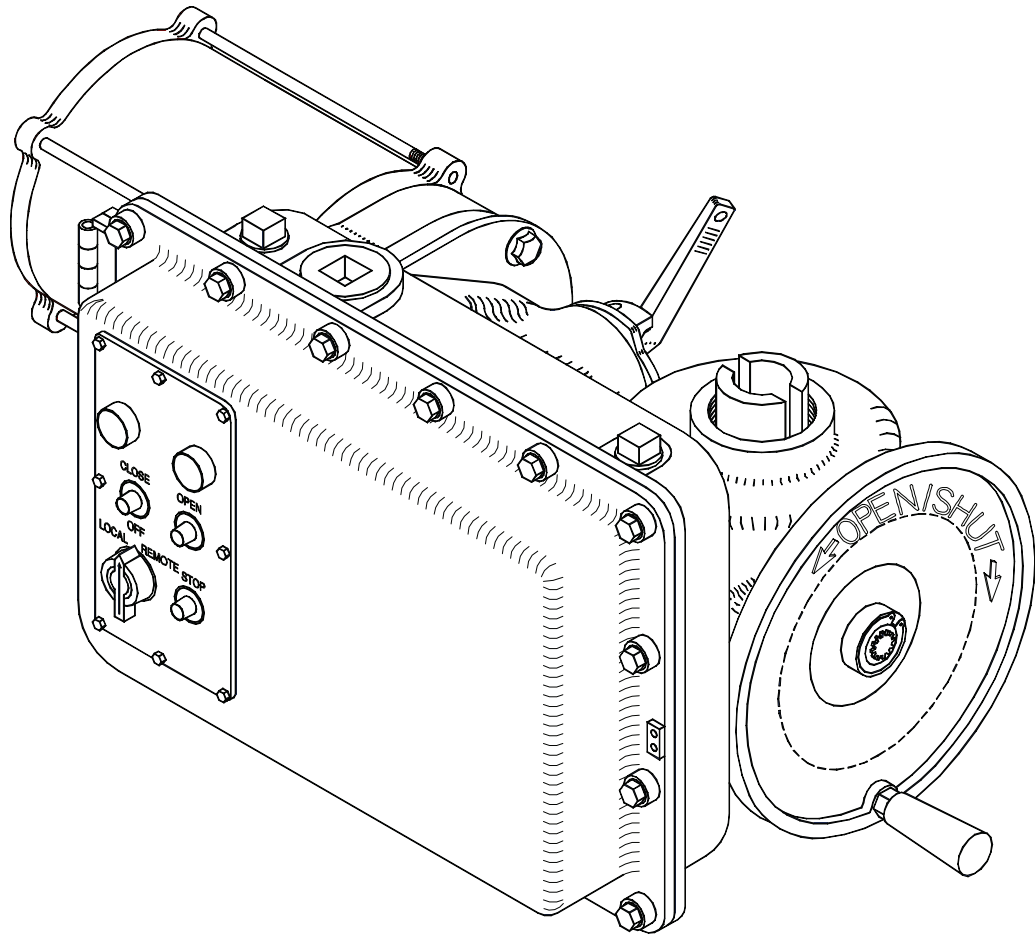


# Bettis 2000 Series E1195 MCP





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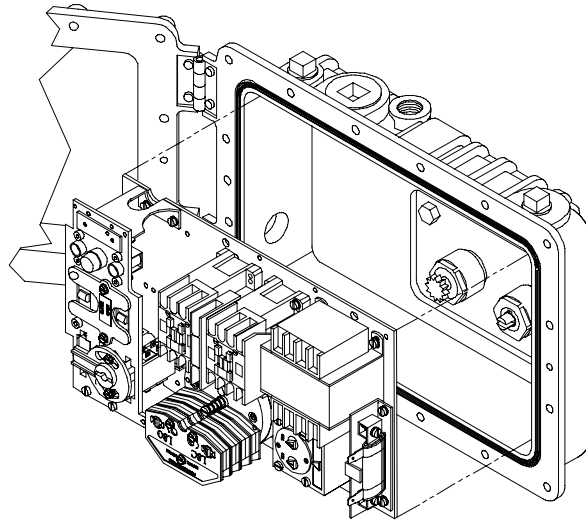
# Section 1: Storage Instructions

## 1.1 Short Term Storage

(Stored at job site less than one year from shipment)

1. Actuator should be stored in the recommended mounting position. The motor should be horizontal and Electrical Enclosure either horizontal or vertical.

Figure 1



2. Actuator should be stored indoors free from job site dirt, mud, moisture and temperature changes.
3. If indoor storage is not possible, the actuator must be stored off the ground, above possible water or snow level. Remove MCP and store with other electrical and electronic equipment in protected warehouse. If MCP is not removed, Space Heater MUST be energized to protect Electrical and Electronic Controls.
4. Bettis supplies plugs in each conduit entry. Do not remove until electrical hook-up.
5. Cover units loosely with a plastic sheet. This serves as partial protection from rain.

## 1.2 Long Term Storage

(Stored more than one year from shipment)

1. Store indoors or MCP must be removed and stored in protected area. Follow procedures of short term storage.

### **⚠ WARNING:**

Failure to store actuator properly will void warranty of electrical & electronic components.

