VA-9070 Series Electric Rotary Actuators for Two-Position and Modulating Service

Technical Bulletin

Code No. LIT-977325
Issued August 24, 2009
Supersedes May 29, 2007

Johnson Controls

VA-9070 Series Electric Rotary Actuators for Two-Position and Modulating Service Technical Bulletin

Introduction

The VA-9070 Series (Bray® Series 70) are quarter-turn, electric rotary actuators with manual override, designed for use on most Johnson Controls® VF Series Butterfly Valves sized for up to 6,500 lb·in (734.5 N·m) of torque. VA-9070 Series electric actuators cannot be used on the VF4000 and VF5000 Series Butterfly Valves with the M9000 Series Actuators. Operating speeds vary between 6 and 60 seconds.

Internal and External Components

The VA-9070 Series actuator is divided into two internal sections: the power center below the switch plate and the control center above the switch plate. The power center (below the switch plate) contains the capacitor and gear motor, with its spur gear train. The power center drives a final non-backdriveable worm gear output. The power center also houses an override mechanism for manual operation. The control center (above the switch plate) has several user-accessible components: the camshaft assembly, limit switches, terminal strips, torque switches, heater, and servo.

On the outside of the actuator housing are adjustable mechanical travel stops, a large position indicator, the manual override handwheel, and dual conduit entry ports. The external coating is a polyester powder coat, providing resistance to Ultraviolet (UV) radiation exposure and chemical exposure.

Electrical Operation

The motor in the VA-9070 Series actuator is a permanent induction split capacitor design (single phase AC power). Travel limit switches are mechanical Form C Single-Pole, Double-Throw (SPDT) switches with two independent circuits. These SPDT switches are rated at 10 amperes (75 to 80% power factor), 1/2 hp 125 VAC, and 3/4 hp 250 VAC.

If the torque capacity of the actuator is exceeded to the point where the motor stalls and overheats, a thermal protector switch built into the motor windings automatically disconnects the motor power. Once the motor cools sufficiently, the thermal switch resets.

Mechanical Operation

Mechanically, the ratio of the gear motor determines the speed of the actuator. The gear motor uses high-efficiency spur gears with different ratios for the different speeds. Initial gear reduction through the spur gears transfers to the worm shaft. The final gear reduction and output happens through a non-backdriveable worm gear set. An indicator-camshaft linked to the output shaft determines positioning. The manual override drives the worm shaft when engaged.

Manual Override Operation

The manual override operates similarly to the adjusting knob on a mechanical wristwatch. To engage the manual override, pull the handwheel to its outermost position. When the manual override engages, the actuator stops electrical operation.

A yellow position indicator provides visual indication that the manual override is engaged. Dry contacts on an internal switch can provide remote electrical indication of the override status.

Spring plungers hold the two handwheel positions (engaged and disengaged) in place. The handwheel remains in position until physically moved. Rotating the handwheel in a clockwise direction rotates the output shaft in the same clockwise (closed) direction. Rotating the handwheel in a counterclockwise direction rotates the output shaft in the same counterclockwise (open) direction.

Pre-installation Storage

A temporary conduit entry plug, installed in shipped actuators, prevents foreign matter from entering the actuator. Store the actuator properly in a dry, temperature-controlled area to prevent moisture from entering through this temporary plug. Replace the temporary conduit plug with a permanent conduit plug if the actuator is stored for a long period of time or stored in adverse conditions. Prevent condensation from forming by maintaining a near constant external temperature and supplying power to the heater internal to the actuator.

Installation

Mounting

VA-9070 Series electric actuators are suitable for direct mounting on most Johnson Controls VF Series Butterfly Valves. VA-9070 Series Electric Actuators cannot be used on the VF4000 and VF5000 Series Butterfly Valves with the M9000 Series Actuators. Installing the VA-9070 Series actuator onto other quarter-turn valves or devices requires proper mounting hardware.

When mounting the actuator in the standard position, orient the actuator with its handwheel in a vertical plane and parallel to the pipeline. When mounting the actuator on a vertical pipe, position the actuator with the conduit entries on the bottom to prevent condensation from entering the actuator by way of the conduit. In all cases, position the conduit to prevent drainage into the actuator.

Mount the actuator to the valve using the following procedure:

1. Manually operate the actuator until the output shaft of the actuator lines up with the valve stem. If possible, use an intermediate position, such as valve disc/stem and actuator half-open.
2. Place the proper sleeve adaptor (if required) onto the valve stem. Apply a small amount of grease to the sleeve adaptor to ease assembly.
3. Install the furnished mounting studs by threading them all the way into the actuator base. Insert the short, threaded length into the actuator.
4. Mount the actuator onto the valve stem. Be sure the mounting studs are properly aligned with the holes in the top plate of the valve or the mounting bracket. If necessary, manually override the actuator to align the mounting studs with the mounting holes.
5. Lower the actuator onto the valve and secure it tightly in place with the furnished hex nuts and lock washers.

Wiring

Connect the actuator to field wiring:

1. Remove the metal conduit plug for the power connection. Each actuator has two conduit entries (one for power and one for control).
2. Terminate all field wiring at the actuator terminal strip in accordance with the wiring diagrams attached to the inside of the actuator cover.

   Note: The terminal strip accepts wire sizes ranging from 10 to 22 AWG (12 to 22 AWG for the servo). Do not use wire smaller than 18 AWG.

   Note: The motor full load current is noted on the nameplate of the actuator.

   Note: The heaters use approximately 0.5 amperes at 110 volts.
3. Properly seal the conduit connections to maintain the weatherproofed integrity of the actuator enclosure.

   Note: The square-head conduit plug is weatherproofed but may eventually degrade. If the square-head conduit plug degrades, replace it with a metal plug.

Figure 1 shows typical field wiring for a two-position actuator, whereas Figure 2 shows typical field wiring for a modulating actuator.

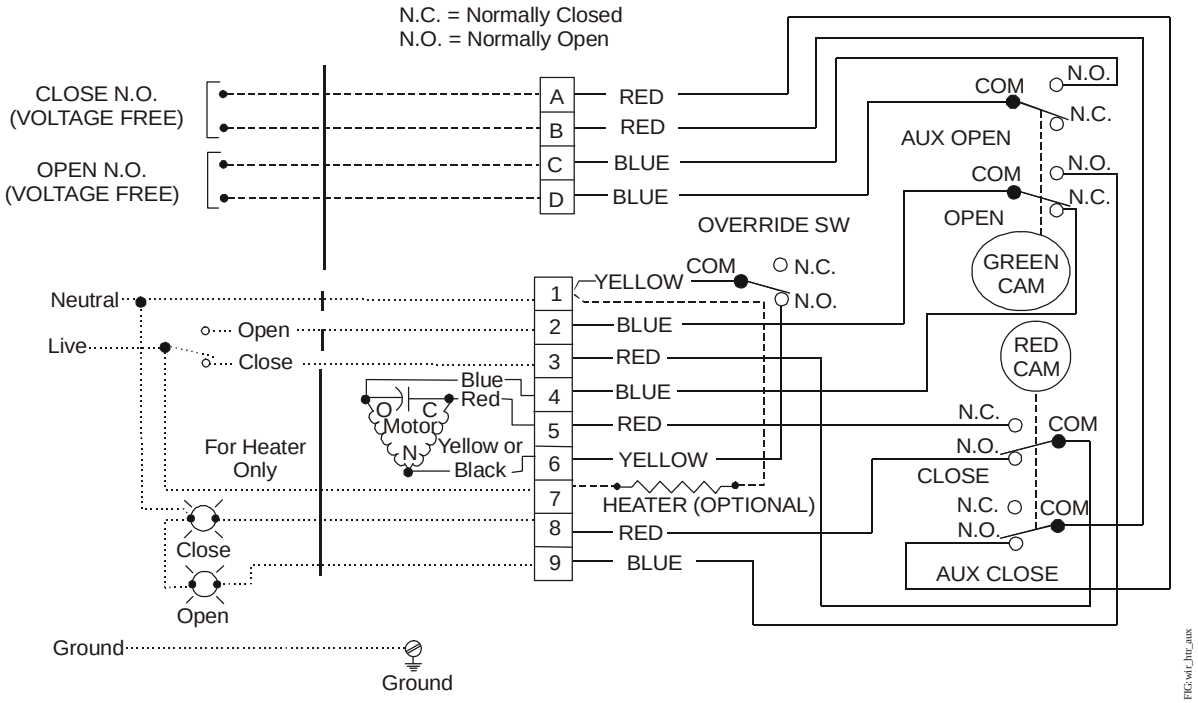

Figure 1: Typical Wiring Diagram of VA-9070 Series Two-Position Electric Rotary Actuator (Shown with Heater and Auxiliary Switches)

