80-3100-03
Rev. 01.3

**GROUP 31**
**STANDARD AND EXPLOSION-PROOF ROTARY DRIVES**

BECK®

# INSTRUCTION MANUAL


*ELECTRIC ACTUATORS FOR INDUSTRIAL PROCESS CONTROL*

# CONTENTS

## INTRODUCTION

Providing up to 30 lb-ft of torque, the Group 31 control drive is designed for operation with quarter-turn valves (typically up to 4 inches) or small dampers and may be direct coupled or connected by means of a linkage. The Group 31 drive meets NEMA 4 specifications for providing a weatherproof enclosure, and is also available FM approved for use in hazardous locations (Class I, Division 1, Group D; Class II, Division 1, Groups E, F and G; and Class III, Divisions 1 and 2). Beck drives may be mounted in any orientation.

The Group 31 drive is a compact, in-line assembly made up of two main sections: The output section and the control module. The output section consists of the gear train and motor. The control module contains the motor control, feedback signal electronics, switches and wiring terminal board. This module is enclosed and sealed by a bolted cast aluminum cover and gasket (or a threaded aluminum cover and O-ring on FM approved drives). Customer power and control wires are brought to the terminal board through two threaded conduit entrances located on the output section.

## STORAGE INFORMATION

The Group 31 drive should be stored in its shipping carton in a clean, dry area.

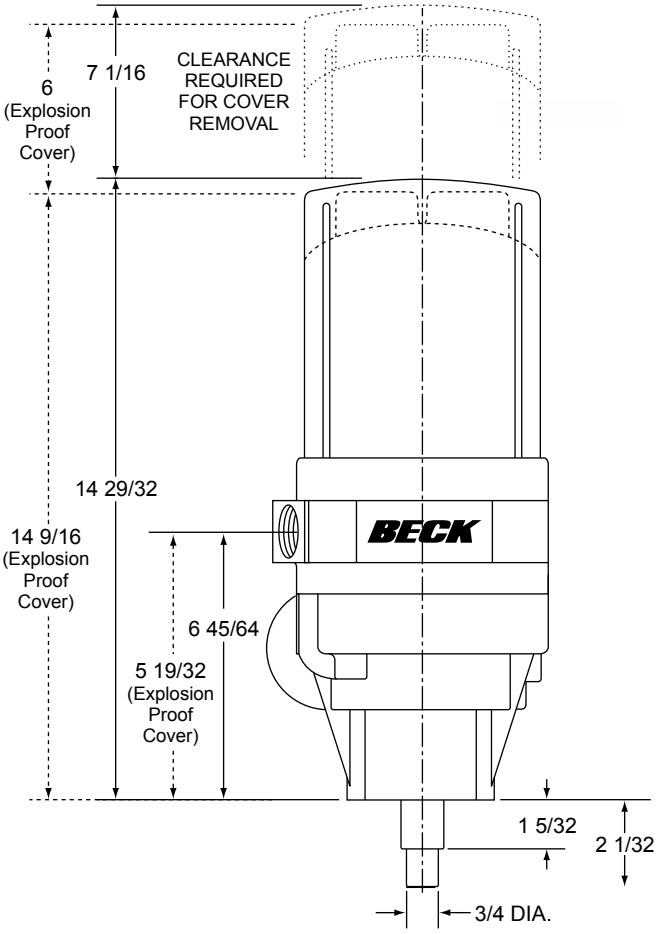
If it is necessary to store the drive outdoors for a long period of time, it should be removed from its shipping carton and stored above ground. A waterproof cover should be securely fastened over it. Do not stack drives on top of one another. Stored drives should be checked periodically to ensure no condensation has formed in the control module. Damage due to moisture while in storage is not covered by warranty.

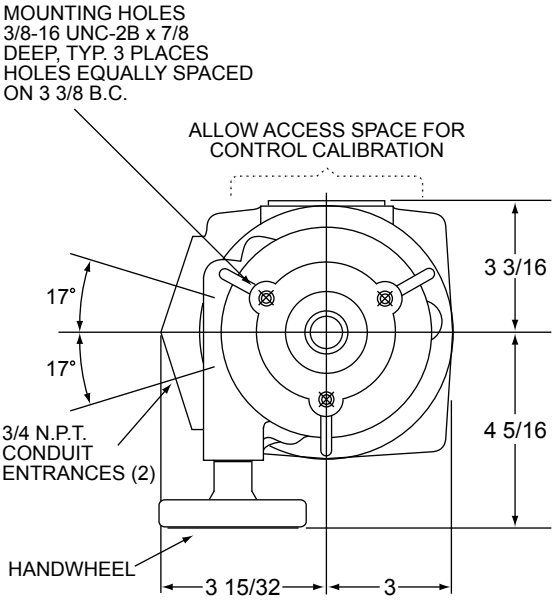
**WARNING**

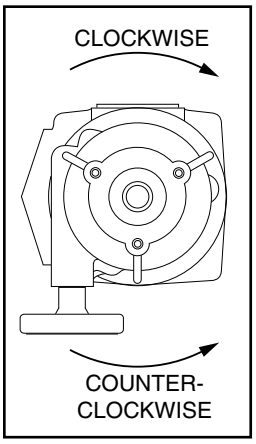
**All qualified personnel responsible for the installation, operation and maintenance of this product must read and understand the appropriate sections of this manual. To avoid injury and electric shock, do not perform any servicing other than that detailed in this manual. Save this manual for future reference.**

# PRODUCT DESCRIPTION

## OUTLINE DIMENSIONS FOR BASIC CONTROL DRIVE




**DIRECTION OF TRAVEL**
Direction of travel is determined by looking at the end of the output shaft.

NOTE: All dimensions are in inches and are subject to change.

## FACTORY-MOUNTED ASSEMBLIES

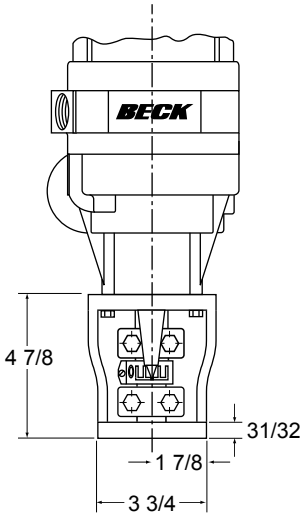
Beck can supply Group 31 drives factory mounted to new valves or dampers and shipped as a unitized package ready for pipeline installation. A Beck designed coupling or linkage assembly connects the drive to the final control element and permits easy field adjustment with reliable transmission of drive torque.

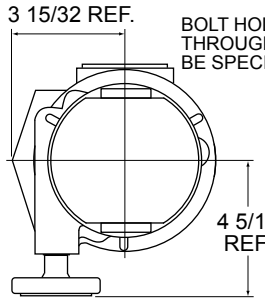
The drive can also be supplied separately with a yoke or bracket designed for your installation.

# PRODUCT DESCRIPTION

## MOUNTING OPTION A

YOKE MOUNTING WITH COUPLING CONNECTION
AND STANDARD MECHANICAL STOP

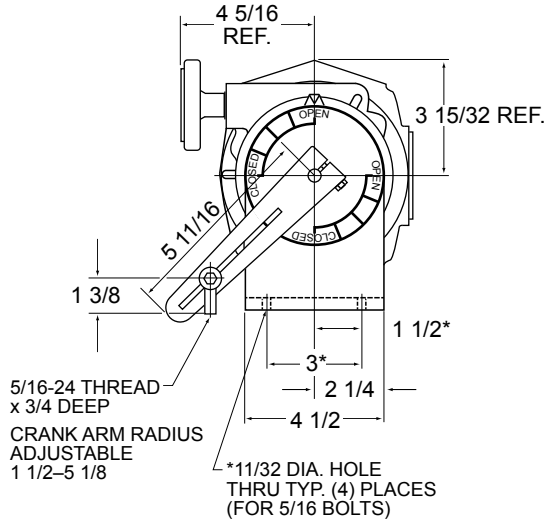


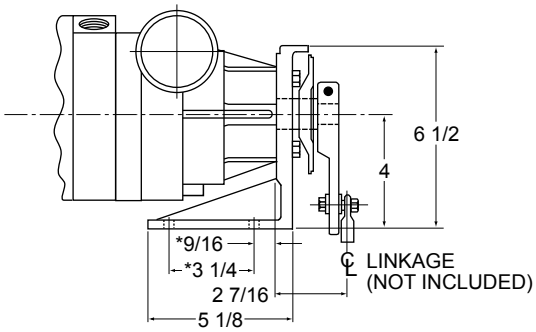




BOLT HOLE PATTERN AND SHAFT
THROUGH HOLE DIMENSION MUST
BE SPECIFIED PER APPLICATION

## MOUNTING OPTION B

BRACKET MOUNTING WITH CRANK ARM ASSEMBLY
AND STANDARD MECHANICAL STOP



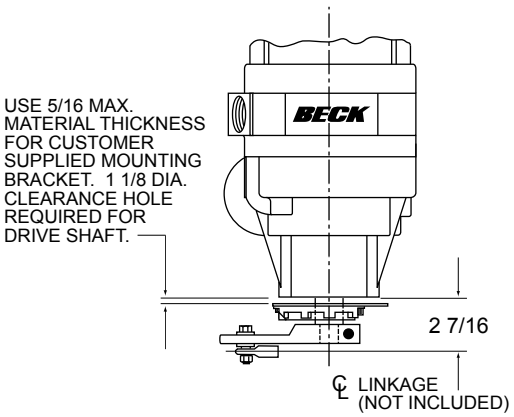




**** Standard dimension shown for mounting bracket, .344 dia. hole thru, typ. 4 places for 5/16 bolts (consult factory if different bolt hole pattern is needed).***

NOTE: All dimensions are in inches and are subject to change.

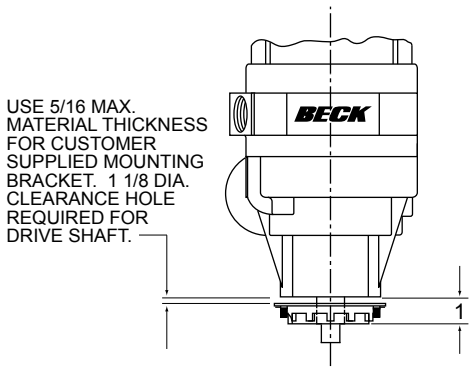
## MOUNTING OPTION C

BASIC DRIVE WITH CRANK ARM ASSEMBLY AND MECHANICAL STOP KIT



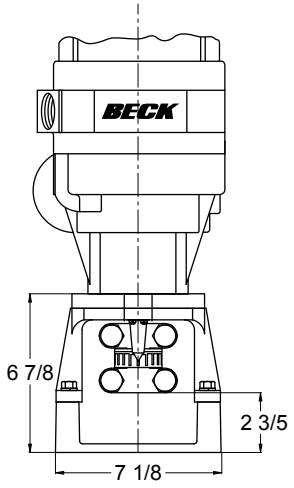

## MOUNTING OPTION D

BASIC DRIVE WITH MECHANICAL STOP KIT




## MOUNTING OPTION E

YOKE AND BASE MOUNTING WITH COUPLING CONNECTION AND STANDARD MECHANICAL STOP




NOTE: All dimensions are in inches and are subject to change.

## Recommended Bolt Torques

| Description | Size/Type | Torque |
|---|---|---|
| Crank Arm Bolt | 5/16-24x1 3/8" L Hex Head (grade 5) | 20 lb-ft |
| Rod End Bolt | 5/16-24x1 3/8" L Hex Head (grade 5) | 20 lb-ft |
| Coupling Bolt (4) | 3/8-24x1 1/4" L Hex Head (grade 8) | 35 lb-ft |
| Mounting Bracket To Drive Bolt (3) | 3/8-16x1" L Hex Head (zinc plated) | 20 lb-ft |
| Stop Collar Clamp Bolt | 3/8-16x7/8" L Socket Head | 22 lb-ft |

# PRODUCT DESCRIPTION

## GENERAL SPECIFICATIONS

| | |
|---|---|
| Input Power | 120 V ac single phase 50 or 60 Hz, 0.5 amp, 60 watts |
| Output Torque | 30 lb-ft at 24 second timing<br>15 lb-ft at 18 second timing |
| Timing Options | 60 cycle power: 18 sec/90° or 24 sec/90°<br>50 cycle power: 22 sec/90° or 29 sec/90° |
| Operating Temperature | -40°F to 150°F (-40°C to 65°C) |
| Motor Control | Two types of motor control are available:<br>1) 120 V ac contact closure -- control options 1 and 2. Motor is energized by 120 V ac line current from a remote controller or manual switches.<br>2) Milliamp modulating -- control option 3. Consists of feedback potentiometer, feedback signal circuit, error amplifier and two electronic output switches. Differences between the feedback signal and input signal are amplified, activating the electronic output switch necessary to drive the motor in the proper direction to force the signal differential to zero. |
| Input Signal (Option 3) | 4-20 mA or 1-5 V dc |
| Signal Span Adj. | 50 to 125% of 4 V span |
| Signal Zero Adj. | Up to 120% of Span<br>Split Signal Range: 4-12 mA or 12-20 mA |
| Deadband | 1.0% of Span |
| Sensitivity | 0.2% of Span |
| Feedback Signal (Options 2 & 3) | 4-20 mA or 1-5 V dc |
| Output Stability for Temperature Change | ±0.03%/°C of Span for -40°C to 50°C |
| Stall Relay Contacts (Option 3) | Form A, 10 volt-amps at 120 V ac or dc |

Feedback may be configured as a two wire transmitter or as a four wire active signal source. Two wire systems require a customer supplied external power supply. Four wire systems require 120 V ac supply to the drive.

