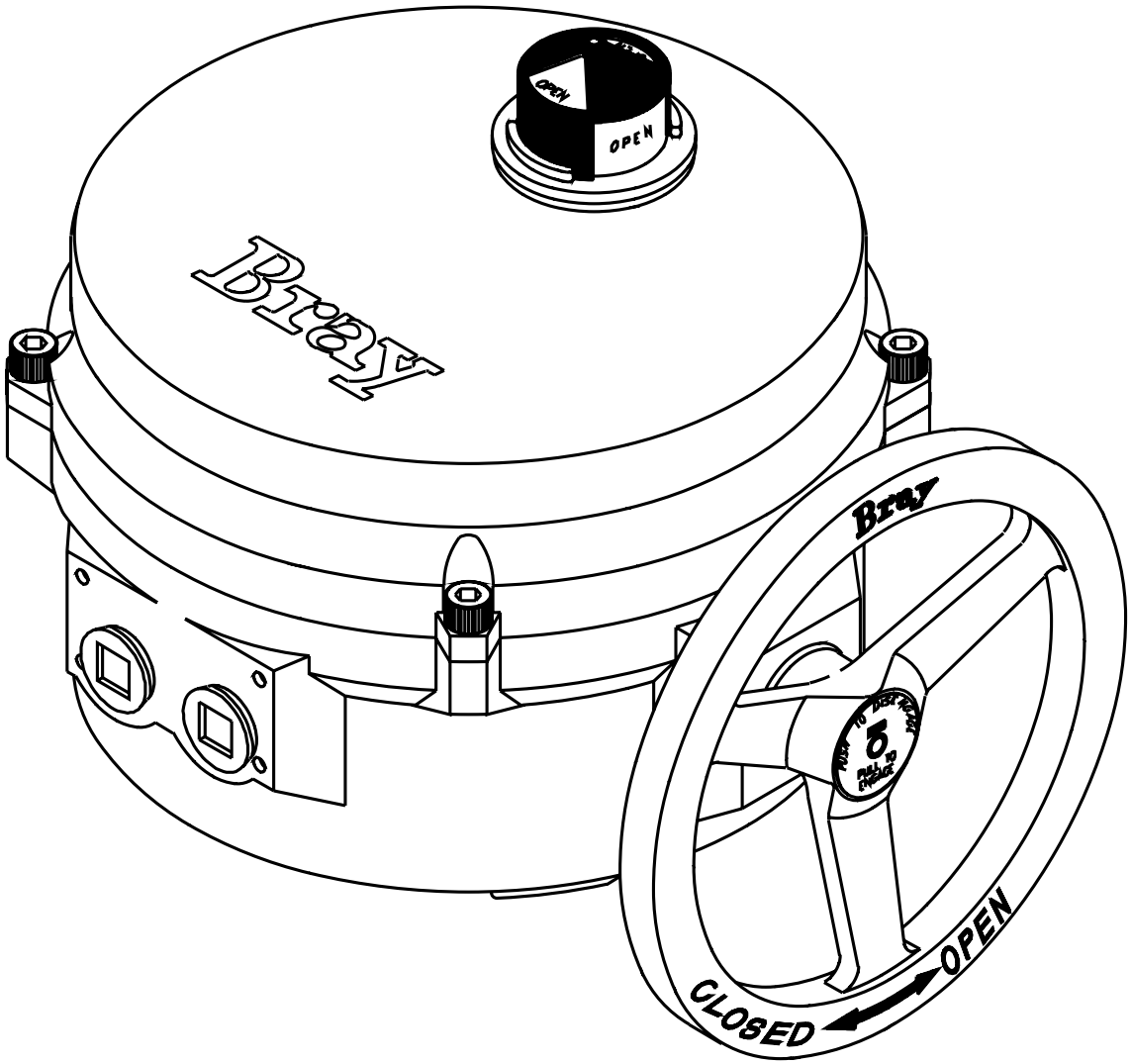
Bray SERIES 70

2ND GENERATION ELECTRIC ACTUATOR

OPERATION AND MAINTENANCE MANUAL



The High Performance Company

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Safety Instructions - Definition of Terms

READ AND FOLLOW THESE INSTRUCTIONS
SAVE THESE INSTRUCTIONS

WARNING	indicates a potentially hazardous situation which, if not avoided, **could** result in death or serious injury.
CAUTION	indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	used without the safety alert symbol indicates a potential situation which, if not avoided, may result in an undesirable result or state, including property damage.

1.1 Hazard-free use

This device left the factory in proper condition to be safely installed and operated in a hazard-free manner. The notes and warnings in this document must be obeserved by the user if this safe condition is to be maintained and hazard-free operation of the device assured.

Take all necessary precautions to prevent damage to the actuator due to rough handling, impact, or improper storage. Do not use abrasive compounds to clean the actuator, or scrape metal surfaces with any objects.

The control systems in which the actuator is installed must have proper safeguards to prevent injury to personnel, or damage to equipment, should failure of system components occur.

1.2 Qualified Personnel

A qualified person in terms of this document is one who is familiar with the installation, commissioning and operation of the device and who has appropriate qualifications, such as:

- Is trained in the operation and maintenance of electric equipment and systems in accordance with established safety practices
- Is trained or authorized to energize, de-energize, ground, tag and lock electrical circuits and equipment in accordance with established safety practices
- Is trained in the proper use and care of personal protective equipment (PPE) in accordance with established safety practices
- Is trained in first aid
- In cases where the device is installed in a potentially explosive (hazardous) location – is trained in the operation, commissioning, operation and maintenance of equipment in hazardous locations

WARNING

The actuator must only be installed, commissioned, operated and repaired by qualified personnel.

The device generates large mechanical force during normal operation.

All installation, commissioning, operation and maintenance must be performed under strict observation of all applicable codes, standards and safety regulations.

Reference is specifically made here to observe all applicable safety regualtions for actuators installed in potentially explosive (hazardous) locations.

Part Numbering System Reference chart

Series	Size Code	Speed	Product	Style	Voltage	Trim
70	AAA	X	113	Y	Z	536

Part Number	Torque (In.Lbs)	Speed, ¼ Turn (Seconds)	Supply (Z Voltage)
70-003**X**-113**yz**-536	300	30/15	0/1/2/3/4
70-005**X**-113**yz**-536	500	30/15	0/1/2/3/4
70-008**X**-113**yz**-536	800	30/15/6	0/1/2/3/4/5/6/7/8
70-012**X**-113**yz**-536	1200	30/15/6	0/1/2/3/4/5/6/7/8
70-020**X**-113**yz**-536	2000	30/15	0/1/2/3/4/5/6/7/8
70-030**X**-113**yz**-536	3000	30/18	0/2/3/4/5/6/7/8
70-050**X**-113**yz**-536	5000	30/18	0/2/3/4/5/6/7/8
70-065**X**-113**yz**-536	6500	30	0/2/4/5/6/7/8
70-13**W**6-113**yz**-536	13000	110	0/2/4/5/6/7/8
70-18**W**6-113**yz**-536	18000	110	0/2/4/5/6/7/8

Use this chart as a guide to interpret the S70 electric actuator part number.

W - DESIGNATES THE OUTPUT BORE DIAMETER

0	2.5 Inches
1	1.97 Inches

X - DESIGNATES THE SPEED

X:	1	2	3	4	5
Sec:	30	18	10	6	8

Y - DESIGNATES STYLE

A	Basic Unit - Declutchable
D	With Interposing Relay Board*

*Only available for 120VAC or 220VAC On/Off units

Z - DESIGNATES THE VOLTAGE

Z:	0	1	2	3	4	5	6	7	8
Voltage:	120VAC	12VDC	24VDC	24VAC	220VAC	380V 3-PH	400V 3-PH	440V 3-PH	480V 3-PH

Introduction

The **Bray** Series 70 is a quarter turn electric actuator with manual override for use on any quarter turn valve requiring up to 18000 in.lb of torque. Operating speeds vary between 6 to 110 seconds.

Principle Of Operation

The Series 70 actuator is basically divided into two internal sections; the power center below the switchplate, and the control center above the switchplate. Below the switchplate the capacitor and gearmotor with its spur geartrain drive a final non-backdriveable worm gear output. The override mechanism for manual operation is also housed here. Above the switchplate is where user required, readily accessible components are placed. The camshaft assembly, limit switches, terminal strips, torque switches, heater, and servo are all placed here for easy access. External to the unit are found adjustable mechanical travel stops, a large easy to read indicator, the unique manual override handwheel and dual conduit entry ports. The external coating is a high quality polyester powder coat which has exceptional UV as well as chemical resistance.

Electrical Operation

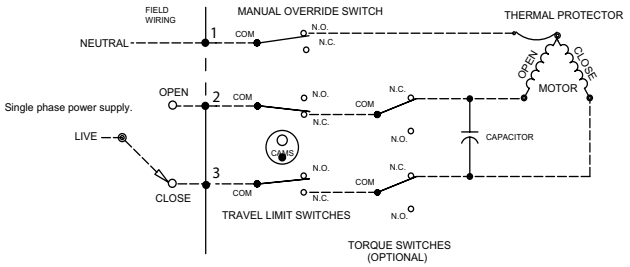
The motors used in the **Bray** Series 70 are either permanent induction split capacitor design (single phase AC power), SCI (Three Phase AC Power) or PM (DC Power). Travel limit switches are mechanical form (SPDT) with contacts rated at 10 amp (0.8 PF), 1/2 HP 125/250 VAC. In cases where the torque capacity of the unit is exceeded to the point where the motor stalls and overheats, a thermal protector switch built into the motor windings will automatically disconnect the motor power. Once the motor cools sufficiently the thermal protector switch will reset. Optional torque switches are available in all units to prevent the possibility of stalling the motor, thus reducing the necessity for an inoperable thermal cooldown period. Torque switches installed by Bray are factory adjusted to the output torque rating of the unit using electronic torque testing equipment.

NOTICE

Field adjustment of the torque switches is not recommended.

General Electrical Schematic

NOTE: *this is only a reference. For the actual wiring diagram refer to the diagram placed inside the actuator cover.*



Mechanical Operation

Mechanically, the ratio of the gearmotor determines the speed of the unit. The gearmotor utilizes high efficiency spur gears with various ratios for the different speeds. Initial gear reduction through the spur gears is then transferred to the worm shaft. The final gear reduction and output is through a non-backdriveable worm gear set. Positioning is determined by an indicator-cam shaft linked to the output shaft. In the declutchable condition the manual override drives the worm shaft when engaged.

Manual Override Operation (Declutchable)

The manual override operates similar to a watch adjusting knob. To engage the manual override, simply pull the handwheel to its outermost position. A yellow stripe is revealed for visual indication that the unit cannot run electrically. The two handwheel positions, engaged and disengaged, are held in place with the use of spring plungers. The handwheel remains in position until physically moved. Rotating the handwheel in the clockwise direction will rotate the output shaft in the same clockwise (closed) direction and vice-versa.

CAUTION

A label on the handwheel hub warns users not to exceed a specific rim pull force, for each size of actuator. If the rim pull force is exceeded, the roll pin securing the handwheel onto the manual override shaft is designed to shear, thus preventing more serious internal gearing damage.

Pre-Installation Storage

Units are shipped with two metal screw-in plugs in order to prevent foreign matter from entering the unit.

NOTICE

To prevent condensation from forming inside these units, maintain a near constant external temperature and supply power to the optional heater internal to the unit.

Installation

Mounting to a Valve

All Bray Series 70 electric actuators are suitable for direct mounting on Bray butterfly valves. With proper mounting hardware, the S70 actuator can be installed onto other quarter-turn valves or devices.

NOTICE

The standard mounting position for the actuator is to orient the unit with its handwheel in a vertical plane and parallel to the pipeline. If the actuator is to be mounted on a vertical pipe, it is recommended that the unit be positioned with the conduit entries on the bottom to prevent condensation from entering the actuator by way of the conduit. In all cases, the conduit should be positioned to prevent drainage into the actuator.

The actuator should be mounted to the valve as follows:

1. Manually operate the actuator until the output shaft of the actuator is in line with the valve stem. If possible, select an intermediate position (i.e. valve disc/stem and actuator both half open).
2. Place the proper adapter, if required, onto the valve stem. It is recommended that a small amount of grease be applied to the adapter to ease assembly.
3. Mount the actuator onto the valve stem. It may be necessary to swing or manually override the actuator to align the bolt patterns.
4. Install the furnished mounting studs by threading them all the way into the actuator base.
5. Fasten in place with the furnished hex nuts and lock washers.

Field Wiring

WARNING

Turn off all power and lock out service panel before installing or modifying any electrical wiring.

