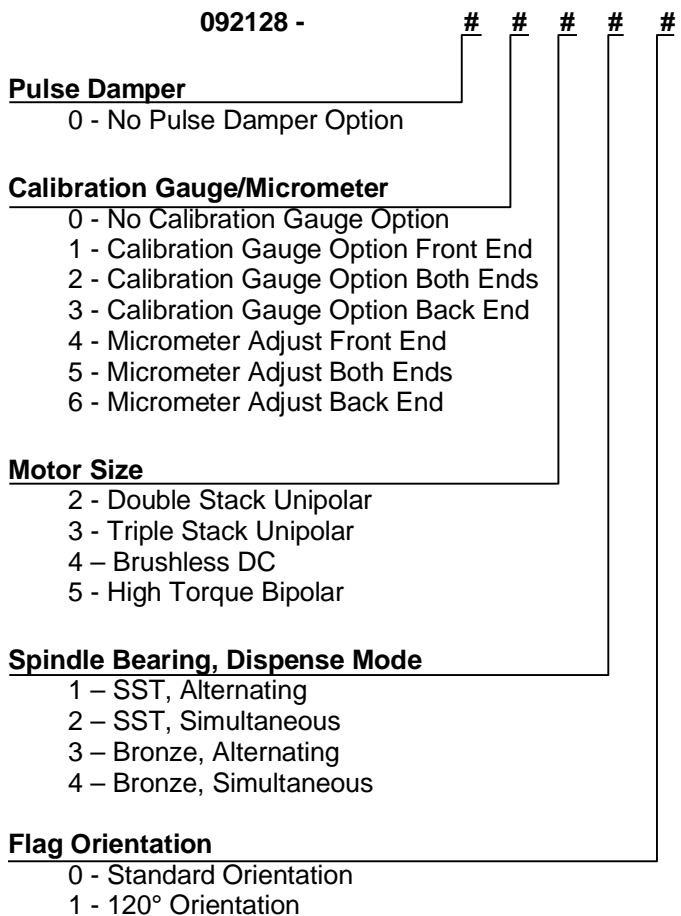
Electrical:  
Winding:  
Resistance: 3.50 Ohms +/- 12.5%  
Torque Sensitivity: 24.0 Oz-In/Amp +/- 10%  
Back EMF: 0.170 Volts/Rad/Sec +/- 10%  
Inductance: 3.80 mH +/- 30%  
Current at Peak Torque: 7.29 Amps  
Voltage at Peak Torque: 25.5 Volts  
Maximum Rated Voltage: 75 Volts

High Torque Motor:      General:  
                                  Step Motor, Nema Size 34  
                                  Housing Color: Black  
                                  Step Angle: 1.8°  
                                  Step Accuracy  
                                  (Non Accumulative): 5%  
                                  Insulation Coil Wire: UL Class B = 130° C  
                                  Protection Class: IP30  
                                  Operating Temperature: -20°C to 40°C

Electrical:  
                                  4 Lead Bipolar  
                                  Insulation Voltage Rating: 500V  
                                  Per Phase:  
                                  Rated Voltage: 0.8 VDC  
                                  Current: 5.0 AMPS  
                                  Resistance: 0.16 OHMS  
                                  Inductance: 1.35 mH  
                                  Voltage Constant: 35 V/KRPM

**5.8 MODEL NUMBER**

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



5.9 ILLUSTRATED PARTS BREAKDOWN

The illustrated parts breakdown (Figure 5.4) contains the information required for identifying and ordering replacement parts.