| | |
|---|---|
| Action on loss of input signal (Option 3) | Stays in place or moves to predetermined position with ac power supplied. |
| Action on loss of power | Stays in place. |
| Action on stall (Option 3) | Relay contacts open after 68 seconds of stall, remote signal available. Power to motor is turned off. |

| | |
|---|---|
| Switches | Cam controlled, field adjustable. Two limit switches (S3 & S4) open the motor circuit at end-of-travel limits. Two auxiliary switches (S1 & S2) provide external signaling as specified through connections made at the terminal board. All four switches are SPDT and are rated for 1 amp at 120 V ac. |
| Handswitch (Option 3) | Permits local electrical operation, independent of controller signal. The Handswitch is located beneath the control module cover on the control board. See "S1", Figure 10, page 21 for location on the control board. |
| Handwheel | Provides manual operation without electrical power. Non-rotating during automatic operation, does not require declutching mechanism. |
| Motor | 120 V ac, single-phase, no burnout, non-coasting. Capable of 60 starts per minute. |
| Gear Train | Precision cut, heat-treated alloy steel and ductile iron. Self-locking and self-releasing, able to hold position at 150% rated torque. |
| Mechanical Stops | Prevent overtravel during automatic or manual operation. Mechanical Stops are external to the drive. |
| Drive Net Weight | 25 lbs. |
| Max. Overhung Load | 500 lbs. |
| Enclosure | Precision machined aluminum alloy castings, painted with corrosion resistant polyurethane paint. All units meet NEMA 4 specifications and are also available FM approved for use in Class I, Div. 1 & 2, Group D; Class II, Div. 1 & 2, Groups E, F & G; and Class III, Div. 1 & 2 hazardous locations. |

## TABLE 1: SUMMARY OF GROUP 31 MODEL NUMBERS AND FEATURES

| Beck Drive Model # | Output Torque (lb-ft) | Timing Sec/90° | Control Option | Hand-switch | Hand-wheel | Input Signal | Feedback Signal | Loss of Signal Function | Stall Sensing & Annunc'n |
|---|---|---|---|---|---|---|---|---|---|
| 31-230 | 15 | 18 | 1 | No | Yes | 120 V ac | None | No | No |
| 31-250 | 30 | 24 | 1 | No | Yes | 120 V ac | None | No | No |
| 31-330 | 15 | 18 | 2 | No | Yes | 120 V ac | 4-20 mA or 1-5 V | No | No |
| 31-350 | 30 | 24 | 2 | No | Yes | 120 V ac | 4-20 mA or 1-5 V | No | No |
| 31-M30 | 15 | 18 | 3 | Yes | Yes | 4-20 mA or 1-5 V | 4-20 mA or 1-5 V | Yes | Yes |
| 31-M50 | 30 | 24 | 3 | Yes | Yes | 4-20 mA or 1-5 V | 4-20 mA or 1-5 V | Yes | Yes |

# INSTALLATION

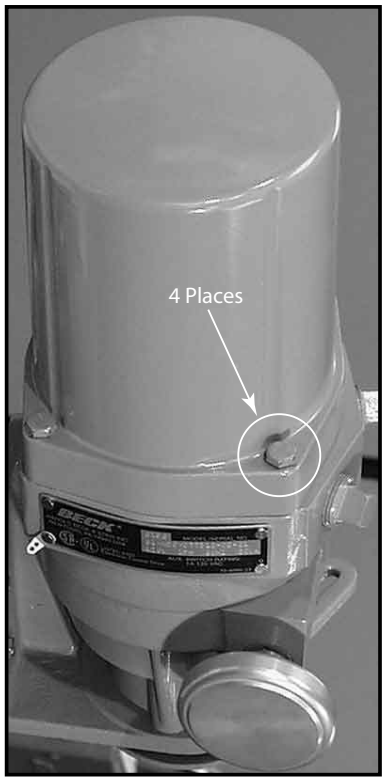
## COVER REMOVAL (HAZARDOUS LOCATION MODELS)

The control module cover may be removed by unscrewing it from the output section. To loosen, place the shaft of a large screwdriver between two lugs on the end of the cover and twist counterclockwise.

**NOTE**: The cover and output section threads are lubricated to permit easy removal of the cover. Do not wipe these threads clean. If it is necessary to replace the lubricant, use a thread lubricating compound such as Loctite Anti-Seize.


## COVER REMOVAL (STANDARD MODELS)

The control module cover may be removed by loosening the four captive bolts (1/2" bolt heads) at the corners of the base of the cover.



## POWER AND SIGNAL WIRING

The Group 31 drive has a pair of 3/4" NPT threaded holes for signal and power conduit connection. A sealant must be used on threaded conduit connections to keep out moisture. Conduits should be routed from below the drive so that condensation and other contaminants entering the conduit cannot enter the drive.

All signal and power connections are made on the terminal board. Typical wiring connections for each Group 31 control option are described below. A specific wiring diagram is affixed to each drive shipped.

All drives are furnished with two auxiliary switches. Wiring connections for these are described separately. In addition, a safety ground is required for all drives and is located on the baseplate of the control module.

**NOTE**: **Customer wiring inside the control module must be properly dressed and routed as shown in Figure 1 to prevent damage to wires from the control module cover.**

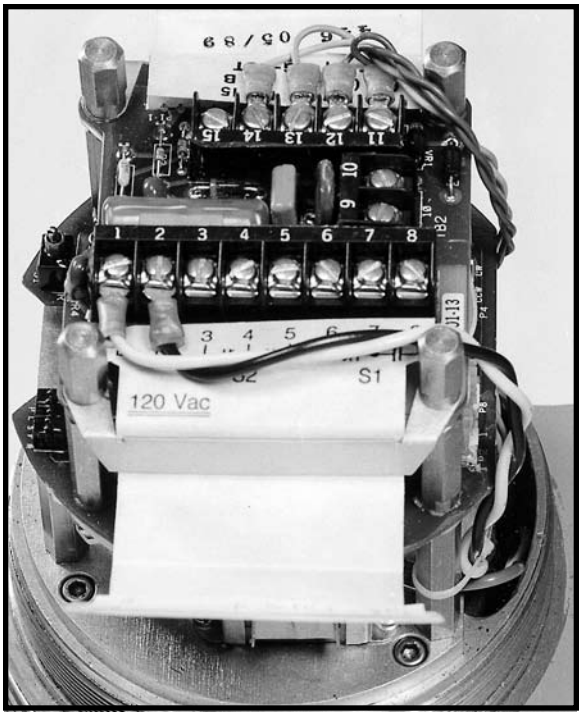
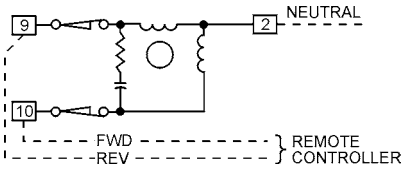



**Figure 1**

### Option 1, Open/Close

*Direct AC Control*

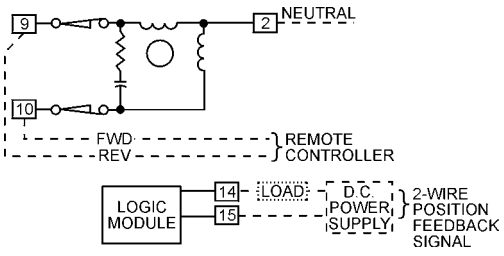
Customer must supply three wires to directly control the drive motor direction: One 120 V ac line to run Forward (terminal 10), one 120 V ac line to run Reverse (terminal 9), and one neutral (terminal 2).




### Option 2, Modulating

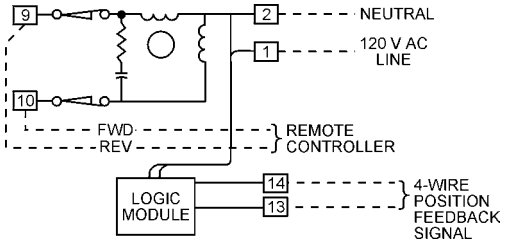
*Direct AC Control with Loop Powered Position Feedback Signal*

Customer must supply three wires to directly control the drive motor direction: One 120 V ac line to run Forward (terminal 10), one 120 V ac line to run Reverse (terminal 9), and one neutral (terminal 2). Customer may supply two additional wires to monitor a loop powered position feedback signal. The loop powered position feedback signal must be connected to a “2-wire” type analog input that provides a dc voltage over the signal wires (a dc voltage power supply must be wired in series with the signal wiring). If the dc supply is 24 to 35 volts, connect to terminal 14 (-) and to terminal 15 (+). If the dc supply is 36 to 45 volts, reverse polarity and connect to terminal 14 (+) and to terminal 15 (-).



*Direct AC Control with Drive Powered Position Feedback Signal*

Customer must supply three wires to directly control the drive motor direction: One 120 V ac line to run Forward (terminal 10), one 120 V ac line to run Reverse (terminal 9), and one neutral (terminal 2). Customer may supply two additional wires to monitor the analog position feedback signal: Connect to terminal 13 (-) and to terminal 14 (+). If position feedback monitoring is desired, a 120 V ac line must be connected to terminal 1. The drive's feedback circuit power supply is derived from this 120 V ac line, therefore the feedback signal must be wired to a "4-wire" type, non-powered analog input.



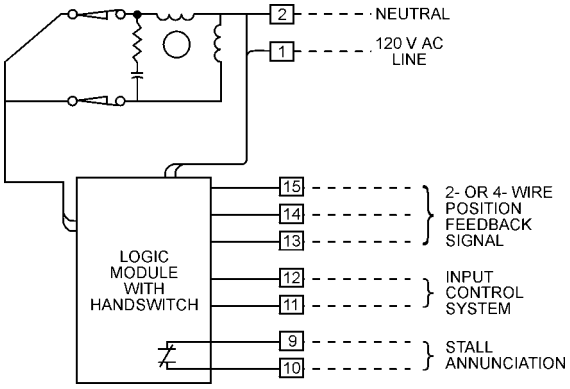

**Option 3, Modulating**

*Analog Position Control with Loop Powered Position Feedback Signal*

Customer must supply two wires to power the drive: One 120 V ac line (terminal 1), and one neutral (terminal 2). Customer must supply two wires for the analog input control signal: Connect to terminal 11 (-) and to terminal 12 (+). The loop powered position feedback signal must be connected to a "2-wire" type analog input that provides a dc voltage over the signal wires (a dc voltage power supply must be wired in series with the signal wiring). If the dc supply is 24 to 35 volts, connect to terminal 14 (-) and to terminal 15 (+). If the dc power supply is 36 to 45 volts, reverse polarity and connect to terminal 14 (+) and to terminal 15 (-).

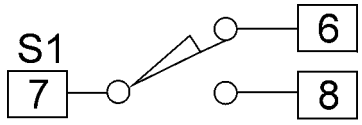
*Analog Position Control with Drive Powered Position Feedback Signal*

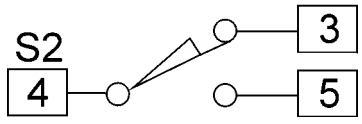
Customer must supply two wires to power the drive: One 120 V ac line (terminal 1), and one neutral (terminal 2). Customer must supply two wires for analog control: Connect to terminal 11 (-) and to terminal 12 (+). Customer may supply two additional wires to monitor the analog position feedback signal: Connect to terminal 13 (-) and to terminal 14 (+). The drive's feedback circuit power supply is derived from the 120 V ac line, therefore the feedback signal must be wired to a "4-wire" type, non-powered analog input.




**Auxiliary Switches**

Customer connections to the auxiliary switches are on the terminal board. Switch 1 connects to terminals 6, 7 and 8. Switch 2 connects to terminals 3, 4 and 5. Each switch is form C, rated for 1 amp at 120 V ac. There is no electrical connection between the two switches. S1 is factory set to operate 5 degrees before the CCW travel limit. S2 is factory set to operate 5 degrees before the CW travel limit. CCW and CW as viewed when looking into the output shaft. See page 16 for additional information about setting the auxiliary switches.



## DRIVE MOUNTING

If your drive includes a standard mechanical stop pin or a mechanical stop kit, the stop must be installed and adjusted prior to mounting the drive to the driven shaft. If your drive does not include a mechanical stop, skip directly to "INSTALLING A DRIVE", page 12.

## MECHANICAL STOPS

The Group 31 drive may be equipped with mechanical stops to prevent overtravel during automatic or manual operation. The mechanical stops prevent the output shaft from rotating more than 100 degrees. Unless otherwise specified at the time of order, all Group 31 drives are shipped with the travel limit switches preset to 90 degrees of output rotation. This leaves approximately 5 degrees of shaft rotation between the limit switch and the mechanical stop at each end of travel.

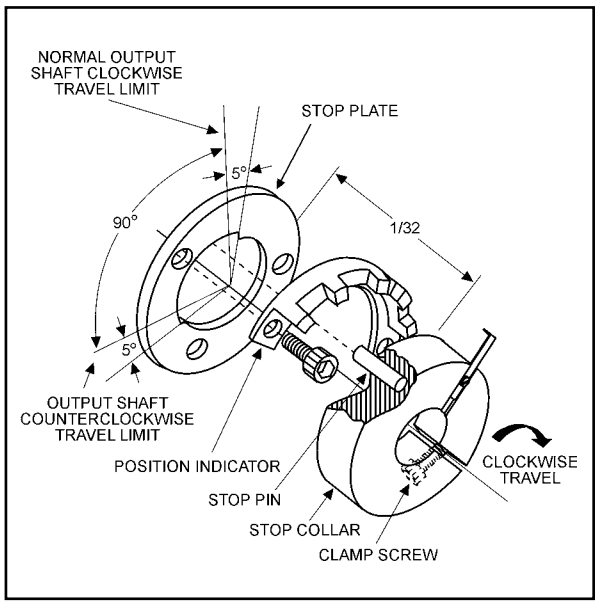
Two types of mechanical stops are used on the Group 31. The standard mechanical stop is incorporated into mounting options A & B and is used for most Beck factory-mounted assemblies. It does not require any adjustment. An optional mechanical stop kit is available for use with a customer supplied mounting bracket or for nonstandard factory-mounted assemblies.