Each actuator is provided with two (2) conduit entries (one for power and one for control).

1. The motor full load current is noted on the nameplate of the actuator. The terminal strip will accept wire sizes ranging from 14 to 22 AWG (14 to 24 AWG for the servo).

NOTICE

18 AWG minimum wire is recommended for all field wiring.

Note that the optional heaters use approximately 0.5 amps at 110 volts.

2. **All actuators have their applicable wiring diagram attached to the inside of the cover**. Field wiring should be terminated at the actuator terminal strip in accordance with **this** wiring diagram.

NOTICE

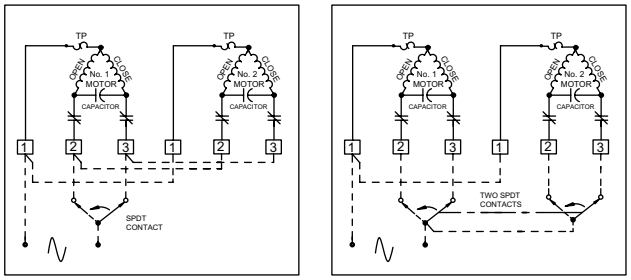
The conduit connections must be properly sealed to maintain the weatherproof integrity of the actuator enclosure.

Multiple Actuator (Parallel) Wiring

CAUTION

Do not connect more than one S70 actuator which do not have I.R.B. installed to a single SPDT switch. A voltage is present on the opposite winding to the powered one. If this winding is connected to another as shown in the INCORRECT diagram it will interfere with the motor performance. Use a multiple pole switch as shown in the CORRECT diagram.*

Actuator diagram without I.R.B.



INCORRECT CORRECT

CAUTION

Do not reverse motor instantaneously when it is still running. Reversing direction to actuator motor when it is running can cause damage to motor, switches and gearing. Directional control switching can be done by PLC in 20ms or by a small relay in 46ms. Therefore time delay of 1s has to be incorporated into the control scheme to avoid damage.

Travel Limit Switch and Mechanical Travel Stop Adjustment

CAUTION

The electrical travel switches **must** be set to activate (depress) prior to reaching the mechanical travel stops. The cams are color coded (green for open, red for closed).

NOTE: *Manual travel stops are designed to prevent manual overtravel from turning the handwheel, not to stop the electric motor. The travel stops have an adjustment range of approximately 10-degrees.*

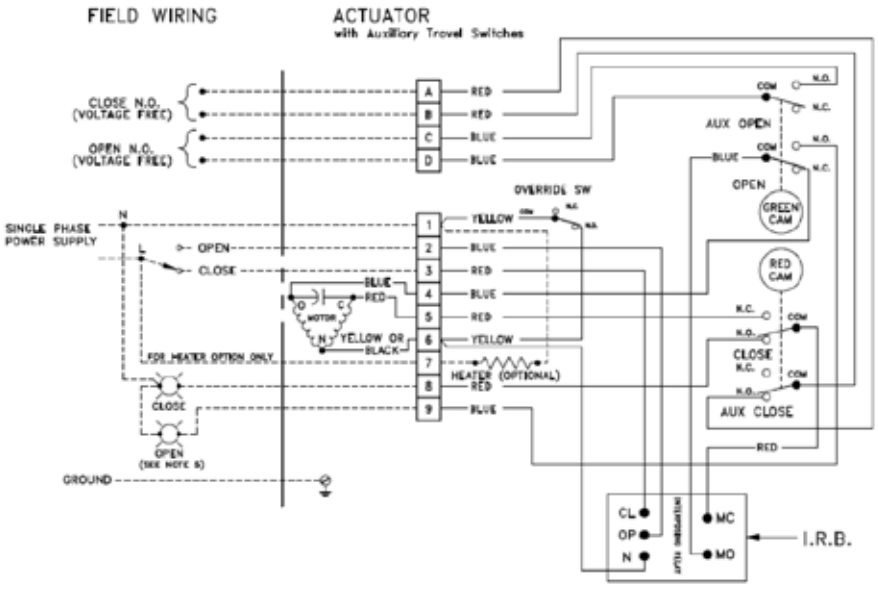
S70 ON/OFF Actuator with Interposing Relay Board (I.R.B.)

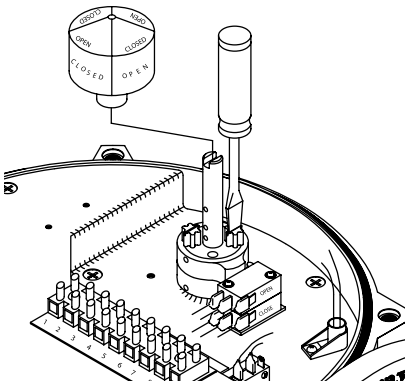
The back feeding of one actuator by another one wired in parallel is eliminated by using the I.R.B.

If actuator is running Open & customer switches "instantaneously" to run Closed, the Open relay will take time to 'drop-out' & the Close relay will take time to 'pull-in' this time lapse is ~ 40ms. The time delay provided by the I.R.B. will protect the switches and gears from the controller's instantaneous command signal reversal.

Current draws and field wirings are not affected by adding I.R.B.

S70 120VAC I.R.B., auxiliary switch option, and heater option are UL certified units.

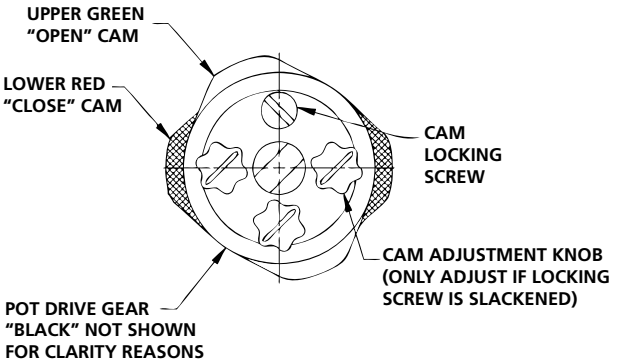




Close Travel Switch adjustment

1. Loosen the mechanical stop for the closed position and back it off so that it does not interfere with actuator travel (closed stop located on right when viewed from travel stop side of actuator).
2. Remove the indicator rotor by pulling up it straight up away from the indicator shaft. This will expose the machined groove on the end of the cam shaft, which is the reference to the valve disc position.
3. ***NOTE:*** *For Sizes 130 and 180, ignore steps 2 and 6. The valve position indicator plate on the lower gearbox is the reference to the valve position.*
4. Manually operate the actuator handwheel clockwise until the valve reaches the desired fully closed position.
5. Rotate the **red** adjusting knob by hand or with a flat head screwdriver until the cam lobe just activates (depresses) the switch from a clockwise direction.

   NOTICE: *All continuous duty actuators have a cam locking screw. Cam locking screw must be slackened before cam adjustments and re-tightened after cam adjustments.*



   NOTE: *It is possible that the rotation of one cam will move the other cam. If this occurs, hold the other knobs or cams during adjustment.*

6. With the travel switch in the closed position, rotate the **handwheel** clockwise ½ turn for size 6, 1 turn for size 12, ½ turn for size 30, and 1 ½ turn for size 130 and180. Adjust the closed travel stop bolt until it bottoms against the output gear and lock it in position with the locknut.
7. After all travel switch adjustments have been completed, replace the indicator rotor and secure the actuator cover.

Open Travel Switch adjustment

1. Loosen the mechanical stop for the open position and back it off, so that it does not interfere with actuator travel. The open stop is located on the left, when viewed from travel stop side of actuator.
2. Remove the indicator rotor by pulling it straight up away from the indicator shaft. This will expose the machined groove on the end of the cam shaft, which is the reference to the valve disc position.

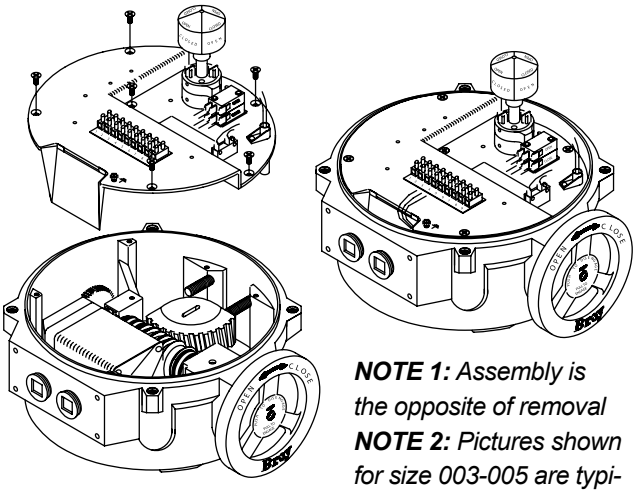
   NOTE: *For Sizes 130 and 180, ignore steps 2 and 6. The valve position indicator plate on the lower gearbox is the reference to the valve position.*
3. Manually operate the actuator handwheel counterclockwise until the valve reaches the desired open position.
4. Rotate the green adjusting knob until the cam lobe just activates (depresses) the switch from a counterclockwise direction.

   NOTICE: *All continuous duty actuators have a cam locking screw. Cam locking screw must be slackened before cam adjustments and re-rightened after cam adjustments.*

   NOTE: *It is possible that the rotation of one cam will move the other cam. If this occurs, hold the other knobs or cams during adjustment.*
5. With the travel switch in the open position, rotate the **handwheel** counterclockwise ½ turn for size 6, 1 turn for size 12, ½ turn for size 30, and 1 ½ turn for size 130 and 180. Adjust the open travel stop bolt until it bottoms against the output gear and lock in position with the locknut.
6. After all travel stop adjustments have been completed, replace indicator rotor and secure the actuator cover.

Disassembly and Assembly

Tools required:



NOTE 1: *Assembly is the opposite of removal*
NOTE 2: *Pictures shown for size 003-005 are typical for all sizes*

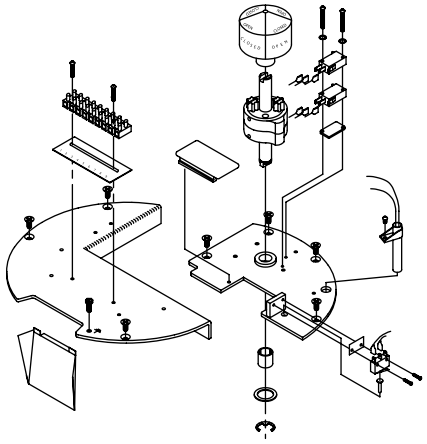
See Appendix A for a complete list of basic tools.

Procedure:

WARNING

Turn off all power and lock out service panel before installing or modifying any electrical wiring.

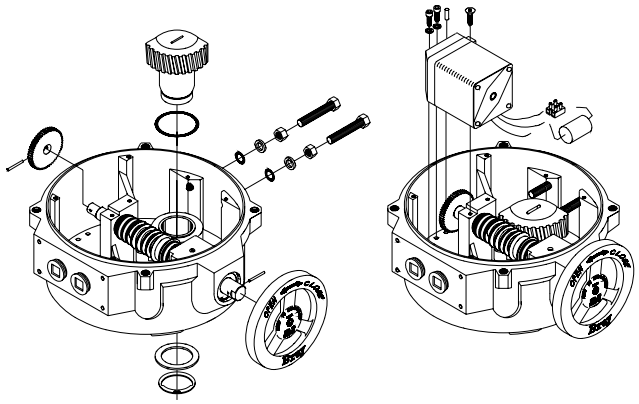
1. Disconnect motor wires from the main terminal strip (motor neutral, open, and close).



2. Remove the switchplate by unscrewing the seven phillips head mounting screws. The switchplate should lift out as an assembly with the camshaft attached.
3. The switchplate can be independently disassembled.
4. To remove the Gearmotor, first disconnect the motor leads which run to the capacitor, and unscrew the mounting screws for size 003-005 (two lower, one upper) for size 008-180 (four lower, one upper). The motor can now be removed vertically out of the unit. Note: do not misplace the alignment pin.
5. To remove the worm shaft spur gear, remove the spring pin using a $^{3}/_{32}$" punch, then slide the gear off the end of the worm shaft for size 003-020. Remove bowed E-clip retainer for size 030-180.
6. To remove the output drive worm gear, back off both mechanical travel stops. Remove the retaining ring and thrust washer, then lift the output drive worm gear out of its base.
7. The handwheel is held by a spring pin.

