EMPLOYEE RESPONSE SHEET

I acknowledge that I have read the operating instructions for the equipment and controls provided by Clarke’s Sheet Metal, Inc. of Eugene, Oregon. I further acknowledge that I understand these instructions and have had the opportunity to ask questions and have received answers to my best understanding and satisfaction.

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</table>

It is the sole responsibility of the Owner and/or the Responsible Supervising Operators of this equipment to properly instruct their employees, either direct or contact, in the safe and proper operation of this equipment.
INTRODUCTION

This manual contains instructions for the installation, operation and maintenance of Clarke's equipment. Reliable operation, safety and long service life of this equipment depends on three important considerations.

1. The care exercised during installation.
2. The quality, frequency of maintenance and periodic inspection.
3. A common sense approach to its operation.

This equipment and its components have been designed for a specific duty. The material to be conveyed, dimensions, magnet assembly and operating conditions are the facts under which this equipment has been prepared. Within limits it is designed with an adequate safety factor, but its use is intended for a specific design and should not be used otherwise; or if so used, at the owner's own responsibility.
## SAFETY INFORMATION

<table>
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<tr>
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<td>3.0</td>
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</tr>
</tbody>
</table>
1.0 SAFETY NOTICE

This manual contains instructions for the operation and maintenance of Clarke's equipment. Reliable operation, safety, and long service life of this equipment depends on three important considerations:

1. The care exercised during installation.
2. The quality and frequency of maintenance and periodic inspection.
3. A common sense approach to its operation.

There is always a safety hazard around operating machinery, especially for untrained personnel. Management and their delegated safety supervisors should train their operating and maintenance personnel to observe the safety precautions as set forth in this Manual.

Listing all safety hazards is impossible, but the primary precautions for safe operation are set forth in the Manual.

**CLARKE'S SHEET METAL, INC. CANNOT BE HELD RESPONSIBLE FOR ANY ACCIDENT.**

The precautions listed may not necessarily be all-inclusive and others might occur to the user which are peculiar to a particular operation or industry. In addition, nearly all employees are now subject to the Federal Occupational Safety and Health Act of 1970, as amended, which will continue to be issued under its authority.

At all times this equipment must be operated in accordance with the instructions and precautions in this manual and on the caution plates attached to the equipment. Only persons completely familiar with the instructions and precautions in the manual should be permitted to operate the unit. The operator should thoroughly understand these instructions and precautions before attempting to operate this equipment.

**NOTICE: FAILURE TO OBSERVE AND FOLLOW THES PRECAUTIONS MAY RESULT IN SERIOUS PERSONAL INJURY OR PROPERTY DAMAGE!**
CAUTION

1. **ALWAYS** operate unit accordance with instructions in this manual.
2. **DO NOT** open inspection doors while unit is in motion.
3. **NEVER** work on unit and related components unless electrical power and motor drive has been locked out and tagged.

**NOTE:** The National Electrical Code requires a manually operable disconnect switch located within sight of motor, or a controller disconnecting means capable of being locked if not in sight of the motor.

4. **DO NOT** put unit to any other use than for which it was designed.
5. **AVOID** poking or prodding into unit openings with a bar or stick.
6. **ALWAYS** have a clear view of unit loading and unloading points and all safety devices.
7. **KEEP** area around the unit, drive and control station free of debris and obstacles.
8. **NEVER** operate unit without guards and all safety devices in position and functioning.
9. **ALWAYS** allow unit to stop naturally. **DO NOT** attempt to artificially break or slow motion of unit.
10. **CAUTION** signs should be attached near all mill openings and service panels.


2.0 SAFETY PRECAUTIONS

GENERAL

Operating machinery always presents a hazard to the safety of personnel who must operate or move among the machines. This is especially true for personnel who are untrained, inexperienced or just passing through the area. Therefore it is the responsibility of management and the safety supervisor to train or instruct all personnel who will come into contact with these units in the proper safety procedures.

Operating and maintenance personnel should be thoroughly trained in the Safety Procedures governing their areas of responsibility.

All personnel should be trained to THINK SAFETY and PRACTICE SAFETY. The following Safety Precautions should be observed during the operation or maintenance of these units.

INSTALLATION

1. Anchor the machine to a suitable and level foundation.
2. Equip infeed system to assure proper flow of material.

OPERATION

1. DO NOT allow personnel to climb or walk on the unit or its drive, inlet or discharge equipment.
2. DO NOT allow personnel to operate product-actuated safety switches by hand/manual means.
3. DO NOT allow personnel to stand or pass between components that close together.
4. Keep hand, heads, feet, etc., and tools clear of product inlet and outlet chutes and drive components of operational units. Never unlock or open the cover on a unit that is operational.
5. Ensure that all personnel and tools are clear of working areas of the unit before placing in operation.
6. DO NOT operate machines with safety guards removed.

MAINTENANCE

1. Keep hand and tools away from rotors until the electrical drive motors has been locked out and the rotor has been blocked to prevent rotation.
2. Assure that material feed equipment is shut down to prevent operation and accidental delivery of material.
3. If the upper housing MUST be in a raised position, block or support it to prevent its accidental lowering.
4. Before working on any component of the unit, assure that it has been adequately blocked or supported.
5. Before restarting the unit, clear all tools and equipment away and ensure all personnel are clear of the unit and drive. Replace drive guard.

SAFETY HAZARDS

1. Mark or code all machine or floor areas with the appropriate methods that are a hazard to personnel.
2. Place appropriate warning signs or lights where necessary to indicate a hazard to personnel moving through the area.
3. Place appropriate guards or barriers, etc., to prevent personnel from coming into contact with hazardous components of a machine or its area of operation.
IT IS EXTREMELY IMPORTANT THAT THE FOLLOWING PRECAUTIONS BE FOLLOWED TO PREVENT PERSONAL OR PROPERTY DAMAGE:

1. Only persons properly trained and familiar with the equipment should be permitted to operate or perform maintenance.
2. **LOCK OFF ALL POWER** prior to any inspection or any maintenance.
3. **PERIODICALLY** check for vibration, loose fasteners, noise, and bearing and drive temperatures.
4. **NEVER** walk on equipment or drive.
5. **DO NOT** place hands, head, feet, or clothing in openings, drive components.
6. **ALWAYS** keep a clear view discharges and all safety devices.

Familiarize yourself with the control devices and the electrical start-up sequence of your system.
3.0 SAFETY INSTRUCTIONS

1. The PowerReset Abort gate should be thoroughly inspected before installation. **Check** for any damage that may have occurred during shipping.

2. **Check** for proper installation, making sure no binding or distortion has occurred.

3. **Check** all bolts for tightness and check blade and shaft assembly to make sure it operates freely.