### Standard Mechanical Stop, Installation and Adjustment (Mounting Options A & B, as shown on page 4)

1. Position the drive Handwheel and conduit connections in the desired orientation relative to the bracket or yoke. Turn the Handwheel until the mechanical stop pin in the output shaft is aligned with the slot in the bracket or yoke.
2. Bolt the drive to the bracket or yoke and tighten the mounting bolts to 20 lb-ft.
3. Remove the control module cover.
4. Turn the Handwheel to position the pin to either the CW mechanical stop or the CCW mechanical stop (whichever location gives you access to the set screw in the switch-cam shaft gear). Refer to the outline dimension drawings on page 3 for clockwise and counterclockwise travel direction.
5. Turn the Handwheel 1 turn off the mechanical stop (6-7 degrees of output shaft rotation).
6. Loosen the set screw in the switch-cam shaft gear.
   a. If the mechanical stop pin is at the CCW limit, grasp the cam assembly and rotate left to right until the S3 switch lever moves from the low portion of the cam to the high portion of the cam. Tighten the set screw.
   b. If the mechanical stop pin is at the CW limit, grasp the cam assembly and rotate right to left until the S4 switch lever moves from the low portion of the cam to the high portion of the cam. Tighten the set screw.
7. Using the Handwheel, move the output shaft until the limit switch (either S3 or S4) just operates. Check for clearance between the mechanical stop pin and the bracket. Using the Handwheel, move the output shaft to the opposite limit switch (either S3 or S4) until the switch just operates. Check for clearance between the mechanical stop pin and the bracket. The travel from the point where the switches actuate until the pin contacts the mechanical stop should be approximately equal at both ends of travel.
8. Connect 120 V ac power to the drive and check operation in manual and automatic modes. Readjust the switch-cam shaft gear if necessary.
9. Replace the control module cover and proceed to "INSTALLING A DRIVE", page 12.

### Mechanical Stop Kit, Installation and Adjustment (Mounting Options C & D, as shown on page 5)

Figure 2 depicts the parts of the mechanical stop kit as referenced in the following procedure.




Mechanical Stop Kit

**Figure 2**

*Continued*

**MECHANICAL STOP KIT, INSTALLATION AND ADJUSTMENT, CONT'D.**

**NOTE: The following procedure assumes a clockwise drive operation.**

1. Align the drive with the mounting bracket, then align the stop plate and position indicator on the opposite side of the bracket. Bolt together.
2. Connect 120 V ac power to the drive.
3. Run the drive output shaft until it is stopped by the forward travel limit switch.
4. Position the stop collar so that it is approximately 5 degrees from the forward travel end of the mechanical stop as shown in Figure 2. Allow approximately 1/32" between the stop collar and stop plate.
5. Using a 5/16" hex wrench, tighten the stop collar clamp screw to 22 lb-ft torque.
6. Operate the drive to check that the output shaft travels through the proper range of motion.

If the drive will travel in one direction only, check the travel limit switches. If one of the limit switch levers is up on the high portion of its cam, the drive will not run in that direction.

If the drive will not run in either direction, both travel limit switch levers are up on the high portion of their cams.

To correct, loosen the stop collar clamp screw, rotate the drive output shaft with the Handwheel until the switches are on the low portion of their cams. Repeat steps 3 to 6.

If the drive output shaft travels only a short distance in either direction and then stalls, the stop pin has been set at the wrong end of the slot in the stop plate. Loosen the stop collar clamp screw and rotate the stop collar until the stop pin is at the opposite end of the stop plate slot. Repeat steps 3 to 6.

## INSTALLING A DRIVE

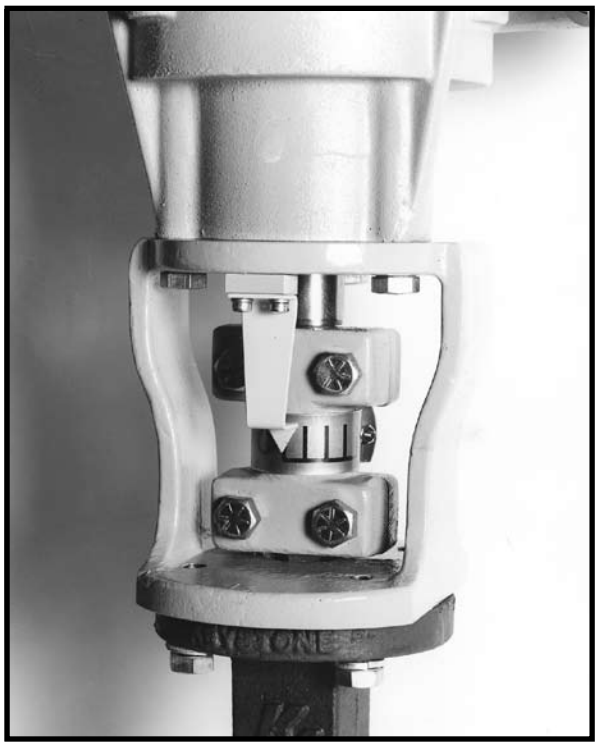
The Group 31 drive may be direct coupled to the shaft of the driven load, or connected to the load with a linkage. Procedures for each method follow.

The drive may be mounted in any orientation. If your drive includes a mechanical stop, the stop must first be installed and adjusted before proceeding with drive installation (see "MECHANICAL STOPS", page 11).

**NOTE: Refer to your valve mounting specification (VMS) sheet for customized installation instructions.**

### Direct Coupling, Installation and Adjustment

The Group 31 drive output shaft can be coupled directly to the shaft of the driven load. In direct coupled applications, the torque required throughout motion range of the driven load must be less than the rated output torque of the drive. This is particularly true for valves where seating torques may be relatively large or operating pressures are high.



Example of a Direct Coupling

**Figure 3**

The drive must be mounted to a bracket that will position the output shaft in line with the driven shaft. A split, clamp type coupling is normally used to couple the output shaft to the driven shaft. A Beck designed coupling with an adjustable position indicator is available. This coupling can be designed to fit on a variety of shaft sizes and types.

1. Mount the drive to the mounting bracket (if not yet mounted).

2. Mount the drive and mounting bracket to the final control element. Loosely tighten the mounting bracket bolts.
3. Connect 120 V ac power to the drive (if not yet connected).
4. Run the drive output shaft to the full reverse (minimum input signal) position.
5. Rotate the driven shaft to the full reverse position.
6. Assemble the coupling halves over the shafts and tighten the coupling bolts. (On the Beck designed coupling, the bolt torque is 35 lb-ft.)
7. Cycle the drive several times to allow the mounting bracket to position itself for good shaft to shaft alignment. Tighten the mounting bracket bolts.
8. Place the position indicator band on the coupling so that it correctly indicates the position of the driven shaft. Clamp the indicator using a #6-32 screw and hex nut.

### Linkage, Installation and Adjustment

Linkage connection to the driven shaft can be used if space is not available for direct coupling. Linkage coupling is also useful if you wish to characterize, or apply high seating torque to the driven shaft.

Example of a Linkage Connection

**Figure 4**

The Group 31 drive bracket must be bolted securely to a rigid mounting surface that will not bend when full linkage forces are applied.

In general, the best control of the driven shaft will result when the linkage is selected so that the full 90 degree travel of the drive is used. This is true even if the driven shaft may travel less than 90 degrees. The requirements for a good linkage are:

1. It must be rigid enough to carry the link thrust without bending or deforming.
2. It should have a built-in means of adjustment so that the length of the connecting link can be changed a small amount.
3. Rod end bearings similar to the ones furnished on the Beck crank arm should be used at both ends of the connecting link. This type of device permits small angular misalignments, and helps prevent binding of the linkage.
4. The radius of the Beck crank arm must be calculated so that the crank arm will move the driven shaft lever through the correct arc as the drive moves from 0 to 90 degrees.
5. Starting angles of the crank arm and driven lever and relative positions throughout the travel must be predetermined to calculate the proper length of the connecting links. A Beck LinkAssist™ computer printout can be furnished which provides details of all these variables.

   The Beck crank arm is not restricted by keyways or splines. Small or large adjustments to its position on the shaft are possible.
6. The drive and driven shaft should be parallel and the linkage should be in a plane perpendicular to the shafts.

The following procedure is recommended to install the drive and connect the linkage to the driven shaft:

1. Mount the drive to the mounting bracket (if not yet mounted).
2. Rotate the driven shaft to the full reverse (valve or damper closed) position.
3. Set the driven shaft lever to its predetermined starting angle in relation to the driven shaft and drive shaft centerline.
4. Adjust the connecting link to the predetermined length.
5. Connect the connecting link to the driven lever at the predetermined radius.
6. Connect 120 V ac power to the drive (if not yet connected).

*Continued*

**Linkage, Installation and Adjustment, cont'd.**

7. Run the drive output shaft to its full reverse limit.
8. Slide the Beck crank arm onto the drive output shaft. Do not tighten the clamping bolt.
9. Set the crank pin on the Beck crank arm to the predetermined radius.
10. Swing the crank arm into position to assemble the connecting link to the crank arm pin.
11. Tighten the crank arm clamping bolt to 20 lb-ft.
12. Lubricate rod end bearings.

Carefully move the drive output shaft to the full forward (maximum input signal) position. Check that no binding occurs between the linkage, crank arm, driven shaft lever and surrounding obstructions. Also observe that the driven shaft rotates the proper amount. Check that the drive reaches the forward limit switch and shuts off.

If binding in the linkage occurs due to excessive travel of the driven lever, reduce the crank pin radius rather than adjusting the connecting link length. Loosen the Beck crank arm clamping bolt and adjust the crank pin as necessary.

For an input control signal change, do not adjust the linkage. The span adjustment on the control board is used to adjust the amount of drive rotation when a change in maximum input signal or span is required.

## LINKAGE KITS AVAILABLE

Beck linkage kits are made to accommodate a wide variation in linkage lengths without having to modify end fittings. This adaptability makes it possible to order the drive with the essential linkage end connections even though the exact linkage length may not be known until the drive is mounted in place. Consult the factory for linkage kits available from stock. Phone 215-968-4600.

## START-UP INSTRUCTIONS

(Note: If the limit switches have not yet been set in relation to the mechanical stop, refer to the appropriate section on page 11.)

After the wiring connections are made and the drive is mounted, the drive is ready to be tested for proper operation.

Turn on the power supply.

**For Options 1 and 2**, turn on the drive 120 V ac control signal and observe that the output shaft travels through its desired stroke and moves in the proper direction. If the direction of travel is wrong, check the wiring connections and verify that the control signal is correct at the drive. If the wiring and signal are correct, then reverse the direction of shaft travel. See page 17 for instructions.

**For Option 3 units**, set the Auto-Manual switch (S2) to Manual. Using the Handswitch (S1), run the drive through its full stroke, first forward then reverse (for location of switches S1 and S2, see Figure 10, page 21). Observe that the output shaft travels through its desired stroke. Note that the “F” and “R” LEDs on the control board light to indicate the direction of travel of the output shaft. The LEDs remain lit when the unit is stopped by the travel limit switches.

Set the Auto-Manual switch to Auto mode and operate the drive by varying the control signal. Check that the output shaft travels in the proper direction for a change in control signal. If it does not, first check the wiring connections and verify that the control signal is correct at the drive. If the wiring and signal are correct, then reverse the direction of travel. See page 17 for instructions. Note that the “F” and “R” LEDs light to indicate the direction the drive output shaft is moving and are not lit when the shaft stops and the input and feedback signals are in balance.

When satisfied that the drive travel is correct with reference to the input signals, the unit is ready to be placed in operation.

# CALIBRATION

## TRAVEL LIMIT SWITCH ADJUSTMENT

All Group 31 drives are shipped with the travel limit switches factory adjusted for full 90 degree travel unless otherwise specified at the time of order. These switches must be set inside the 100 degree range of the output shaft mechanical stops. This will protect the drive from stalling against the mechanical stops. The switches can be reset to limit the travel of the output shaft to any angle down to a minimum of 35 degrees for Option 1 and 60 degrees for Options 2 & 3.

The travel limit switches are opened and closed by cams that are driven by the drive output shaft. Setting the switch position involves moving the drive output shaft to the desired position, loosening the cam and positioning it so that it just opens the switch at that point.

The following procedure recommends the use of a continuity meter to determine when the switch opens or closes. If such a meter is not available, it is possible to hear the switch click as the contacts open and close.

**CAUTION:**

**Do not attach the meter or attempt to move the switch cams until the drive is disconnected from the line voltage and the auxiliary switches are disconnected from external power sources.**

### Setting the CCW Travel Limit Switch (S3)

1. Remove the control module cover.
2. Rotate the output shaft until the locking screw of the CCW travel limit cam (second from top) is accessible. Using a 5/64" hex wrench, loosen the screw so that the cam is just snug on the shaft. See Figure 5.
3. Move the output shaft counterclockwise, to the desired CCW travel limit.
4. Disconnect the power from the drive.
5. Refer to Table 1 to determine which control option exists.
   a. For drives with Options 1 and 2, connect the continuity meter across terminals 2 and 9. Rotate the cam until the meter shows an increase in resistance from approximately 100 ohms to more than 1 M ohms (switch contacts open, switch clicks).
   b. For drives with Option 3, remove the cable tie holding the switch wires, remove the two wires from the CCW limit switch (second from the top), and attach the meter across these contacts. See Figure 6. Rotate the cam until the meter shows no continuity (switch contacts open, switch clicks).
6. Tighten cam locking screw, 2 1/2 lb-in.
7. Disconnect the meter and reconnect switch wires and drive power.
8. Rotate the output shaft in the CW direction away from the CCW travel limit. Note the direction of rotation of the lobe of the cam. The correct cam lobe motion is away from the switch lever and the switch lever should be on the lower part of the cam. If this is not correct, return to step 2 and reset the cam to the proper orientation.
9. Rotate the output shaft again to the desired CCW travel limit. If the desired stopping point is reached, the switch is properly set.
10. For Option 3, redress the switch wires and secure to the control board standoff with a cable tie.
11. Replace the control module cover.

### Setting the CW Travel Limit Switch (S4)

1. Remove the control module cover.
2. Rotate the output shaft until the locking screw of the CW travel limit cam (top switch) is accessible. Using a 5/64" hex wrench, loosen the screw so that the cam is just snug on the shaft. See Figure 5.
3. Move the output shaft clockwise to the desired CW travel limit.
4. Disconnect power from the drive.
5. 
   a. For drives with Options 1 and 2, connect the continuity meter across terminals 2 and 10. Rotate the cam until the meter shows an increase in resistance from approximately 100 ohms to more than 1 M ohms (switch contacts open, switch clicks).
   b. For drives with Option 3, remove the cable tie holding the switch wires, remove the two wires from the CW limit switch (top switch), and attach the meter across these contacts. See Figure 6. Rotate the cam until the meter shows no continuity (switch contacts open, switch clicks).
6. Tighten cam locking screw, 2 1/2 lb-in.
7. Disconnect the meter and reconnect switch wires and drive power.