CAUTION

8. Further disassembly of the unit requires special tools and procedures, and thus will not be covered in this manual.



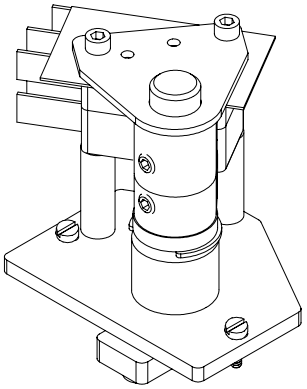
Field Or Factory Installable Options

Torque Switches

Torque switches are a factory installed and calibrated option available for all Series 70 units. Installation is simple, but due to the requirement for special calibration equipment, it is not recommended for field installation. In fact, modifying the factory torque setting voids the actuator warranty.

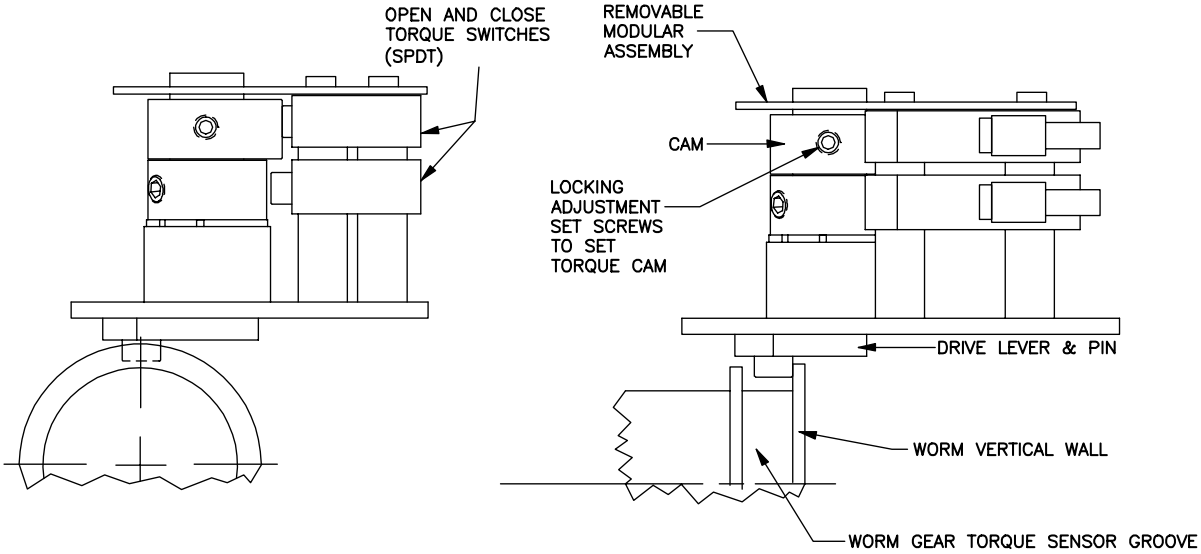
The unique mechanism is extremely accurate and has excellent repeatability. The worm is pinned to the worm shaft, which is held in position with a stack of disc springs at both ends. The torque transmitted through the worm to the output worm gear acts directly against the disc springs, which compress proportionately. The worm and worm shaft shift longitudinally as a result.

A specially designed drive lever and pin is incorporated into the worm, providing the profile for the torque switching mechanism. A drive lever & pin rides in the worm gear torque sensor groove, and in turn drives a cam. The cam then actuates its electrical switch, which interrupts the power to the motor winding when the torque exceeds the setting. The motor can still be powered to run in the opposite direction, or if the torque diminishes, the switch will release automatically.



Switching Mechanism

Torque Switch Mechanism



Heater

To prevent condensation from forming inside the actuator, Bray offers an optional heater. The heater is a PTC (Positive Temperature Coefficient) style which has a unique temperature - resistance characteristic. The heater self-regulates by increasing its electrical resistance relative to its temperature. The heater does not require external thermostats or switches to control its heat output. It is constructed of a polycrystalline ceramic, sandwiched between two conductors, and wrapped inside a thermally conductive electrical insulator.

Connect the heater wires to the terminal strip as indicated on the wiring diagram.

***NOTE**: The heater must have a constant power supply to be effective.*

WARNING

The heater surface can reach temperatures in excess of 200 degrees Celsius

Heater Kit Consists of:

1. Heater with flying leads
2. Heater Mounting Bracket
3. #10 pan head screw, phillips drive

Tools required:

- For terminal wiring: Screwdriver, $^{3}/_{16}$" tip flat blade
- For heater mounting screw: Screwdriver, No.1 phillips

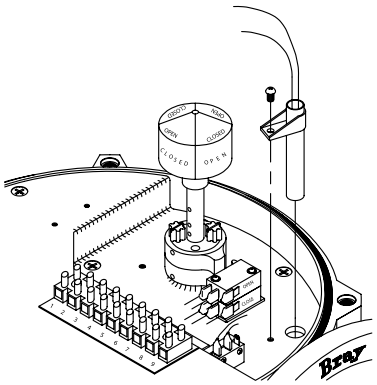
Installation procedure:

The heater is mounted through a hole provided in the switchplate.

Before servicing unit, switch all power off at the service panel and lock the service disconnecting means to prevent power from being switched on accidentally. When the service disconnecting means cannot be locked, securely fasten a prominent warning device, such as a tag, to the service panel.

Disconnect all power to the unit.

1. Place the heater snugly into its mounting bracket until approx. 1/2 to 1" is left above the bracket as shown in diagram.
2. Slip the heater into its mounting hole.
3. Align the fastening hole in the bracket with the threaded screw hole in the plate. Fasten the heater to the switchplate.
4. Connect the heater wires to the terminal strip as indicated on the wiring diagram.



Servo-Pro Module

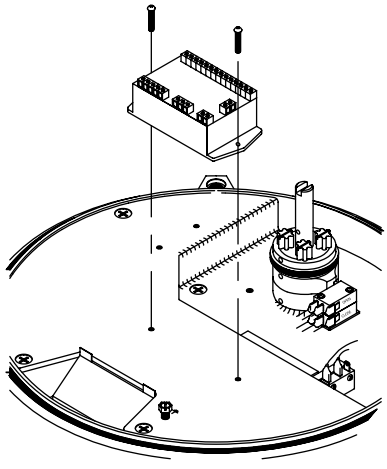
Servo kits can be field installed on any continuous duty actuator (30 or 60 sec. operation speed) to provide proportional positioning in response to a control signal. Intermittent duty actuators are not adaptable for servo control.

Servo Kit Consists of:

1. One servo module
2. Four #6 cross drive pan head screw (two for servo, two for pot)
3. One potentiometer assembly
4. Two #6 type A internal lockwashers (for pot)
5. One wiring diagram sticker for attaching to inside of actuator's cover
6. One wiring diagram sticker for servo units with torque switches

Tools required:

- For actuator terminals wiring Screwdriver, $^{3}/_{16}$" flatblade
- For servo terminals Screwdriver, No.1 phillips
- For servo and pot mounting screws Screwdriver, No.2 phillips



Installation Procedure:

Disconnect all power to the unit.

Remove the on/off duty, 9 point terminal strip and its marker

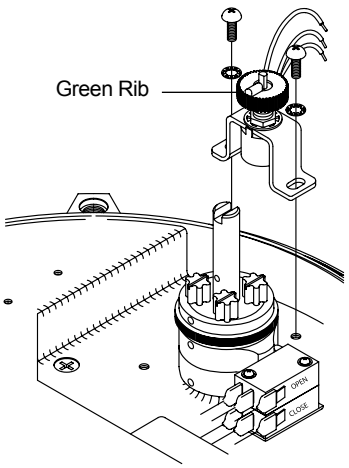
1. Disconnect all wiring to the terminal strip.
2. All wiring in the actuator is color coded to facilitate wiring, and does not need to be tagged or marked.
3. Field wiring should be marked if it is not already color coded.

Mount the servo module

4. Secure the servo card module onto switchplate with the 2X #6 screws.

Install the potentiometer assembly

5. The potentiometer installs next to the camshaft where there are two threaded holes provided.
6. The potentiometer assembly must be mounted in the correct orientation, with the actuator in its fully open (counter clockwise) position, the indicator shaft should be in-line with raised green rib on pot gear.
7. Push the assembly towards the cam to mesh the pot gears. Then tighten the mounting screws.
   Note: *Sizes 130 and 180, the raised green rib on pot gear should be aligned with arrow on lower gear box's position indicator plate.*



Wire the pot to the servo

8. Connect the pot wires into the terminal strip on the servo module.
9. Wire according to the wiring diagram provided.

Wire the servo to the actuator

10. Wire according to the wiring diagram provided.
11. See the servo calibration instructions.

Servo Calibration

The calibration procedure defines the limits of operation of the Series 70 Actuator between the fully open valve position and the fully closed valve position. The cams on the Series 70 Actuator define the fully open and closed positions of the valve and may be set at any degree of opening. The only requirement is that the open cam limit setting must set at a higher degree of opening than the closed cam limit setting. In other words, the "Open" position must be more open than the "Closed" position.

Calibration is performed as follows:

1. Adjust the Open and Closed limit switch cams on the Series 70 Actuator to the desired position.
2. Engage the handwheel and move the Series 70 Actuator to its mid position.

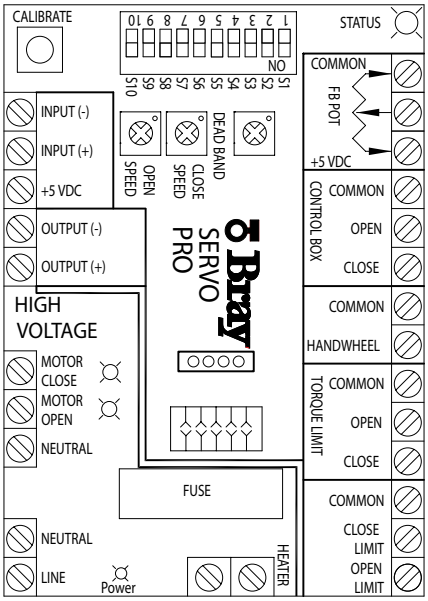
NOTE:

An analog signal source is not required for calibration. Press and hold the "Calibrate" Set pushbutton for a minimum of 2 seconds. When the servo begins to drive the actuator closed, release the button. The servo will now seek both travel limits and record these values to its nonvolatile memory. Following a successful calibration, the status LED will begin to flash a steady single green flash. If the calibration is unsuccessful the status LED will flash two green flashes. If this occurs, make sure the cams and the potentiometer are set correctly.

This completes the "Self Calibration" procedure.

After completing the calibration procedure, it is good practice to apply the fully closed and fully open Command Signals, and verify that the S70 Actuator moves to the proper positions.

* Refer to Servo Pro Manual for more details



External Signal Feedback Potentiometer

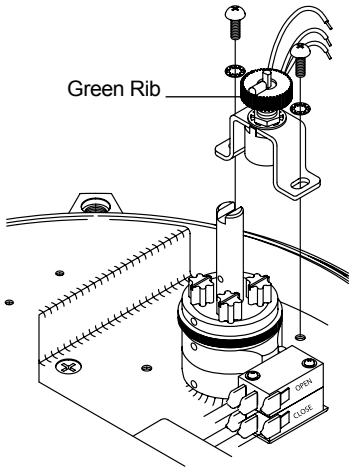
Potentiometers for external feedback can be field installed on all continuous duty actuators. Actuators which are not continuous duty do not have a pot gear fitted on their indicator shafts & must be fitted with a new shaft which has a pot drive gear for feedback pot (see Options: Auxiliary Switches).

Feedback Potentiometer Kit consists of:

1. One potentiometer assembly
2. Two #6 cross drive pan head screws
3. Two #6 internal lockwashers
4. One 4 point terminal strip
5. One terminal strip marker for feedback pot
6. One small wiring diagram sticker for the additional potentiometer

Tools Required:

- For terminal wiring Screwdriver, $^{3}/_{16}$" tip flat blade
- For pot mounting screws Screwdriver, No.2 phillips



Installation Procedure:

1. The potentiometer installs next to the camshaft where there are two threaded holes provided for it.
2. The potentiometer assembly must be mounted in the correct orientation, with the actuator in its fully open (counter clockwise) position, the indicator shaft should be in-line with raised green rib on pot gear.
3. Push the assembly towards the cam to mesh the pot gears. Then tighten the mounting screws.
4. Fit the 4 point terminal strip and marker in the kit. Before laying down the marker, cut it to obtain a marker as illustrated: opposite
5. Wire the pot to the terminal strip using the small stick-on wiring diagram provided.
6. Adhere the wiring diagram sticker to the inside of the cover.

Set 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 engage the potentiometer gear at the closed position.
3. Manually operate the actuator to the fully open position.