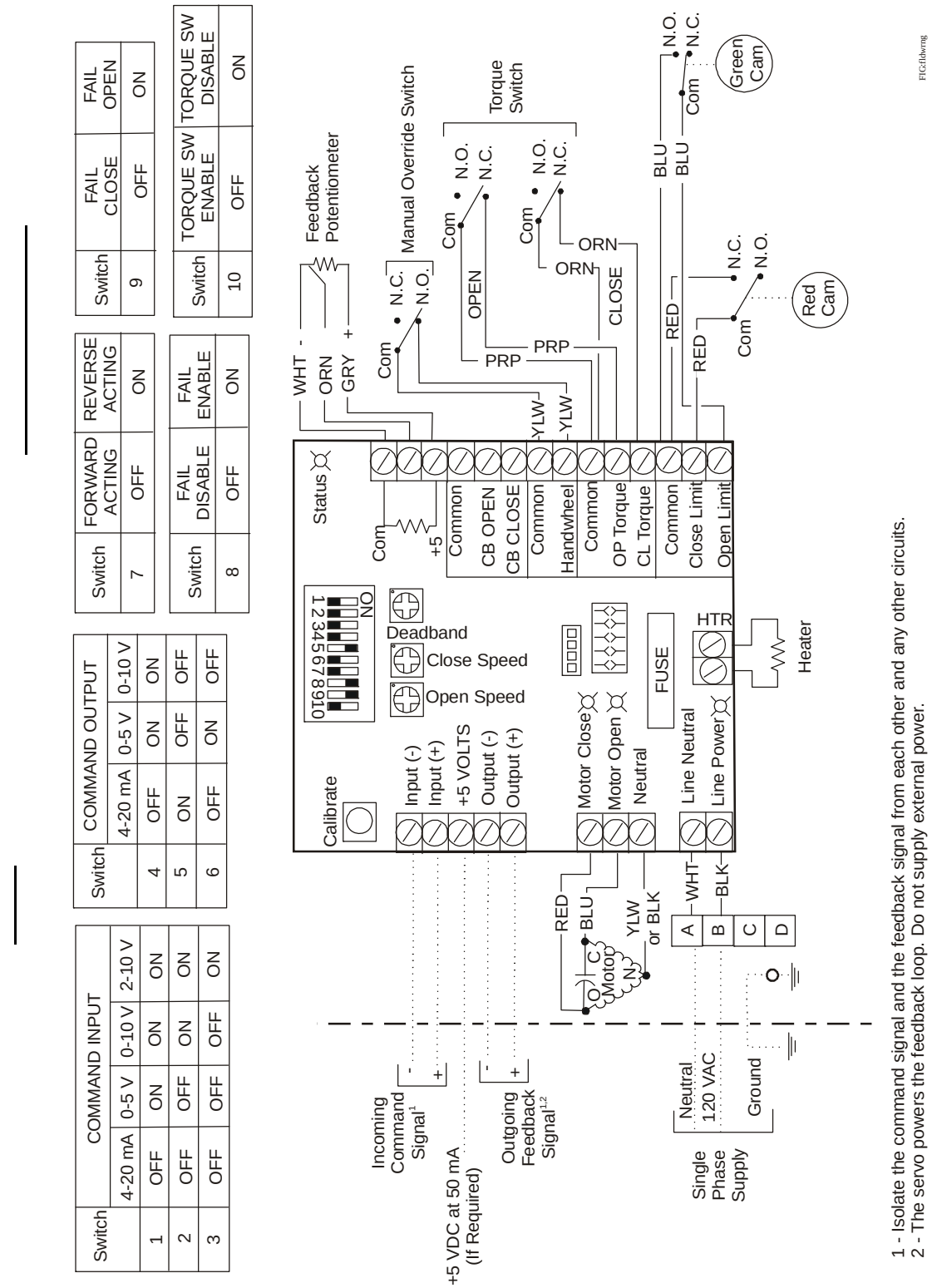

Figure 2: Typical Wiring Diagram of VA-9070 Series Modulating Electric Rotary Actuator (Shown with Heater)

Multiple Actuator (Parallel) Wiring

Use a multiple pole switch to connect two VA-9070 Series electric actuators. See the **Correct Wiring** schematic in Figure 3.

Do not connect more than one actuator to a Single-Pole, Double-Throw (SPDT) switch. In the actuator, voltage is present on the non-powered motor winding (opposite to the powered motor winding). Connecting the voltage-containing, non-powered motor winding to another voltage-containing, non-powered motor winding interferes with the motor performance. See the **Incorrect Wiring** schematic in Figure 3.

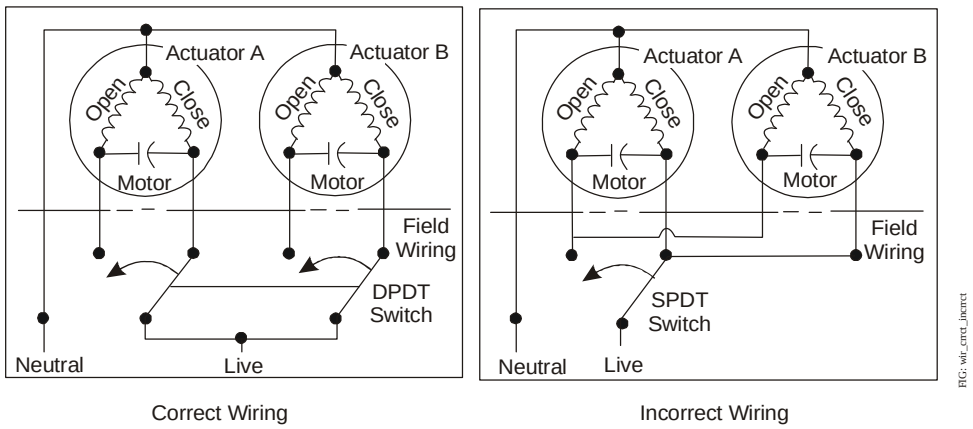

Figure 3: Correct and Incorrect Wiring Schematics

Setup and Adjustment

To set up and adjust the actuator, use the following procedure:

1. Set up and adjust the electrical travel switches and manual travel stops. See the *Electrical Travel Switches and Manual Travel Stop Adjustments* section in this document.
2. Set the input control signal. See the *Setting the Input Control Signal* section in this document.
3. Set the potentiometer. See the *Setting the Potentiometer* section in this document.
4. Set the servo. See the *Setting the Servo* section in this document.

Electrical Travel Switches and Manual Travel Stop Adjustments

You must set the electrical travel switches to trigger prior to reaching the mechanical travel stops. The travel switches are labeled for open and close. The cams are color-coded (green for open; red for closed).

Manual travel stops are designed to prevent manual overtravel, not to stall the electric motor. The travel stops have an adjustment range of approximately 10 degrees.

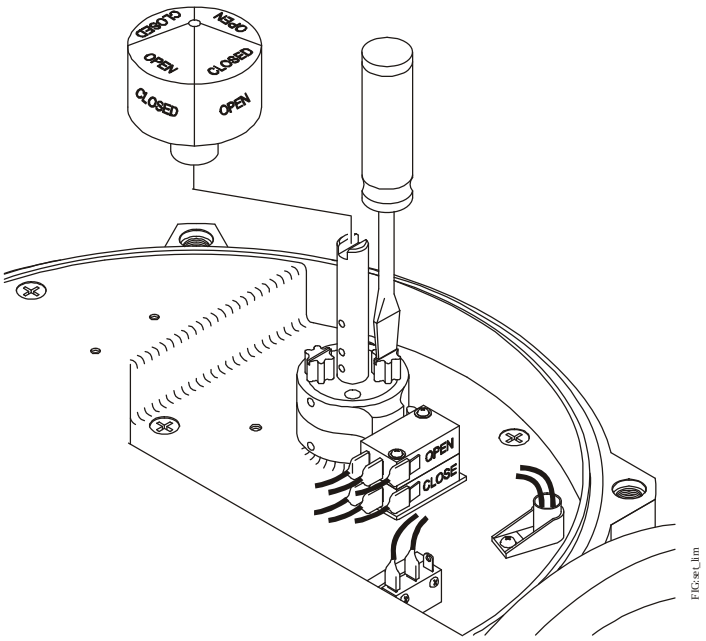

Figure 4: Setting the Travel Limit Switches

Closed Travel Switch and Travel Stop Adjustment

1. Loosen the mechanical stop for the closed position and back it off so that it does not interfere with actuator travel. The closed stop is located on the right when viewed from the travel stop side of the actuator.
2. Remove the indicator rotor by pulling it up. This action exposes the machined groove on the end of the camshaft, which is the reference for the valve disc position.
3. Manually operate the actuator handwheel Clockwise (CW) until the valve reaches the desired closed position.
4. Rotate the red adjusting knob (by hand or with a flat-head screwdriver) until the cam lobe barely trips the switch from a CW direction.

   Note: If the rotation of one cam moves the other cam, hold the other knobs or cams during adjustment.
5. With the travel switch in the closed position, rotate the handwheel one-half turn CW, then turn the closed travel stop CW until it stops against the output gear. Lock the travel stop bolts.