## 1.3 Do

1. Do follow proper storage procedures. Improper storage will void warranty.
2. DANGER: Do check for proper motor rotation. If valve goes wrong direction when button is pushed, you have no torque or limit protection. Either incoming power or motor wiring must be reversed.
3. Do read and follow procedures before attempting to energize actuator.
4. Do cut off electric power before opening switch compartment.
5. Do install pressure relief vent in highest point of gearbox.
6. Do use stem covers of sufficient length to protect valve stem.
7. Do clean Electrical Enclosure flange thoroughly & lightly grease before closing.
8. Do secure all Electrical bolts.
9. Do follow an annual maintenance procedure.
10. Do use caution when working on, with, or around valves and actuators. You are dealing with high pressures, forces, voltages and flammable or toxic media.

## 1.4 Don't

1. Start-up without reading this manual.
2. Don't stack actuators.
3. Don't store actuator on the ground unprotected.
4. Don't lift the unit by clutch lever or handwheel.
5. Don't lift a valve assembly by electric actuator.
6. Don't operate electrically without first checking for proper phase rotation, valve position, torque and limit switch adjustments.
7. Don't plug the motor by starting and stopping repeatedly to move a valve that is too stiff. Check for cause.
8. Don't jumper torque switches except as recommended by Wiring Diagram or Valve Manufacturer.
9. Don't use oversize thermal motor overloads to eliminate a tripping problem. Find the cause and correct.
10. Don't use a cheater to try to force the handwheel. You can damage gearing and shafting. Find the cause and correct.
11. Don't torque seat valve, sluice gate or damper unless the valve manufacturer recommends.

## 1.5 Lubrication

Bettis Actuators are factory filled with a high quality lubricant carefully selected to insure actuator performance under specified operating conditions. Refer to Bettis JOB SPEC SHEET to identify the lubricant provided. Normal operation of actuator will not require replacement of lubricant.

## 1.6 Maintenance

At least once a year a check should be made of your Bettis actuator.

- a. Disconnect all electrical power to actuator.
- b. Open Electrical Enclosure. Inspect and tighten all electrical connections.
- c. Visually inspect for any electrical or mechanical damage.  
Replace worn or damaged components.
- d. Check lubrication consistency and level. Fill or replace if required.

## 1.7 Pressure Relief

During normal operation of Electric Actuator, gear temperature increase in combination with outdoor temperature variations will cause a small pressure build-up.

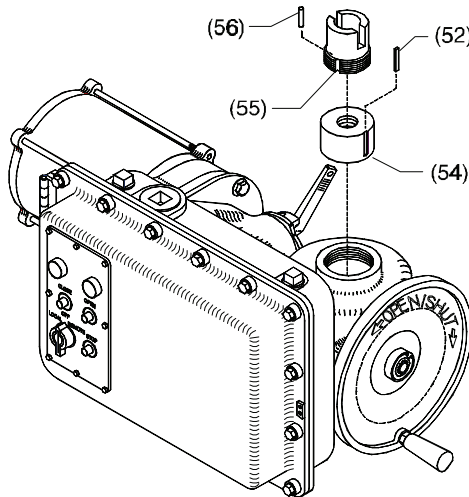
Bettis furnishes a Pressure Relief Vent Fitting P/N 83385. Placement on Actuator can be determined only after field location and position of valve has been determined.

Select the highest 1/2 NPT vent location in the Gear Box, remove 1/2 NPT Plug and replace with P/N 83385. Possible locations of the Plugs are shown on Bettis Outline Drawing.

## Section 2: Assembly to Valves

### 2.1 Threaded Valve Stem

**Figure 2 Stem Nut Installation (Multi-Turn)**



1. Unscrew Locknut (55) holding Bronze Stem Nut (54) and remove Stem Nut and Key (52).
2. Lubricate Stem and run Stem Nut down Stem to check acme thread fit, then remove Stem Nut and set aside.
3. Lower actuator over Stem onto valve flange. The screws thru valve flange into actuator must engage a minimum of one full screw diameter deep into bottom base and be tightened to a preload. See assembly drawing for screw size and torque to tighten properly.
4. Screw Stem Nut on Valve Stem until it enters Drive Sleeve. Line Nut Key with Drive Sleeve keyway and insert Stem Nut Key (52).
5. Turn handwheel in Open direction, pulling the Stem Nut into Drive Sleeve until it bottoms out (valve will begin to open).

#### **⚠ CAUTION:**

Locknut must be tight against stem nut.

6. Lower Locknut (55) over Valve Stem and screw into place firmly against top of Stem Nut. Tap Locknut ears using brass drift.



### 2.1.0.1 Mounting Screws

If Bettis supplied adaption, the mounting screws are included. If the adaption to the valve was the responsibility of others, the mounting screws are not furnished by Bettis. Screws thru adapter MUST engage a minimum of one screw diameter deep into Bettis actuator base.

### 2.1.0.2 Locknut Lockpin Installation

1. With the actuator in place on the valve, ensure proper flange mating and valve actuator orientation.
2. Use a number 30 (.1285) drill bit to drill a hole 3/4 inch deep into the Drive Sleeve assembly threads for the Locknut Lockpin(56). Use the groove in the Stem Nut Locknut threads as a guide.
3. Install the Locknut Lockpin (56) into the drilled hole to prevent the Stem Nut Locknut from working loose and turning.

---

**NOTE:**

When installing, the Locknut Lockpin should extend 1/4 inch above the Drive Sleeve assembly to allow for easy removal.