Auxiliary Switches

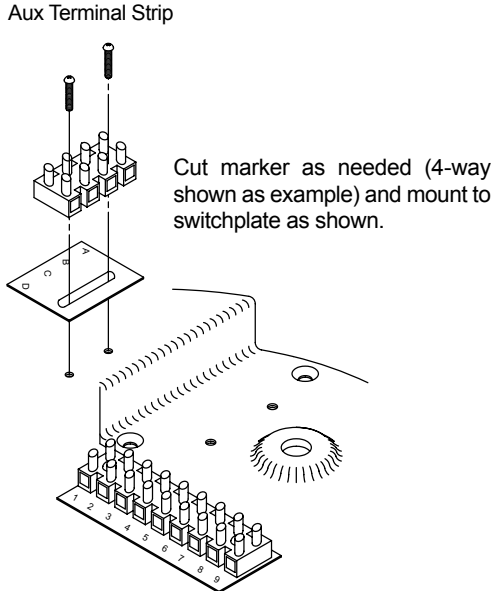
Auxiliary switches are available / refer to chart on next page.

NOTES:

1. All auxiliary switches have voltage-free contacts.
2. Size 6, 12, and 30 have double lobe cams. Sizes 130 and 180 has single lobe cams.
3. Main switches are one OPEN and one CLOSE switch.
4. Auxiliary switches are one OPEN and one CLOSE switch, which are fixed to activate 3° before the main switches.
5. Adjustable auxiliary switches are adjustable to any position.

Installation Procedure:

1. Cut terminal strip marker to length needed with letters facing up.
2. Mount terminal strip and marker to switchplate using two #4-40 screws.



Modulating Configuration for Fail Open or Close Battery Backup Unit (BBU)

Operation

If the external power fails, the actuator will switch to battery power, send a signal to the Servo Pro and drive the actuator to its fail-open or fail-close position.

The BBU has a 4.5 minute fail safe feature during which time if the actuator does not reach its end of travel, the BBU will shutdown until external power is reapplied. Once external power is reapplied, there is a 10 second time delay before the actuator goes to the position dictated by the control signal. Every time external power is reestablished, the 4.5 minute timer is reset.

Affects On S70 Design

The BBU in no way modifies the basic operation of the Servo Pro. Under normal operations it simply passes power to operate the actuator and charge the batteries. In the event of power failure the BBU switches to the battery and supplies power to the Servo and fails open or close depending on the BBU configuration. In order to prevent battery discharge the unit shuts itself off after 4.5 minutes. Battery condition is checked hourly. The charging circuit is also temperature regulated to prevent over heating or over charging the batteries.

Fail Open Or Close Configuration Fail Open or Fail Close is determined by the wiring of the M and N terminal block to the Servo Pro mounted inside the S70 Actuator.

Fail Close Wire terminal M on the terminal block to the Close terminal block on the Servo Pro's Control Box Input. Refer to Figure 1 for wiring details.

Fail Open Wire terminal M on the terminal block to the Open terminal block on the Servo Pro's Control Box Input. Refer to Figure 2 for wiring details.

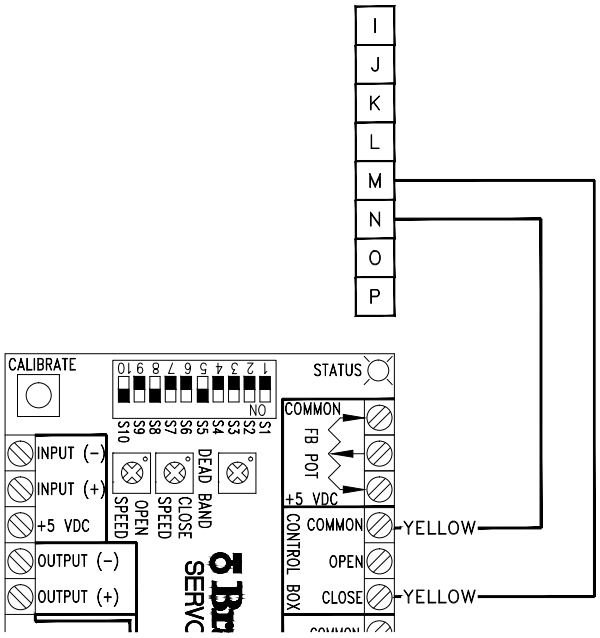


Figure 1

On/Off Configuration for Fail Open or Close Battery Backup Unit (BBU)

Operation

If the external power fails, the actuator will switch to battery power, send a signal to the Servo Pro and drive the actuator to its fail-open or fail-close position. The BBU has a 4.5 minute fail safe feature during which time if the actuator does not reach its end of travel, the BBU will shutdown until external power is reapplied. Once external power is reapplied, there is a 10 second time delay before the actuator goes to the position dictated by the control signal. Every time external power is reestablished, the 4.5 minute timer is reset.

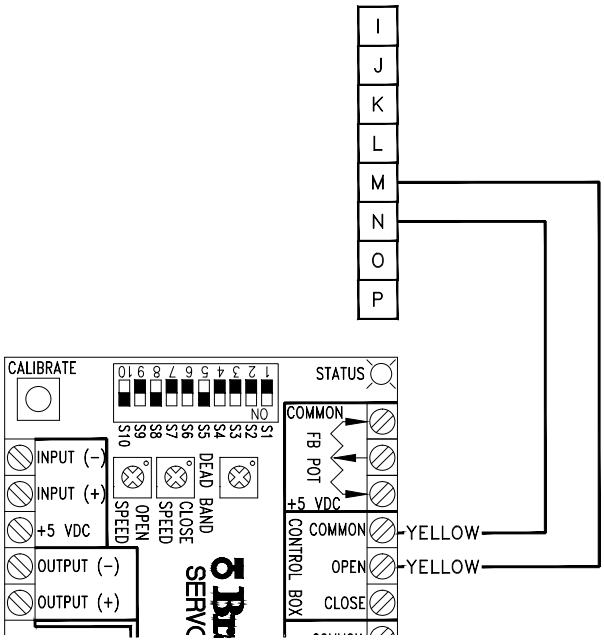


Figure 2

Affects On S70 Design

The BBU in no way modifies the basic operation of the Servo Pro. Under normal operations it simply passes power to operate the actuator and charge the batteries. In the event of power failure the BBU switches to the battery and supplies power to the Servo and fails open or close depending on the BBU configuration. In order to prevent battery discharge the unit shuts itself off after 4.5 minutes. Battery condition is checked hourly. The charging circuit is also temperature regulated to prevent over heating or over charging the batteries.

Fail Open Or Close Configuration

Fail Open or Fail Close is determined by the jumper pin position on the BBU board labeled J1. Refer to Figure 3 for proper orientation.

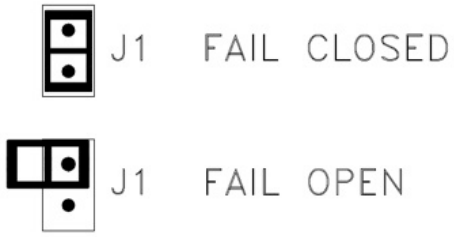
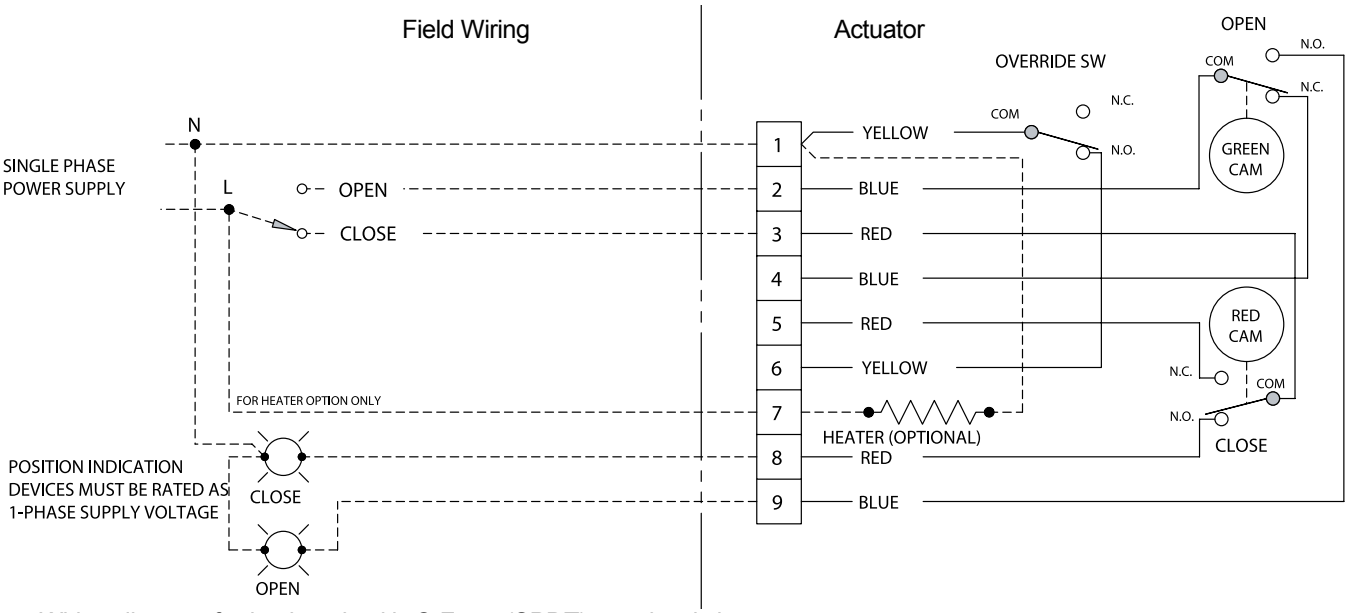
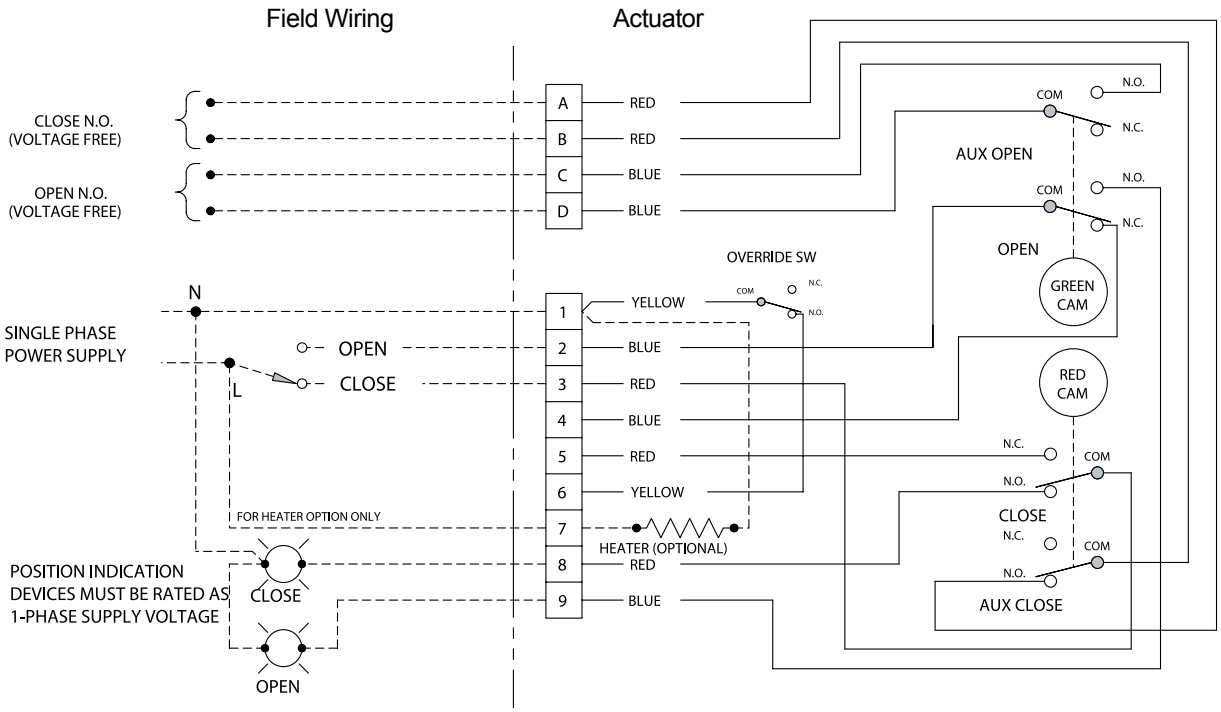