Open Travel Switch and Travel Stop Adjustment

Manually operate the actuator handwheel Counterclockwise (CCW) until the valve is fully open. Follow the same procedure as outlined in the *Closed Travel Switch and Travel Stop Adjustment* section, except use the **green** cam (open) and the travel stop located on the left side (as seen when viewed from the travel stop side of the actuator).

Setting the Input Control Signal

Set the input control signal for the input type used.

Table 1: Input Control Signal Switch Settings

Switch	Input Signal			
	4-20 mA	**DC 0 to 5 V**	**DC 0 to 10 V**	**DC 2 to 10 V**
1	OFF	ON	ON	ON
2	OFF	OFF	ON	ON
3	OFF	OFF	OFF	ON

See Figure 2 for the location of the input control signal switches.

Setting the Potentiometer

1. Manually operate the actuator handwheel until the unit is in the fully closed position.
2. Rotate the black potentiometer drive gear adjustment knob to barely engage the potentiometer gear segment at the closed position.
3. Manually operate the actuator to the fully open position.
4. Fine-tune the potentiometer adjustment at this end to equalize the difference between the ends. The potentiometer gear segment should maintain engagement with the drive gear throughout full actuator travel.

Setting the Servo

1. Wire the input signal to the incoming command signal terminals. Ensure that you maintain proper polarity when making wiring connections.
2. Connect the power supply and activate the actuator.
3. Check the Status Light-Emitting Diode (LED).
   - If the red Status LED is flashing, see the *Servo Troubleshooting* section.
   - If the green Status LED is flashing, press and hold the CALIBRATE button until the green Status LED flashes rapidly (approximately 2 seconds), then release the CALIBRATE button. The servo drives the valve to the open and close travel limit switch settings. When the calibration is complete, the green Status LED resumes flashing at the normal rate.
   - If the Status LED alternately flashes red, then flashes green, the calibration has failed. To resolve the problem, see the *Servo Troubleshooting* section.

4. After calibration is complete, apply the desired minimum and maximum input signals and observe the actuator operation through one full cycle for proper operation.

Accessories

External Feedback Potentiometer for Actuators without Servos

Potentiometers for external feedback are available for field installation on VA9072, VA-9073, VA-9074, VA-9075, VA-9076, VA-9077, and VA-9078 actuators.

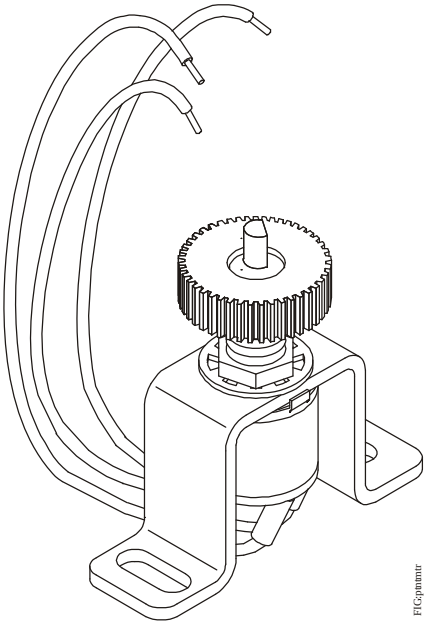

Figure 5: Potentiometer for VA-907x Series Actuators

IMPORTANT: In special instances where dual potentiometers are required (such as when a servo is installed and an external feedback potentiometer is also required), you must make modifications to the switch plate - including locating, drilling, and tapping two new mounting holes. Consult the local Bray representative for instructions.

Contents of the Feedback Potentiometer Kit

- one potentiometer assembly
- two No. 6 cross-drive pan-head screws
- two No. 6 internal lock washers
- one 10-point terminal strip
- one terminal strip marker for auxiliary switches and/or feedback potentiometer
- one small wiring diagram sticker for the additional potentiometer

Tools Required

For terminal wiring: 3/16 in. (5 mm) blade screwdriver

For potentiometer mounting screws: No. 2 Phillips screwdriver

Installation Procedure

1. Install the potentiometer next to the camshaft, where the two threaded holes are provided.
2. Mount the potentiometer in the correct orientation with its gear centered so that it meshes with the potentiometer drive gear.
3. Push the assembly towards the cam to mesh the potentiometer gears, and tighten the mounting screws.

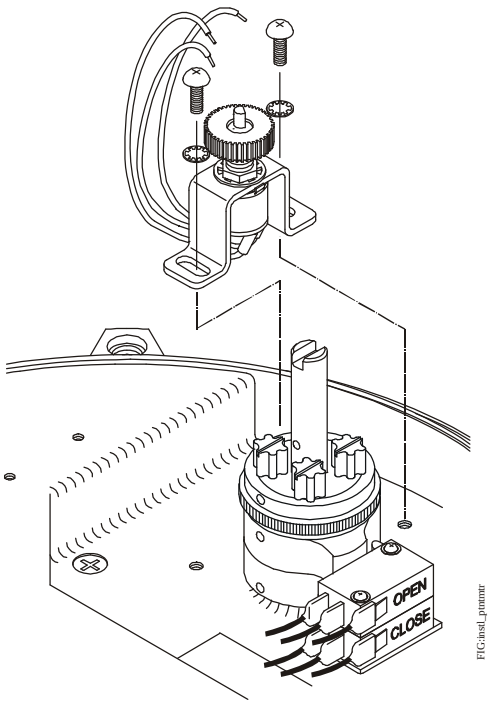

Figure 6: Installing the Feedback Potentiometer

4. Move the wiring from the six-point strip to the new terminal strip, reconnecting the wiring in the same positions.

5. Wire the potentiometer to the terminal strip using the small stick-on wiring diagram provided.
6. Adhere the wiring diagram sticker to the inside of the cover.

Setting the Potentiometer

1. Manually operate the actuator handwheel until the unit is in the fully closed position.
2. Rotate the black potentiometer drive gear adjustment knob to barely engage the potentiometer gear segment at the closed position.
3. Manually operate the actuator to the fully open position.
4. Fine-tune the potentiometer adjustment at this end to equalize the difference between the ends. The potentiometer gear segment should remain engaged with the drive gear throughout full actuator travel.

Troubleshooting Procedures

Actuator Troubleshooting

See Table 2 for actuator troubleshooting information.

Table 2: Actuator Troubleshooting Chart (Part 1 of 2)

Problem	Possible Cause	Solution
Actuator does not operate.	Override is engaged.	Push handwheel in all the way.
	Wiring is incorrect.	Check wiring and power supply.
	Actuator has reached its thermal shutdown temperature.	Allow time to cool.
Actuator operates in reverse directions.	Field wiring is reversed.	Rewire field wiring.
Actuator does not fully close valve.	Limit switches are tripping.	Readjust travel limit switches.
	Mechanical travel stop is stopping actuator.	Adjust mechanical travel stops.
	Valve torque requirement is higher than actuator output.	Manually override out of seat; try angle seating or larger actuator.
	Optional torque switches are tripping.	Valve torque exceeds actuator torque rating; consult the local Bray representative.
	Voltage power supply is low.	Resize actuator; consult the local Bray representative.
Actuator does not fully open valve.	Travel limit switches tripping.	Readjust travel limit switches.
	Mechanical travel stop is stopping actuator.	Adjust mechanical travel stops.
	Optional torque switches are tripping.	Mechanical travel stops are hitting prior to electrical limit switch.
	High valve torque.	Obtain higher capacity actuator.
Engaging override handwheel does not shut off motor.	Override pin is corroded or damaged.	Clean and check for smooth operation of the override switch pin.
	Override switch is damaged.	Replace switch.

Table 2: Actuator Troubleshooting Chart (Part 2 of 2)

Problem	Possible Cause	Solution
Disengaging override handwheel does not restart motor.	Not completely disengaged.	Push handwheel in as far as possible so that no yellow shows.
	Override pin is damaged and does not trigger switch.	Replace override pin.
	Incorrect wiring of override switch.	Check wiring.
Motor runs but worm and gear segment do not run.	Worm gear segment is not meshing with worm.	Remove switch plate and inspect; adjust travel stops to prevent problem.
Corrosion inside actuator.	Condensation forming.	Test heater wiring; should have constant power.
	Water leaking in.	Check all seals and possible water entry through conduit.
Actuator moves back and forth near set point (hunts).	Signal has interference.	Shield signal from interference.
Potentiometer gear disengages from potentiometer drive gear.	Potentiometer gear was not meshed correctly.	Adjust the potentiometer drive gear to maintain engagement.
	Actuator is electrically operating beyond the 90 degree travel limit.	Set electrical travel limit switches for less than 90 degrees of operation.
	Actuator has been manually operated beyond the 90 degree travel limit.	Set mechanical travel limits for 90 degrees of operation.
Actuator does not travel fully open or fully closed.	Travel limit switches are not set correctly.	Set travel limit switches for 90 degrees of operation.
	Mechanical travel stops are not set correctly.	Set mechanical travel stops for 90 degrees of operation.
Actuator motor does not run and yellow servo power light is off.	Power is disconnected.	Reconnect power.
Actuator does not properly respond to command signal.	Potentiometer gear is not engaged.	Engage and adjust potentiometer gear.
	Command signal jumper position is not correct. Jumper is missing or should be installed.	Install or remove jumper. Then use Autocalibrate button to recalibrate servo.
Actuator runs in one direction only.	Wiring is incorrect.	Inspect and correct wiring.
	Potentiometer is wired backwards.	Reverse black and gray wires; see wiring diagram inside cover.
	Limit switch or torque switch is triggered.	Ensure connections to servo from these switches are shorted.
	Command signal jumper position is not correct. Jumper is missing or should be installed.	Install or remove jumper. Then use the Autocalibrate button to recalibrate the servo.