4. Clean and **check** scale or rust off magnet surface or matching plate.

**Any abort gate is a part of a system or is used in conjunction with other equipment such as dust collectors, screw conveyors, etc. In connecting ducting or other equipment to the abort gate, care should be taken in positioning the blade in the upright position.**

**Familiarize yourself with the control devices and the electrical start-up sequence of your system. Proper sequence is always to start the last piece of equipment in the system first.**
## START UP AND OPERATING INSTRUCTIONS

<table>
<thead>
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<th>Section</th>
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<tbody>
<tr>
<td>1.0</td>
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</tr>
<tr>
<td>2.0</td>
<td>Operating Instructions</td>
<td>9</td>
</tr>
</tbody>
</table>
1.0 INSTALLATION NOTES

1. The HiSpeed™ PowerReset Abort Gate must be supported and have an access platform for ease of maintenance, etc.

2.0 OPERATION

1. The blade should always be in the raised position during normal operation. The Electro-Magnet that releases the blade can be de-energized manually or by a signal from the Clarke’s PyroGuard Spark Suppression System.

2. To reset blade, press raise button on control panel and hold until upward motion stops. When blade is lifted to raised position and firmly seated against upper seal, the magnet must be firmly seated to contact plate. If proper contact cannot be achieved, the magnet assembly must be adjusted up or down for correct positioning. After securing blade, release raise button and linear actuators will automatically return to retracted position. Inspect gate to be sure that the blade is secured in UP position and that the linear actuators have fully retracted. Gate is now ready to resume operation.

CAUTION: Stay clear of all moveable parts during and after resetting procedure.
### MAINTENANCE INSTRUCTIONS

<table>
<thead>
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<th>Section</th>
<th>Description</th>
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<tbody>
<tr>
<td>1.0</td>
<td>Maintenance Information</td>
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<td><em>(Refer to attached Manufacturer's recommendations)</em></td>
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<tr>
<td>2.0</td>
<td>Parts/Lubrication Drawing</td>
<td>12</td>
</tr>
<tr>
<td>3.0</td>
<td>Limit Switch Information Drawing</td>
<td>13</td>
</tr>
<tr>
<td>4.0</td>
<td>Electrical Schematic</td>
<td>14</td>
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<td><em>(Refer to attached Manufacturer's recommendations)</em></td>
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</table>
1. **Seals:**

The **HiSpeed™** PowerReset Abort Gate blade is designed to be sealed. Replacement seals are available at Clarke's.

**General:**

The interior of **HiSpeed™** PowerReset Abort Gate should be checked for material build-up that may restrict operation.

**NOTE:** IT IS IMPORTANT THAT THE AREA WHERE BLADE SEALS TO LID BE INSPECTED AND CLEANED ON A REGULAR BASIS TO ALLOW BLADE TO SEAL PROPERLY.

FAILURE TO CLEAN BLADE/LID SEAL GROOVE COULD CAUSE DISTORTION OF BLADE/SHAFT/LIFTING ARM ASSEMBLY AS WELL AS PREVENT MAGNET FROM MAKING CONTACT WITH PLATE ON BLADE.

Also inspect and clean magnet and contact plate. The torsion springs at each end of the blade shaft should be checked periodically for fractures. Replacement springs are available through Clarke's.

**Operation of the abort gate should be tested on a regular basis.**

The frequency of testing should be based on the particular application of the Abort Gate. An Abort Gate in a system that has the potential for material buildup within the confines of the Abort Gate should be tested more frequently than an Abort Gate that would be handling the relatively clean air of a return air duct.

There may be other local or plant site considerations that dictate the frequency of testing necessary for the Abort Gate and those considerations should be examined and the frequency of testing should then be implemented by the management of the plant.

Where material buildup within the Abort Gate becomes a possibility, Clarke’s Sheet Metal, Inc. recommends testing the Abort Gate on a weekly basis until a pattern has been developed regarding the potential for the buildup of material and the affect it may have on the operation of the Abort Gate.

Testing of the Abort Gate that is not susceptible to material buildup within the Abort Gate may be done less frequently on a monthly basis. The management of the plant site may be able to refine the frequency of the testing based on the findings of the initial testing in the early stages of the operation of the system.
Position indicating switches are located at the abort gate.

Purpose: for the remote indication of the abort gate position.

Typical usage: to notify the plant personnel of the abort gate activation.

1 2
3 4

Must be the same polarity

Aborting gate position indicating the switch indicating light
4.0 MAGNA LATCH CONTROL PANEL SCHEMATIC

HiSpeed Power Reset Abort Gate

FOR ABORT GATES WITH SINGLE MAGNET

CP-06 THRU CP-45

Hoffman A-1212 CHNF ENCLOSURE

WIRE NUMBERS

1. L1
2. Abort Test
3. Abort Signal

4. "Armed" Limit Switch
5. "Abort" Limit Switch
6. Light illuminated when abort gate is armed
7. For customer use: abort gate armed
8. Raise
9. Light illuminated when abort gate is aborted
10. For customer use: abort gate aborted

11. Refract
12. Extend
13. Motor

14. Terminal #18
15. S1
16. For customer use: actuator retracted
17. Limit Switch
18. CNO
INSTRUCTIONS OF 110-C ELECTROMAGNETS

The 110-C electromagnets are designed to be operated by applying 110-120 volts direct current (DC) to the black and white wires of the power cord and connecting the green wire to a suitable ground. This magnet may be used for continuous operation. If you require the magnet to be used in any other application with parameters other than those listed, consult our engineering department for assistance.

OPERATING PARAMETERS:

INPUT VOLTAGE: 100-120 VOLTS DC
DUTY CYCLE: CONTINUOUS
MAXIMUM 'ON' CYCLE: UNLIMITED
MAXIMUM TEMPERATURE RISE: 45 DEG. F. TO A MAXIMUM OF 140 F.

MAINTENANCE INSTRUCTIONS:

Electromagnets require very little maintenance to provide a long useful life. Daily use of a shop towel to wipe the magnetic face of the magnet free of debris, grease and oil or other foreign matter will ensure years of service life and thousands of safe lifts.

The lifting capacity is greatly reduced when the face of the magnet is dirty. Use care when handling the magnet so as not to nick or mar the lifting service. If the face becomes heavily worn, lightly surface grind a few thousandths off the face to clean up the lifting surface.

This electromagnet is equipped with a quick-disconnect power cord. Be sure the locking ring is securely tightened. Never try to remove the male receptable mounted in the magnet. Should you do this, you will destroy the magnet and it will require rebuilding or replacement.

IF YOU HAVE ANY QUESTIONS ABOUT THIS MAGNET OR THE CORRESPONDING DC POWER SUPPLY, PLEASE CALL OUR ENGINEERING DEPARTMENT FOR ASSISTANCE: 541-343-3395.