Figure 3

Configuration	Size 6	Size 12 & 30	Size 180
1. ON/OFF (Intermittent Duty Motor) with Main Switches (Standard OPEN and CLOSE switches)	2 Switch 2 Cams Standard Assembly P/N	2 Switch 2 Cams Standard Assembly P/N	N/A
2. ON/OFF (Continuous Duty Motor) with Main Switches (Standard OPEN and CLOSE Switches	2 Switch 2 Cams & Pot Gear Standard Assembly P/N	2 Switch 2 Cams & Pot Gear Standard Assembly P/N	N/A
3. ON/OFF (Intermittent Duty Motor) with Main and 1 set of Auxiliary Switches	4 Switch 2 Cams Kit PN/ 70-0006-22980-536	4 Switch 2 Cams Kit PN/ 70-0012-22960-536	N/A
4. ON/OFF (Continuous Duty Motor) with Main and 1 set of Auxiliary Switches	4 Switch 2 Cams & Pot Gear Kit P/N 70-006-22983-536	4 Switch 2 Cams & Pot Gear Kit P/N 70-0012-22960-536	4 Switch 2 Cams & Pot Gear Standard Assembly P/N
5. ON/OFF with Main, 1 set of Auxiliary, and 1 Adjustable Auxiliary Switches	5 Switch 3 Cams Kit P/N 70-0006-22983-536	6 Switch 3 Cams Kit P/N 70-0012-22964-536	N/A
6. ON/OFF with Main, 1 set of Auxiliary, and 1 set of Adjustable Auxiliary Switches	6 Switch 3 Cams Kit P/N 70-006-22984-536	6 Switch 3 Cams Kit P/N 70-0012-22964-536	N/A
7. ON/OFF with Main, 1 set of Auxiliary, and 2 adjustable Auxiliary Switches	N/A	6 Switch 4 Cams Kit P/N 70-0012-22961-536	6 Switch 4 Cams & Pot Gear
8. ON/OFF with Main, 1 set of Auxiliary, and 2 sets of adjustable Auxiliary Switches	N/A	8 Switch 4 Cams Kit P/N 70-0012-22962-536	N/A
9. Servo with Main, 1 set of Auxiliary, and 1 adjustable Auxiliary Switches	N/A	5 Switch 3 Cams & 1 Pot Gear Kit P/N 70-0012-22966-536	N/A
10. Servo with Main, 1 set of Auxiliary, and 2 Adjustable Auxiliary Switches	N/A	N/A	6 Switch 4 Cams & Pot Gear
11. ON/OFF with Main and 1 Adjustable Auxiliary Switch	3 Switches 3 Cams Kit P/N 70-0006-22988-536	3 Switch 3 Cams Kit P/N 70-0012-22968-536	3 Switch 3 Cams
12. Servo with Main and 1 Adjustable Auxiliary Switch	N/A	3 Switch 3 Cams & 1 Pot Gear Kit P/N 70-0012-22971-536	3 Switch 3 Cams 1 Pot Gear



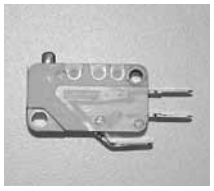
Wiring diagram for basic unit with C-Form (SPDT) travel switches.
(Drawn for actuator in its fully closed condition.)



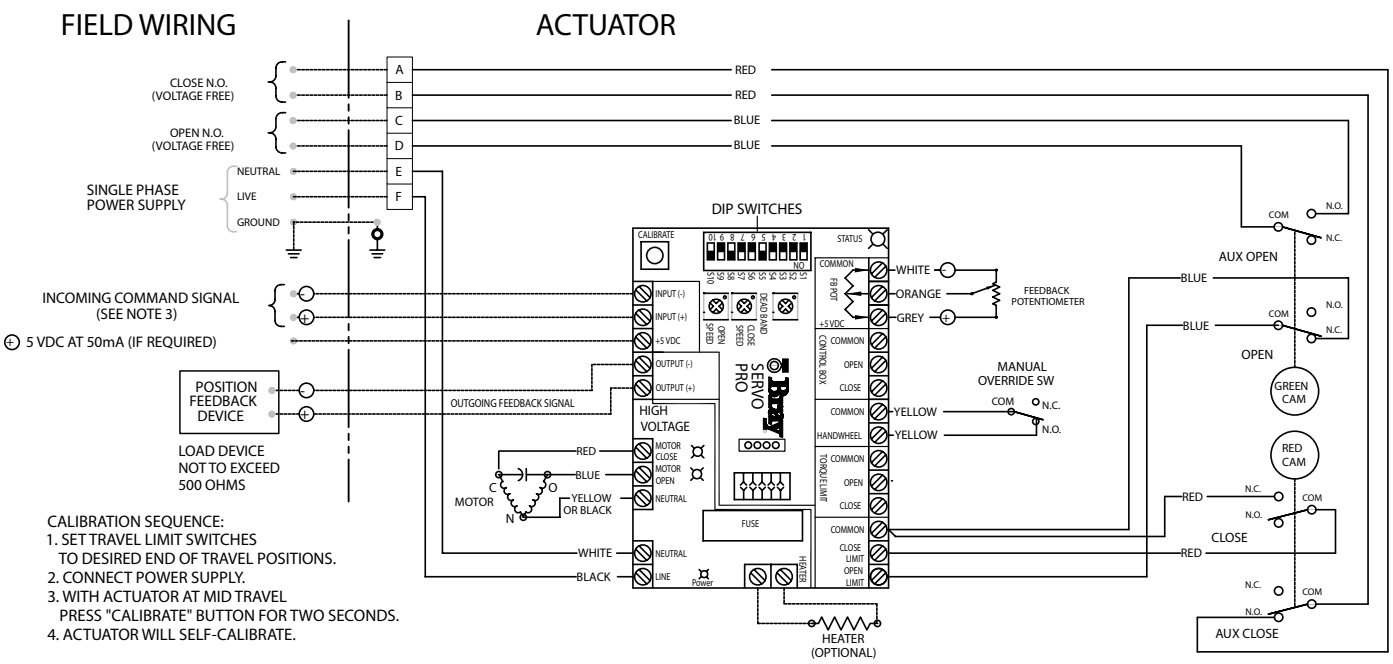
Wiring diagram for unit with one set of “Voltage Free” C-Form (SPDT) open/close travel switches.
(Drawn for actuator in its fully closed condition.)

Actuator ‘C’-Form Switches, SPDT

Size-6
V3-Sw



Size-12 & 30
V3-Sw with
Lever



WARNING: TURN ALL POWER OFF PRIOR TO ADJUSTING DIP SWITCHES.

SWITCH	COMMAND INPUT			
	4-20 mA DC	**0-5 VDC ***	**0-10 VDC**	**2-10 VDC**
1	Off	On	On	On
2	Off	Off	On	On
3	Off	Off	Off	On
	OUTPUT			
	4-20 mA DC	**0-5 VDC**	**0-10 VDC**	**2-10 VDC**
4	Off	On	On	N/A
5	On	Off	Off	N/A
6	Off	On	Off	N/A
	FORWARD ACTING	**REVERSE ACTING**		
7	Off	On		
	FAIL IN LAST POSITION	**FAIL ENABLE ****		
8	Off	On		
	FAIL CLOSE	**FAIL OPEN**		
9	Off	On		
	TORQUE SWITCH ENABLE	**TORQUE SWITCH DISABLE**		
10	Off	On		

*To control servo with a remote potentiometer, set the Command Input to 0-5VDC (see Command Signal Connector section; page 8 Servo Pro Manual).

**Fail position is the position that the servo will travel to when the control signal is removed. It does not apply to 0-5VDC or 0-10VDC Command Signals.

I. Adjust the open and close speed of your actuator (The fastest closing speed of your actuator is printed on the label of the unit):

1. Use the Close Speed trim pot to adjust the closing speed of your actuator (pot in the fully CCW position equals fastest close speed).
2. Use the Open Speed trim pot to adjust the opening speed of your actuator (pot in the fully CCW position equals fastest open speed).

II. Calibrate the Servo:

1. Manually position your actuator somewhere in mid position; away from the travel limits.
2. Disengage your handwheel (push it back in towards the actuator), hold down the Calibration push button for two seconds and release, the servo will begin to drive the actuator in the close direction and then in the open direction in order to save these limits to memory.
3. Following a successful calibration the servo's Status LED will begin to flash the normal operation code, an unsuccessful calibration will yield a Red-Green-Red-Green flash immediately following the attempted calibration (for more information on the Status LED flash codes see the Status LED Flash Code Table).

Status LED

The "Status LED" is a bi-color LED which provides detailed information regarding the operation of the S70 Servo Pro. Table 2 below illustrates the different combinations of LED flash codes and their corresponding conditions. Following the table is a more descriptive explanation of the Flash Code. Whenever the LED is flashing green, regardless of the flash code, the servo will operate, but not necessarily optimally. Whenever the LED flash codes are RED, the servo will not operate. An example is an engaged handwheel, the Status LED will flash a single red flash code and will not operate.

Table 2: Status LED flash codes

Green Status LED warning and information Flash Codes:

#	Indication	Reason	Solution
1	Steady Green Flash	Normal Operation	Servo Functioning Ok
2	2 Green Flashes	Calibration Defaults Loaded	Adjust travel limits, push autocalibration PB
3	3 Green Flashes	Reverse Acting Mode	If you would like your servo to not operate in reverse acting mode, set DIP switch 7 accordingly
4	4 Green Flashes	2-10VDC Input Command Signal Selected	If you require a different configuration, set DIP switches 1, 2, and 3 accordingly
5	1 Red Flashes	Handwheel engaged	Push the Handwheel in towards the actuator
6	2 Red Flashes	Command Signal Failure	Set DIP switches accordingly, send servo appropriate signal
7	3 Red Flashes	Feedback Pot Fault	Position the feedback Pot correctly, see Feedback Pot calibration
8	4 Red Flashes	Limit Switch Fault	Check wiring of limit switches, ensure that both switches are not tripped simultaneously
9	5 Red Flashes	Torque Switch Fault	Ensure that DIP switch 10 is positioned correct, check wiring of torque switches, reverse direction of actuator, correct over torque condition
10	6 Red Flashes	Feedback Pot Wired In Reverse	Correctly wire the Feedback Pot

Note: *A flashing green LED provides status and warning information. The servo will operate normally in this state. Some flash codes indicate a warning, where the servo has recovered automatically such as the detection of an invalid calibration. In this case, a default calibration is automatically loaded that will allow the Servo to operate, but may not be a perfect match to the actuator. The servo should be re-calibrated as soon as possible.*

Receptacles (Quick Connectors)

Unless otherwise specified, power receptacles will be 5-pin mini style standard duty with a black anodized aluminum finish. They conform to ANSI B93.55M except in wire color. Euro receptacles will be used for low power instrument and signal cable since they can be supplied shielded. Wiring diagrams for plug-in receptacles for either the **Bray** Series 70 or the local control station will be provided as a separate diagram. Units ordered with pin connector receptacles factory installed are wired and tested. Cordsets which fit these receptacles may be ordered in several lengths.

Receptacle Kit consists of:

1. Receptacle(s), male pin and male thread $^1/_2$"-NPT, in the qty., style and number of pins ordered
2. Reducing bushing $^3/_4$" to $^1/_2$" NPT for installation in size 12 - 180 and control stations
3. Wiring diagram (SK-# below)

Tools required:

- For terminal wiring Screwdriver, $^3/_{16}$" tip flat blade
- For Mini or Euro receptacle Wrench, 1"

Installation procedure:

1. Screw the receptacle into the actuator conduit entry using teflon tape or similar.
2. Wire to the terminal strip according to the wiring diagram or the field wiring requirements.

Wiring schematic for optional Pin Connector Receptacles

REQUIREMENTS				RECEPTACLES REQ'D		NO L.C.S.[1] DIAGRAM	WITH L.C.S.[1] DIAGRAM
ON - OFF UNITS (intermittent or continuous)							
Power	———			one mini		SK-960517	SK-960515
Power	———	Position indication[2]		one mini	one euro	SK-960717	SK-960513
Power	———	Position indication[3]		one mini	one euro	SK-960516	SK-960716[5]
Power	———		Feedback potentiometer	one mini	one euro	SK-960718	SK-960720
Power	———	Position indication[3]	Feedback potentiometer	one mini	6-pin euro[4]	SK-960719	n/a

Custom configurations are possible - consult the factory.

[1] L.C.S.: Local Control Station , WHICH implies mounted to the actuator

[2] Travel indication is wired to the supply voltage

[3] Travel indication wiring is voltage free

[4] A 6-pin EURO connector is required for this application, consult factory for price and availability.

[5] The Local Control Station comes standard with 120 Volt lamp bulbs, for other voltages consult factory.

Note: *the Control Station lights must be wired to the same voltage as the remote end of travel indication.*

Euro receptacles use 22 AWG wire rated at 250V, 4 Amp. Pin configuration interfaces with European standards.