Servo Troubleshooting

The Status LED is a bicolor (red or green) LED that provides information on the operation of the servo. Whenever the LED flashes green, the servo operates, although it may not operate at optimal levels. Whenever the LED flashes red, the servo does not operate. The servo uses sequences of flashes to give troubleshooting indications. See Table 3.

The LED flash codes are prioritized. The red flash codes take precedence over the green flash codes. The lowest number flash codes take precedence over the higher numbered flash codes. After resolving a problem, the next highest flash code appears.

Table 3: Troubleshooting by the Status LED

Meaning	Code	Flash Sequence[1]							
		Flash 1	Flash 2	Flash 3	Flash 4	Flash 5	Flash 6	Flash 7	Flash 8
Normal Operation	1	green	unlit	green	unlit	green	unlit	green	unlit
Control Signal Calibration Warning	2	green	green	unlit	unlit	unlit	unlit	unlit	unlit
Feedback Potentiometer Calibration Warning	3	green	green	green	unlit	unlit	unlit	unlit	unlit
Reverse Acting Warning	4	green	green	green	green	unlit	unlit	unlit	unlit
Split Range 0 to 50% Warning	5	green	green	green	green	green	unlit	unlit	unlit
Split Range 50 to 100% Warning	6	green	green	green	green	green	green	unlit	unlit
Calibration in Progress	7	green	green	green	green	green	green	green	green
Handwheel Is Engaged (Pulled Outward)	8	red	unlit	unlit	unlit	unlit	unlit	unlit	unlit
Command Signal Failure (0-20 mA, 4-20 mA modes only)	9	red	red	unlit	unlit	unlit	unlit	unlit	unlit
Feedback Potentiometer Failure	10	red	red	red	unlit	unlit	unlit	unlit	unlit
Open and Close Limit Switch Failure	11	red	red	red	red	unlit	unlit	unlit	unlit
Open Torque Limit Reached	12	red	red	red	red	red	unlit	unlit	unlit
Close Torque Limit Reached	13	red	red	red	red	red	red	unlit	unlit
Feedback Potentiometer Wired Reverse	14	red	red	red	red	red	red	red	unlit
General Servo Failure	15	red	red	red	red	red	red	red	red
Immediately Displayed after an Invalid Calibration	16	red	green	red	green	red	green	red	green

1. The LED flash rate interval (the time to completely cycle the LED from Off to On) is 1/2 second, except for Normal Operation mode, which is 1 second.

Green LED

A flashing green LED provides status and warning information. The servo operates normally in this state.

Some flash codes indicate a warning condition. In a warning condition (such as the indication of an invalid calibration), the servo recovers automatically. In this case, default calibration automatically loads. This allows the servo to operate, but it may not be a perfect match to the actuator. If this happens, recalibrate the servo as soon as possible.

To recalibrate the servo, press and hold the CALIBRATE button until the green Status LED flashes rapidly (approximately 2 seconds), then release the CALIBRATE button. The servo drives the valve to the open and close travel limit switch settings. When the calibration is complete, the green Status LED resumes flashing at the normal rate.

Note: If you detect error codes 3, 5, 6, or 7, contact your Bray representative for further information.

Table 4: Green LED Warning and Information Flash Codes

Code	Description	Meaning
1	Normal Operation	The servo detects no errors and operates normally.
2	Control Signal Calibration Error	If this error occurs, add or remove jumpers for the input type. See the *Setting the Input Control Signal* section.
3	Feedback Potentiometer Error	An invalid feedback potentiometer calibration is detected. To ensure a valid feedback calibration, ensure that these conditions exist. The upper limit calibration is greater than the lower limit calibration. The difference between the upper and lower limits is at least 3 volts. The feedback potentiometer is not wired backwards.
4	Calibration in Process	The green LED flashes rapidly during this operation.
5	Reverse Acting Warning	This warning indicates that the servo is configured to operate in the Reverse Acting Mode.
6	Split Range 0 to 50% Warning	This warning indicates that the servo is configured to operate in the Split Range 0 to 50% range mode.
7	Split Range 50 to 100% Warning	This warning indicates that the servo is configured to operate in the Split Range 50 to 100% range mode.
8	Calibration in Process	During a calibration, the LED flashes rapidly at one-half second intervals. When the calibration is complete, the LED resumes with the Normal Operation flash code (Code 1) unless another warning is still pending.

Red LED

A flashing red LED indicates a fault condition that prevents the actuator from operating. Correct the fault condition to allow the actuator to resume operating. If you detect error Code 16, contact your Bray representative for further information.

Table 5: Red LED Warning and Information Flash Codes

Code	Description	Meaning
9	Handwheel Is Engaged (Pulled Outward)	When the handwheel is engaged, the servo can only be operated manually. This error also occurs if the handwheel switch is incorrectly connected to the servo.
10	Command Signal Failure	When the servo is configured to operate in the 0 to 20 mA mode, an input greater than 20 mA triggers an error. When the handwheel is configured to run in 4 to 20 mA operating mode, an input less than 4 mA or greater than 20 mA triggers an error. The Command Signal is not checked in the 0 to 10 V mode.
11	Feedback Potentiometer Failure	If the feedback potentiometer cannot be detected, or if in the fully closed or fully open position and the feedback potentiometer is at the end of its travel, an error is detected.
12	Open and Close Limit Switch Failure	When both the open and close limit switches are open-circuited at the same time, an error is detected.
13	Open Torque Limit Reached	The open torque limit switch has been tripped or the open torque limit switch is incorrectly connected to the servo.
14	Close Torque Limit Reached	The close torque limit switch has been tripped or the close torque limit switch is incorrectly connected to the servo.
15	Feedback Potentiometer Wired in Reverse	This check is made only during the servo autocalibration. The feedback potentiometer is wired in reverse when, at the completion of the calibration, the feedback potentiometer value at the fully open position is less than the value at the fully closed position. To clear the error, turn off the power to the servo, correct the feedback potentiometer wiring, turn on the power to the servo, and complete the autocalibration.
16	General Servo Failure	If after cycling the power to the servo, this error persists, contact your local Bray representative for assistance.
17	Calibration Error	This flash code is displayed after a failed calibration for 3 seconds. See Code 2 and Code 3 in Table 4 for more information.

Disassembly and Assembly

General Information

VA-9070 Series actuators are differentiated into three groups, according to size:

- VA-9072 actuators
- VA-9073, VA-9074, and VA-9075 actuators
- VA-9076, VA-9077, and VA-9078 actuators

Tools Required

Table 6: Basic Tools Common to All Actuators

Item	Tool
Terminal Connections, Cam Adjustment	Screwdriver, 3 to 4 Tip Blade
All Switches, Terminal Strip, Torque Switch Plate	Screwdriver, No. 1 Phillips
Switch Plate Screws, Capacitor	Screwdriver, No. 2 Phillips
Servo Trimmer Potentiometers	Screwdriver, Blade for Trim Potentiometers

Table 7: Basic Tools for VA-9072 Actuators

Item	Tool
Mounting Nuts	Wrench, 1/2 in. (13 mm)
Cover Captivated Cap Screws	Hex Key, 1/4 in. (6 mm)
Travel Stop Adjusting Studs	Hex Wrench, 1/8 in. (3 mm)
Travel Stop Jam Nuts	Wrench, 7/16 in. (11 mm)
Motor Mount Socket Flat-Head Cap Screw	Hex Key, 3/32 in. (2 mm)
Motor Mount Socket-Head Cap Screw	Hex Key, 9/64 in. (4 mm)

Table 8: Basic Tools for VA-9073, VA-9074, and VA-9075 Actuators

Item	Tool
Mounting Nuts (Small Pattern), Travel Stop Jam Nuts	Wrench, 1/2 in. (13 mm)
Mounting Nuts (Large Pattern)	Wrench, 3/4 in. (19 mm)
Cover Captivated Cap Screws	Hex Key, 5/16 in. (8 mm)
Travel Stop Adjusting Studs	Hex Key, 3/16 in. (5 mm)
Motor Mount Socket-Head Cap Screw	Hex Key, 5/32 in. (4 mm)