REMEMBER, ALL LIFTING DEVICES SHOULD BE USED WITH CARE. DON'T ALLOW ANYONE TO BE UNDER THE OBJECT BEING LIFTED.
THE FOLLOWING IS THE PROCEDURE TO REPLACE THE SILICONE SEAL ON THE CLARKE'S HiSPEED Abort Gates. The seal is located in a channel trough on the underside of the abort gate top. The S-100 3/16" x 1" adhesive backed silicon foam rubber strip should be used in this application. Two (2) layers of the silicon rubber strip are used to make up the seal.

1. Remove the existing seal from the trough located on the underside of the abort gate top.
2. The contact surface for the new seal must be free of silicone caulking and clean to the bare metal.
3. Cut the new 3/16" x 1" adhesive backed silicon foam rubber strip to the appropriate lengths for both the first and second layers. These pieces need to be cut a little longer than required, as they tend to shrink when the paper is removed. Stagger the corners so that the seams are lapped and not located on top of one another.
4. With the seal trough clean, apply a bead of caulking where the seal will adhere to the bare metal.
5. For the first layer, remove the paper protecting the adhesive back and press the seal into the channel trough where the caulking has been applied. Trim ends of seal as required.
6. Once the first layer of seal has been installed in the channel trough around the perimeter of the opening, apply a bead of silicone caulking over the face of the foam rubber strip.
7. The second layer of seal can now be applied in the same manner as outlined above, taking care to lap the seams.
8. Once the second layer of seal has been installed over the first layer, apply a bead of silicone caulking on the outside edges to adhere the seal to the metal.

![Diagram of seal installation process]

**STEP:**
1. Bead of caulk
2. 1” Wide x 3/16” Strip-N-Stick
3. Bead of caulk
4. 1” Wide x 3/16” Strip-N-Stick
5. Caulk outside edges all the way around
GENERAL SAFETY RULES

SAFETY NOTICE

This manual contains instructions for the operation and maintenance of Clarke’s equipment. Reliable operation, safety and long service life of this equipment depends on three important considerations.

1. The care exercised during installation.
2. The quality and frequency of maintenance and periodic inspection.
3. A common sense approach to its operation.

This system and its components have been designed for a specific duty. Within limits this system is designed with an adequate safety factor, but its use is intended for a specific duty and should not be use otherwise.

There is always a safety hazard around operating machinery, especially for untrained personnel. Management and their delegated safety supervisors should train their operating and maintenance personnel to observe the safety precautions set forth in this Manual.

CLARKE’S SHEET METAL, INC. CANNOT BE HELD RESPONSIBLE FOR ANY ACCIDENT.

The precautions listed may not necessarily be all-inclusive and others might occur to the user which are peculiar to a particular operation or industry. In addition, nearly all employees are subject to the Federal Occupational Safety and Health Act of 1970, as amended, which will continue to be issued under its authority.

At all times this equipment must be operated in accordance with the instructions and precautions in this manual and on the caution plates attached to the equipment. Only persons completely familiar with the instructions and precautions in the manual should be permitted to operate the unit. The operator should thoroughly understand these instructions and precautions before attempting to operate this equipment.

NOTICE: FAILURE TO OBSERVE AND FOLLOW THESE PRECAUTIONS MAY RESULT IN SERIOUS PERSONAL INJURY OR PROPERTY DAMAGE.

1. ALWAYS operate unit in accordance with instructions in this manual.
2. NEVER work on unit and related components unless electrical power and motor drive has been locked out and tagged.

NOTE: The National Electrical Code requires a manually operable disconnect switch located within sight of the motor, or a controller disconnecting means capable of being locked if not in the motor.

3. DO NOT put unit to any other use than for which it was designed.
4. AVOID poking or prodding into unit openings with a bar or stick.
GENERAL SAFETY RULES

5. **ALWAYS** have a clear view of unit loading and unloading points and all safety devices.
6. **KEEP** area around the unit, drive station free of debris and obstacles.
7. **NEVER** operate unit without all safety devices in position and functioning.
8. **ALWAYS** allow unit to stop naturally. **DO NOT** attempt to artificially break or slow motion of unit.
9. **CAUTION** signs should be attached near all service panels.

GENERAL

Operating machinery always presents a hazard to the safety of personnel who must operate or move among the machines. This is especially true for personnel who are untrained, inexperienced or just passing through the area. Therefore it is the responsibility of management and the safety supervisor to train or instruct all personnel who will come into contact with these units in the proper safety procedures.

Operating and maintenance personnel should be thoroughly trained in the Safety Procedures governing their areas of responsibility.

All personnel should be trained to THINK SAFETY and PRACTICE SAFETY. The following Safety Precautions should be observed during the operation or maintenance of these units.

INSTALLATION

1. Anchor the machine to a suitable and level foundation.

OPERATION

1. **DO NOT** allow personnel to climb or walk on the unit or its drive.
2. **DO NOT** allow personnel to operate limit switches by hand or manual means.
3. **DO NOT** allow personnel to stand or pass between components that close together.
4. Keep hands, head, feet, etc., and tools clear of product inlet and outlet chutes and drive components of operational units.
5. Ensure that all personnel and tools are clear of working areas of the unit before placing in operation.

MAINTENANCE

1. Keep hands, tools away from moving parts until the electrical drive motors has been locked out.
2. Before working on any component of the unit, assure that it has been adequately blocked or supported.
3. Assure that material feed equipment is shut down to prevent operation and accidental delivery of material.
4. Before restarting the unit, clear all tools and equipment away and ensure all personnel are clear of the unit and drive.
GENERAL SAFETY RULES

SAFETY HAZARDS

1. Mark or code all machine or floor areas with the appropriate methods that are a hazard to personnel.
2. Place appropriate warning signs of lights where necessary to indicate a hazard to personnel moving through the area.
3. Place appropriate guards or barriers, etc., to prevent personnel from coming into contact with hazardous components of a machine or its area of operation.

IT IS EXTREMELY IMPORTANT THAT THE FOLLOWING PRECAUTIONS BE FOLLOWED TO PREVENT PERSONAL OR PROPERTY DAMAGE:

1. Only persons properly trained and familiar with the equipment should be permitted to operate or perform maintenance.
2. **LOCK OFF ALL POWER** prior to any inspection or any maintenance.
3. **PERIODICALLY** check for vibration, loose fasteners, noise, and bearing and drive temperatures.
4. **NEVER** walk on equipment or drive.
5. **DO NOT** place hands, head, feet, or clothing in openings, drive components
6. **ALWAYS** keep a clear view discharges and all safety devices.