Mini receptacles use 18 AWG wire rated at 300 V, 9 Amp. Pin configuration conforms to ANSI B93.55M.

*** For requirements beyond these ratings consult the factory.**

Spinner

A spinner is available to ease and speed the manual override of the **Bray** Series 70 actuator. The 300 and 500 in.lb. units mount the spinner on a lever which screws onto the back of the handwheel. The 800 through 18000 in.lb. units mount the spinner on the rim of the handwheel. Note that care should be exercised in the use of spinner equipped handwheels. Rapid operation of the handwheel to close the valve may cause water hammer. Also, rapid travel into a travel stop may cause damage.

Spinner Kit consists of:

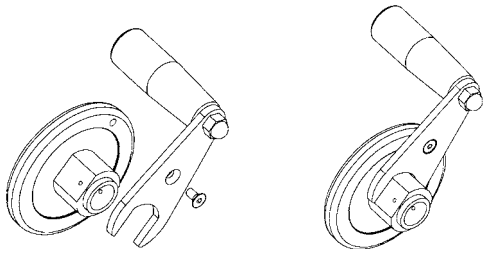
For 300 and 500 in.lb.	**For 800 to 18000 in.lb. units**
Spinner and lever assembly	Socket head shoulder bolt,
Flat head socket cap screw,	1/4-20UNC x .75
#10-32UNF x 3/8	Spinner handle

Tools required:

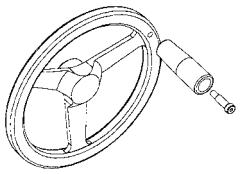
- For socket head shoulder bolt and flat head capscrew
- Hex key, $^{1}/_{8}$" for 300 and 500 in.lb.
- Hex key, $^{3}/_{16}$" for 800 to 18000 in.lb.

Installation procedure:

- For 300 and 500 in.lb. units simply position the lever onto the back of the handwheel then screw the flat head cap screw in to place from behind.



- For 800 up to 18000 in.lb. units, put the socket head shoulder bolt through the spinner handle and screw it firmly into the handwheel rim.



Local Control Station (Single Phase Powered Actuators)

Bray's local control station gives the user the ability to locally override the actuator electrically. The station is open / stop / close operation in the local control mode. Red and green end of travel indication lights are also provided. Depending on how it is wired the control stationcan be used on the on - off units and the servo controlled modulating units. Optional key operated locking switches are available.

Note: *The control station used with On - Off S70 and that used with modulating S70 have different contact blocks internally, the correct part number must be used to ensure you order the correct unit (see price sheet).*

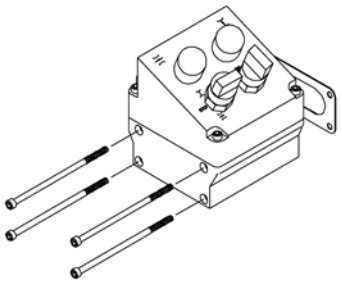
Local Control Station Kit consists of:

1. Local control station assembly
2. Four socket head cap screws, #10-24UNC x 4.50 long, for mounting the station to the actuator
3. A gasket for sealing the station to the actuator
4. Wiring diagram

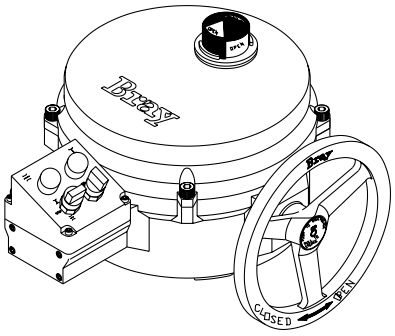
Tools required:

- For tapping control station mounting holes on actuator, #10-24UNC Tap.
- For wiring Screwdriver, $^{3}/_{16}$" flat blade.
- For mounting and cover screws Hex key, $^{5}/_{32}$"

Installation procedure:



1. Tap #10-24UNC holes using the cored holes on the side of actuator.
2. Adhere the gasket to the control box.
3. Mount the control box to the actuator using the 4 long socket head capscrews.
4. Wire the control box to the actuator in accordance to the wiring diagram provided. The local control station contains no terminal strips, and all wiring is direct to the switches and lights via 2" x $^{3}/_{4}$" NPT holes in bottom of housing. Ordering the control station with optional pin connector receptacles will eliminate the necessity of field wiring. The units will be completely factory wired and tested.



Note: *The inclined cover of the local control station can be mounted in any of its four symmetrical positions. If field wiring is required , first mount the base to the actuator, then remove the cover to gain access for wiring.*

**Local Control Station requires a dedicated set of auxiliary switches for contral station use only*

APPENDIX A

BASIC TOOLS

COMMON TO ALL UNITS

Terminal connections, cam adjustment	Screwdriver, 1/4" tip flat tip blade
All switches, terminal strip, torque switch plate	Screwdriver, No.1 phillips
Switchplate screws, capacitor	Screwdriver, No.2 phillips
Servo trimmer pots	Screwdriver, 1/8" flat tip for trim pots

300-500 IN•LB UNITS

Mounting nuts	Wrench, $^{1}/_{2}$"
Cover captivated capscrews	Hex key, $^{1}/_{4}$"
Travel stop adjusting bolts	Wrench, $^{7}/_{16}$"
Travel stop jam nuts	Wrench, $^{7}/_{16}$"
Motor mount socket flat head capscrew	Hex key, $^{3}/_{32}$"
Motor mount socket head capscrew	Hex key, $^{9}/_{64}$"

800-1200 IN•LB UNITS

Mounting nuts (small pattern)	Wrench, $^{1}/_{2}$"
Mounting nuts (large pattern)	Wrench, $^{3}/_{4}$"
Cover captivated capscrews	Hex key, $^{5}/_{16}$"
Travel stop adjusting bolts	Wrench, $^{9}/_{16}$"
Travel stop nuts	Wrench, $^{9}/_{16}$"
Motor mount socket head capscrew	Hex key, $^{5}/_{32}$"

3000-6500 IN•LB UNITS

Mounting nuts, travel stop jam nuts	Wrench, $^{3}/_{4}$"
Cover captivated capscrews	Hex key, $^{3}/_{8}$"
Travel stop adjusting studs	Wrench, $^{3}/_{4}$"
Motor mount socket head shoulder bolt	Hex key, $^{5}/_{32}$"
Motor mount socket head cap screws	Hex key, $^{3}/_{16}$"

13000-18000 IN•LB UNITS

Mounting nuts, travel stop jam nuts	Wrench, $^{3}/_{4}$"
Cover captivated capscrews	Hex key, $^{3}/_{8}$"
Travel stop adjusting studs	Wrench, $^{15}/_{16}$"
Motor mount socket head shoulder bolt	Hex key, $^{5}/_{32}$"
Motor mount socket head cap screws	Hex key, $^{3}/_{16}$"

Appendix B

Actuator Troubleshooting Chart

Problem	Possible cause	Solutions
Actuator does not operate	Override is engaged	Push handwheel in all the way
	Wiring is incorrect	Check wiring and power supply
	Actuator motor 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 (or open valve)	Limit switches are depressed	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 activating	Valve torque exceeds actuator torque rating - consult factory
	Voltage power supply is low	Check power source.
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
Disengaging override hand-wheel does not restart motor	Not completely disengaged	Push handwheel in as far as possible (no yellow showing)
	Override pin is damaged or and does not activate switch	Replace override pin
	Incorrect wiring of override switch	Check wiring
Motor runs but worm and gear segment do not	Worm gear segment is not meshing with worm	Remove switchplate and inspect, adjust travel stops to prevent gear disengaging
	Pin/Key on Worm/Motor drive gear sheared	Replace Pin/Key on drive gear
Corrosion inside unit	Condensation forming	Test heater wiring, should have constant power
	Water leaking in	Check all seals and possible water entry through conduit

S70 Servo Pro troubleshooting chart

Refer to the Servo Pro Operation Manual for more information.

Problem	Possible cause	Solutions
Actuator moves back and forth near setpoint (hunts)	Signal is fluctuating beyond deadband setting	Increase the deadband using the Deadband trim pot.
	Signal has interference	Shield signal from interference
Actuator does not travel fully open or fully closed	Travel limit switches are not set correctly	Set travel limit switches for 90° operation
	Servo DIP switches are not set correctly	See Quick Setup Instructions on page 5
	Mechanical travel stops are not set correctly	Set mechanical travel stops for 90° operation
Actuator motor does not run and green servo power light is off	Power is disconnected	Connect power
Actuator motor does not run and green servo power light is on	Limit switches or torque switches are triggered	Ensure that there is continuity between the two wires going to each switch
	Handwheel is engaged	Push handwheel in (disengage)
	Servo is not wired correctly	Check servo wiring to all points
	Motor has thermally tripped	Allow motor to cool down
Actuator does not properly respond to command signal	Potentiometer gear is not engaged	Engage and adjust pot. gear
	Command signal DIP switch selection is not correct	Set the DIP switches correctly
	Command signal polarity is incorrect	Wire the command signal correctly
Actuator runs in one direction only	Wiring is incorrect	Correct Wiring
	Potentiometer wired backwards	Reverse white and gray wires, see wiring diagram inside cover
	Limit switch or torque switch is triggered	Ensure that there is continuity between the wires coming from the switches. If your actuator has reached its travel limit, reverse direction. If one of your torque switches has tripped, reverse the actuator direction and correct the over torque condition.
	Command signal DIP switch selection is not correct	Set the DIP switches correctly