Table 9: Basic Tools for VA-9076, VA-9077, and VA-9078 Actuators

Item	Tool
Mounting Nuts, Travel Stop Jam Nuts	Wrench, 3/4 in. (19 mm)
Cover Captivated Cap Screws	Hex Key, 3/8 in. (10 mm)
Travel Stop Adjusting Studs	Hex Key, 1/4 in. (6 mm)
Motor Mount Socket-Head Shoulder Bolt	Hex Key, 5/32 in. (4 mm)
Motor Mount Socket-Head Cap Screws	Hex Key, 3/16 in. (5 mm)

Procedure for VA-9072 Actuators

1. Disconnect all power to the actuator and remove the cover. See Figure 7.

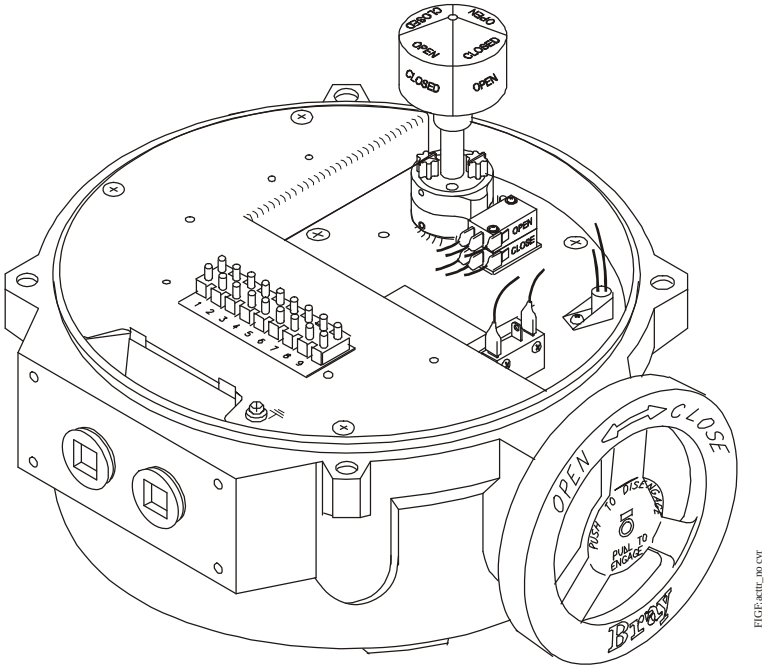

Figure 7: Two-Position Actuator with Cover Removed

2. Disconnect the motor wires from the main terminal block (motor close, motor open, and neutral).

3. Remove the switch plate by unscrewing the seven Phillips mounting screws. The switch plate should lift out as an assembly with the camshaft attached. See Figure 8 and Figure 9.

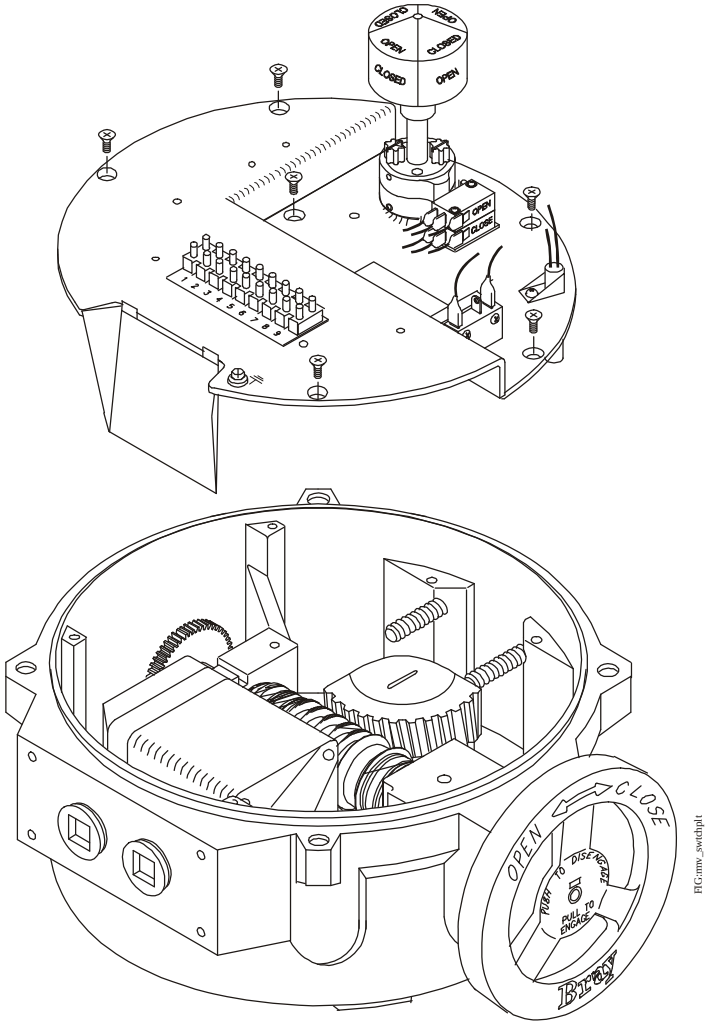

Figure 8: Removing the Switch Plate (Two-Position Actuator)

4. Disassemble the switch plate. See Figure 9.

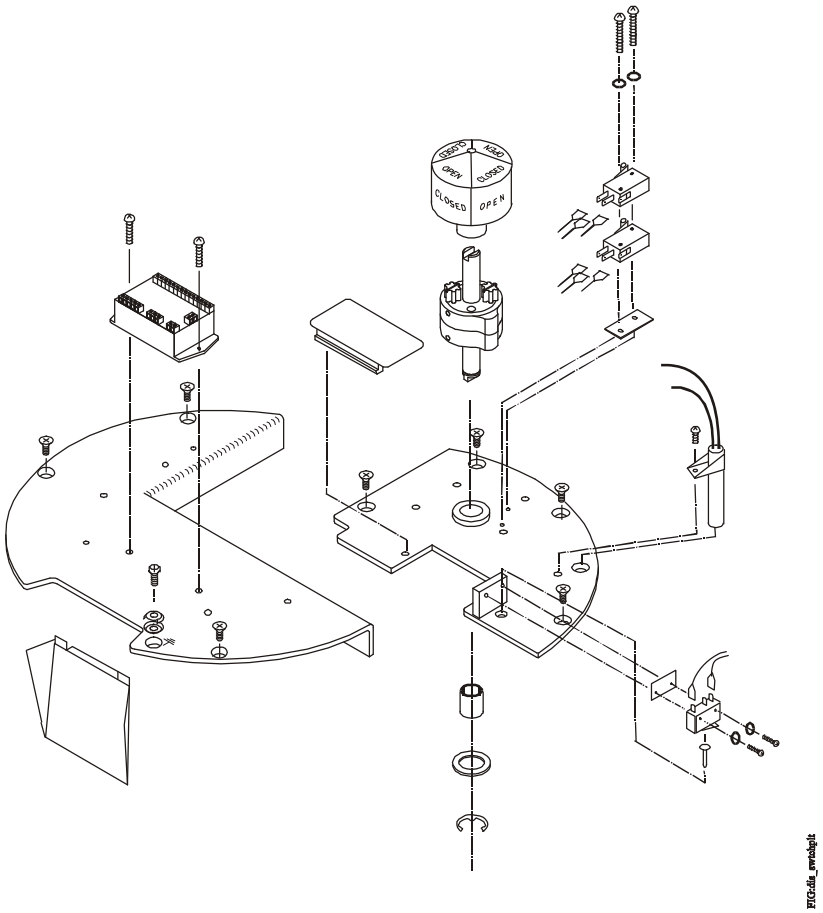

Figure 9: Disassemble the Switch Plate (Modulating Actuator)

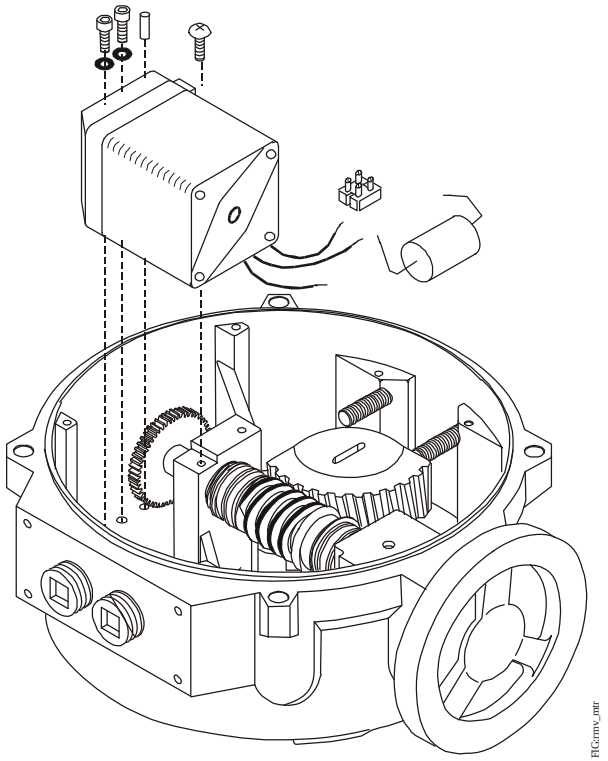

Figure 10: Removing the Motor

5. Disconnect the motor leads that run to the capacitor (plug-in connectors), and then unscrew the three mounting screws (two lower and one upper). See Figure 10.
6. Vertically remove the gear motor out of the actuator. See Figure 10. Do not misplace the alignment pin.