---

## 2.1.1 Thrust Spool Installation (Multi-Turn)

1. Locate Thrust Mounting bolts.
2. Remove the eight mounting bolts and separate the Spool from the actuator.
3. Position the Spool over the Valve Stem. Thread the Spool onto the Valve Stem until it meets the valve plate.
4. Bolt and secure the Spool onto valve.
5. Position actuator above Spool. Lower actuator onto Spool while manually rotating the unit until ears on the Stem Nut and ears on the main Drive Sleeve mesh.
6. Grease the flange face before securing unit to Spool.
7. Re-install thrust plate mounting bolts. Tighten to proper torque.

---

**NOTE:**

Reverse procedure if the Stem Nut needs to be replaced. Actuator does not need to be returned to factory for this procedure.

---

## 2.1.2 Spline Bushing (Quarter-Turn)

Bettis removable Spline Bushing allows easy adaption to valve shaft diameter and Key. Actuator may be rotated with respect to the valve shaft for unexpected or awkward field installations.

1. Move valve to full Open or Close.
2. Place Spline Bushing on valve shaft with Key and tighten set screw.
3. Using the handwheel on actuator, move the Gear Position Indicator Arrow (21) to full Open or Close (duplicating the position in Step 1).
4. Position actuator so the spline bore is correctly aligned with the Spline Bushing on stem shaft.
5. Move the actuator onto the shaft until the flange faces properly mate. Secure with screws thru the adapter flange into the base of the actuator.

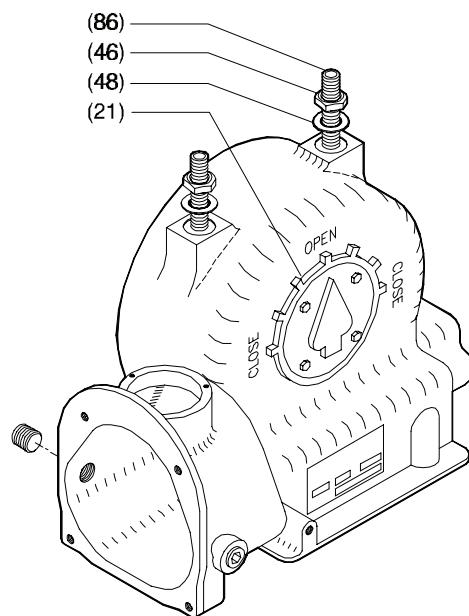
## 2.2 Quarter Turn Valve

### 2.2.1 Stop Setting Procedure (Quarter-Turn)

Built-in mechanical stops are provided to prevent handwheel operation beyond total valve travel ( $90^\circ \pm 6^\circ$ ).

Positive mechanical stops are in full accordance with AWWA 250% rim pull overload requirement. End of travel stops are independently adjusted, locked in place and sealed.

**Figure 3**



Loosen both Locknuts (46) and back out the two Stopbolts (86) to allow the valve to close and open fully. Insure Electrical Travel Limit Switches have been properly adjusted (see appropriate section of this manual), proceed as follows:

1. Run the actuator electrically to the full Closed position.
2. Screw the Close Stopbolt (86) in until it seats, then back off 1/2 turn. Install Washer (48) and tighten Locknut (46).
3. Run the actuator electrically to the full Open position.
4. Screw the Open Stopbolt (86) in until it seats, then back off 1/2 turn. Install Washer (48) and tighten Locknut (46).

**⚠ CAUTION:**

Do not set Actuator Position Limit Switches to drive into mechanical stops. Damage can occur if electric unit is allowed to repeatedly stall into end stops.

## Section 3: MCP and Electrical Hook Up

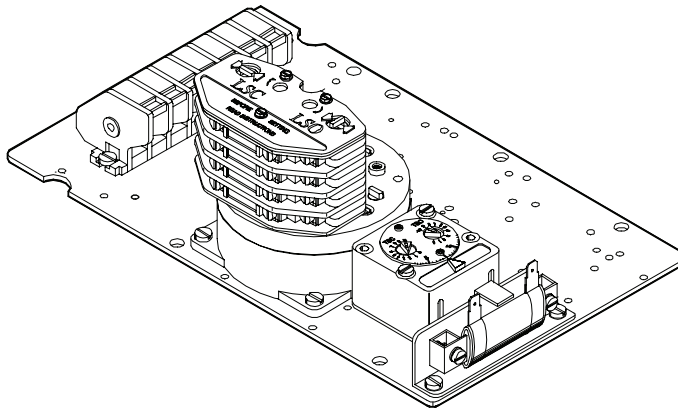
### 3.1 Modular Control Package - MCP

Electrical components are Bettis factory assembled, wired and tested as a module, with three possible MCP configurations.