APPENDIX C

SERIES 70
SIZE: 003 - 005

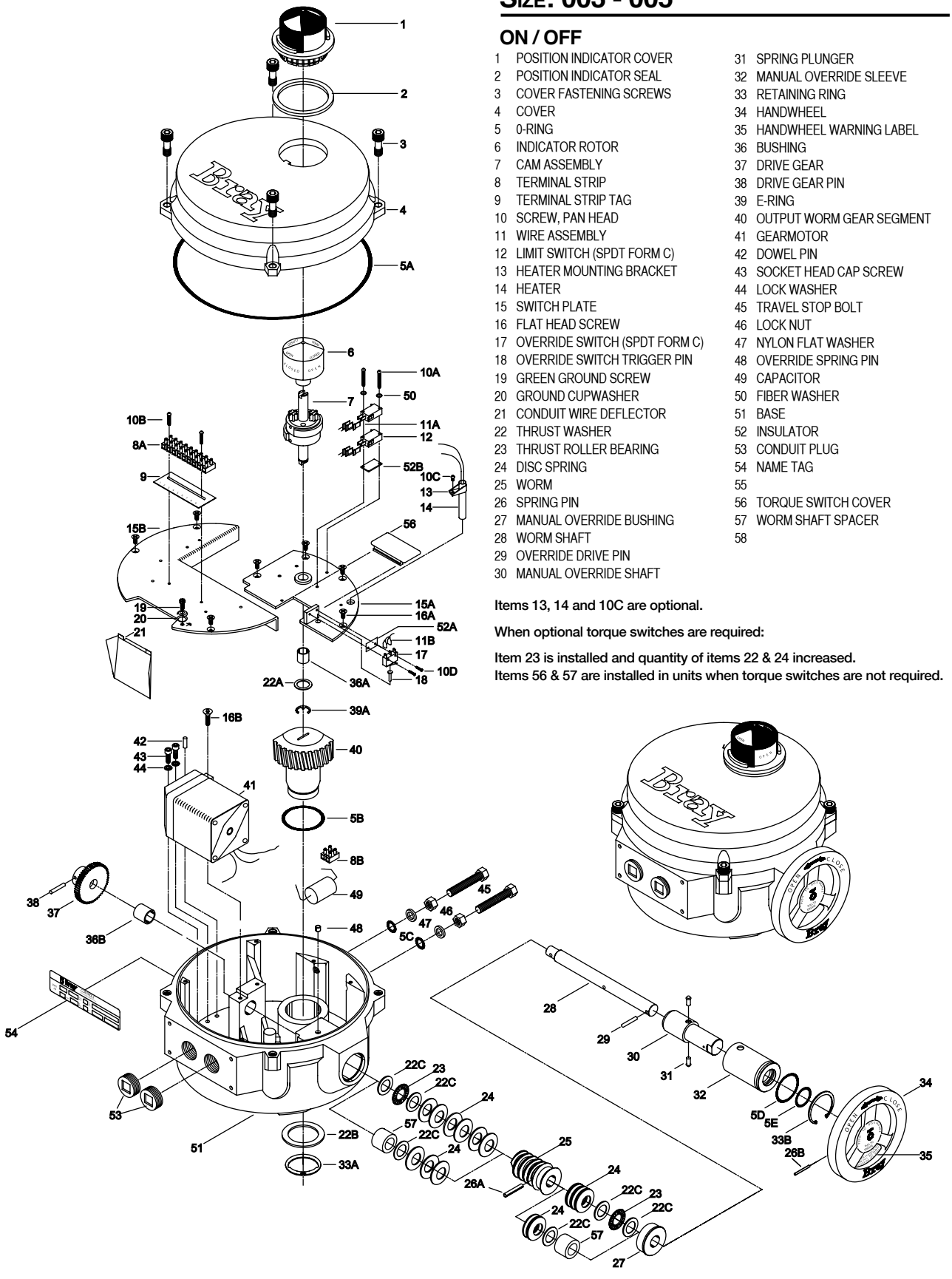
ON / OFF

1 POSITION INDICATOR COVER
2 POSITION INDICATOR SEAL
3 COVER FASTENING SCREWS
4 COVER
5 0-RING
6 INDICATOR ROTOR
7 CAM ASSEMBLY
8 TERMINAL STRIP
9 TERMINAL STRIP TAG
10 SCREW, PAN HEAD
11 WIRE ASSEMBLY
12 LIMIT SWITCH (SPDT FORM C)
13 HEATER MOUNTING BRACKET
14 HEATER
15 SWITCH PLATE
16 FLAT HEAD SCREW
17 OVERRIDE SWITCH (SPDT FORM C)
18 OVERRIDE SWITCH TRIGGER PIN
19 GREEN GROUND SCREW
20 GROUND CUPWASHER
21 CONDUIT WIRE DEFLECTOR
22 THRUST WASHER
23 THRUST ROLLER BEARING
24 DISC SPRING
25 WORM
26 SPRING PIN
27 MANUAL OVERRIDE BUSHING
28 WORM SHAFT
29 OVERRIDE DRIVE PIN
30 MANUAL OVERRIDE SHAFT
31 SPRING PLUNGER
32 MANUAL OVERRIDE SLEEVE
33 RETAINING RING
34 HANDWHEEL
35 HANDWHEEL WARNING LABEL
36 BUSHING
37 DRIVE GEAR
38 DRIVE GEAR PIN
39 E-RING
40 OUTPUT WORM GEAR SEGMENT
41 GEARMOTOR
42 DOWEL PIN
43 SOCKET HEAD CAP SCREW
44 LOCK WASHER
45 TRAVEL STOP BOLT
46 LOCK NUT
47 NYLON FLAT WASHER
48 OVERRIDE SPRING PIN
49 CAPACITOR
50 FIBER WASHER
51 BASE
52 INSULATOR
53 CONDUIT PLUG
54 NAME TAG
55
56 TORQUE SWITCH COVER
57 WORM SHAFT SPACER
58

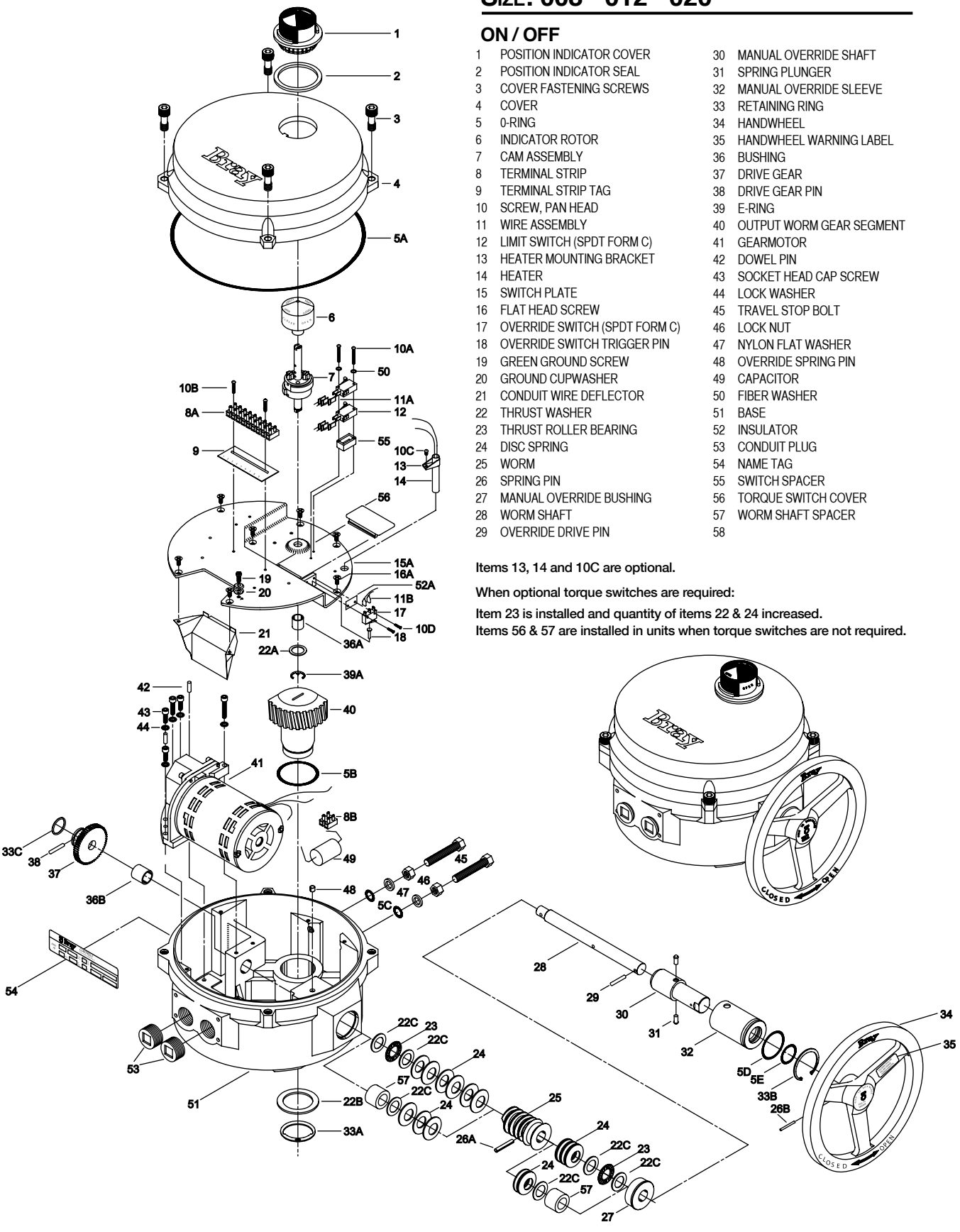
Items 13, 14 and 10C are optional.

When optional torque switches are required:

Item 23 is installed and quantity of items 22 & 24 increased.
Items 56 & 57 are installed in units when torque switches are not required.



SERIES 70
SIZE: 008 - 012 - 020



ON / OFF

1	POSITION INDICATOR COVER	30	MANUAL OVERRIDE SHAFT
2	POSITION INDICATOR SEAL	31	SPRING PLUNGER
3	COVER FASTENING SCREWS	32	MANUAL OVERRIDE SLEEVE
4	COVER	33	RETAINING RING
5	0-RING	34	HANDWHEEL
6	INDICATOR ROTOR	35	HANDWHEEL WARNING LABEL
7	CAM ASSEMBLY	36	BUSHING
8	TERMINAL STRIP	37	DRIVE GEAR
9	TERMINAL STRIP TAG	38	DRIVE GEAR PIN
10	SCREW, PAN HEAD	39	E-RING
11	WIRE ASSEMBLY	40	OUTPUT WORM GEAR SEGMENT
12	LIMIT SWITCH (SPDT FORM C)	41	GEARMOTOR
13	HEATER MOUNTING BRACKET	42	DOWEL PIN
14	HEATER	43	SOCKET HEAD CAP SCREW
15	SWITCH PLATE	44	LOCK WASHER
16	FLAT HEAD SCREW	45	TRAVEL STOP BOLT
17	OVERRIDE SWITCH (SPDT FORM C)	46	LOCK NUT
18	OVERRIDE SWITCH TRIGGER PIN	47	NYLON FLAT WASHER
19	GREEN GROUND SCREW	48	OVERRIDE SPRING PIN
20	GROUND CUPWASHER	49	CAPACITOR
21	CONDUIT WIRE DEFLECTOR	50	FIBER WASHER
22	THRUST WASHER	51	BASE
23	THRUST ROLLER BEARING	52	INSULATOR
24	DISC SPRING	53	CONDUIT PLUG
25	WORM	54	NAME TAG
26	SPRING PIN	55	SWITCH SPACER
27	MANUAL OVERRIDE BUSHING	56	TORQUE SWITCH COVER
28	WORM SHAFT	57	WORM SHAFT SPACER
29	OVERRIDE DRIVE PIN	58	

Items 13, 14 and 10C are optional.

When optional torque switches are required:

Item 23 is installed and quantity of items 22 & 24 increased.
Items 56 & 57 are installed in units when torque switches are not required.