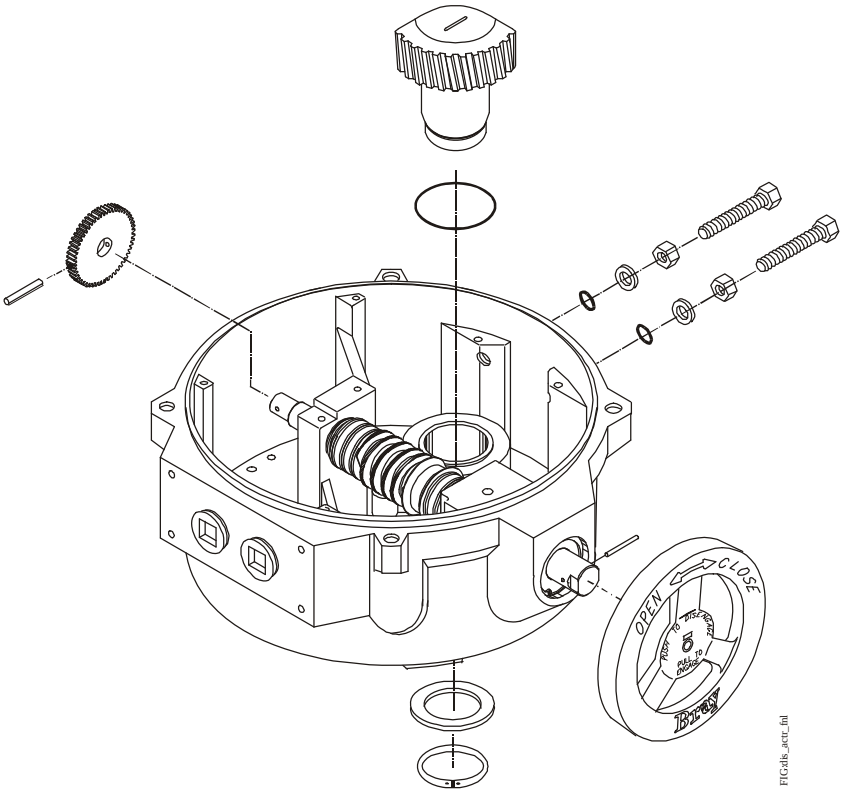

Figure 11: Disassembling the Actuator

7. To remove the worm shaft spur gear, remove the spring pin using a 3/32 in. (2 mm) punch, then slide the gear off the end of the worm shaft. See Figure 11.
8. To remove the output drive worm gear, back off both mechanical travel stops. Manually override the worm gear until it disengages the worm. Remove the retaining ring and thrust washer, then lift the output drive worm gear out of its bushing. See Figure 11.
9. Remove the capacitor. See Figure 10.

Note: A spring pin holds the handwheel in place. Further disassembly of the actuator requires special tools and procedures and is not covered in this document.

The reassembly procedure is the opposite of the disassembly procedure.

Procedure for VA-9073, VA-9074, VA-9075, VA-9076, VA-9077, and VA-9078 Actuators

1. Disconnect all power to the actuator and remove the cover. See Figure 12.

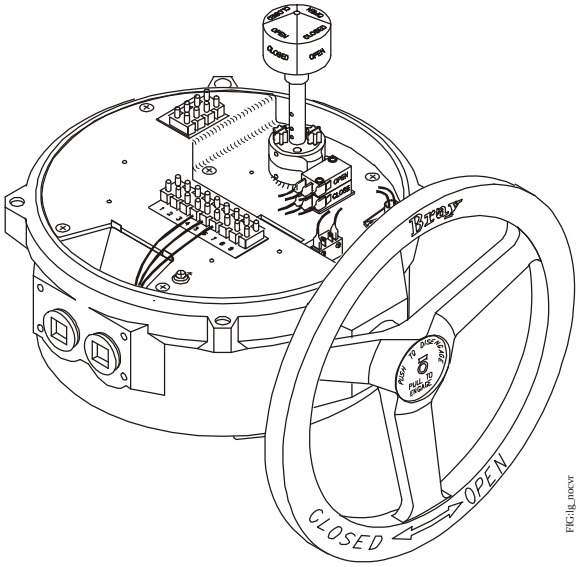

Figure 12: Two-Position Actuator with Cover Removed

2. Remove the field wiring and the internal motor wiring from the terminal strips. See Figure 13.

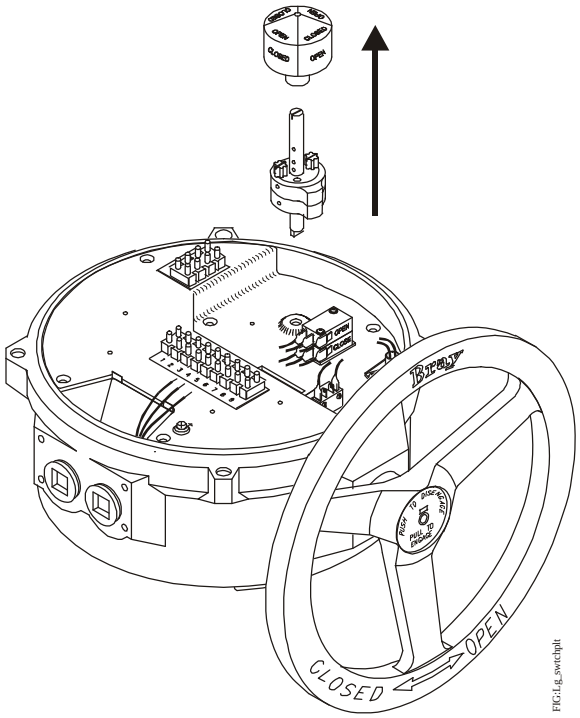

Figure 13: Removing the Switch Plate (Two Position Actuator)

3. Remove the switch plate by unscrewing the seven Phillips-head mounting screws and then pull up on the switch plate to remove it. See Figure 14.