# CALIBRATION

8. Rotate the output shaft in the CCW direction away from the CW travel limit. Note the direction of rotation of the lobe of the cam. The correct cam lobe motion is away from the switch lever and the switch lever should be on the lower part of the cam. If this is not correct, return to step 2 and reset the cam to the proper orientation.
9. Rotate the output shaft again to the desired CW travel limit. If the desired stopping point is reached, the switch is properly set.
10. For Option 3, redress the switch wires and secure to the control board standoff with a cable tie.
11. Replace the control module cover.

## SETTING AUXILIARY SWITCHES

All Group 31 drives are shipped with two auxiliary switches. They may be set at any point in the active range of drive travel. Unless otherwise specified at time of order, these switches are set as follows:

Auxiliary switch S1 is set approximately 5 degrees before the CCW limit.

Auxiliary switch S2 is set approximately 5 degrees before the CW limit.

The auxiliary switches are opened and closed by cams that are driven by the drive output shaft.

Setting the switch position involves moving the drive output shaft to the desired position, loosening the cam and positioning it so that it just opens the switch at that point.

**CAUTION:**

**Do not attach the meter or attempt to move the switch cams until the drive is disconnected from the line voltage and the auxiliary switches are disconnected from external power sources.**

The following procedure recommends the use of a continuity meter to determine when the auxiliary switch opens or closes. If such a meter is not available, it is possible to hear the switch click as the contacts open and close.

1. Remove the control module cover.
2. Rotate the output shaft until the locking screw of the auxiliary switch cam (lower two cams) is accessible. Using a 5/64" hex wrench, loosen the screw so that the cam is just snug on the shaft. See Figure 5.
3. Move the output shaft to the desired switch position.
4. Disconnect power from the drive.

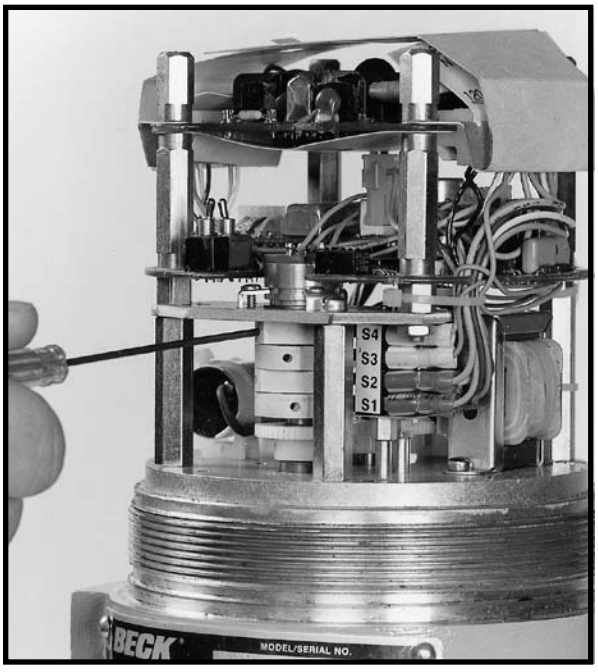



**Figure 5**

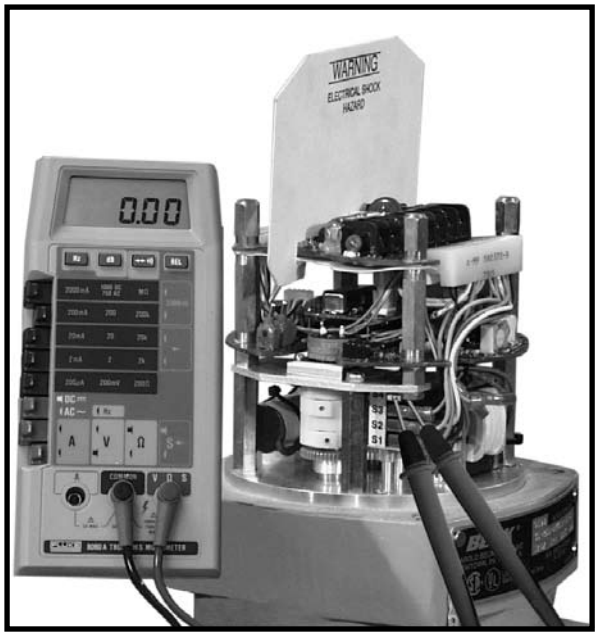



**Figure 6**

5. Connect the continuity meter across the normally closed terminal on the terminal board (terminals 6 and 7 for S1, and 3 and 4 for S2). Rotate the cam until the meter shows no continuity (switch contacts open, switch clicks). Tighten cam locking screw, 2 1/2 lb-in.
6. Disconnect the meter and reconnect drive power.
7. Rotate the output shaft in the direction away from the switch position. Note the direction of rotation of the lobe of the cam. The correct cam lobe motion is away from the switch lever and the switch lever should be on the lower part of the cam. If this is not correct, return to step 2 and reset the cam to the proper orientation.
8. Reconnect the meter and drive power.
9. Rotate the output shaft again to the desired switch position. If the contacts close, the switch is properly set.
10. Replace the control module cover.

## CHANGING OUTPUT SHAFT DIRECTION OF TRAVEL

Forward direction of travel is defined as the direction of output shaft rotation produced by an increasing signal. Direction of rotation is determined by looking at the end of the output shaft. Unless otherwise specified at the time of order, the factory set output shaft rotation is clockwise in response to an increasing signal.

The following procedure should be followed to check or change the direction of travel of the output shaft.

**CAUTION:**

**Be sure the drive is disconnected from the line voltage and the auxiliary switches are disconnected from the external power sources before proceeding with direction change procedure.**

1. Remove the control module cover.
2. To reverse the output shaft direction of travel, the wires to the common terminals of travel limit switches S3 and S4 must be interchanged. The common terminals are those located furthest to the right (see Figure 7).
3. For clockwise rotation of the output shaft on a forward direction (increasing) signal, the red wire must be on the common terminal of S4 and the brown wire on the common terminal of S3.
4. For counterclockwise rotation of the output shaft on a forward direction (increasing) signal, the brown wire must be on the common terminal of S4 and the red wire must be on the common terminal of S3. Note that on drives with Options 2 and 3, steps 5 through 7 are also required to complete the direction change procedure.
5. Locate plug P4 on the control board. It is a three wire plug with a grey, blue and yellow wire attached to it. See Figures 9 or 10 for location of plug P4.
6. For clockwise rotation of the output shaft on a forward direction (increasing) signal, this plug must be attached to the terminal labeled CW. Note that this is a locking type plug and must be located properly in its receptacle. The tapered side of the plug must be against the tapered side of the receptacle. See Option 2 or 3 wiring diagram, page 29, for an illustration of the correct orientation of the plug.
7. For counterclockwise rotation of the output shaft on a forward direction (increasing) signal, this plug must be attached to the terminal labeled CCW.

**NOTE: If the direction of travel of the output shaft is changed; the feedback signal, the feedback potentiometer, and (for Option 3) the input signal must be recalibrated. See instructions beginning on page 18.**

8. Replace the control module cover.

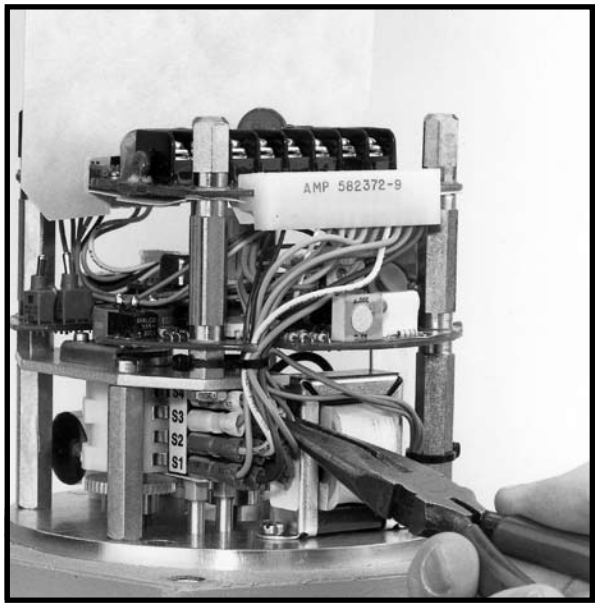



**Figure 7**

# CALIBRATION

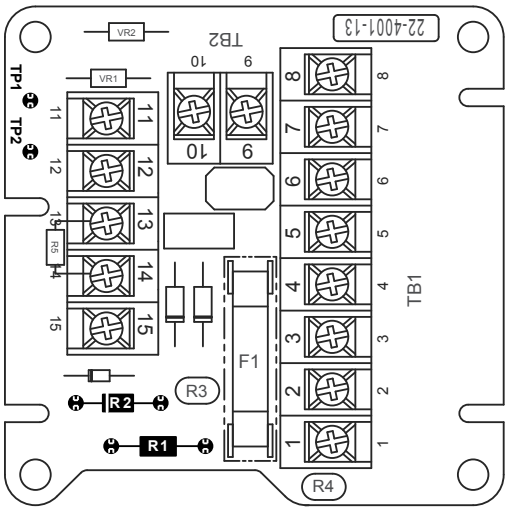
## FEEDBACK SIGNAL OPTIONS

The feedback signal is an analog voltage or current signal proportional to the position of the drive's output shaft. It may be used for remote position indication or for automatic control loop feedback. Drives with Options 2 or 3 may be field connected to function as a two wire transmitter or as a four wire active current source. This circuit configuration is determined by the position of Jumper Plug J5/J6 located on the control board (J-J5 for 2-wire, J-J6 for 4-wire). Unless otherwise specified at the time of order, all Group 31 drives are shipped with the feedback circuit configured as a 4-wire system. Also, all Option 3 models are shipped with a 360 ohm resistor (R5) mounted between output signal terminals 13 and 14. This resistor is used to ensure proper operation of the control board when the feedback signal is not connected to a control room indicator. A summary of position feedback options, output signal ranges and control board and terminal board part numbers is provided in TABLE 2, below.

## FEEDBACK SIGNAL CALIBRATION

### For 4-wire feedback only

Feedback signal calibration is necessary to ensure that the signal current or voltage correctly corresponds to the drive output shaft position. All Group 31 drives are shipped with the feedback calibrated for full 90 degrees of output shaft travel unless otherwise specified at time of order. The feedback signal may be specified as 4-20 milliamps or 1-5 volts when ordered or it may be changed at installation, using the following methods.




Option 3 Terminal Board

**Figure 8**

**TABLE 2**

| Feedback System | Control Option | Signal Configuration: Input | Signal Configuration: Output | External Power Supply | Feedback Signal Connections: Plus | Feedback Signal Connections: Minus | Jumper Location | Maximum External Load | Input Resistor R1 | Feedback Resistor R2 | Input Resistance (ohms) | Output Resistance (ohms) | Meter Connections for Signal Calibration: Plus | Meter Connections for Signal Calibration: Minus |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Milliammeter Connection | |
| 2-Wire | 2 | 120 V | 4-20 mA | <35 V | 15 | 14 | J-J5 | 300 ohms | -- | DIODE | -- | >1 M | 14 | Cust. Minus (Series) |
| 2-Wire | 2 | 120 V | 4-20 mA | >36 V | 14 | 15 | J-J5 | 800 ohms | -- | OPEN | -- | >1 M | 15 | Cust. Minus (Series) |
| 2-Wire | 3 | 1-5 V | 4-20 mA | <35 V | 15 | 14 | J-J5 | 300 ohms | -- | DIODE | 2 M | >1 M | 14 | Cust. Minus (Series) |
| 2-Wire | 3 | 1-5 V | 4-20 mA | >36 V | 14 | 15 | J-J5 | 800 ohms | -- | OPEN | 2 M | >1 M | 15 | Cust. Minus (Series) |
| 2-Wire | 3 | 4-20 mA | 4-20 mA | <35 V | 15 | 14 | J-J5 | 300 ohms | 249 ohms | DIODE | 249 | >1 M | 14 | Cust. Minus (Series) |
| 2-Wire | 3 | 4-20 mA | 4-20 mA | >36 V | 14 | 15 | J-J5 | 800 ohms | 249 ohms | OPEN | 249 | >1 M | 15 | Cust. Minus (Series) |
| 4-Wire | 2 | 120 V | 4-20 mA | 120 V | 14 | 13 | J-J6 | 500 ohms | -- | DIODE | -- | >1 M | 14 | Cust. Plus (Series) |
| 4-Wire | 3 | 1-5 V | 4-20 mA | 120 V | 14 | 13 | J-J6 | 500 ohms | -- | DIODE | 2 M | >1 M | 14 | Cust. Plus (Series) |
| 4-Wire | 3 | 4-20 mA | 4-20 mA | 120 V | 14 | 13 | J-J6 | 500 ohms | 249 ohms | DIODE | 249 | >1 M | 14 | Cust. Plus (Series) |
| | | | | | | | | | | | | | Voltmeter Connection | |
| 4-Wire | 2 | 120 V | 1-5 V | 120 V | 14 | 13 | J-J6 | 0.4 mA | -- | 249 ohms | -- | 249 | 14 | 13 (Parallel) |
| 4-Wire | 3 | 1-5 V | 1-5 V | 120 V | 14 | 13 | J-J6 | 0.4 mA | -- | 249 ohms | 2 M | 249 | 14 | 13 (Parallel) |
| 4-Wire | 3 | 4-20 mA | 1-5 V | 120 V | 14 | 13 | J-J6 | 0.4 mA | 249 ohms | 249 ohms | 2 M | 249 | 14 | 13 (Parallel) |

** Control Option 2 = Control Board 22-4001-03 & Terminal Board 22-4001-07.*
*Control Option 3 = Control Board 22-4001-12 & Terminal Board 22-4001-13.*
*Note: For Split Range Operation, 1-5 V dc input can be calibrated 1-3 or 3-5 V dc. 4-20 mA input can be calibrated 4-12 or 12-20 mA.*
*Maximum Input Common Mode Range +15 V to -5 V as measured from Terminal 11 to Terminal 13.*

FOR OPTION 3: To convert a 4-20 milliamp configuration to 1-5 volts, remove the diode from position R2 on the terminal board and replace with a 249 ohm resistor. To convert a 1-5 volt configuration to 4-20 milliamps, remove the 249 ohm resistor and replace it with a 12 volt zener diode, Beck Part Number 13-2550-04. See Figure 8 for location of resistor R2.