SERIES 70
SIZE: 030 - 050 - 065

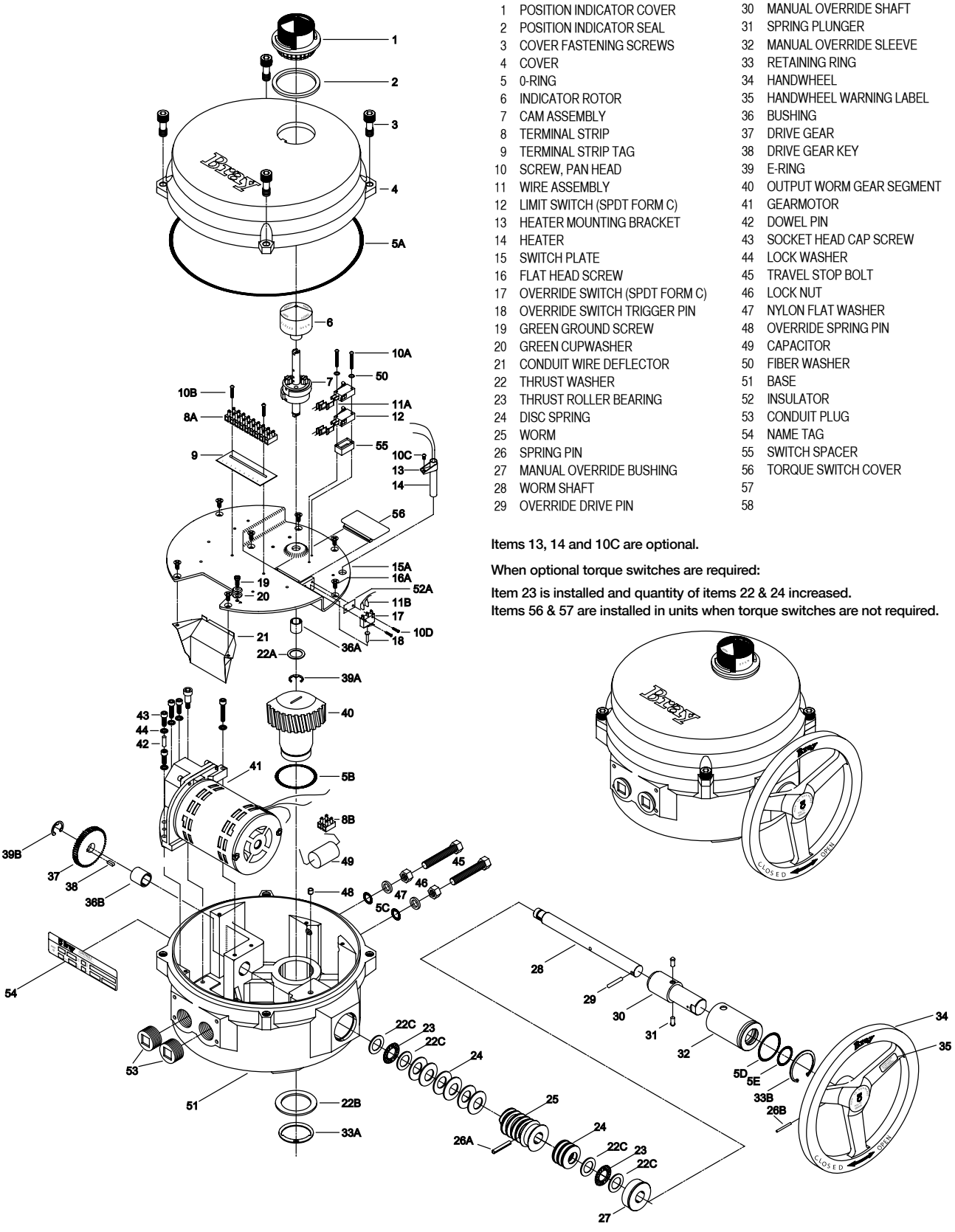
ON / OFF

1	POSITION INDICATOR COVER	30	MANUAL OVERRIDE SHAFT
2	POSITION INDICATOR SEAL	31	SPRING PLUNGER
3	COVER FASTENING SCREWS	32	MANUAL OVERRIDE SLEEVE
4	COVER	33	RETAINING RING
5	0-RING	34	HANDWHEEL
6	INDICATOR ROTOR	35	HANDWHEEL WARNING LABEL
7	CAM ASSEMBLY	36	BUSHING
8	TERMINAL STRIP	37	DRIVE GEAR
9	TERMINAL STRIP TAG	38	DRIVE GEAR KEY
10	SCREW, PAN HEAD	39	E-RING
11	WIRE ASSEMBLY	40	OUTPUT WORM GEAR SEGMENT
12	LIMIT SWITCH (SPDT FORM C)	41	GEARMOTOR
13	HEATER MOUNTING BRACKET	42	DOWEL PIN
14	HEATER	43	SOCKET HEAD CAP SCREW
15	SWITCH PLATE	44	LOCK WASHER
16	FLAT HEAD SCREW	45	TRAVEL STOP BOLT
17	OVERRIDE SWITCH (SPDT FORM C)	46	LOCK NUT
18	OVERRIDE SWITCH TRIGGER PIN	47	NYLON FLAT WASHER
19	GREEN GROUND SCREW	48	OVERRIDE SPRING PIN
20	GREEN CUPWASHER	49	CAPACITOR
21	CONDUIT WIRE DEFLECTOR	50	FIBER WASHER
22	THRUST WASHER	51	BASE
23	THRUST ROLLER BEARING	52	INSULATOR
24	DISC SPRING	53	CONDUIT PLUG
25	WORM	54	NAME TAG
26	SPRING PIN	55	SWITCH SPACER
27	MANUAL OVERRIDE BUSHING	56	TORQUE SWITCH COVER
28	WORM SHAFT	57	
29	OVERRIDE DRIVE PIN	58	

Items 13, 14 and 10C are optional.

When optional torque switches are required:

Item 23 is installed and quantity of items 22 & 24 increased.
Items 56 & 57 are installed in units when torque switches are not required.

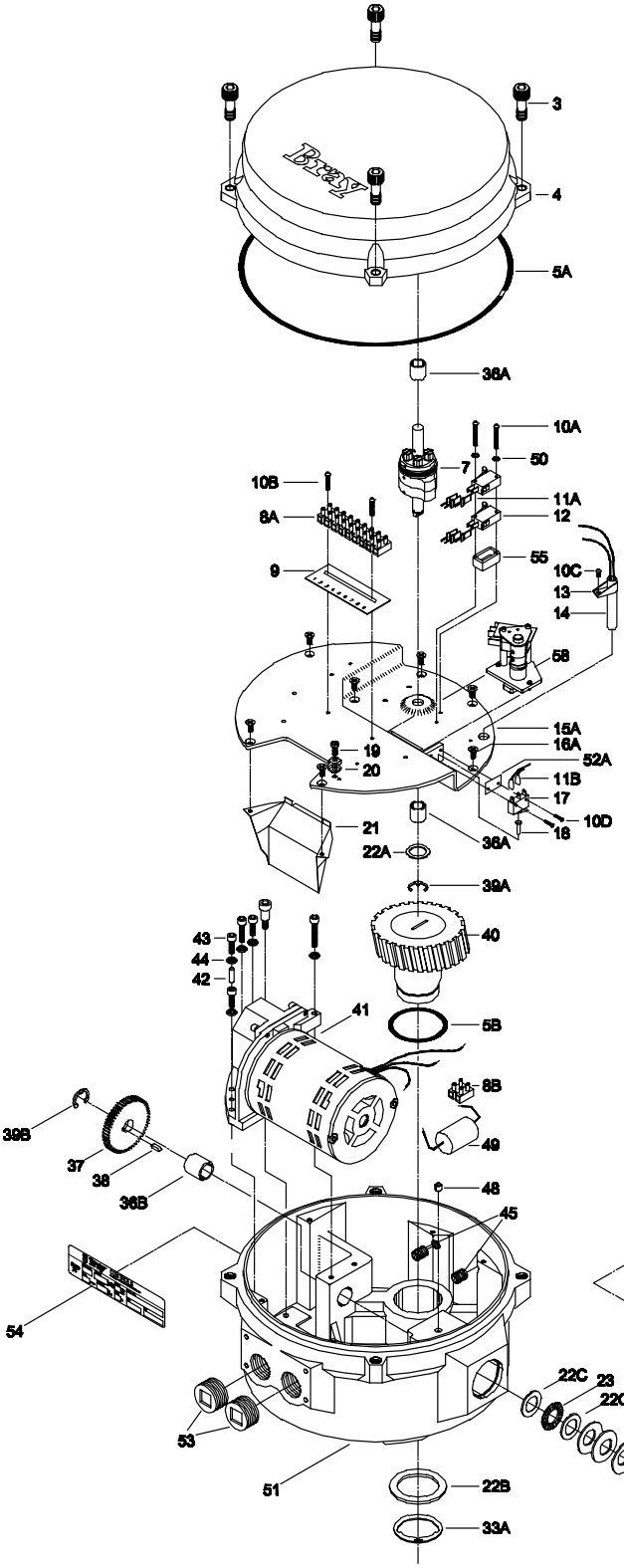


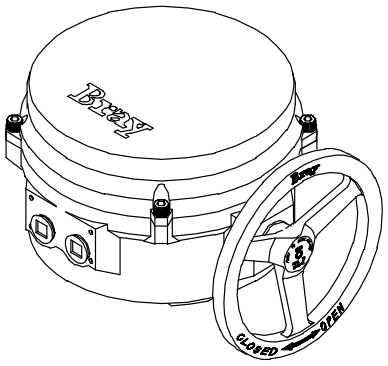
SERIES 70
SIZE: 130-180 FOR 3:1 GEAR BOX

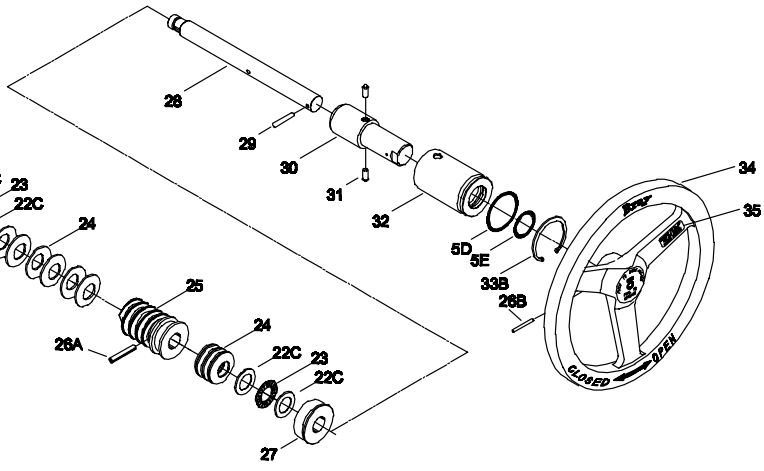
ON / OFF

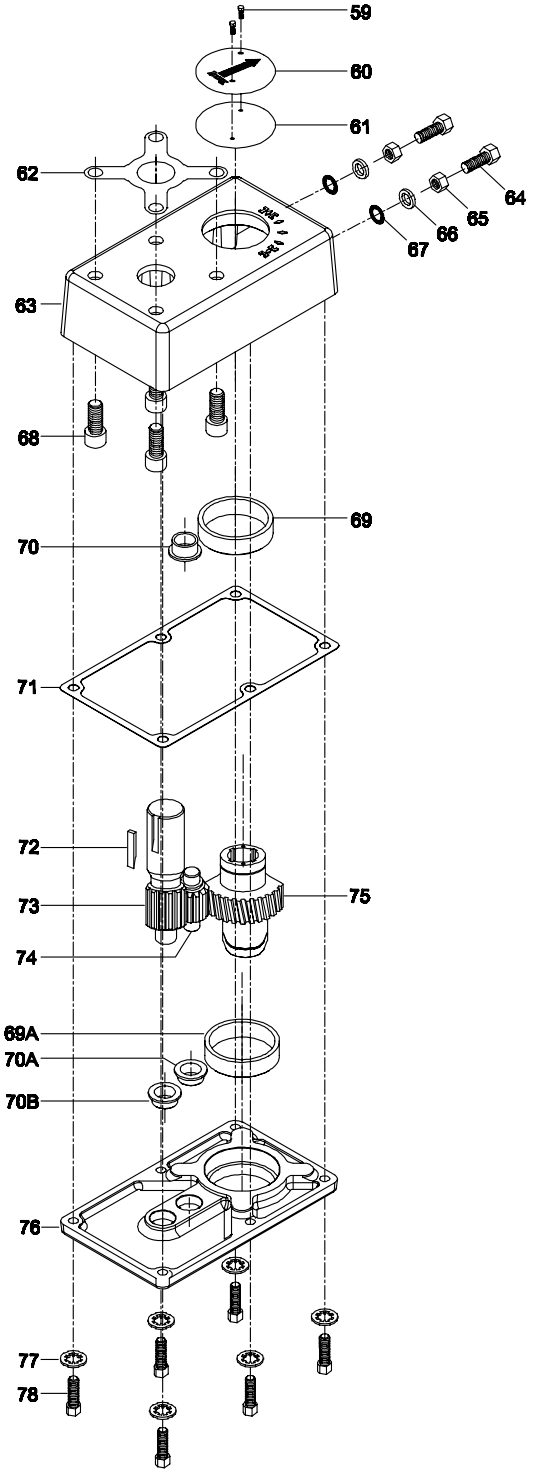
1	
2	
3	COVER FASTENING SCREWS
4	COVER
5	0-RING
6	
7	CAM ASSEMBLY
8	TERMINAL STRIP
9	TERMINAL STRIP TAG
10	SCREW, PAN HEAD
11	WIRE ASSEMBLY
12	LIMIT SWITCH (SPDT FORM C)
13	HEATER MOUNTING BRACKET
14	HEATER
15	SWITCH PLATE
16	FLAT HEAD SCREW
17	OVERRIDE SWITCH (SPDT FORM C)
18	OVERRIDE SWITCH TRIGGER PIN
19	GREEN GROUND SCREW
20	GREEN CUPWASHER
21	CONDUIT WIRE DEFLECTOR
22	THRUST WASHER
23	THRUST ROLLER BEARING
24	DISC SPRING
25	WORM
26	SPRING PIN
27	MANUAL OVERRIDE BUSHING
28	WORM SHAFT
29	OVERRIDE DRIVE PIN
30	MANUAL OVERRIDE SHAFT
31	SPRING PLUNGER
32	MANUAL OVERRIDE SLEEVE
33	RETAINING RING
34	HANDWHEEL
35	HANDWHEEL WARNING LABEL
36	BUSHING
37	DRIVE GEAR
38	DRIVE GEAR KEY
39	E-RING
40	OUTPUT WORM GEAR SEGMENT
41	GEARMOTOR
42	DOWEL PIN
43	SOCKET HEAD CAP SCREW
44	LOCK WASHER
45	TRAVEL STOP BOLT
46	
47	
48	OVERRIDE SPRING PIN
49	CAPACITOR
50	FIBER WASHER
51	BASE
52	INSULATOR
53	CONDUIT PLUG
54	NAME TAG
55	SWITCH SPACER
56	
57	
58	TORQUE SWITCH ASSEMBLY

Items 13, 14 and 10C are optional.





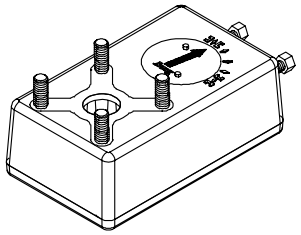




SERIES 70
3:1 GEAR BOX

ON / OFF

59 INDICATOR FASTENING SCREW
60 POSITION INDICATOR PLATE
61 POSITION INDICATOR GASKET
62 ACTUATOR/GEAR BOX GASKET
63 COVER
64 TRAVEL STOP BOLT
65 LOCK NUT
66 NYLON FLAT WASHER
67 O-RING
68 ACTUATOR/GEAR BOX FASTENING SCREW
69 OUTPUT GEAR BEARING
70 IDLER/INPUT GEAR BEARING
71 COVER GASKET
72 INPUT GEAR KEY
73 INPUT GEAR
74 IDLER GEAR
75 OUTPUT GEAR
76 BASE
77 LOCK WASHER
78 BASE FASTENING SCREW






Bray CONTROLS

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