Table 5.1 Common Operational Problems And Solutions

PROBLEM	PROBABLE CAUSE	POSSIBLE SOLUTION
<p>Power is on, Controller Module accepts trigger, motor spindle fails to rotate and motor makes a sound that fluctuates in tone. * This condition does not harm the system.</p>	<p>Motor spindle binding.</p>	<p>Turn off controller power. Remove Pump Modules from Motor/Base Module. Inspect and verify the Pump Module pistons are moving freely. Turn on Controller Module and try again.</p> <p>If the motor operates correctly, the Pump Module may need to be cleaned or serviced.</p> <p>If none of the above solves the problem, contact IVEK technical support for assistance.</p>
<p>Power is on, Controller Module accepts a trigger, (START indicator illuminates, STOP indicator does not), motor spindle fails to rotate, and motor is silent.</p>	<p>A motor malfunction can cause this problem.</p>	<p>Turn off Controller Module power. Check to ensure Motor/Base Module is properly connected to Controller Module. Turn on Controller Module and try again. If the motor operates incorrectly, servicing may be necessary to the motor or the controller. Return complete Controller, Motor/Base and Pump Modules to IVEK Corporation for repair.</p>
<p>Controller Module power on and operational, but will not actuate Motor/Base Module.</p>	<p>Controller cable</p>	<p>Check connection of cable between Controller Module and Motor/Base Module. Inspect and replace faulty cable.</p>
<p>Motor turns 3 times, stalls and repeats.</p>	<p>Sensor problem</p>	<p>Contact IVEK technical support for assistance.</p>
<p>Thumb wheel does not operate smoothly.</p>	<p>Dirt in gear tooth</p>	<p>Clean.</p>
<p>Low volume noise during operation.</p>	<p>Sensor End Shield vibrating.</p>	<p>Tighten end shield.</p>