FOR OPTION 2: To convert a 4-20 milliamp configuration to 1-5 volts, install a 249 ohm resistor in position R2. To convert a 1-5 volt configuration to 4-20 milliamps, remove the 249 ohm resistor from position R2.

When properly adjusted, the feedback signal will be 20 milliamps (5 volts) with the drive output shaft in the full forward (maximum input signal) position. At the 50% travel position, the signal should be 12 milliamps (3 volts) and at full reverse (minimum input signal) 4 milliamps (1 volt).

The calibration procedure requires checking and/or setting the feedback potentiometer and two trim potentiometers located on the control board. The following paragraphs describe the procedure to check and set feedback signal calibration.

**NOTE: The travel limit switches must be properly adjusted before the feedback signal is calibrated. The feedback signal must be calibrated before the input signal can be calibrated.**

Tools required for calibration:

mA/V dc voltmeter
3/32 inch screwdriver
Large screwdriver

TABLE 2 lists the meter connections required for the calibration procedure.

Figures 9 and 10 show the location of the jumper plug, feedback potentiometer, trim potentiometers, the Forward/Reverse and Manual/Automatic switches and plug P4 on the control boards.

1. Remove the control module cover.
2. Set the Forward/Reverse switch (S1 ) to STOP (center position), Option 3 Control Board only.
3. Set the Manual/Automatic switch (S2) to MANUAL, Option 3 Control Board only.
4. Connect the meter to read the feedback signal.

**FOR CURRENT FEEDBACK APPLICATIONS:** Connect the meter in series with the plus signal line of the control room indicator and the plus signal position (terminal 14 or 15; see TABLE 2 for correct meter polarity).

**FOR VOLTAGE FEEDBACK APPLICATIONS:** Connect the meter across the signal terminals 13 and 14. Terminal 14 is positive.

**FOR INSTALLATIONS WITH NO REMOTE INDICATOR:** Remove the resistor from between terminals 13 and 14 and connect the meter across these terminals. Terminal 14 is positive.

5. If the mechanical position of the feedback potentiometer has not been set:
   a. Move the output shaft to the full reverse (minimum input signal) position.
   b. Disconnect all power to the drive.
   c. Loosen potentiometer clamp screws.
6. Turn trim potentiometer R38 clockwise 20 turns (to limit), then rotate it 8 full turns counterclockwise.
7. Turn trim potentiometer R46 clockwise 20 turns (to limit), then rotate it 3 full turns counterclockwise.
8. Reconnect drive power.
9. Turn the feedback potentiometer until the output signal reads 20 + 0.5 milliamps (5 + 0.1 volts on units configured for voltage output).
10. Tighten the feedback potentiometer clamp screws to hold the potentiometer in position.
11. Turn trim potentiometer R46 counterclockwise until the output signal reads 4 milliamps (1 volt on units configured for voltage output).
12. Move the output shaft towards the forward (maximum input signal) position.
13. If the output signal decreases:
    a. Reverse plug connection P4. Note that plug P4 is a locking type plug and must be located properly in its receptacle. The tapered side of the plug must be against the tapered side of the receptacle. See Option 2 or 3 wiring diagram, page 29, for an illustration of the correct installation of the plug.
    b. Move the output shaft to the full reverse (minimum input signal) position.
    c. Loosen the potentiometer clamp screws.
    d. Return to step 7.
14. Move the output shaft to the full forward (maximum input signal) position.
15. Turn trim potentiometer R38 counterclockwise until the output signal is 20 milliamps (5 volts on units configured for voltage output).

*Continued*

# CALIBRATION

**Feedback Signal Calibration for 4-wire feedback, cont'd.**

16. Move the output shaft to the full reverse (minimum input signal) position.
17. Turn trim potentiometer R46 clockwise to increase output, or counterclockwise to decrease output.
18. Move the output shaft to the full forward position.
19. Turn trim potentiometer R38 clockwise to increase output or counterclockwise to decrease output.
20. Repeat steps 17 through 20 until satisfied with calibration.
21. Disconnect drive power, tighten feedback potentiometer clamp screws and reinstall resistor between terminals 13 and 14 (if used).
22. Reconnect power.
23. Replace the control module cover.

**NOTE: The input signal is calibrated relative to the feedback signal. Therefore the shaft travel limit switches must be properly adjusted and the feedback signal calibrated before the input signal can be calibrated.**

## INPUT SIGNAL CALIBRATION

Input signal calibration is necessary to ensure that the input signal correctly corresponds to the position of the drive output shaft.

Unless otherwise specified at the time of order, all Group 31 drives are shipped with the input signal calibrated for full 90 degrees of output shaft travel and the input signal range set to 4 to 20 milliamps. A 1 to 5 volt input signal may be specified at time of order or changed at installation. To convert a 4-20 milliamp input configuration to 1-5 volts, remove input resistor R1 from the terminal board. To convert a 1-5 volt input configuration to 4-20 milliamps, install a 249 ohm resistor in position R1. See Figure 8, page 18 for the location of R1.

When properly adjusted, the drive output shaft will be in the full forward position when the input signal is 20 milliamps (5 volts). At 50% travel, the input signal should be 12 milliamps (3 volts) and at full reverse 4 milliamps (1 volt).

Split signal operation is also possible. The control board can be adjusted to produce full drive travel with 50% of the input signal, permitting two drives to respond independently from the same signal source. Split signal ranges are:

4 to 12 milliamps (1 to 3 volts)
12 to 20 milliamps (3 to 5 volts)

It is also possible to calibrate the control board to give a span anywhere between 8 and 16 milliamps (2 to 4 volts), with the minimum signal between 4 and 12 milliamps (1 to 3 volts). The maximum input signal may be anywhere between 12 and 20 milliamps (3 to 5 volts) as long as the span is at least 8 milliamps (2 volts).

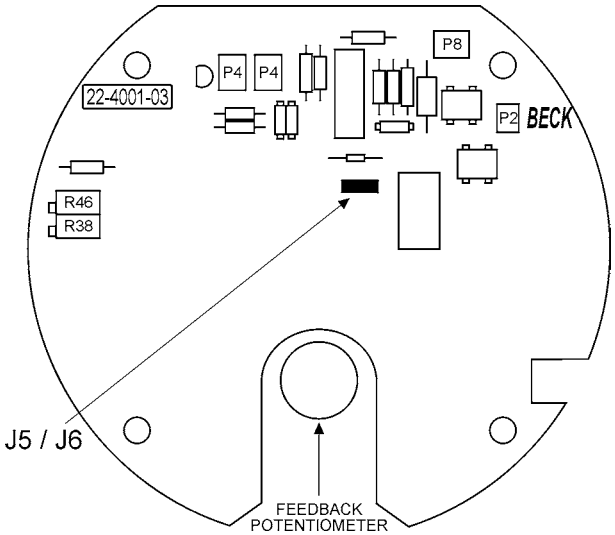
Tools required for calibration:

mA/V dc voltmeter
3/32 inch screwdriver
Large screwdriver

Table 3 lists the meter connections required for the calibration procedure.

The calibration procedure requires setting two trim potentiometers R13 and R14 on the control board. Figure 10 shows the location of these potentiometers and the Manual/Automatic switches.

1. Remove the control module cover.
2. Set the Manual/Automatic switch S2 to AUTOMATIC.
3. Turn the trim potentiometer R13 counterclockwise 20 turns (to limit).
4. Turn the trim potentiometer R14 clockwise 20 turns (to limit).
5. Connect a signal source to terminals 11 and 12, positive to 12.
6. Connect the meter to read the feedback signal.




Option 2 Control Board

**Figure 9**

**FOR CURRENT FEEDBACK APPLICATIONS:** Connect the meter in series with the plus signal line of the control room indicator and the plus signal position (terminal 14 or 15, see TABLE 2 for correct meter polarity) on terminal block 3.

**FOR VOLTAGE FEEDBACK APPLICATIONS:** Connect the meter across the signal terminals 13 and 14. Terminal 14 is positive.

**FOR INSTALLATIONS WITH NO REMOTE INDICATOR:** Remove the resistor from between terminals 13 and 14 and connect the meter across these terminals. Terminal 14 is positive.

7. Connect 120 V ac to terminals 1 and 2.
8. Turn on the 120 V ac power supply.
9. Set the input signal to 100 percent, that is 20 milliamps (5 volts) maximum.
10. Turn trim potentiometer R13 until the feedback signal is 20 milliamps (5 volts). Turn potentiometer clockwise to increase signal, counterclockwise to decrease signal. Note that drive must run.
11. Set the input signal to zero percent, that is 4 milliamps (1 volt).
12. Turn trim potentiometer R14 until the feedback signal is 4 milliamps (1 volt). Turn potentiometer clockwise to increase signal, counterclockwise to decrease signal. Note that drive must run.
13. Repeat steps 9 through 12 until satisfied with calibration.
14. Replace the control module cover.

## SETTING LOSS OF SIGNAL FUNCTION

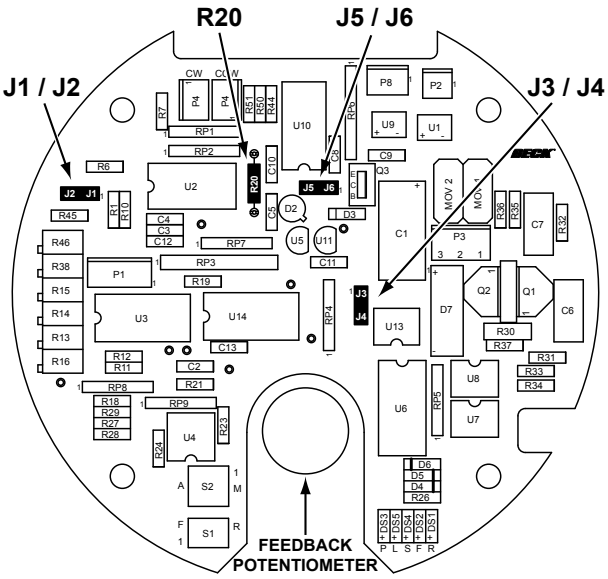
### Option 3 only

The Loss of Signal (LOS) feature gives the drive the ability to move the output shaft to a predetermined position if the input signal falls below a predetermined value, as long as ac power is supplied. LOS can function in two ways:

1. Drive will stay in its last position when the signal was lost.
2. Drive will move to a position determined by the setting of trim potentiometer R16.

The LOS function will start when the input signal falls below the level set by trim potentiometer R15. The range of adjustment for this input signal trigger level is from zero milliamps input to 8 milliamps (2 volts). The choice of having the drive stay in place or move to a position is determined by the position of jumper plug J1/J2 on the control board. (J1 moves to a predetermined position, J2 stays in place.)

Unless otherwise specified at time of order, all Group 31 drives are shipped with the LOS input signal trigger level set to 3.4 milliamps (.85 volts). Jumper plug J1/J2 is set in the J2 or stay in place position. The move to position trim potentiometer (R16) is set so that if this function is chosen the drive will move to the full reverse (minimum input signal) position.




Option 3 Control Board

**Figure 10**

**NOTE: The LOS position is adjusted relative to the feedback signal. The feedback signal must be calibrated before the LOS can be set.**

Tools required for setting LOS:

- mA/V dc voltmeter
- 3/32 inch screwdriver
- Large screwdriver

Figure 10 shows the location of the jumper plug J1/J2 and the trim potentiometers R15 and R16 on the control board. Figure 8 shows the location of test points TP1 and TP2.

1. Remove the control module cover.
2. Verify the position of jumper plug J1/J2. Use J1 to select the move to position function or J2 to select the stay in place function.

**CAUTION:**

**NEVER USE BOTH J1 AND J2—DAMAGE WILL RESULT.**

*Continued*

**SETTING LOSS OF SIGNAL FUNCTION, CONT'D.**

3. Connect 120 V ac to terminals 1 and 2.
4. Turn on 120 V ac power supply.
5. Connect the voltmeter between test points TP1 and TP2. TP2 is positive.
6. Turn trim potentiometer R15 until the desired trigger level is measured on the voltmeter. The voltage scale is:
   0 V = 0 milliamps
   1 V = 4 milliamps
   2 V = 8 milliamps
   Turn the potentiometer clockwise to increase the trigger voltage, counterclockwise to decrease the trigger voltage.
7. Disconnect the input signal (if connected) so that the LOS becomes active.
8. If LOS is set to stay in place, the drive output shaft will not move.
9. If LOS is set to move to position:
   Turn trim potentiometer R16 until the desired output shaft position is reached. Turn the potentiometer clockwise to increase the output shaft position, counterclockwise to decrease the output shaft position.
10. Replace the control module cover.

## STALL FUNCTION

### Option 3 only

The Stall function for Group 31, Option 3 control drives provides protection for the drive motor and gearing in the event of a stalled condition. The time to stall is set at 68 seconds, after which power to the motor is turned off. The timer resets automatically when the signal reverses or the Handswitch is moved from Auto to Manual.

The stall time of 68 seconds is set by the factory and requires Jumper J3/J4 on the control board (see Figure 10, page 21) to be set to the J3 position. If this Jumper is set to the J4 position (not recommended), the time to stall will be increased to 136 seconds.

## DEADBAND ADJUSTMENT

Group 31, Option 3 control drives are shipped with the deadband set to 1% of span to satisfy the requirements of most control systems. If excessive process and/or signal noise is present, the drive may be subject to unnecessary cycling. It is recommended that excessive noise be reduced at the source in order to prevent unnecessary cycling. This will improve process control and prolong component life.