Familiarize yourself with the control devices and the electrical start-up sequence of your system.
CP-45 Powered Re-Set Abort Gate

CUSTOMER: ________________________________________________________________

LOCATION: ________________________________________________________________

SERIAL NUMBER: ____________________________________________________________

SO NO. _______ FS NO. ___________ DWG. NO. ________________________

1. SET COLLAR: (3) Req’d. 2 7/16” φ Solid Steel Set Collar
2. CONTACT PLATE: (1) Req’d. Clarke’s # AG00120
3. LIMIT SWITCH: (3) Req’d. Eaton # E50-AR1
4. SWITCH LEVER ARM: (3) Req’d. Eaton # E50-KL538 ARM
5. SWITCH SOCKET: (1) Req’d. Idec SR2P-06
6. SWITCH ENCLOSURE: (1) Req’d. SCE # A-606 CHNF
7. MLC: (1) Req’d. Clarke’s # 9009-00012
8. MAGNET: (1) Req’d. Clarke’s # 9009-00001-110 Volt DC
9. SEAL: (1) Req’d. Boyd 3/16” x 1” Strip-n-Stick
10. ACTUATOR: (1) Req’d. Duff Norton WSPA6415-18, 110VAC
11. BEARINGS: (2) Req’d. Dodge Type “SC” 2 7/16”, (4) Bolt Flange
## Component Part List

### CP-45 HiSpeed Abort Gate

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QTY</th>
<th>NAME</th>
<th>MFG</th>
<th>DESCRIPTION/MFG #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>ACTUATOR</td>
<td>DUFF-NORTON</td>
<td>WSPA6415-18 110 VAC</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>BEARING</td>
<td>DODGE</td>
<td>SC 2 7/16” DIA. 4-BOLT FLANGE</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>LIMIT SWITCH</td>
<td>EATON</td>
<td>E50-AR1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>LIMIT SWITCH ARM</td>
<td>EATON</td>
<td>E50-KL538</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>RUBBER BUMPER</td>
<td>McMASTER</td>
<td>9546K16</td>
</tr>
<tr>
<td>6</td>
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<td>SPRING</td>
<td>CENTURY</td>
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<td>7</td>
<td>1</td>
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<td>#9009-00001-110</td>
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<td>9</td>
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<td>MLC RELAY BASE</td>
<td>IDEC</td>
<td>#SR2P-6</td>
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<td>10</td>
<td>1</td>
<td>CONTROL RELAY</td>
<td>DELTRON</td>
<td>#20844-84</td>
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<td>11</td>
<td>1</td>
<td>FUSE</td>
<td>BUSSMAN</td>
<td>#FNM-15</td>
</tr>
</tbody>
</table>
INSTRUCTION MANUAL FOR DODGE® SETSCREW, ECCENTRIC COLLAR, D-LOK, H, H-E SERIES & EZ-KLEEN MOUNTED BALL BEARINGS

INSTALLATION

WARNING
To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Failure to observe these precautions could result in bodily injury.

Under certain operating conditions it is possible for a static electric charge to build-up on E-Z KLEEN® Polymer Housings. Do not operate these bearings in any environment where a sudden static discharge may cause either an operating hazard or personnel discomfort.

1. Clean shaft and bearing bore thoroughly. Measure and confirm shaft size and tolerance. File flats on shaft at setscrew locations to permit easy removal of bearing.

2. Slip bearing into position. Be sure that bearing is not on a worn section of the shaft. For tighter fits, tap inner ring face only with soft driver. DO NOT HAMMER ON HOUSING.

3. The bearing outer ring OD is spherical and swivels in the housing to accommodate misalignment. Snug hold-down bolts and use shaft to swivel each bearing until its final position is in the center of free movement top to bottom as well as side to side. Pass shaft through both bearings without forcing. This will prevent preloading of the bearings. Housing slippage depends on the mounting hold-down bolt tightening torque, number of bolts and friction characteristics between mounting surfaces. Auxiliary load carrying devices such as shear bars are advisable for side or end loading of pillow blocks and radial loads for flange units where normal to heavy loading or shock loading is encountered.

NOTE: On coated and non-metallic housings, hold-down bolts should be tightened carefully with flat washers to prevent damage to the coating. Coated housings have reduced friction characteristics, so auxiliary load carrying devices are even more important in those applications.

4. Tighten hold-down bolts to proper torque (Table 1). Turn shaft by hand. Resistance to turning should be the same as before full tightening of hold-down bolts.

5. For setscrew mounted bearings: After final alignment of the shaft, tighten both setscrews hand tight, then the setscrews should be tightened alternately and in small increments to the torque specified in Table 1. After 24 hours operation, the setscrews should be retightened to the torque in Table 1 to assure full locking of the inner race to the shaft. Care should be taken that the socket key or driver is in good condition with no rounded corners and the key is fully engaged in the setscrew and held square with the setscrew to prevent rounding out of the setscrew socket when applying maximum torque. Do not drill through the setscrew holes for spot drilling of the shaft. (Some inner rings have tempered setscrew threads and can be damaged by a drill.) If spot drilling is required, locate bearings on the shaft and center punch through the setscrew hole. Remove bearing and spot drill the shaft, then reassemble over the spot drilled position and assemble as above. Milled or filed flats are preferable to spot drilling.

NOTE: On all SC Product the setscrews can be re-torqued many times without damage to the bearing system. To achieve maximum shaft holding power it is highly recommended that setscrews be replaced with new hardware after any disassembly operation.

6. For eccentric collar mounted bearings, slide collar against cam end of inner race. Use a punch in the hole provided in the collar, tap collar smartly in the direction of shaft rotation. Tighten setscrews to proper torque (Table 1). To remove bearings, loosen setscrew and tap collar in the direction opposite of shaft rotation.

7. For D-LOK mounted bearings, be sure collar is square and tight against shoulder on inner ring. Tighten cap screw to recommended torque shown in Table 1.

8. For expansion bearings (H-E Series), locate inner unit in housing to allow expansion in the desired direction before locking to the shaft.

WARNING: Because of the possible danger to persons(s) or property from accidents which may result from the improper use of products, it is important that correct procedures be followed: Products must be used in accordance with the engineering information specified in the catalog. Proper installation, maintenance and operation procedures must be observed. The instructions in the instruction manuals must be followed. Inspections should be made as necessary to assure safe operation under prevailing conditions. Proper guards and other suitable safety devices or procedures as may be desirable or as may be specified in safety codes should be provided, and are neither provided by Rockwell Automation nor are the responsibility of Rockwell Automation. This unit and its associated equipment must be installed, adjusted and maintained by qualified personnel who are familiar with the construction and operation of all equipment in the system and the potential hazards involved. When risk to persons or property may be involved, a holding device or shear bars must be an integral part of the driven equipment.
### LUBRICATION

High Speed Operation — In the higher speed ranges, too much grease will cause over-heating. The amount of grease that the bearing will take for a particular high speed application can only be determined by experience. If excess grease in the bearing causes overheating, it will be necessary to remove grease fitting to permit excess grease to escape. The bearing has been greased at the factory and is ready to run. When establishing a relubrication schedule, note that a small amount of grease at frequent intervals is preferable to a large amount at infrequent intervals.