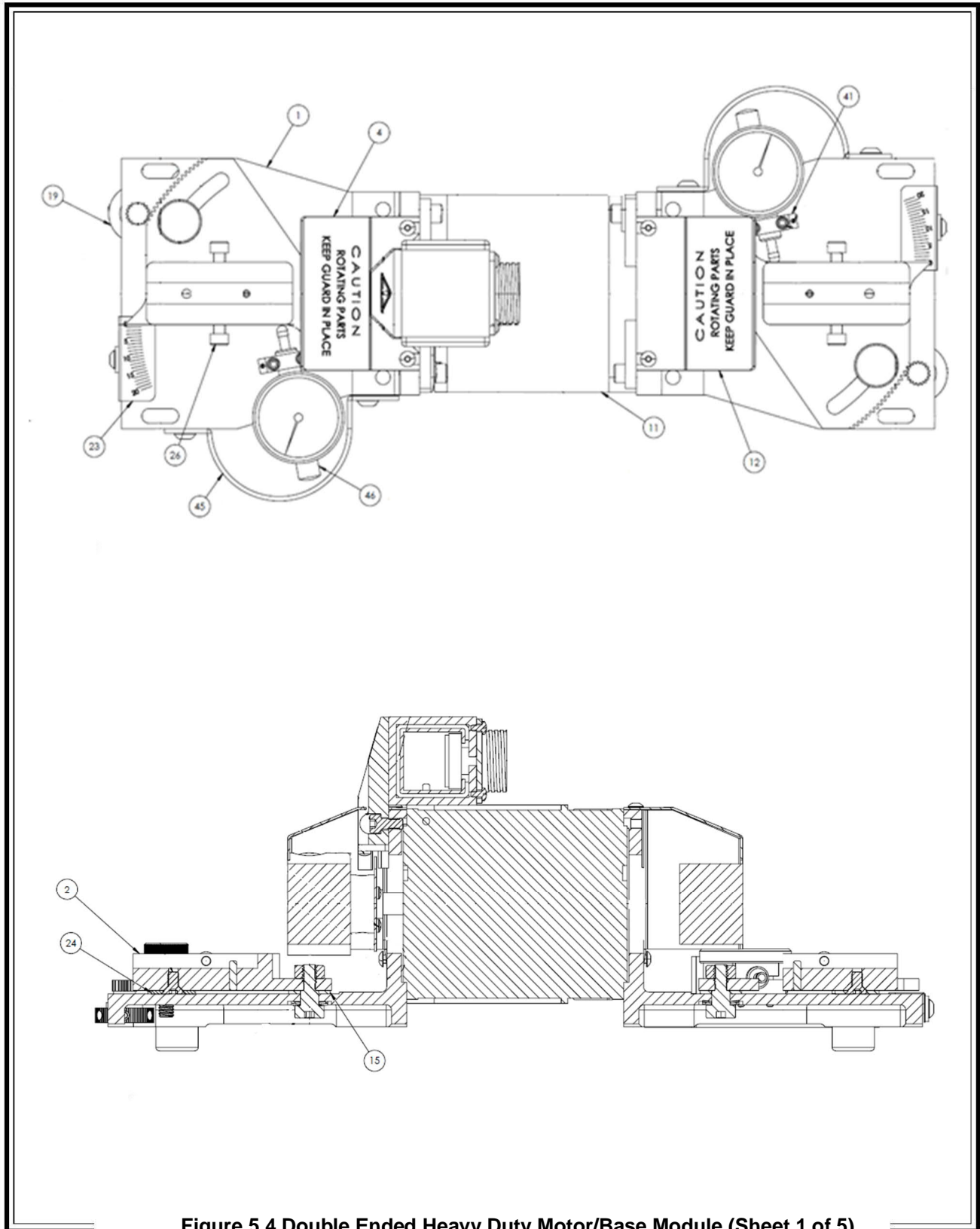


Figure 5.4 Double Ended Heavy Duty Motor/Base Module (Sheet 1 of 5)