1. MINI FRAME – Position Limit Switches, Torque Limit Switches, and Terminal Strip. (No Controls).

---

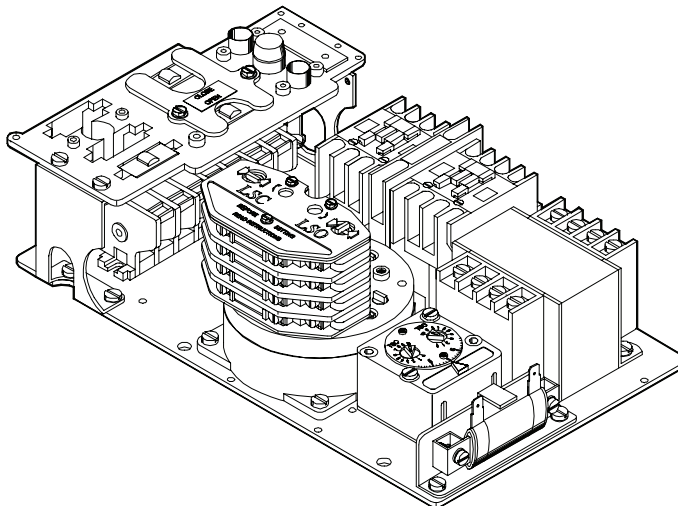
**Figure 4 Mini MCP Frame**



2. SHORT FRAME – Furnished when Reversing Contactor or additional electrical controls are supplied.

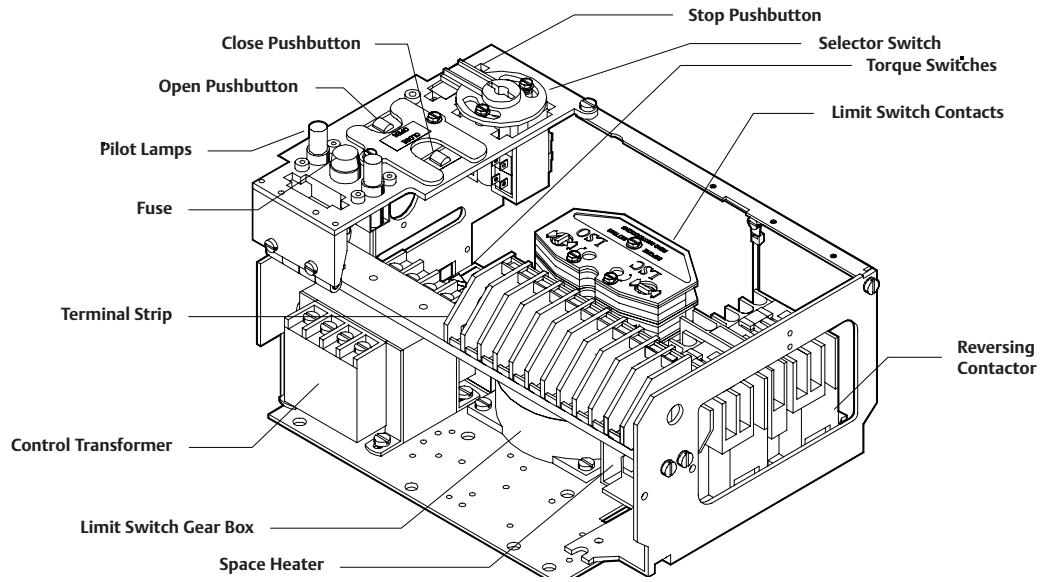
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**Figure 5 Short MCP Frame**



3. FULL FRAME – Reversing Contactor with the addition of electronic plugin modules.

**Figure 6 Full MCP Frame**



Bettis Modular Control Package (MCP) is available configured in thousands of possible combinations of electrical and electronic parts. Refer to WIRING DIAGRAM and Bettis JOB SPEC SHEET provided by Bettis with each actuator.

## 3.2 Electrical Hook Up

- Step 1. Move valve to mid-position by handwheel. This will allow sufficient time to stop actuator in case of improper hookup or reversed power phases.
- Step 2. Identify a means of removing power from actuator during check out.
- Step 3. Be sure no erroneous remote control signal can be received causing actuator to energize.
- Step 4. Energize Open control to check operation of contactor and push buttons. Open controls must move valve in Open direction. If valve Closes, actuator must be stopped and the power leads reversed to correct voltage phasing or improper field wiring.

### **⚠ CAUTION:**

If voltage is improperly phased, Torque and Limit Switches are not in circuit to protect valve.

- Step 5. Seal all field conduit entries in accordance with National Electric Code requirements

## Section 4: Geared Rotary Limit Switch Setting Instructions

### 4.1 Before making any switch setting:

1. Move valve to mid-position using handwheel.
2. Phase the power (motor) voltage and make sure that open contactor moves valve Open and Close contactor moves valve Closed.

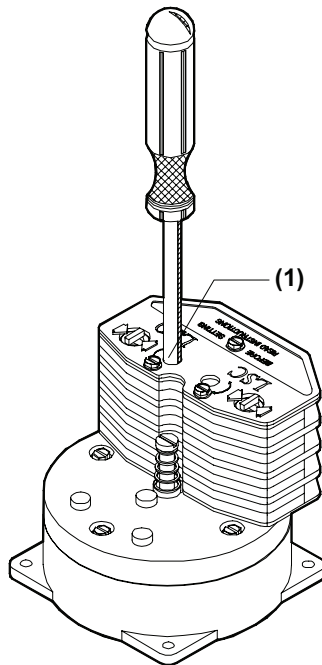
#### **⚠ DANGER:**

Improper power voltage phasing eliminates protection of both geared limit switch and torque switch, risking valve damage.

### 4.2 To set Open Limit Switch (LSO)

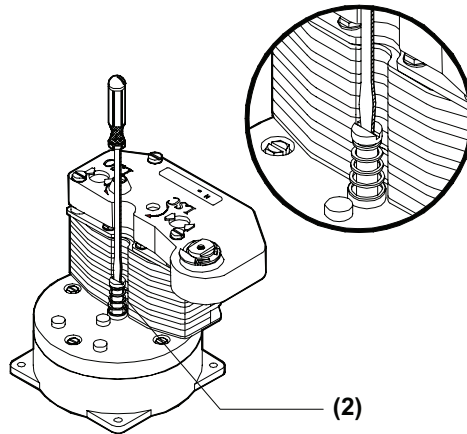
1. Open valve — During handwheel operation note direction of rotation of LSO Adjusting Shaft (1) Fig. 7. After the valve is fully Open, Close it three handwheel turns to allow for coast.