**Lubrication Guide**

Use a No. 2 Lithium complex base grease or equivalent.*

<table>
<thead>
<tr>
<th>Hours Run per Day</th>
<th>Suggested Lubrication Period in Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 250 RPM</td>
<td>251 to 500 RPM</td>
</tr>
<tr>
<td>501 to 750 RPM</td>
<td>1001 to 1500 RPM</td>
</tr>
<tr>
<td>1001 to 2000 RPM</td>
<td>2001 to 2500 RPM</td>
</tr>
<tr>
<td>2501 to 3000 RPM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8 hours</td>
</tr>
<tr>
<td></td>
<td>12 12 10 7 5 3 1</td>
</tr>
<tr>
<td></td>
<td>2 2 1 1</td>
</tr>
<tr>
<td></td>
<td>24 hours</td>
</tr>
<tr>
<td></td>
<td>12 12 10 7 5 3 1</td>
</tr>
<tr>
<td></td>
<td>2 2 1 1</td>
</tr>
</tbody>
</table>

* For H and H-E series bearings, use Exxon Unirex N3 or equivalent suitable to 300°F.

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[Image of barcode]

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Installation, Operating and Maintenance Instructions with Parts Lists

Publication Part No. SK-6415-200
1500 Pound Electromechanical Actuators with Built-In Limit Switches
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Figure 6-4.  Wiring Diagram, Position Transducer and Visual Position Indicator for PSPA 6415 & PSPA 7415 Models ......................... 15

IMPORTANT — CAUTION

This manual contains important information for the correct installation, operation and maintenance of the equipment described herein. All persons involved in such installation, operation and maintenance should be thoroughly familiar with the contents. To safeguard against the possibility of personal injury or property damage, follow the recommendations and instructions of this manual and keep it for further reference.

WARNING

The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people.
Section I
General Information

1-1. General
This manual provides instructions for the installation, operation and maintenance of the Duff-Norton 6415 & 7415 Series AC actuator. It includes proper procedures for the disassembly, cleaning, inspection, rebuilding and assembly of the actuator. To ensure efficient, long, satisfactory use of this unit, these instructions should be followed closely.

1-2. Industrial Use Only
The actuators described and illustrated in this manual are intended for industrial use only and should not be used to lift, support or otherwise transport people, unless you have a written statement from Duff-Norton Company which authorizes this actuator unit, as used in your application, as suitable for moving people.

1-3. Factory Preparation
Each actuator is carefully assembled and tested at the factory to ensure that the motor and the mechanical components will function properly and that the actuator will lift its rated load. The brake is preset at the factory and no further adjustment is required. With proper maintenance, this brake prevents the actuator from self-lowering. The actuator is pre-lubricated at the factory and thus requires minimum maintenance. Limit switches are checked at the factory for proper functioning.

External wires are provided for customer hookup. Wires are color coded as to direction of travel of the actuator (see wiring diagram, Figure 6.2).

1-4. Specifications
Table 1-4. 6415 & 7415 Series AC Actuator Specifications

<table>
<thead>
<tr>
<th>Applied Load (lbs)</th>
<th>Speed (in/min)</th>
<th>Amps</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>52</td>
<td>44</td>
</tr>
<tr>
<td>1000</td>
<td>51</td>
<td>42</td>
</tr>
<tr>
<td>1500</td>
<td>50</td>
<td>41</td>
</tr>
</tbody>
</table>

Note: Duty figures are based on 75°F (24°C) ambient temperature. All ratings are nominal and are based on actuator being broken-in for approximately 2500 inches of travel.

1-5. Warranty and Warranty Repair
Subject to the conditions stated herein, Duff-Norton will repair or replace, without charge, any parts proven to Duff-Norton's satisfaction to have been defective in material and workmanship. Claims must be made within one year after date of shipment. Duff-Norton will not repair or replace any parts that become inoperative because of improper maintenance, eccentric loading, overloading, chemical or abrasive action, excessive heat, or other abuse.

Equipment and accessories not of Duff-Norton's manufacture are warranted only to the extent that they are warranted by their manufacturer, and only if the claimed defect arose during normal use, applications and service. Equipment which has been altered or modified by anyone without Duff-Norton's authorization is not warranted by Duff-Norton. Except as stated herein, duff-norton makes no other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.

If you have any questions concerning warranty repair, please contact the Duff-Norton Company. Authorization for return must be received from the Duff-Norton Company before returning any equipment for inspection or warranty repair.
AC Motor is enclosed, permanent split capacitor induction type. Load/no-load speeds are approximately equal. Equipped with thermal overload which opens and resets automatically. Standard motor requires capacitor for applied loads up to 1500 pounds.

Note: The SPA series Actuators (AC models) supersede the MPA series equivalent models. The SPA Actuators incorporate major internal advancements principally in the limit switch area. The external dimensions remain unchanged. SPA series models will serve as direct field replacements for MPA series actuators.

With 115 V 60 Hz & 220 V 50 Hz

<table>
<thead>
<tr>
<th>Applied Load (lbs)</th>
<th>#Duty Cycle (inches per hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard 115 Volt Motor (60 Hz)</td>
</tr>
<tr>
<td>500</td>
<td>560</td>
</tr>
<tr>
<td>1000</td>
<td>540</td>
</tr>
<tr>
<td>1500</td>
<td>500</td>
</tr>
</tbody>
</table>

#Total inches of travel (up and down) per hour with equally timed intervals between cycles.

Warning:
1. Some actuator external surface temperatures may reach 230°F at or near maximum allowable duty cycle.
2. Do not operate actuator before setting limit switches.
3. Position hooded vent to prevent moisture and dirt from entering actuator (see instruction and maintenance sheet).
4. The actuator is not recommended for use in applications where it can be jammed. Examples of jamming include overtraveling the limit switches and jamming the nut and screw internally at the extreme ends of the stroke, or driving the actuator against an immovable object and thus overloading the actuator severely. Therefore, consult Duff-Norton Engineering if jamming is expected.

Figure 1-6. Dimensions and Specifications
Section II
Installation

2-1. Installation Procedures

Use Figure 6-2 as a guide to properly attach the SPA 6415 & SPA 7415 AC actuator to your power source.

2-2. Limit Switch Adjustment

Caution

Disconnect power before making any adjustments to the limit switches.

Important

Before attempting to set limit switch nuts by these instructions, be certain that the red and blue motor leads and the switch leads are connected to the proper capacitor terminals per Figure 6-2. Unless leads are connected exactly as shown, the following steps will be meaningless.

1. Setting Retracted Position
   a. Do not install actuator in the intended application at this time.
   b. With nut retainer “A” installed in actuator and the translating tube unstrained, operate actuator toward retracted position until limit switch nut “B” trips limit switch (see Figure 6-3).