If it is not possible to eliminate the excessive noise, the drive's deadband can be widened; however, this will reduce the resolution of the drive. Widening the deadband can be accomplished by changing the value of resistor R20 on the Control Board (see Figure 10). The recommended procedure is to solder a second resistor in parallel with the existing resistor R20. The new resistance value, recommended parallel resistor and corresponding deadband are listed in the following chart.

| R20 (ohms) | PARALLEL RESISTOR (ohms) | EFFECTIVE RESISTANCE (ohms) | DEAD-BAND |
|---|---|---|---|
| 1,000,000 | | | 1.0% |
| 1,000,000 | 2,000,000 | 666,000 | 1.5% |
| 1,000,000 | 1,000,000 | 500,000 | 2.0% |
| 1,000,000 | 665,000 | 400,000 | 2.5% |

# **MAINTENANCE** TROUBLESHOOTING

| CONDITIONS | POSSIBLE CAUSES | CORRECTIONS |
|---|---|---|
| 1. Drive will not run in either direction with input signal applied. | a. Handswitch left in wrong position.<br>b. No 120 V ac line supply. No lamps lit on control board.<br>c. Fuse F-1 open. No lamps lit on control board.<br>d. External auto/man switch in wrong position (Position-all).<br>e. Torque on driven load shaft exceeds drive torque rating. "S" LED on.<br>f. Input signal below range or reversed. "L" LED on.<br>g. Control board failure. | a. Return Handswitch to auto position.<br>b. Check fuses and switches in power panel.<br>c. Check for possible shorts, then replace fuse. Use only Beck part no. 13-2230-04 for proper protection of triacs.<br>d. Return switch to auto position.<br>e. Check operation with Handswitch and remove obstruction.<br>f. Input signal voltage between terminal 11 and 12 (+) must be between 1 - 5 V dc.<br>g. Replace control board. |
| 2. Drive runs in one direction only in auto and both directions with Handswitch in FORWARD and REVERSE. | a. Zero adjustment incorrect.<br>b. Loss of signal feature activated and set to drive shaft to full forward or reverse position. "L" LED on.<br>c. Loss of feedback signal.<br>d. Control board failure. | a. Readjust Zero. See calibration instructions, page 18.<br>b. Check input signal against LOS trigger.<br>c. Check feedback signal at terminals 13, 14, or 15.<br>d. Replace control board. |
| 3. Drive runs in the wrong direction with input signal applied. | a. Input signal reversed. "L" LED on.<br>b. Wiring to limit switches reversed. | a. Check polarity of input signal. Terminal 12 is positive, 11 negative.<br>b. Check limit switch connections. See Limit Switch adjustment, page 15. |
| 4. Drive shaft position oscillates. | a. Excessive noise on input signal.<br>b. Control board failure. | a. Check input signal.<br>b. Replace control board. |
| 5. Drive does not stop at normal or desired limit of shaft travel. | a. Span or Zero adjusted incorrectly.<br>b. Limit switches adjusted incorrectly.<br>c. Loss of input signal. "L" LED on.<br>d. Limit switch failure. | a. Check control board calibration. See calibration procedure, page 18.<br>b. Readjust limit switches. See limit switch adjustment, page 15.<br>c. Restore input signal to drive.<br>d. Replace limit switch. See page 27 for drives with Option 1 or 28 for drives with Options 2 or 3. |
| 6. Loss of signal feature does not function. | a. Control board failure. | a. Replace control board. See page 28. |

# **MAINTENANCE** TROUBLESHOOTING

| CONDITIONS | POSSIBLE CAUSES | CORRECTIONS |
|---|---|---|
| 7. Drive activates to full forward or reverse position and stays. | a. Handswitch left in FORWARD or REVERSE position.<br>b. Loss of input signal when LOS move to position is selected. "L" LED on.<br>c. Loss of feedback signal<br>d. Control board failure. | a. Return FORWARD/REVERSE Handswitch (S1) to center STOP position.<br>b. Restore input signal to drive.<br>c. Check feedback signal at terminals 13, 14 or 15.<br>d. Replace control board. See page 28. |
| 8. Drive movement erratic while driving from full reverse to full forward and runs normally from full forward to full reverse. | a. Feedback potentiometer dirty. Loss of wiper contact moves drive in reverse direction.<br>b. Feedback potentiometer open. | a. Replace feedback potentiometer. See page 28.<br>b. Replace feedback potentiometer. See page 28. |
| 9. Drive moves uncontrollably to some position then oscillates. | a. Feedback potentiometer open. | a. Replace feedback potentiometer. See page 28. |
| 10. Pilot LED light out. | a. No power.<br>b. Control section transformer failure. | a. Check power sources.<br>b. Replace control section transformer. See page 28. |
| 11. Feedback signal decreases when it should increase. | a. Plug P4 in wrong position on control board. | a. Check feedback calibration procedure. See page 18. |
| 12. Feedback signal does not reach maximum signal, but low end calibration is correct. | a. Output is overloaded:<br>-- load resistance is too low for voltage range.<br>-- load resistance is too high for current range.<br>b. Low voltage.<br>c. Feedback potentiometer not set correctly.<br>d. Incorrect drive feedback configuration. | a. Check load resistance against suggested feedback signal terminal hookup.<br>b. Check line voltage at terminal board.<br>c. Check feedback calibration procedure. See page 18.<br>d. Check feedback calibration procedure for correct R2 component on terminal board. See page 19. |
| 13. Drive does not reach desired travel limit. | a. Mechanical stop improperly set.<br>b. Physical obstruction, e.g. valve jammed or load exceeds rating of drive. "S" LED on. | a. Check mechanical stop installation and adjustment procedure. See page 11.<br>b. Check operation with Handswitch and remove obstruction. |
| 14. Motor continues running after 68 seconds of stall. | a. Jumper J3/J4 on control board is set to J4 (see Fig. 10, p. 21). | a. Set Jumper J3/J4 to the J3 position. |

# MAINTENANCE

## LUBRICATION

The Group 31 drive is designed so that no field maintenance of the output section is required. The gear train and bearings are permanently lubricated and do not require any relubrication. Field disassembly of the output section is not recommended. If the rotor is removed from the motor it will result in a loss of motor torque that can only be restored by returning the complete output section to the factory to be remagnetized.

## LEVEL 1 MAINTENANCE

**Removal and replacement of:**
**Output section, control module, gasket (or "O" ring), mechanical stop and fuse**

TABLE 3 contains the part numbers of the assemblies and parts that are replaceable on the Group 31 Drive assembly.

**CAUTION:**

**Be sure that the drive is disconnected from the line voltage and auxiliary switches are disconnected from the external power sources before any replacement procedures are begun.**

If replacing the entire output section and the control module, refer to the next section on page 26. If the output section or control module is replaced, it will be necessary to check the setting of the travel limit switches, auxiliary switches and signal calibration. For a Group 31 already installed, refer to Figure 11 and follow the steps below to remove and replace parts or subassemblies from the drive.

1. Disconnect drive from line voltage and auxiliary switches from external power sources.
2. Remove the control module cover.
3. To replace the fuse, remove the fuse cover. Use a small screwdriver to lift the cover off. Remove and replace the fuse and replace the cover.
4. To help protect the internal components, replace the gasket (or "O" ring) if worn or damaged. Remove the gasket being replaced and clean the area. Slide the replacement gasket completely over the output section threads.
5. Disconnect all power and signal wiring from the wiring terminals and ground lugs. Disconnect the six pin connector from the motor plug on the back of the output section casting.

*Continued*

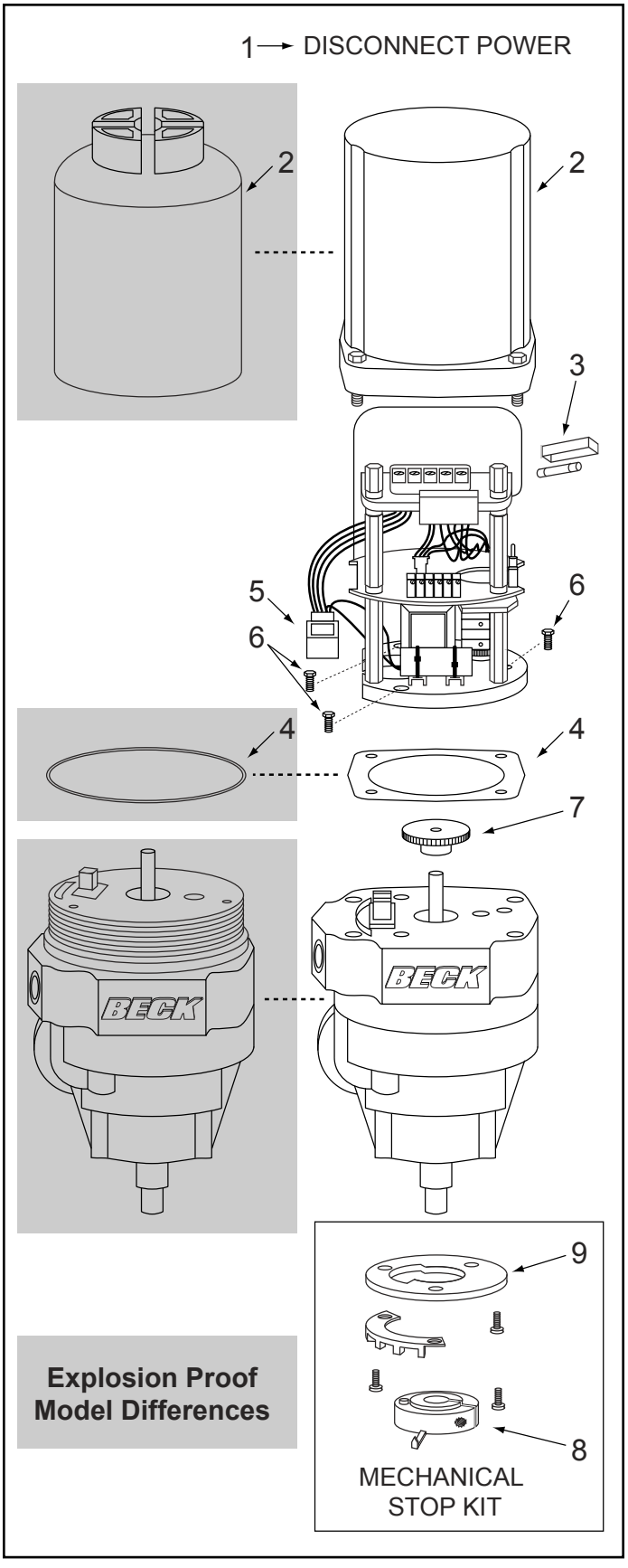



**Figure 11**

## TABLE 3: LEVEL 1 MAINTENANCE REPLACEMENT PARTS

| | | | Standard Model | | | Explosion -proof Model | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model | Timing (sec/90°) | Control Module | Output Section | Cover | Gasket | Output Section | Cover | "O" Ring | Fuse | Optional Stop Kit |
| 31-230 | 18 | 23-2101-01 | 23-2201-02 | 11-0990-20 | 10-8080-02 | 23-2200-06 | 11-0995-05 | 14-9840-08 | n/a | 20-3112-01 |
| 31-250 | 24 | 23-2101-01 | 23-2201-01 | 11-0990-20 | 10-8080-02 | 23-2200-05 | 11-0995-05 | 14-9840-08 | n/a | 20-3112-01 |
| 31-330 | 18 | 23-2101-02 | 23-2201-02 | 11-0990-20 | 10-8080-02 | 23-2200-06 | 11-0995-05 | 14-9840-08 | 13-2230-04 | 20-3112-01 |
| 31-350 | 24 | 23-2101-02 | 23-2201-01 | 11-0990-20 | 10-8080-02 | 23-2200-05 | 11-0995-05 | 14-9840-08 | 13-2230-04 | 20-3112-01 |
| 31-M30 | 18 | 23-2101-03 | 23-2201-02 | 11-0990-20 | 10-8080-02 | 23-2200-06 | 11-0995-05 | 14-9840-08 | 13-2230-04 | 20-3112-01 |
| 31-M50 | 24 | 23-2101-03 | 23-2201-01 | 11-0990-20 | 10-8080-02 | 23-2200-05 | 11-0995-05 | 14-9840-08 | 13-2230-04 | 20-3112-01 |

**LEVEL 1 MAINTENANCE, CONT'D.**

6. Remove the three #10-32 Socket Head screws that hold the control module assembly to the back of the output section. Use 5/32" hex wrench. Lift the control section approximately 1/4 inch and slide sideways away from the output section.
7. Remove the gear from the control section drive shaft. Use a 1/16" hex wrench.
8. Loosen the 3/8-16 socket head screw that holds the stop collar to the drive output shaft. Remove the stop collar. Refer to Mechanical Stop Installation and Adjustment instructions for correct procedure to reinstall and set the stop collar. See page 11.
9. Remove the three 3/8-16 socket head screws that hold the stop plate and position indicator to the output end of the drive. Use a 5/16" hex wrench. Refer to Mechanical Stop Installation and Adjustment instructions for correct procedure to reinstall and set the stop collar. See page 11.

## REPLACING THE OUTPUT SECTION AND THE CONTROL MODULE

1. Position the output section so that the drive Handwheel is in the desired orientation.
2. If the mechanical stop is by means of a pin in the output shaft, turn the Handwheel until the pin is aligned with the slot in the mounting bracket/yoke, with the Handwheel in the desired orientation.
3. Bolt the output section to the bracket/yoke using the three 3/8-16 bolts and torque the bolts to 20 lb-ft.
4. If the mechanical stop design is as described in Step 2, turn the Handwheel clockwise until the mechanical stop pin contacts the bracket. If the optional mechanical stop kit is used, proceed to step 5.
5. Replace the gear on the control shaft and position the top of the gear 3/4" from the output section body. Tighten the gear set screw on the shaft flat. Rotate the gear back and forth slightly as the set screw is tightened to ensure the set screw is perpendicular to the flat.
6. Grasp the cam assembly on the replacement control module and rotate from left to right until the S3 switch lever moves from the low portion of the cam to the high portion of the cam. Maintain this cam position.
7. Slide the cutout section of the control module base plate under the gear on the control module drive shaft and around the electrical connector. Position the bushing that protrudes from the bottom of the base plate in the locating hole on the output section. Install the three #10-32 socket head cap screws and tighten to 36 lb-in. Plug the control module into the output housing.
8. Connect 120 V ac power to the drive and check the travel in the manual mode. Check for clearance between the mechanical stop pin and the bracket/yoke at approximately both ends of travel. This clearance should be equal at both ends of travel. If not, loosen the set screw on the switch-cam shaft gear and reposition cams to make the clearance equal.
9. If the optional mechanical stop kit is used, refer to Mechanical Stop, Installation and Adjustment on page 11.
10. Connect the control signal to the drive and check for proper operation in the automatic mode. If travel direction is not correct with an increasing signal refer to Changing Output Shaft Direction of Travel on page 17.