Figure 7



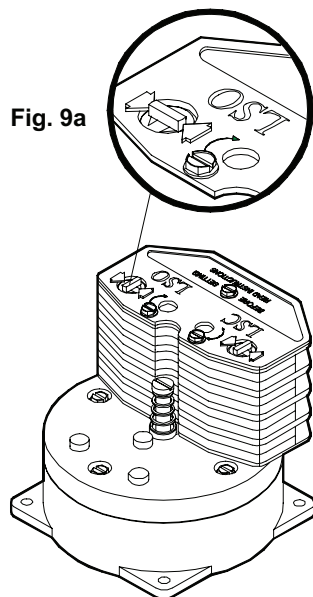
2. Disengage spring loaded spur gear — Push Disengage Shaft (2) in Fig. 8 down, then rotate 90° so that shaft is captured in down position. This disengages limit switch gears from the spring loaded gear pinion assembly.

---

**Figure 8**

3. Line up LSO indicator: If switch rotor does not line with arrows on instruction plate as shown in fig. 9, rotate screwdriver in same direction noted in Step 1 until switch just rotates. If indicators line up as shown in fig. 9a, rotate screwdriver in the opposite direction until switch just rotates, then slowly reverse direction to match fig. 9a.

---

**Figure 9**

---

Re-engage spring loaded spur gear by turning Disengage Shaft (2) in Figure 8. Disengage Shaft (2) will rise.

---

**IMPORTANT:**

To insure that spur gears have engaged properly, lightly jiggle all adjusting shafts (1) with screwdriver back and forth; proper engagement has been made if all shafts will not turn. If all shafts do not lock in place, the limit switch setting will be lost when valve is moved.

---

---

**NOTE:**

Since many turns may be required to set limit switches, it may be convenient to use a reversible variable speed drill to rotate Adjusting Shaft (1) instead of screwdriver.

---

Limit Switch Gear Box is gear driven by the gear limit pinion assembly. The gear limit pinion is driven by the actuator output worm and is always mechanically in step with valve position. N is the total number of turns of spring loaded gear limit pinion assembly for full valve stroke.

### 4.3 To set Close Limit Switch (LSC)

1. Close valve, using handwheel. During handwheel operation note direction of LSC adjusting shaft. After valve is fully Closed, Open it several handwheel turns to allow for coasting.
2. Repeat steps 2 through 5 of LSO setting instructions with screwdriver in LSC cavity.

### 4.4 To set Intermediate Switch (LSA or LSB)

1. Open Valve to desired position, then repeat steps 2 through 5 of LSO.

### 4.5 Torque Seated Valves

If valve is a torque seating valve, and the geared limit contacts are used for pilot light indication only, the LSC switch should be set several handwheel turns ahead of torque switch contact action. This gives proper valve position Pilot Lamp indication in spite of minor position variations which might occur due to torque seating.



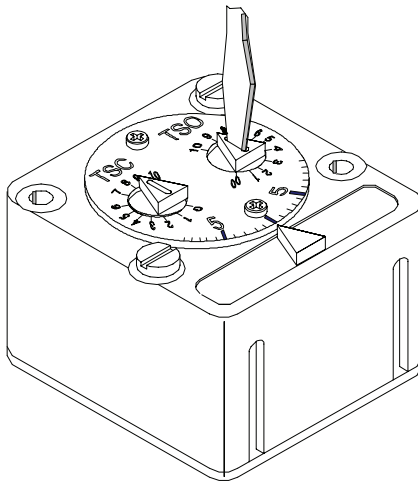
## Section 5: Torque Switch TSC and TSO Setting

### 5.1 Description

Bettis Torque Switch senses mechanical over load in Close (TSC) or Open (TSO) direction. Worm is supported with bi-directional disc spring stack. As worm and gear torque increases, the worm moves axially against spring allowing Torque Limit Gear Assembly to rotate Part No. 1050, Torque Switch.

Part Number 1050 has N.C. contact for (LSC) and (LSO). Part number 1050-1, in addition to N.C. also provides a N.O. contact.

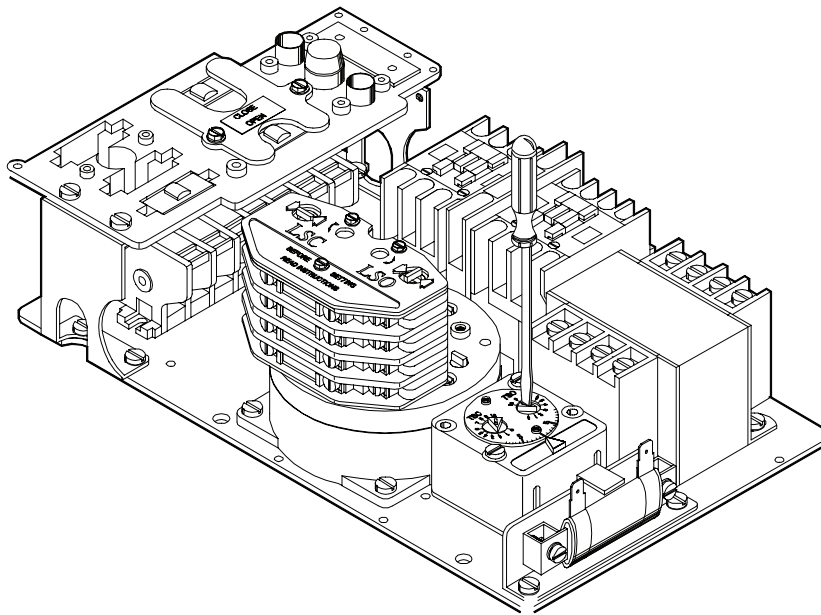
**Figure 10**



## 5.2 Adjust with Screwdriver

The only tool required for torque adjustment is a screwdriver. To change setting: push screwdriver down about 1/16" and rotate.