   Note

   Translating tube may jam and rotate prior to tripping limit switch.

   c. Rotate the translating tube by hand until distance between the housing clevis hole centerline and the translating tube clevis hole centerline equals the desired closed height. This centerline to centerline dimension is not to be less than the retracted centerline to centerline dimension listed in Figure 1-6. If the two clevis end holes are not oriented as required, rotate the translating tube no more than ½ turn in either direction until they are properly oriented.

   d. Install actuator in application and check drift. Slight readjustment in switch actuation may be attained by removing nut restrainer “A” and rotating limit switch nut “B” (1 notch of rotation = .05 in. of screw travel). Replace nut restrainer, “A”.

2. Setting Extended Position
   a. Restrained the translating tube against rotation by hand. Operate the actuator toward the extended position, until the distance between the housing clevis hole centerline and the translating tube clevis hole centerline equals the desired extended height. This centerline to centerline dimension is not to exceed the extended centerline to centerline dimension listed in Figure 1-6.

   b. Remove nut restrainer “A” and rotate limit switch nut “C” (see Figure 6-3) until it activates the limit switch.

   c. Replace nut restrainer “A”.

   d. Install actuator in application and check the unit’s drift. Slight readjustment in switch actuation may be attained by removing nut restrainer “A” and (1) rotating limit switch nut “B” to adjust retracted position or (2) rotating limit switch nut “C” to adjust extended position (1 notch of rotation = .05 in. of screw travel).

   e. After adjusting limit switch nuts, replace nut restrainer “A”. Operate the actuator and readjust limit switch nuts as necessary to achieve desired travel.

2-3. Post-Installation Procedures

After actuator installation, position the air vent to prevent moisture and dirt from entering the actuator. Vent can be repositioned by loosening the set screw and rotating the outer air tube into which the air vent is threaded. Spot drill and re-tighten set screw.

If necessary, an elbow (1/16” female x 1/8” male pipe thread) can be used for more effective positioning.

2-4. Actuator Equipped With Position Indicator (Optional)

A. Potentiometer Installation

1. a. Actuator travel limits should be set for extreme limits of travel per instructions (see Section 2-2), prior to potentiometer installation.

   Warning

   Do not install potentiometer assembly into actuator at this time. Engaging potentiometer assembly gear teeth with plastic worm can cause damage by jamming the potentiometer internally.

2. a. Do not operate actuator without nut restrainer “A" installed.

   b. Retract or extend actuator translating tube until stopped by limit switch. This position will be indicated as 100% on meter.

3. a. If extended position is to be 100% on meter, turn geared shaft of potentiometer counter-
clockwise until shaft stops. DO NOT FORCE.

Turn geared potentiometer shaft clockwise approximately 1/4 turn. This will prevent internal jamming of the potentiometer during operation.

b. If retracted position is to be 100% on meter, turn geared shaft of potentiometer clockwise until shaft stops. DO NOT FORCE.

c. Turn geared potentiometer shaft counterclockwise approximately 1/4 turn. This will prevent internal jamming of the potentiometer during operation.

4. With actuator translating tube in position to indicate 100% on meter and potentiometer set per instructions 3a and 3b, remove nut restrainer "A". Take care not to rotate limit switch nuts as this will affect operating limits of translating tube travel. Install potentiometer assembly on nut restrainer "A". Tighten nut and washer firmly against nut restrainer. Potentiometer assembly should be fully engaged into .41 in. wide slot of nut restrainer. Install potentiometer assembly and nut restrainer into actuator limit switch box, taking care not to rotate the potentiometer shaft or the limit switch nuts. Make certain that nut restrainer "A" is firmly in place and potentiometer shaft gear is engaged with worm.

B. Calibration Box Wiring and Adjustment

1. After installing potentiometer in switch box per instructions in part "A", connect sufficiently long leads to reach from potentiometer terminals to calibration box. Reference Figure 6-4.

   Note
   Translating tube must be restrained from rotating when operating actuator to make these adjustments.

2. a. Connect lead "S" from potentiometer terminal to terminal 4 on calibration box.

   b. If extended actuator position is to be indicated by 100% on meter, connect lead "C-CW" from potentiometer terminal to terminal 5 on calibration box.

   c. If retracted actuator position is to be indicated by 100% on meter, connect lead "CW" from potentiometer terminal to terminal 5 on calibration box.

3. Connect position (+) terminal of meter to terminal 3 of calibration box. Connect negative (−) terminal of meter to terminal 5 of calibration box.

4. Connect 115 VAC power source to terminals 1 & 2 of calibration box.

5. With translating tube in same position as in Step A-3-a or A-3-b, energize circuit and turn "Adjust Span 100% End" screw of calibration box until meter indicates 100%.

6. Extend or retract actuator to other extreme limit of travel and turn "Adjust Span 0% End" screw of calibration box until meter reads 0%.

   Note
   In certain applications, the position indicator cannot be adjusted to indicate the full range of meter readings from 0% to 100%. Actuators with travels near the maximum or minimum travels allowable for a given potentiometer will have this characteristic. For ease in future reading, calibrate the position indicator to read 0% at desired limit position (full extension or retraction, as required) of translating tube travel. After positioning actuator translating tube at opposite end of travel, record the meter percentage reading. If future readings are to be recorded as percentages of full travel, this maximum meter reading should be used as a constant divisor for all meter readings. If future readings are to be recorded in inches of travel, the application's total travel should be divided by this maximum percentage reading, thus providing a constant multiplier for all meter readings.

7. Retract or extend actuator to minimum or maximum position and repeat steps 5 & 6 until the system is balanced for best repeatability.

   Note
   SK-6415-60 Actuator Position Indicator Ammeter is a 2 milliamp meter with 1 milliamp suppression. Therefore, needle adjusting screw on face of instrument is inoperable and all adjustments must be made through the calibration box.

8. Replace switch cover.
Section III
Operation

3-1. Operational Procedures

This motor is an intermittent duty type motor. Since the motor draws approximately the same amperage at no load as at full rated load, it only takes 10 minutes of continuous running, regardless of how light the load may be, before the thermal overload relay cuts out. It then takes about 10 minutes before the motor cools sufficiently for the thermal relay to close. Make sure that the duty cycle to which the actuator is subjected is not too severe for the motor.

Avoid using a low voltage supply for the motor. All wiring, switches, etc. must be of sufficient capacity to carry the required current.

The axis of the clevis pins should be parallel so that the actuator can pivot without binding. The preset brake will provide consistent braking for the actuator. However, in the event the brake friction surfaces become worn as indicated by excessive drift, the brake will require rebuilding. To aid in rebuilding, a repair kit with step-by-step instructions is available through Duff-Norton Company under repair kit Part Number SK-6415-43. The repair can be performed by the customer or by any authorized repair station.

Warning

This actuator is not recommended for use in applications where it can be jammed. Examples of jamming include overtraveling the limit switches and thus jamming the nut and screw internally at the extreme ends of the stroke, and driving the actuator against an immovable object and thus severely overloading it. This actuator can jam a limited number of times without damage. Therefore, consult Duff-Norton Engineering if jamming is expected.

Do not operate actuator before setting limit switches.