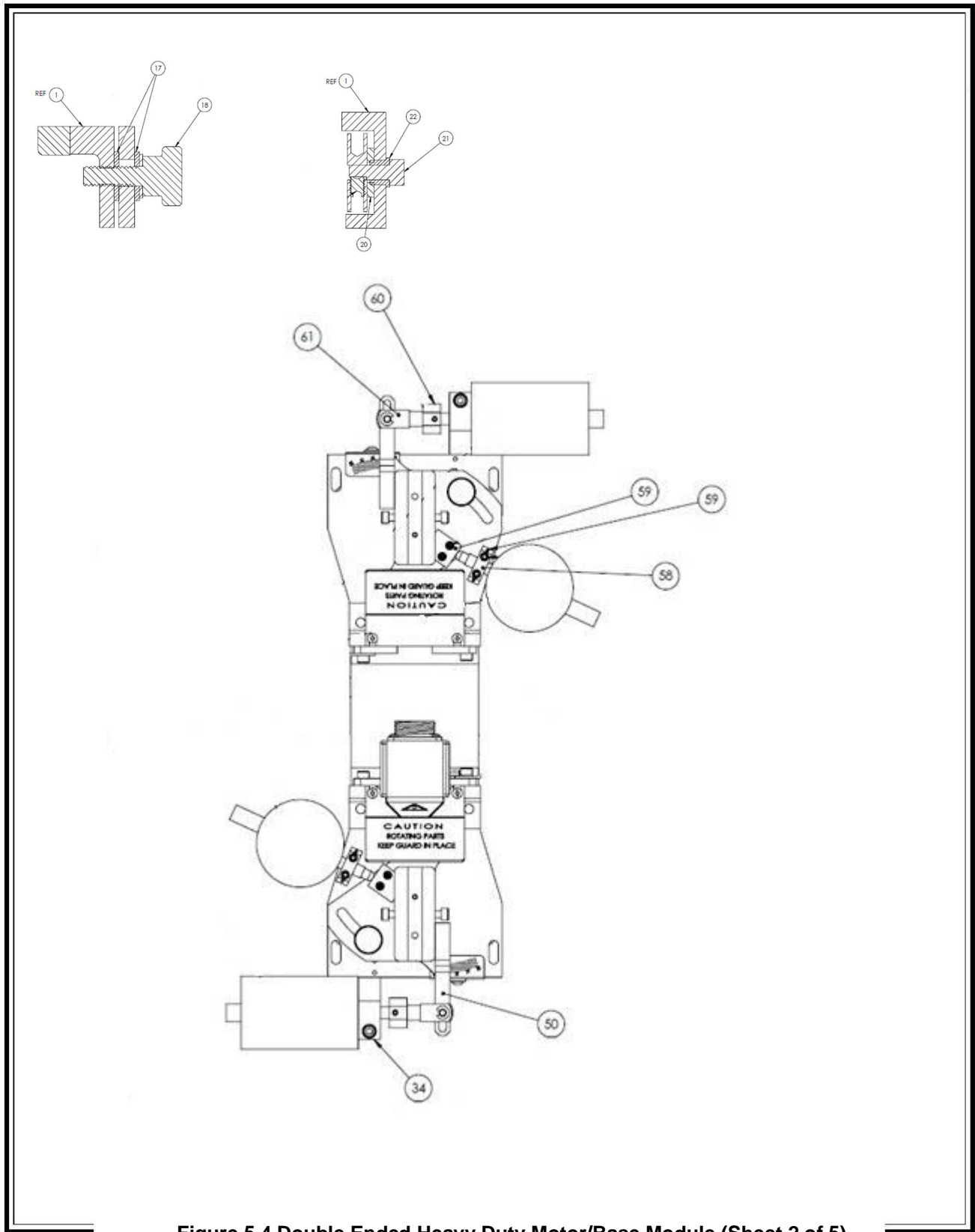


Figure 5.4 Double Ended Heavy Duty Motor/Base Module (Sheet 2 of 5)

		NUMBER	DESCRIPTION	UNITS PER ASSY
		092128-#####	Double Ended Heavy Duty Motor/Base Module	1
Model #	Dwg Index	Part #	Description	Qty
Tab	#	#		
4		092106	Shield, Sensor End	1
12		092105	Shield 1	
15		092242	Plain Bearing, 0.060 Thick	2
17		092240	Plain Bearing, 0.062 Thick	4
18		092115	Thumb Nut	2
23		092107	Vernier Scale	2
24		092228	Bearing, Oilite, C'Sink	2
26		092238	Screw, Retainer	4
<b>092128 # ## ## CALIBRATION/MICROMETER OPTION</b>				
0	1	092111	Motor Base, without Calibration Gauge Option	2
0	2	092120 -001	Swing Plate Fabrication	2
0	19	092100	Thumb Wheel	2
0	20	092243	Plain Bearing	2
0	21	092096	Pinion Gear	2
0	22	092099 -001	Flange Bearing	2
1	1	092111 -1	Motor Base, with Calibration Gauge Option	1
1	1	092111	Motor Base, without Calibration Gauge Option	1
1	2	092120 -001	Swing Plate Fabrication	2
1	19	092100	Thumb Wheel	2
1	20	092243	Plain Bearing	2
1	21	092096	Pinion Gear	2
1	22	092099 -001	Flange Bearing	2
1	41	092225	Indicator Block, Gauge Option	1
1	45	092230	Indicator Guard, Gauge Option	1
1	46	092229	Calibration Indicator, Gauge Option	1
2	1	092111 -1	Motor Base, with Calibration Gauge Option	2
2	2	092120 -001	Swing Plate Fabrication	2
2	19	092100	Thumb Wheel	2
2	20	092243	Plain Bearing	2
2	21	092096	Pinion Gear	2
2	22	092099 -001	Flange Bearing	2
2	41	092225	Indicator Block, Gauge Option	2
2	45	092230	Indicator Guard, Gauge Option	2
2	46	092229	Calibration Indicator, Gauge Option	2
3	1	092111 -1	Motor Base, with Calibration Gauge Option	1
3	1	092111	Motor Base, without Calibration Gauge Option	1
3	2	092120 -001	Swing Plate Fabrication	2
3	19	092100	Thumb Wheel	2

Figure 5.4 Double Ended Heavy Duty Motor/Base Module (Sheet 3 of 5)