Figure 11



## 5.3 Approximate Torque Spring Chart

See Bettis supplied specification sheet for approximate torque spring settings. Manufacturing tolerances affect the torque at a specific torque switch setting. If exact torque curve is required; at an additional charge, Bettis will test and plot curve for specific actuator.

## 5.4 Torque Switch Calibration

### 5.4.1 To set CLOSE Torque Switch (TSC)

- a. Close valve using handwheel. Set valve to the desired torque. Observe rotating dial for number that corresponds to desired Valve Close Torque.
- b. Insert screwdriver in slot of TSC dial. Press down to disengage and turn the arrow to the setting determined in a). Release at this point and it will re-engage and remain set automatically.
- c. Back the valve away from Close position and reseal by handwheel to verify the trip point is at desired setting. The trip point of switch is distinctive as it makes or breaks contact.

**⚠ DANGER:**

Reverse voltage phasing removes torque switch protection from reversing contractor valve damage could occur.

If phasing has not been checked, do so before proceeding. Back valve away from Close position with handwheel and test electrically, using Close controls. Readjust as required.

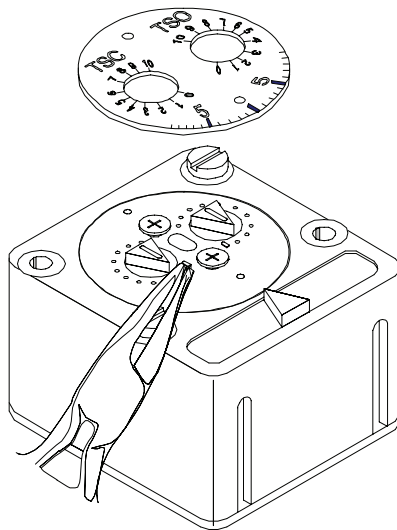
## 5.4.2 To Set OPEN Torque Switch (TSO)

- a. Follow the procedure as for the TSC in open position.

## 5.5 Switch Rotation Limit

Torque Switch adjustment rotation may be limited. Remove switch cover to expose anti-rotation pins at Open and Close positions. Remove pin from position 10 and insert into desired number. Torque may be roughly estimated from Table on Bettis Spec Sheet or determined by production or actual field test.

**Figure 12**

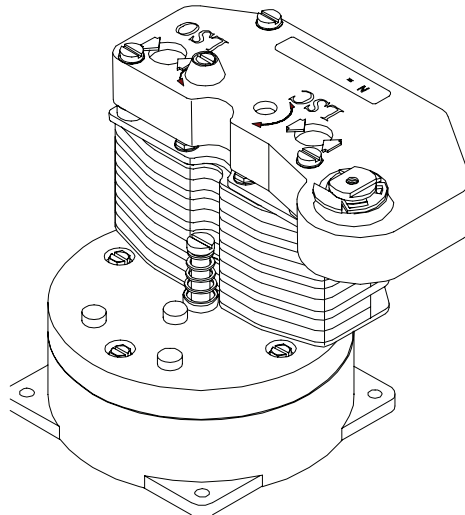


## Section 6: MDPI and Potentiometer Gear Box P/N 1030

### 6.1 Description

Mechanical Dial Position Indicator, MDPI, Part No. 1030 is a precision assembly of gears, shafts, bearings and slip-clutch designed to drive Position Indication arrow and/or Potentiometers. The MDPI is geared to actuator mechanism and is “in-step” with the valve position at all times, whether operation is by motor or handwheel. MDPI is mounted to the top of Limit Switches; this allows addition of potentiometer to valve actuators that are determined later to require process control. Top mounting allows for moving valve actuator from one valve to another.

Figure 13



### 6.2 N Number

N is the total number of Gear Limit Pinion turns for full valve travel. Pinion is Part No. (17) on assembly drawings.

### 6.3 Calibration

MDPI & POT Drive is calibrated after LSC and LSO are properly set. See Section 4 - Geared Rotary Limit Switch Setting Instructions.

## 6.4 MDPI and POT

Move valve to Close position. Manually rotate MDPI arrow to indicate Close. Calibration is complete. Open valve to check that MDPI arrow goes to Open, indicating that N is correct for full valve travel. Potentiometer, if included, has also been calibrated. Mechanical dial travel is 270°. Approximately 5% of total resistance is left on each end of Pot for total valve travel. 10-Turn Pot is driven 8.89 turns; 5% resistance of element is left on each end of Pot for total travel. This may be adjusted to a specific minimum resistance value at Open or Close by using a screwdriver in slot on 10 turn pot.