Some actuator external surface temperatures may reach 230°F at or near maximum allowable duty cycle.

Section IV
Maintenance

4-1. Lubrication

Duff-Norton recommends the use of the following lubricants in conjunction with proper maintenance procedures for this unit:

Gear Box & Brake — Shell Oil Co., Aeroshell #6
Lifting Screw & Nut — W.I. Grace Co., Duboise M.P.G.

4-2. Required Tools

A bearing puller, press, soft jaw table clamp and common hand tools are required for proper disassembly and assembly.

4-3. General Procedures

Duff-Norton recommends following these procedures during disassembly and assembly:

1. Tag critical parts to facilitate reassembly.
2. Mark mating surfaces to ensure proper meshing.
3. Clean and lubricate parts as required.
4. All seals must be replaced at time of rebuild, if damaged.
5. All screws, washers and other small common parts must be replaced if mutilated in any way.

4-4. Disassembly

Disassemble the actuator as follows while referring to Figure 5-1. Read instructions thoroughly before disassembling.

Note

Disassembly should be accomplished on a clean cloth.

1. Clamp actuator housing (42) in vise (use soft jaws). Unit should be in horizontal position with outer tube (55) up.
2. Remove screws (1) from limit switch box cover (11) and remove limit switch box cover (11) and gasket (12).
3. Remove nut retainer (14).

Note

If unit has potentiometer assembly (26) and potentiometer (26a) or gear (26b) is not damaged proceed to Step 4.

a. Loosen nut (26c) and remove potentiometer assembly from nut retainer (14).

b. Remove gear (26b) from potentiometer (26a). Washer and nut do not have to be removed from potentiometer (26a).
Caution
Take care not to damage potentiometer when removing gear.

4. Remove screws (1) from capacitor box cover (2) and remove cover (2) and gasket (3). Remove insulation (4) from capacitor box.

5. Discharge capacitor (5). Disconnect motor (53) lead wire terminals from capacitor (5). Remove capacitor from box.

6. Disconnect jumper wires (17 and 18) and motor (53) lead wire terminals from switches (16). Remove jumper wires (17 and 18) and pull motor (53) lead wires into capacitor box.

7. Remove set screw (38) from housing (42).

8. Remove button head cap screws (7) and lock washer (8).

9. Lift cover (9) from housing (42) passing motor (53) lead wires through hole in bottom of capacitor cavity in cover (9). Slight tapping with soft hammer may be necessary to overcome dowel pin friction. Care should be taken to prevent damage to motor (53) lead wires. Remove dowel pins (27).

10. Remove thrust washer (35) and thrust bearing (36) from cover (9). Thrust washer (35) and thrust bearing (36) may stay on spacer nut (37) in housing (42) and can be removed in Step 18.

11. Remove limit switch shaft assembly, consisting of limit switch shaft (22), limit switch nuts (23) and worm (24), from cover (9). Allow limit switch shaft (22) to drop out of flange bearing (25). Tilt shaft assembly and remove from cover (9).

Note
If limit switch nuts (23) or worm (24) do not have to be replaced, proceed to Step 14.

12. Thread limit switch nuts (23) off of limit switch shaft (22).

13. Remove worm (24) from limit switch shaft (22).

Note
If switches (16), insulation (19) or limit switch bracket (21) do not have to be replaced, proceed to Step 16.

14. Remove screws (20) and bracket (21) from cover (9).

15. Remove screws (15), switches (16) and insulation (19) from bracket (21).

16. Press clevis end bushing (6) out of cover (9). If bushing (6) is not damaged it should not be removed.

17. Remove bearing (28), bushing (34) and flange bearing (25) from cover (9).

Note
Bushing (34) and flange bearing (25) should not be removed unless they are damaged. Bearing (28) may stay on pinion (29) and can be removed in Step 18.

18. Remove thrust washer (31) from intermediate pinion shaft (32). Bearing (28) from pinion (29), thrust washers (35) and thrust bearing (36) from spacer nut (37) may have been removed in Step 10.

19. Remove spring (61) from end of screw (62).

20. Remove intermediate cluster gear (33), intermediate pinion shaft (32) and thrust washer (31).

21. Remove socket head cap screws (45), lock washers (46) and disassemble motor (53) from housing (42).

Warning
Care must be taken not to damage motor lead wires.

22. Remove “O”-Ring (52) and rubber grommet (50).

23. Disassemble outer tube (55) and slip off over translating tube and clevis (66).

24. Remove air vent (58), wiper scraper (60) and guide bushing (59) from outer tube (55).

Note
If wiper scraper or guide bushing are not damaged they should not be removed.

25. Remove set screw (68) from spacer nut (37) and disassemble spacer nut (37) from screw (62) by clamping screw (62) between soft jawed vise.

Warning
Care must be taken not to damage bearing journal of spacer nut (37).

26. Remove output gear (39), key (40), thrust washers (35), thrust bearing (36), and gear spacer (43).

27. Remove screw (62), translating tube and clevis (66) and nut assembly (64).

28. Remove washer (44) from screw (62).

29. Thread screw (62) into the translating tube until the screw bottoms out and cannot rotate farther, or until the screw thread becomes disengaged from the lifting nut thread (64).

30. Drive the four pins (65) just far enough into the lifting nut (64) to clear the translating tube wall; then remove the translating tube from the nut.

31. Remove the lifting screw (62) from the lifting nut (64)
32. Remove the four pins (65) by pressing each one the rest of the way through the lifting nut wall.

33. Remove the stop pin (63) from the lifting screw (62) if necessary.

34. Removing the brake (49). (Required only if drift is excessive. If brake removal is not necessary, proceed to Step 35).
   a. Push the pinion (29) and coupling (47) until it slips back enough to make the spring (49) tang accessible.
   b. Remove the spring (49) by grabbing the tang with pliers and twisting out. (Spring must now be replaced and can no longer be used.)
   c. Remove the brake insert (51). Remove retaining ring (48) from input pinion (29). Input pinion (29) and bearing (30) can now be removed from housing (42).
   d. The brake insert (51) has straight knurls on its O.D. which prevent it from rotating. Therefore, the insert can only be removed by pulling straight out.
   e. One method of removing the insert (51) is to use a blind hole bearing puller. This tool expands into the internal spring cavity and pulls against the lip of the insert (51).

35. If coupling (47) on motor (53) shaft must be replaced, remove retaining ring (48) from motor (53) shaft and remove coupling (47).

Disassembly is complete.

4-5. Assembly

Assemble the actuator as follows while referring to Figure 5-1. Read instructions thoroughly before assembling.

**Note**

Be sure all components are clean and dry before assembling.

1. Assemble coupling (47) on motor (53) shaft, then install retaining ring (48) on motor shaft.

2. Press bearing (30) on input pinion (29) (press load should be applied to inner race of bearing to avoid damage to bearing).