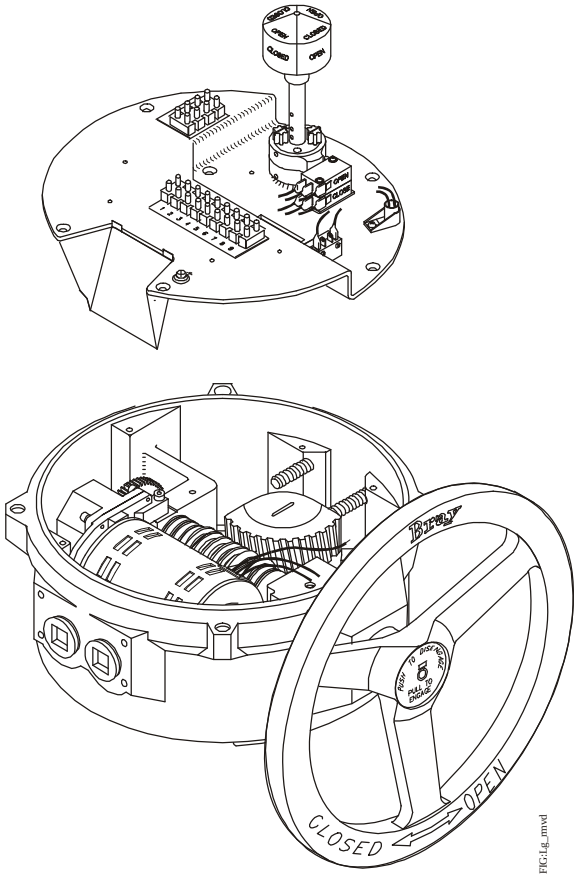

Figure 14: Two-Position Actuator with Switch Plate Removed

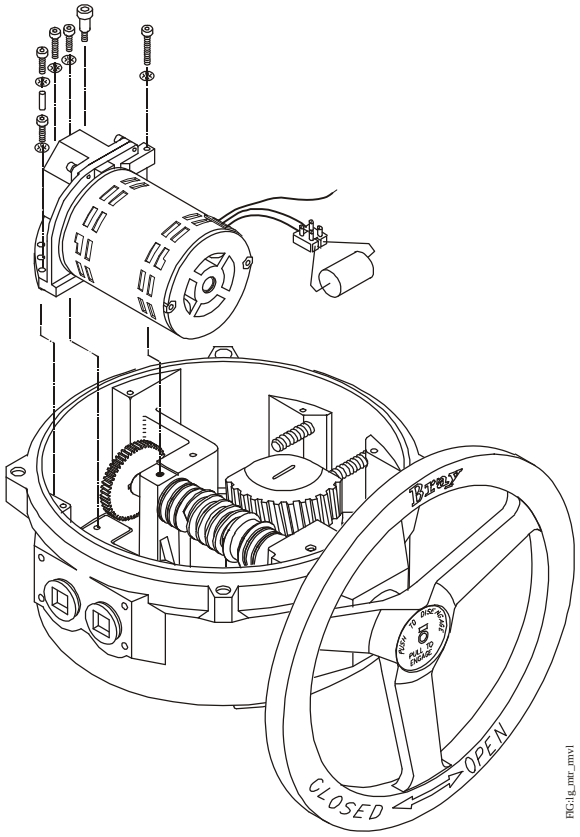

Figure 15: Removing the Motor

4. Disconnect the motor leads that run to the capacitor. See Figure 15.
5. Unscrew the mounting screws. See Figure 15.

   Note: The VA-9072 Series Actuator has two lower mounting screws and one upper mounting screw. The VA-9073 through VA-9075 Series Actuators have four lower mounting screws and one upper mounting screw. The VA-9076 through VA-9078 Series Actuators have four lower mounting screws, one upper mounting screw, and one lower locating screw.
6. Remove the motor vertically out of the actuator. See Figure 15.

   Note: Do not misplace the alignment pin.

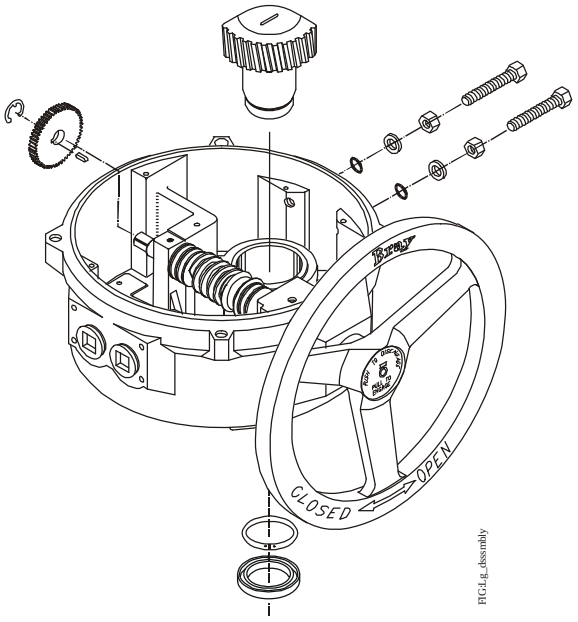

Figure 16: Disassembling the Actuator

7. Remove the bowed E-clip retainer and slide the worm shaft spur gear off the end of the worm shaft. See Figure 16.

   Note: The VA-9073 through VA-9075 Series Actuators use a drive gear with pin and retaining ring.

8. Back off both mechanical travel stops.

   Note: This is not needed on the VA-9076 through VA-9078 Series Actuators.

9. Manually override the worm gear until it disengages the worm.

   Note: This is not needed on the VA-7076 through VA-7098 Series Actuators.

10. Remove the seal and retaining ring, then lift the output drive worm gear out of its bushing. See Figure 16.

Further disassembly of the actuator requires special tools and procedures and is not covered in this document.

The reassembly procedure is the opposite of the disassembly procedure.

Appendix A

VA-9072 Actuators

Table 10: VA-9072 Two-Position Actuator Callouts

Callout	Description	Callout	Description
1	Position Indicator Cover	**29**	Override Drive Pin
2	Position Indicator Seal	**30**	Manual Override Bushing
3	Cover Fastening Screws	**31**	Manual Override Shaft
4	Cover	**32**	Spring Plunger
5	O-ring	**33**	Manual Override Sleeve
6	Indicator Rotor	**34**	Retaining Ring
7	Cam Assembly	**35**	Handwheel
8	Terminal Strip	**36**	Bushing
9	Terminal Strip Tag	**37**	Drive Gear
10	Pan Head Screw	**38**	Output Worm Gear Assembly Segment
11	Wire	**39**	Gear Motor
12	Limit Switch (SPDT, Form C)	**40**	Dowel Pin
13	Flat Head Screw	**41**	Socket Head Cap Screw
14	Switch Plate	**42**	Lock Washer
15	Motor Cover Plate	**43**	Lock Nut
16	Override Switch (SPDT Form C)	**44**	Nylon Flat Washer
17	Flat Head Screw	**45**	Hex Head Bolt
18	Switch Plate	**46**	Override Spring Pin
19	Motor Cover Plate	**47**	Capacitor
20	Green Ground Screw	**48**	Override Switch Trigger Pin
21	Conduit Wire Deflector	**49**	Base
22	Washer	**50**	Fiber Washer
23[1]	Thrust Washer	**51**	Temporary Conduit Plug
24[1]	Thrust Roller Bearing	**52**	Name Tag
25[1]	Disc Spring	**53**	Switch Spacer
26	Worm	**54**	Insulator
27	Spring Pin	**55**	E-ring
28	Worm Shaft	**56**	Retaining Ring

1. Items 23, 24, and 25 are installed when optional torque switches are required. Worm shaft spacers are used in units when torque switches are not required.