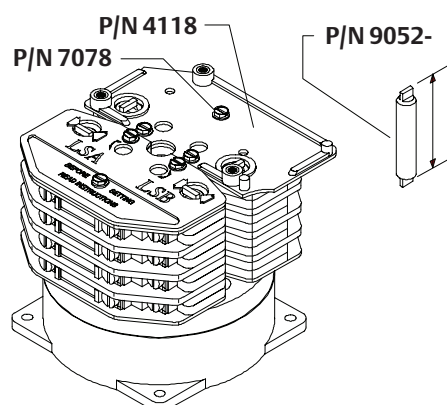
## 6.5 Potentiometer Only

Potentiometer shaft is rotated by grasping flats of P/N 1031 slip-clutch and turning to desired resistance. 1-turn Pot is rotated 270° by P/N 1030 gear box.

## 6.6 Gear System to Field Mount MDPI

1. Remove (3) P/N 7078 mounting screws holding P/N 4106 Instruction Plate to Limit Switch Modules.
2. Using same (3) P/N 7078 screws, attach P/N 4118 MDPI Adapter to top of Limit Switch Modules.
3. Insert MDPI Input Shaft, (P/N 9052-) making sure blade drops into slot. Input Shaft is different length for combination of limit switches and gear boxes.
  - 3 gear-2 switch uses P/N 9052-5 (0.8")
  - 3 gear-4 switch uses P/N 9052-1 (1.8")
  - 3 gear-5 switch uses P/N 9052-2 (2.3")

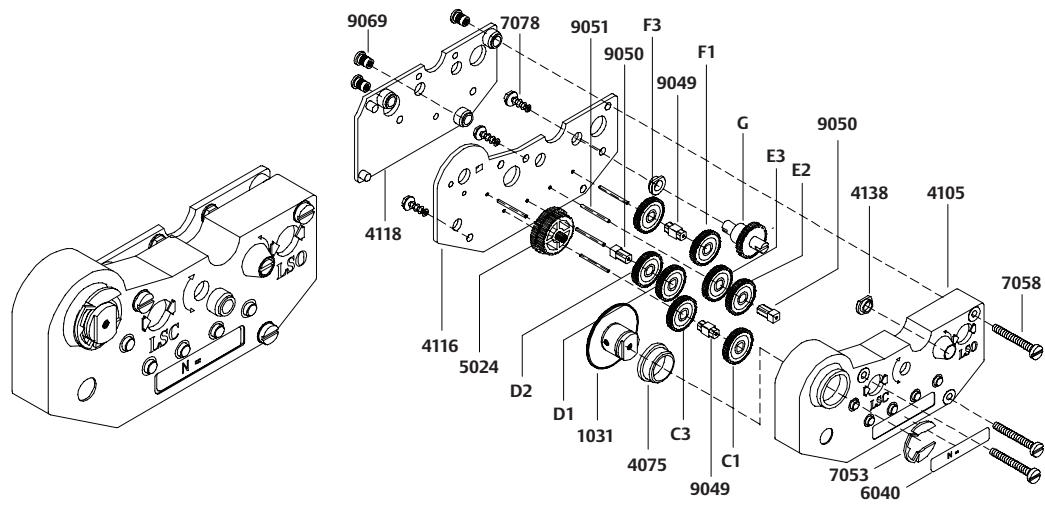
**Figure 14**



4. Install the 1030 assembly on top of the P/N 4118 plate, making sure that the P/N 9052- engages in the slot in bottom of the 1030 assembly.
5. Secure the P/N 1030 with the (3) P/N 7058 screws.

## 6.7 Part No. 1030 - CHANGE

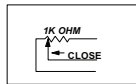
Figure 15



## Section 7: Wiring Diagram

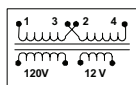
### 7.1 Symbols for MCP

**Figure 16 Potentiometer**



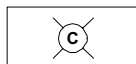
Pot. Slider is geared to Valve Position and “In-step” at all times.

**Figure 17 Transformer**



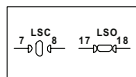
230 or 460 Voltage: 460V: 2 to 3 | 230V: 1 to 3 & 2 to 4 Outputs: 120 & 12 VAC.

**Figure 18 Pilot Lamps**



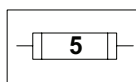
Actuated by position limit switches.

**Figure 19 Position Limit Switch**



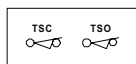
Wiping action double break. LSC shown open. LSO shown made.

**Figure 20 Fuse**



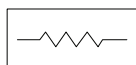
Fuse trip in amps.

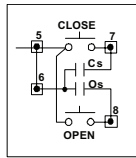
**Figure 21 Torque Limit Switch**



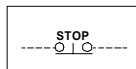
N.C. Double Break Contact Opens when overload occurs.

**Figure 22 Register-Fixed**

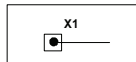


**Figure 23 Pushbuttons N.O.**

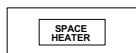
Momentary N.O. Contact connects control voltage to reversing contactor coils. Seal-in contacts Cs and Os on contactor allow actuator to go to extremes of travel without continued holding down of button.

**Figure 24 Pushbuttons N.C.**

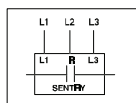
Momentary N.C. Contact

**Figure 25 Terminal Points**

Factory wired by Bettis

**Figure 26 Circuit Plug & Receptacle****Figure 27 Space heater**

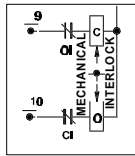
Heater in Switch Compartment is standard

**Figure 28 Phase Sentry**

Contact made only when Power Voltage phase is proper to L1, L2, & L3. Damage to valve is prevented if Voltage is improperly field connected.