## LEVEL 2 MAINTENANCE
### (Option 1 parts)

The following parts are replaceable on the Option 1 control module:

| Part Name | Part Number |
|---|---|
| Terminal board | 22-4001-06 |
| Switch | 20-3211-07 |
| Gear, Switch shaft | 14-9940-21 |
| Motor capacitor (60 hz) | 14-2842-02 |
| Motor capacitor (50 hz) | 14-2842-03 |

Refer to Figure 13 and follow the steps required to remove parts from the Option 1 control module. Reverse the steps to replace parts.

**CAUTION:**

**Do not attempt to replace control module parts with the module still mounted on the drive. See page 25, level 1 maintenance, steps 1 through 6, for procedure to remove the module from the drive. Disconnect line voltage and make certain that auxiliary switches are disconnected from external power sources before any replacement procedures are begun.**

If only the motor capacitor is to be replaced, go directly to step 7.

1. Remove four 3/8'' hex standoffs from the terminal board. Use 3/8" hex wrench.
2. Remove terminal shield and disconnect plug P2.
3. Carefully lift the terminal board straight up off the threaded ends of the control module standoffs.
4. Carefully lift the terminal board protective shield off the threaded standoffs.
5. Remove the two #2-56 x 1 1/4" long screws from the cam and switch assembly mounting bracket.
6. Remove the switch to be replaced and disconnect the wires. Before replacing the switch, reconnect the wires. Refer to Figure 12, Option 1 Wiring Diagram, for proper connections.
7. Cut the cable ties holding the motor capacitor to its mounts. Use wire removal tool, Beck part number 20-3600-01, to remove the two capacitor wires from the six position plug. Insert wires from replacement capacitor into the six position plug. Refer to Figure 12, Option 1 Wiring Diagram, for proper wire locations. Place capacitor on mounts and secure with two cable ties.

### Option 1 Wiring Diagram

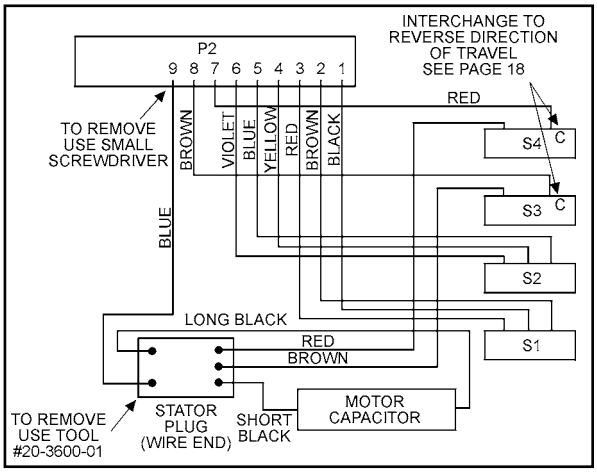



**Figure 12**

### Option 1

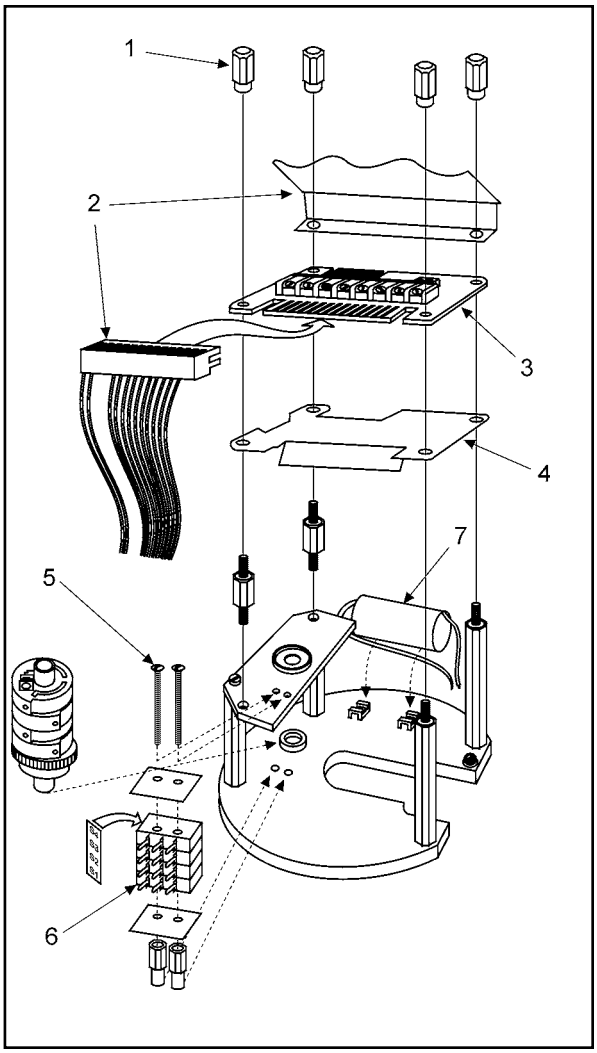



**Figure 13**

**Option 2 & 3**

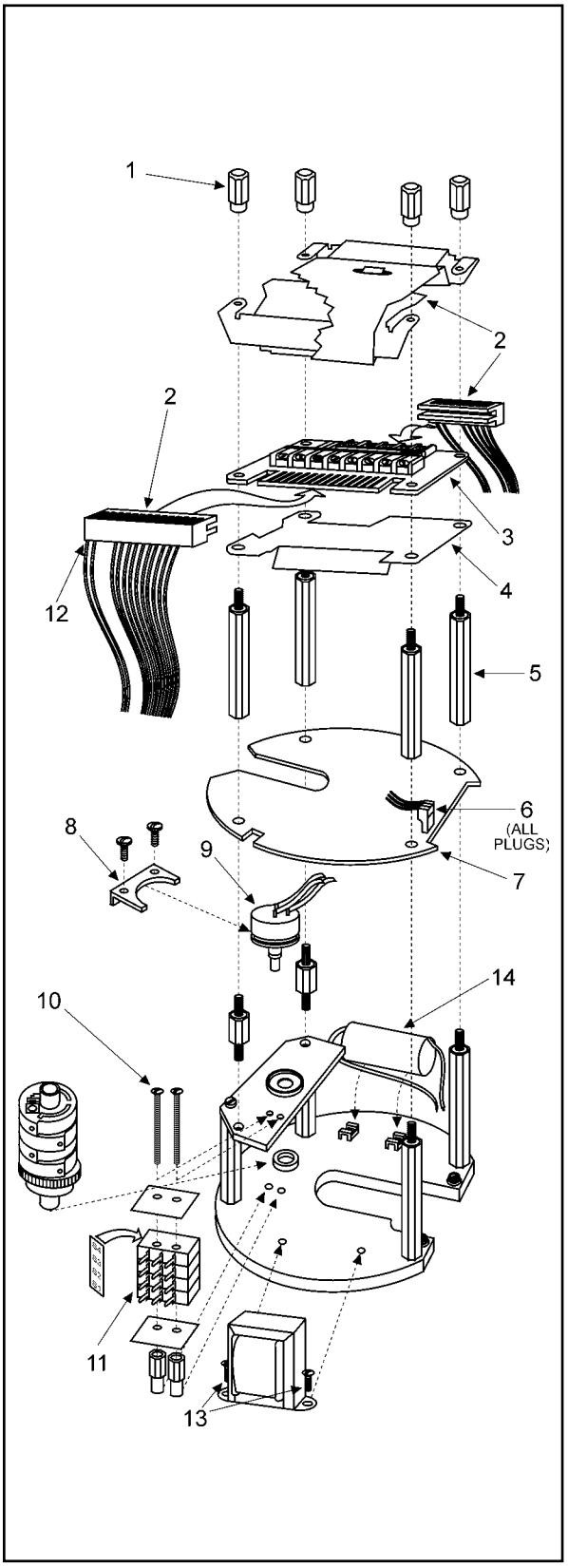



**Figure 14**

## LEVEL 2 MAINTENANCE
### (Option 2 and 3 parts)

The following parts are replaceable on the Options 2 and 3 control module:

| Part Name | Option 2 Part No. | Option 3 Part No. |
|---|---|---|
| Terminal board | 22-4001-07 | 22-4001-13 |
| Control board | 22-4001-03 | 22-4001-17 |
| Switch | 20-3211-07 | 20-3211-07 |
| Gear, Switch shaft | 14-9940-21 | 14-9940-21 |
| Motor capacitor (60 hz) | 14-2842-02 | 14-2842-02 |
| Motor capacitor (50 hz) | 14-2842-03 | 14-2842-03 |
| Feedback potent. | 20-3062-03 | 20-3062-03 |
| Transformer | 13-1810-14 | 13-1810-14 |

Refer to Figure 14 and follow the steps required to remove parts from the Options 2 and 3 control module. Reverse the steps to replace parts.

**CAUTION:**

**Do not attempt to replace control module parts with the module still mounted on the drive. See page 25, level 1 maintenance, steps 1 through 6, for procedure to remove the module from the drive. Disconnect line voltage and make certain that auxiliary switches are disconnected from external power sources before any replacement procedures are begun.**

If only the motor capacitor is to be replaced, go directly to step 14.

1. Remove four 3/8" hex standoffs from the terminal boards. Use 3/8" hex wrench.
2. Remove terminal shields and disconnect plugs P1 and P2.
3. Carefully lift the terminal board straight up off the threaded ends of the control board standoffs.
4. Carefully lift the terminal board protective shield off the threaded standoffs.
5. Remove four 3/8" hex standoffs from the control board. Use 3/8" hex wrench.
6. Disconnect plugs P1, P2, P3, P4, P8, and P9 from the control board. See Figures 15 and 16, Option 2 and 3 Wiring Diagram, for correct location to reconnect plugs.

*Continued on page 30*

## Option 2 Wiring Diagram

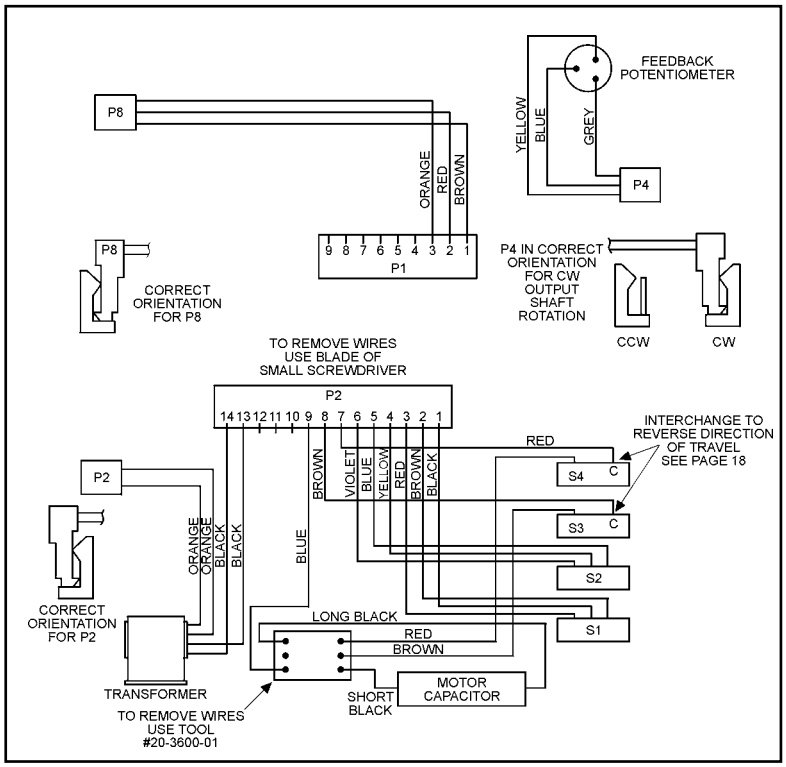



**Figure 15**

## Option 3 Wiring Diagram

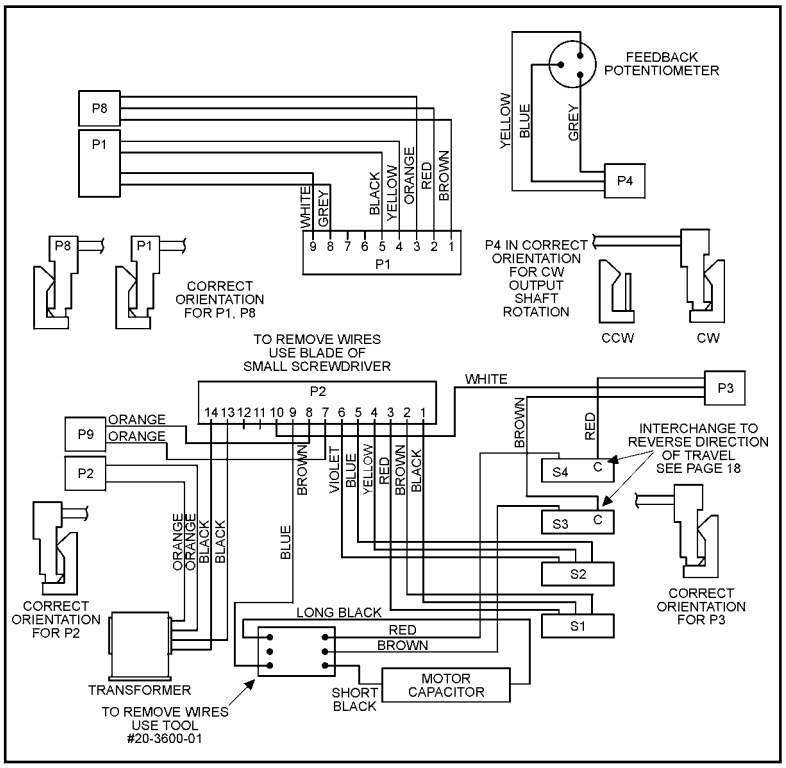



**Figure 16**

**LEVEL 2 MAINTENANCE, CONT'D.**

7. Carefully lift the control board straight up off the threaded ends of the control module standoffs.
   If the transformer is to be replaced go directly to step 12.
8. Remove the two #4-40 x 5/16" long screws and clamp that holds the feedback potentiometer to the cam and switch assembly mounting bracket.
9. Pull the potentiometer assembly straight up out of the switch shaft.
10. Remove the two #2-56 x 1 1/4" long screws from the cam and switch assembly mounting bracket.
11. Cut the cable tie holding the switch and transformer wires to the control module standoff. Remove the switch to be replaced and disconnect the wires. Before replacing the switch, reconnect the wires. Refer to Figures 15 and 16, Option 2 and 3 Wiring Diagram, for proper wire connections. IMPORTANT: Switch and transformer wires must be properly secured to the control module standoff to prevent interference with the control module cover.
12. Cut the cable tie holding the switch and transformer wires to the control module standoff. Remove the two black transformer wires from plug P2. To remove, insert the blade of a small screwdriver into the slot on the plug opposite the wire entrance. This will release a tang holding the wire termination into the plug. See Figures 15 and 16, Option 2 and 3 Wiring Diagram, for correct location to replace wires. IMPORTANT: Switch and transformer wires must be properly secured to the control module standoff to prevent interference with the control module cover.
13. Remove the two #80-32 x 1/4" long screws holding the transformer to the control module base.
14. Cut the cable tie holding the motor capacitor to its mounts. Use wire removal tool, BECK part number 20-3600-01, to remove the two capacitor wires from the six position plug. Refer to Figures 15 and 16, Option 2 and 3 Wiring Diagram, for proper wire locations. Replace capacitor on mounts and secure with two cable ties.