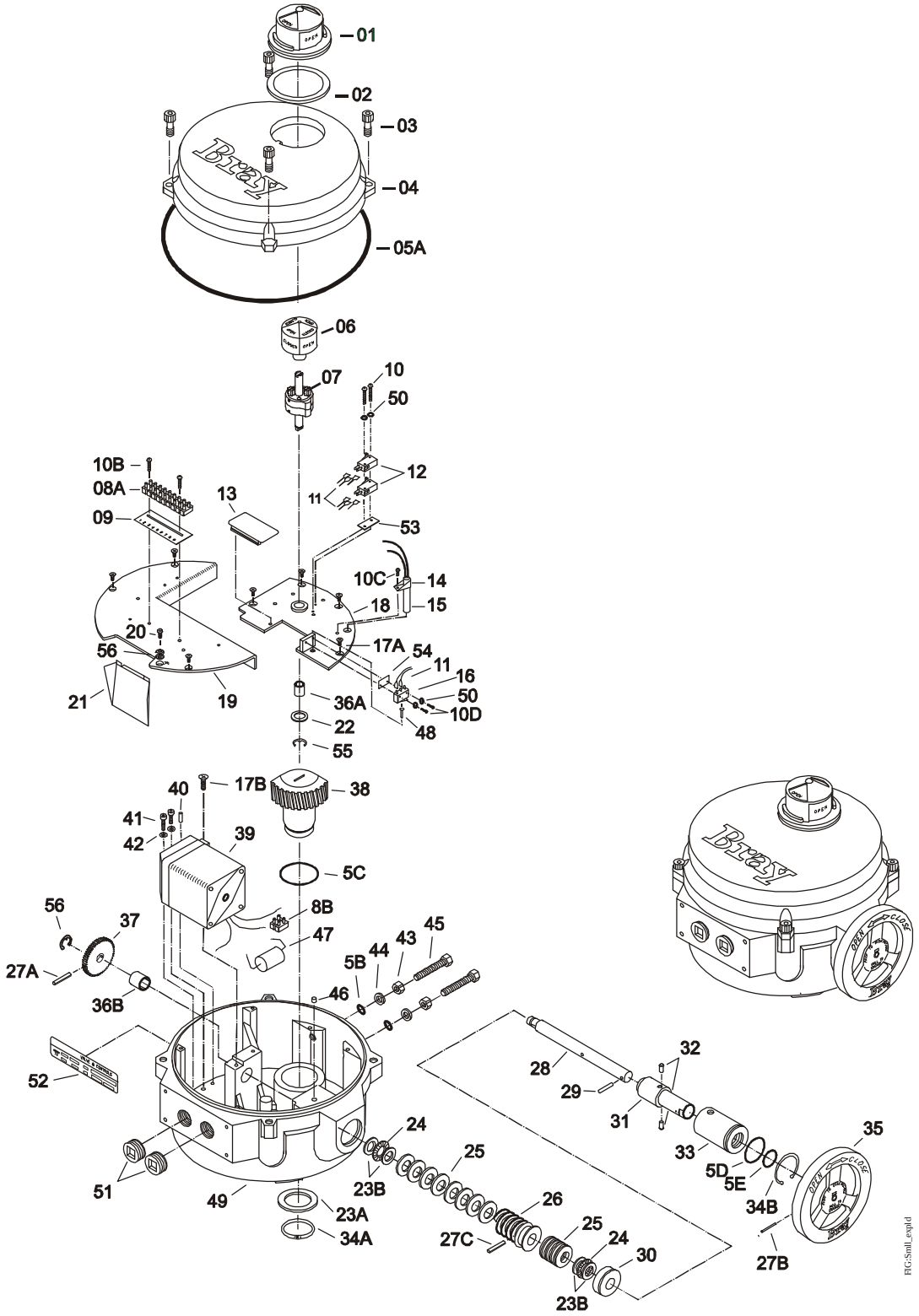

Figure 17: VA-9072 Two-Position Actuators, Exploded View

VA-9076, VA-9077, and VA-9078 Actuators

Table 11: VA-9076, VA-9077, and VA-9078 Two-Position Actuator Callouts

Callout	Description	Callout	Description
1	Position Indicator Cover	**28**	Worm Shaft
2	Position Indicator Seal	**29**	Override Drive Pin
3	Cover Fastening Screws	**30**	Manual Override Bushing
4	Cover	**31**	Manual Override Shaft
5	O-ring	**32**	Spring Plunger
6	Indicator Rotor	**33**	Manual Override Sleeve
7	Cam Assembly	**34**	Retaining Ring
8	Terminal Strip	**35**	Handwheel
9	Terminal Strip Tag	**37**	Bushing
10	Pan Head Screw	**38**	Key
11	Wire Assembly	**39**	Drive Gear
12	Limit Switch (SPDT, Form C)	**40**	E-ring
13	Switch Spacer	**41**	Output Worm Gear Segment
14	Torque Switch Cover	**42**	Gear Motor
15	Heater Mounting Bracket	**43**	Dowel Pin
16	Heater	**44**	Socket Head Cap Screw
17	Override Switch Trigger Pin	**45**	Lock Washer
18	Override Switch (SPDT, Form C)	**46**	Lock Nut
19	Motor Cover Plate	**47**	Nylon Flat Washer
20	Switch Plate	**48**	Hex Head Bolt
21	Green Ground Screw	**49**	Override Spring Pin
22	Conduit Wire Deflector	**50**	Capacitor
23[1]	Thrust Washer	**51**	Fiber Washer
24[1]	Thrust Roller Bearing	**52**	Base
25[1]	Disc Spring	**53**	Insulator
26	Worm	**54**	Conduit Plug
27	Spring Pin	**55**	Name Tag

1. Items 23, 24, and 25 are installed when optional torque switches are required. Worm shaft spacers are used in units when torque switches are not required.

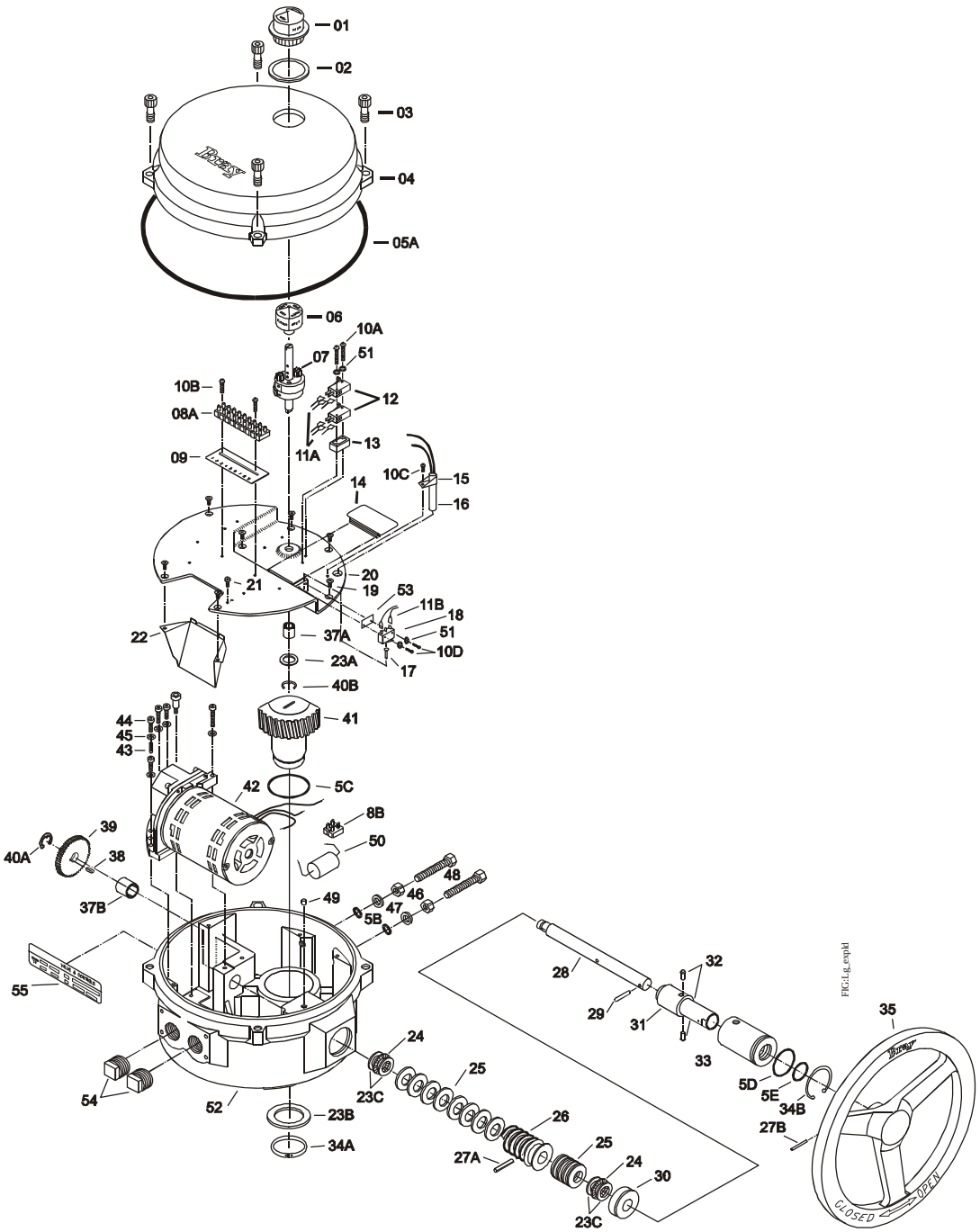

Figure 18: VA-9076, VA-9077, and VA-9078 Two-Position Actuators, Exploded View

Appendix B

Use this information as a guide to interpret VA-9070 Series (Johnson Controls) and S70 (Bray) Electric Actuator part numbers.

Table 12: Code Numbers and Cross-Reference Data for Electric Two-Position Models

Johnson Controls Actuator Only Code Number	Johnson Controls VF Series Butterfly Valve Assembly Actuator Sub-Code	Bray Series Number
VA-9072-02	-722	S70-005 On-Off
VA-9073-02	-723	S70-008 On-Off
VA-9074-02	-724	S70-012 On-Off
VA-9075-02	-725	S70-020 On-Off
VA-9076-02	-726	S70-030 On-Off
VA-9077-02	-727	S70-050 On-Off
VA-9078-02	-728	S70-065 On-Off

Table 13: Code Numbers and Cross-Reference Data for Electric Modulating Models

Johnson Controls Actuator Only Code Number	Johnson Controls VF Series Butterfly Valve Assembly Actuator Sub-Code	Bray Series Number
VA-9072-01	-702	S70-005 Modulating
VA-9073-01	-703	S70-008 Modulating
VA-9074-01	-704	S70-012 Modulating
VA-9075-01	-705	S70-020 Modulating
VA-9076-01	-706	S70-030 Modulating
VA-9077-01	-707	S70-050 Modulating
VA-9078-01	-708	S70-065 Modulating

Table 14: Bray Part Numbering System Reference Chart

Bray Part Number[1, 2]	Torque lb·in (N·m)	Standard Speeds in Seconds for 90° Operation (Total Gear Ratio)	Optional Speeds in Seconds at Each 1/4 Turn[1]	Voltage (Volts)[2]
70-005y-113zz-536	500 (56.5)	30 (5,070:1)	60/30/15	110/220
70-008y-113zz-536	800 (90.4)	30 (3,340:1)	30/15/10/6	
70-012y-113zz-536	1,200 (135.6)		30/15/10	
70-020y-113zz-536	2,000 (226.0)		30/15	
70-030y-113zz-536	3,000 (339.0)		30/18	
70-050y-113zz-536	5,000 (565.0)			
70-065y-113zz-536	6,500 (734.5)		30	

1. **Y** designates the speed. See Table 15.
2. **ZZ** designates the voltage. See Table 16.

Table 15: Speed Designations

Y =	0	1	2	3	4
Sec =	60	30	10	8	6

Table 16: Voltage Designations

ZZ=	00	10
Voltage	115	220

Johnson Controls

Building Efficiency
507 E. Michigan Street, Milwaukee, WI 53202