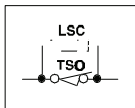


**Figure 29 Reversing Contractor**



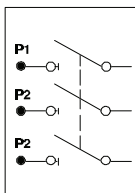
Showing Open and Close coils, Mechanical Interlock, and Electrical Interlock Contacts Oi & Ci.

**Figure 30 Nuisance Trip**

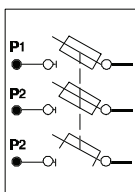


To prevent (TSO) contact tripping when valve has been jammed closed – LSC contact allows valve to open slightly. Contact then open, ensuring torque protection for remaining travel.

**Figure 31 Non-Fused Disconnect**



**Figure 32 Fused Disconnect**



**Figure 33 Circuit Breaker**

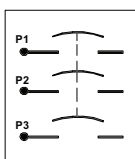


Figure 34      Grounds

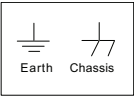


Figure 35      Overload Heater

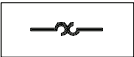


Figure 36      Contact N.C.

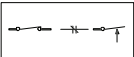


Figure 37      Contact N.O.

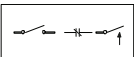


Figure 38      Selector Switch N.C. and N.O. Double Break

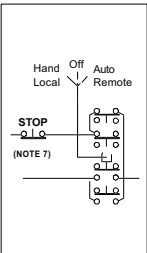
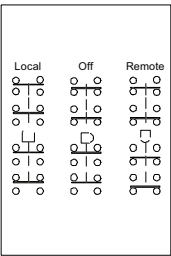
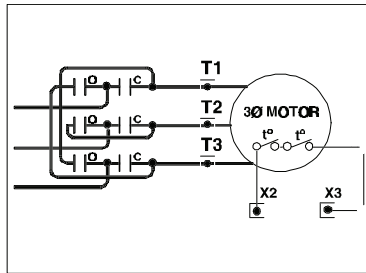


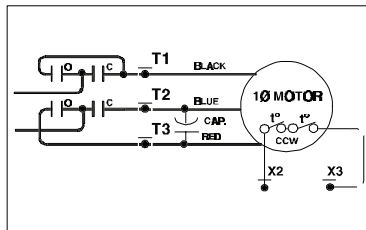
Figure 39      Truth Table Selector Switch



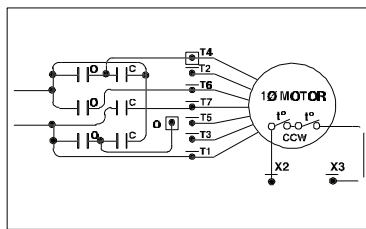
**Figure 40 3 Phase Motor**



**Figure 41 Single Phase Motor P, Q & R**



**Figure 42 Single Phase Motor Multi-Turn & M/MGs**



Motor Thermal Overload Protection Shown.

## Section 8: Troubleshooting

Symptom	Probable Cause	Corrective Action
Motor will not Run	Blown Control Fuse	Check Fuse and Replace as necessary
	Open in Control Circuit	Refer to appropriate wiring diagram and check for continuity
	Insulation Resistance Breakdown in Motor	Perform Megger Test
No Power available to Actuator	Tripped Circuit Breaker	Reset Circuit Breaker
Handwheel Hard to Turn	Valve Stem improperly Lubricated	Lubricate with Grease
	Actuator Lubrication has broken down	Clean out old grease and replace with recommended lubricant
	Valve packing gland too tight	Loosen packing gland nuts as necessary
	Drive Sleeve Bearing Failure	Replace Bearing
	Jammed Valve	Refer to Valve Maintenance
Valve only opens or closes partially with motor	Torque Switch Setting too low	Check Setting and Reset if necessary
	Limit Switch Improperly Set	Check Switch Actuation and recalibrate if necessary
Torque switch is properly set, but actuator	Damaged or bent valve stem	Refer to Valve Maintenance
	Valve packing too tight	Refer to Valve Maintenance
Torque's out in mid-travel, open or closed direction	Jammed Valve (obstruction in line)	Refer to Valve Maintenance
Handwheel will not operate valve	Handwheel shaft bearing assembly malfunction	Repair or replace as necessary
	Sheared gear key or Stripped Gearing	Replace as necessary
	PS Shifter Position or Malfunction	Replace Gear(s)
	Broken Handwheel Shaft	Repair or replace as necessary
	Broken Valve Stem or Stripped Stem Nut	Repair or replace as necessary
Motor runs but will not operate the valve	Motor Bearing Assembly Malfunction	Repair or replace as necessary
	Sheared gear key (fastener pin)	Replace
	Stripped Gearing	Replace
	Broken Valve Stem or Stripped Stem Nut	Repair or replace as necessary

Moisture in Electrical Enclosure	Leakage through Conduit Entry	Replace Packing (O-ring, neoprene grommet, etc.) as necessary
	Electrical Enclosure is not properly sealed	Inspect and replace O-ring if necessary
	Space Heater Inoperable	Check Circuit continuity for Heater
Gear (Oil) in Electrical Enclosures	Pressure Relief Fitting not installed	Install Pressure Relief Fitting
	Bad Seal on T/L or G/L Assembly	Replace Stat-O-Seals or O-Rings
		Rotate Actuator Mounting



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