	NUMBER	DESCRIPTION	UNITS PER ASSY
	092128-####	Double Ended Heavy Duty Motor/Base Module	1
<b>Model #</b>	<b>Dwg Index</b>	<b>Part #</b>	<b>Description</b>
<b>Tab</b>	<b>#</b>	<b>#</b>	<b>Qty</b>
3	20	092243	Plain Bearing 2
3	21	092096	Pinion Gear 2
3	22	092099 -001	Flange Bearing 2
3	41	092225	Indicator Block, Gauge Option 1
3	45	092230	Indicator Guard, Gauge Option 1
3	46	092229	Calibration Indicator, Gauge Option 1
4	1	092111 -2	Motor Base, Micrometer Option 1
4	1	092111	Motor Base, without Calibration Gauge Option 1
4	2	092120 -002	Swing Plate Fabrication, Micrometer 1
4	2	092120 -001	Swing Plate Fabrication 1
4	19	092100	Thumb Wheel 1
4	20	092243	Plain Bearing 1
4	21	092096	Pinion Gear 1
4	22	092099 -001	Flange Bearing 1
4	34	092329 -001	Bracket, Micrometer Holder, Heavy Duty Motor/Base 1
4	50	092328 -001	Bracket, Clevis, Heavy Duty Motor/Base 1
4	58	092305 -001	Clamp Block, Indicator Gauge 1
4	59	092330 -001	Stop, Indicator Gauge, Heavy Duty Motor/Base 1
4	60	092331 -001	Adapter, Micrometer to Clevis 1
4	61	092332 -001	Clevis, Plastic, with Pin and Clip 1
5	1	092111 -2	Motor Base, Micrometer Option 2
5	2	092120 -002	Swing Plate Fabrication, Micrometer 2
5	34	092329 -001	Bracket, Micrometer Holder, Heavy Duty Motor/Base 2
5	50	092328 -001	Bracket, Clevis, Heavy Duty Motor/Base 2
5	58	092305 -001	Clamp Block, Indicator Gauge 2
5	59	092330 -001	Stop, Indicator Gauge, Heavy Duty Motor/Base 2
5	60	092331 -001	Adapter, Micrometer to Clevis 2
5	61	092332 -001	Clevis, Plastic, with Pin and Clip 2
6	1	092111 -2	Motor Base, Micrometer Option 1
6	1	092111	Motor Base, without Micrometer Option 1
6	2	092120 -002	Swing Plate Fabrication, Micrometer 1
6	2	092120 -001	Swing Plate Fabrication 1
6	19	092100	Thumb Wheel 1
6	20	092243	Plain Bearing 1
6	21	092096	Pinion Gear 1
6	22	092099 -001	Flange Bearing 1
6	34	092329 -001	Bracket, Micrometer Holder, Heavy Duty Motor/Base 1
6	50	092328 -001	Bracket, Clevis, Heavy Duty Motor/Base 1
6	58	092305 -001	Clamp Block, Indicator Gauge 1
6	59	092330 -001	Stop, Indicator Gauge, Heavy Duty Motor/Base 1
6	60	092331 -001	Adapter, Micrometer to Clevis 1
6	61	092332 -001	Clevis, Plastic, with Pin and Clip 1
<b>092128 # # # # MOTOR SIZE OPTION</b>			
2	11	092133	Motor, 34 Frame Step, Double Stack, Double End 1
3	11	092134	Motor, 34 Frame Step, Triple Stack, Double End 1
4	11	800039-01R	Motor, 34 Frame, Double End, Brushless DC 1
5	11	800051-01	Motor, 34 Frame Step, Triple Stack, Double End 1

Figure 5.4 Double Ended Heavy Duty Motor/Base Module (Sheet 4 of 5)

<b>092128 # # # # # SPINDLE BEARING, DISPENSE OPTION</b>				
1	3	092118	Stainless Bearing, Alternating	1
2	3	092118	Stainless Bearing, Simultaneous	1
3	3	092268	Bronze Bearing, Alternating	1
4	3	092268	Bronze Bearing, Simultaneous	1

Figure 5.4 Double Ended Heavy Duty Motor/Base Module (Sheet 5 of 5)



## CHAPTER REVISIONS

- G 06/22/22 Per DCR/N 21071 and 20920 Removed Pulse Dampener and updated Dispense Mode 1 and 2 on page 11 and added 3 and 4. Page 5-10.
- F 09/29/21 Per DCR/N 20778 Micrometer now RoHS compliant and add tab ##4##.
- E 03/12/20 Per DCR/N19724 update Model # and description for new motor types.
- D 02/21/17 Per DCR/N17756 updated Model # for Flag Orientation.
- C 07/07/16 Per DCR/N17081 updated to include Micrometer option.
- B 10/27/08 Per DCR/N 12128 corrected kilogram conversion on p2
- A 5/28/03 Model Number Update
- 07/22/97 Original Release