## LEVEL 3 MAINTENANCE

### Removal and replacement of output section parts.

The following parts are replaceable on the Output Section:

| Part Name | Part Number |
|---|---|
| Handwheel shear pin | 30-0314-38 |
| Output shaft seal | 15-1440-04 |
| Handwheel shaft seal 5/16 ID | 15-1440-06 |
| Control module shaft seal | 15-1440-03 |
| Output shaft stop pin | 30-0314-39 |

**NOTE: Field disassembly of the output section beyond what is described below is not recommended. If the rotor is removed from the motor it will result in a loss of motor torque that can only be restored by returning the complete output section to the factory to be remagnetized.**

Refer to Figure 17 and follow the steps required to remove parts from the Output Section. Reverse the steps to replace parts.

**CAUTION:**

**Disconnect line voltage and make certain auxiliary switches are disconnected from external power sources before any of the following procedures are begun. See page 25, level 1 maintenance, for instructions to remove the control module cover, control module and output section parts.**

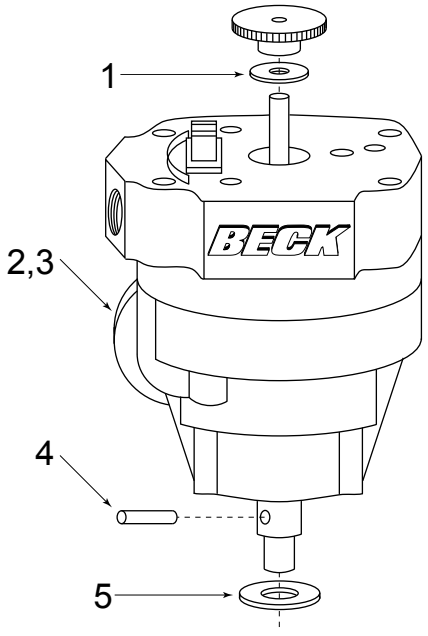
1. Remove the Control Module shaft seal by pushing a small blade screwdriver along the shaft and under the seal lip. Pry up the seal and force it out of the housing. CAUTION: The seal is only 1/8 inch wide. Do not force the screwdriver blade beyond the width of the seal; damage to the shaft bearing could result. Wipe the shaft and housing bore clean before replacing the seal. To replace, slide the seal over the shaft, with the closed side facing out, and press the seal into the housing.

2. To remove the Handwheel, lightly tap the shear pin out of the Handwheel and shaft using a hardened 3/32 diameter drive pin. Pull the Handwheel off the shaft.

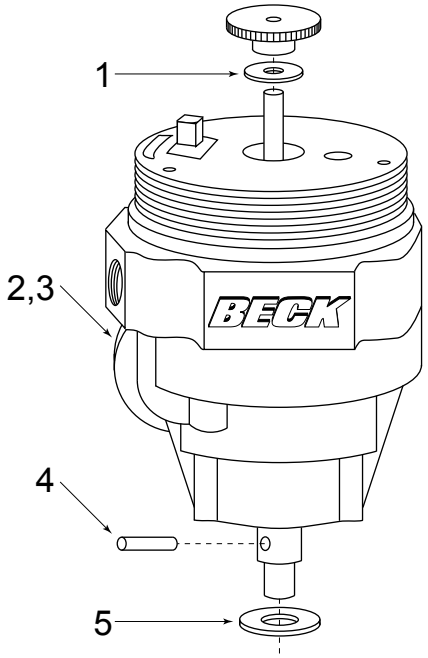
**NOTE: Support the Handwheel shaft to prevent bending.**

If the Handwheel pin has sheared, pull the Handwheel off the shaft then tap the shear pin parts out of the shaft and Handwheel. Remove any burrs from the shaft. Place the Handwheel on the shaft and align the pin holes in the Handwheel with the hole in the shaft. Lightly tap the pin through the Handwheel and shaft using the 3/32 drive pin.

3. Remove the Handwheel shaft seal by pushing a small blade screwdriver along the shaft and under the seal lip. Pry up on the seal and force it out of the housing. Wipe the shaft and housing bore clean before replacing the seal. To replace, slide the seal over the shaft, with the closed side facing out, and press the seal into the housing.
4. To remove the stop pin, drive the pin out of the shaft using a hardened 3/16 diameter drive pin. (The stop pin is held in the shaft with an adhesive. It may be necessary to heat the shaft to loosen the adhesive.) To replace the pin, clean the hole and bond the stop pin with an adhesive such as Loctite 640.
5. Remove the output shaft seal by pushing a small blade screwdriver along the shaft and under the seal lip. Pry up on the seal and force it out of the housing. CAUTION: The seal is only 1/4 inch wide. Do not force the screwdriver blade beyond the width of the seal; damage to the shaft bearing could result. Wipe the shaft and housing bore clean before replacing the seal. To replace, slide the seal over the shaft, with the closed side facing out, and press the seal into the housing.




**STANDARD MODEL**




**EXPLOSION PROOF MODEL**

**Figure 17**

# MAINTENANCE

## RECOMMENDED SPARE PARTS

It is recommended that certain replacement parts be stocked for quick availability in the event that service of your Beck control drive is required. The types of parts are listed in TABLE 4.

## HOW TO ORDER SPARE PARTS

Select the needed parts from the spare parts list given below. Specify the drive's model/serial number given on the nameplate to allow the factory to verify the part selection. Parts may be ordered by mail, telephone or fax, with the confirming order sent to the factory (see back cover).

### TABLE 4: RECOMMENDED SPARE PARTS

| Drive Configuration | | | | | |
|---|---|---|---|---|---|
| Beck Drive Model No. | Control Option | Control Module | Cover Gasket (Standard Drive) | "O" Ring (Explosion Proof Drive) | Fuse |
| 31-230<br>31-250 | 1 | 23-2101-01 | 10-8080-02 | 14-9840-08 | NONE |
| 31-330<br>31-350 | 2 | 23-2101-02 | 10-8080-02 | 14-9840-08 | 13-2230-04 |
| 31-M30<br>31-M50 | 3 | 23-2101-03 | 10-8080-02 | 14-9840-08 | 13-2230-04 |

# WARRANTY

## THREE YEAR LIMITED WARRANTY STATEMENT

Harold Beck & Sons, Inc. (Beck) warrants that our equipment shall conform to Beck's standard specifications. Beck warrants said equipment to be free from defects in materials and workmanship. This warranty applies to normal recommended use and service for three years from the date on which the equipment is shipped. Improper installation, misuse, improper maintenance, and normal wear and tear are not covered.

The Buyer must notify Beck of any warranty issues within 37 months of original shipment date and return the goods in question, at Buyer's expense, to Beck for evaluation. If the product fails to conform to the warranty, Beck's sole obligation and the Buyer's exclusive remedy will be: 1) the repair or replacement, without charge, at Beck's factory, of any defective equipment covered by this warranty, or 2) at Beck's option, a full refund of the purchase price. In no event will Beck's liability exceed the contract price for the goods claimed to be defective.

**THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTY, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ALL OTHER OBLIGATIONS OR LIABILITIES OF BECK. In no case shall Beck be liable for any special, incidental or consequential damages based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory. Such damages include, but are not limited to, loss of profits, loss of revenue, loss of use of the equipment or any associated equipment, cost of capital, cost of any substitute equipment, facilities or service, downtime, the claims of third parties including customers and injury to property.**

Buyer acknowledges its responsibilities under OSHA, related laws and regulations, and other safety laws, regulations, standards, practices or recommendations that are principally directed to the use of equipment in its operating environment. Buyer acknowledges that the conditions under which the equipment will be used, its use or combination with, or proximity to, other equipment, and other circumstances of the operation of such equipment are matters beyond Beck's control. **Buyer hereby agrees to indemnify Beck against all claims, damages, costs or liabilities (including but not limited to, attorney's fees and other legal expenses), whether on account of negligence or otherwise, except those claims based solely upon the negligence of Beck and those claims asserted by Beck's employees which arise out of or result from the operation or use of the equipment by Beck's employees.**


Beck Control Drives are covered by the following patents: 3,667,578; 4,690,168; 6,563,412 B2; and 6,639,375 B2 with other patents pending.

# INDEX



## LIST OF FIGURES



## LIST OF TABLES

# NOTES:

# SERVICES

## PRODUCT DEMONSTRATIONS

Each of Beck's Sales Engineers has access to a complete set of drive models so that he can demonstrate virtually any of their features at your location. In order to arrange to see a Beck drive in your plant or office, contact Beck's Sales Department.

## SITE SURVEYS

Beck Sales Engineers are available to discuss your process control requirements. Often a visit to your location is the best way to gain a thorough understanding of your needs, in order to meet them most accurately and completely.

Mounting hardware, torque requirements, linkage, control signal information, and optional equipment can be analyzed most effectively at the worksite. Beck's analysis at the jobsite can help ensure that specifications are accurate, especially in the case of complex applications.

## APPLICATION REVIEWS

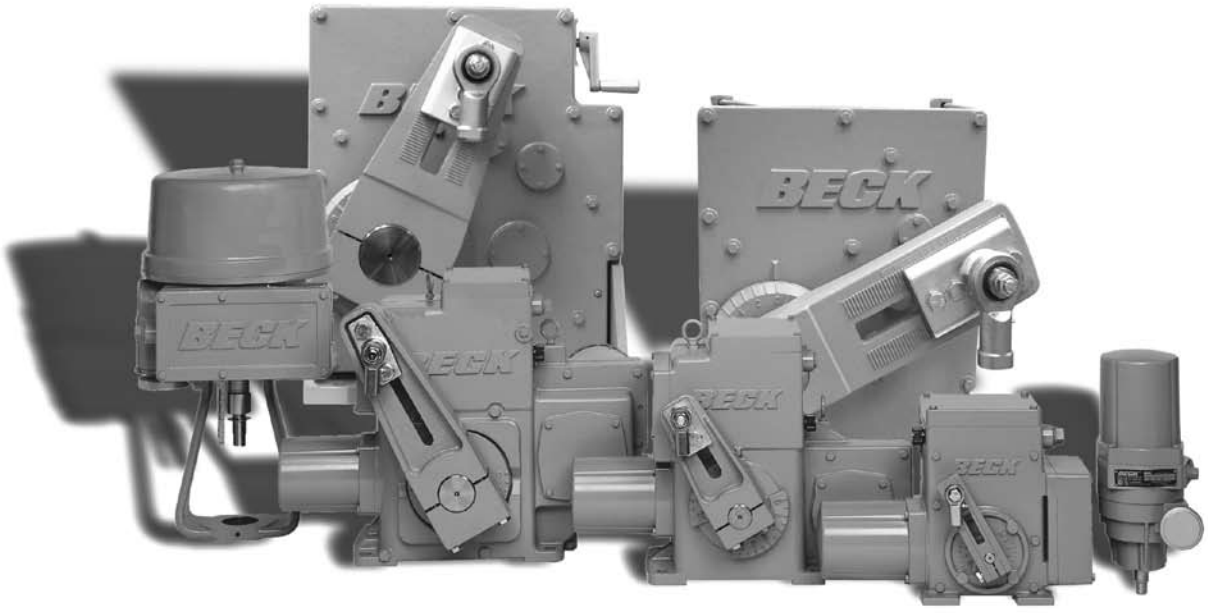
By sharing your needs with a Beck Sales Engineer you can take advantage of the best application advice for the type of control you need. This review will yield a better understanding of the versatility of Beck drives for your installations, as well as complete details on options and accessories to make the process as effective as possible.

## SPECIFICATION WRITING

Beck provides specification writing assistance in order to help you specify and order the right drives for your applications. Beck Sales Engineers will work with you to make it easier for you to obtain the proper equipment and give you confidence that no details are overlooked.

## HOW TO OBTAIN SERVICE

Factory repair of drives or subassemblies is available for both normal and emergency service. To assure prompt processing, contact the factory to receive a Returned Material Authorization (RMA) number. If a repair estimation is desired, please send the name and phone number of your contact for service authorization. It is helpful to include a description of the work desired with the shipment or, in the event of a problem, the malfunction being experienced.

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10/07