3. Press bushing (34) into housing (42).

4. Install input pinion (29) and bearing assembly (30) in housing (42) (press load should be applied to outer ring of bearing to prevent damage to bearing).

5. Assemble coupling (47) on input pinion (29) and install retaining ring (48).

6. Brake Assembly
   a. Grease O.D. of spring (49) and pocket of insert (51) (chamfered end) with Aeroshell #6 grease.

**Caution**

When using replacement parts, make sure you have correct spring (Part No. SK-6415-18). Red spring designates DC unit. If your replacement spring is red, contact your local distributor or the Duff-Norton Factory for immediate replacement.

b. Install spring (49) into insert (51) pocket (chamfered end).

c. Align pinion coupling (47) and spring (49) as shown in Figure 6-1A and press insert (51) and spring (49) assembly into housing (42) (alignment must be as shown in Figure 6-1A).

7. Press bushing (34), bushing (6) and flange bearing (25) into cover (9).

8. Assembly of Limit Switch Components (refer to Figure 6-3).
   a. Assemble insulation (19), limit switch (16) and screw (15) on limit switch bracket (21).

**Note**

Limit switch (16) leads should face each other. Insulation (19) should be folded up and behind common terminal of switches (16). See Figure 6-3.

b. Assemble limit switch nuts (23) on limit switch shaft (22) (care should be taken not to cross-thread nuts). Nut hubs should be facing away from each other. See Figure 6-3.

c. Assemble worm (24) on limit switch shaft (22). Unthreaded hub on worm should be away from limit switch shaft (22) threads. See Figure 6-3.

9. Assembly of Limit Switch Components in cover. Refer to Figures 6-2 and 6-3.

**Note**

Cover (9) should be in a soft-jaw vise with limit switch box cover up.

10. Assemble limit switch bracket (21), insulation (19) and switch (16) assembly into cover (9) with screws (20).

11. Assemble limit switch shaft (22), limit switch nuts (23) and worm (24) assembly into cover (9). Tilt shaft and insert into I.D. of bushing (34). Then straighten and assemble shaft into flange bearing (25).

**Note**

Worm (24) should be facing up toward flange bearing (25). See Figure 6-3 (shaft will be loose
in cover).

12. Attach red terminal wire (17) to common terminal of left side switch (16). Attach blue terminal wire (18) to common terminal of right side switch (16). Feed ends of terminal wires (17) and (18) through $\frac{5}{8}$" dia. hole into cover (9) capacitor box.

13. Press guide bushing (59) and wiper scraper seal (60) into outer tube (55). (Scraper part of scraper seal should be facing outward away from guide bushing.)

14. Install the stop pin (63) in the end of the lifting screw (62), taking care to center the pin in the screw.

15. Screw the lifting nut (64) on to the lifting screw (62) with the flange end away from the stop pin (63).

16. Fill the translating tube (66) approximately $\frac{1}{2}$ to $\frac{3}{4}$ full with Duboise M.P.G. grease (no substitutes).

17. Slide the translating tube over the lifting screw (66) and on to the lifting nut (64), lining the four holes in the translating tube up with the four holes in the lifting nut (64). Install pins (65) flush with translating tube O.D.

18. Assemble washer (44) and gear spacer (43) on screw (62). Install key (40) in key groove of screw.

19. Clamp sides of housing (42) in vise (use soft jaws with input pinion up).

20. Install screw (62), gear spacer (43), washer (44), translating tube (66), and tube nut (64) assembly into housing (42) through bushing (34).

21. Apply a generous amount of Aeroshell #6 grease (no substitutes) to thrust washers (35) and thrust bearing (36) and assemble over gear spacer (37).

22. Aligning keyway in output gear (39) with key (40) in screw (62), assemble output gear (39) on screw (counter-bore in gear facing up away from thrust bearing).

23. Clamp screw (62) between soft jawed vise. Thread spacer nut (37) on screw (62) and tighten against output gear (39). Spacer nut flange should be in counterbore of output gear. Do not grip on bearing journal of spacer nut when tightening spacer nut.

24. Check alignment of tapped holes in spacer nut (37) with holes in output gear (39). Use two $\frac{9}{64}$ dia. pins approximately $1\frac{1}{2}$" long. One pin should drop into hole in output gear (39). If pin does not drop into hole, tighten or loosen spacer nut until hole is aligned and one pin drops into hole. (Note: spacer nut should not be rotated more than $22^{1/2}$ before pin drops into hole in gear.) It is preferable to tighten spacer nut down instead of loosening.

25. Remove pin from aligned hole. Install half dog set screw (68) and tighten half dog point into hole in output gear (39). Remove remaining pin and proceed with assembly. Note: One hole must be in alignment to have proper assembly.

26. Lightly grease O.D. of translating tube (66) with Duboise M.P.G. grease (no substitutes) and assemble outer tube (55) assembly over translating tube (66) and thread into housing (42) (a sealing compound such as Non-Hardening Permatex 2 should be used on threads).

27. Insert intermediate pinion shaft (32) in housing (42) and place thrust washer (31) over shaft (32). Assemble intermediate cluster gear (33) on shaft and place thrust washer (31) on top.

28. Assemble bearing (28) on input pinion (29) (press on inner bearing ring to prevent damage to bearing).

29. Pack housing (42) gear box cavity with Aeroshell #6 grease (no substitutes).

30. Assembly of Motor (53) to Housing (42)
   a. Note location of flat on input pinion by marking spot on the housing. See Figure 6-1B.
   b. Insert grommet (50) on input pinion (29) between coupling (47) posts and install "O"-Ring (52) in cavity of insert (51).
   c. Pack cavity with Aeroshell #6 grease.
   d. Remove hole plug (54) in rear end of motor.
   e. Feed motor (53) lead wires through hole in housing (42) and lining up couplings (47) on input pinion (29) and motor (53) shaft. (Alignment is critical at this point. See Figure 6-1B.)

   Note
   Input pinion (29) and motor (53) shaft flats are opposite each other.

   f. Assemble motor (53) into housing (42). Before assembling lock washers (46) and socket head screws (45), hold motor firmly in place and, with a screwdriver, turn motor shaft by using screwdriver slot in end of motor shaft.

   Note
   Before turning motor shaft, make sure pinion shaft has not been pushed out. It may be
necessary to hold pinion shaft down while turning motor shaft. If couplings are properly installed, the motor can be turned freely in both directions. If motor shaft will not turn, this is an indication that couplings are not properly aligned and assembly should be corrected.

g. Install lock washers (46) and socket head screws (45).

h. Replace hole plug (54) in end of motor.

31. Insert dowel pins (27) in housing (42) and place gasket (41) in place over dowel pins (27).

32. Install air vent (58) in outer tube (55) (it may be necessary to back outer tube out to install air vent or to have vent in a more desirable position). Spot drill tube and install set screw (33) to hold tube in place.

33. Install spring (61) into end of screw (62).

Note
If unit has potentiometer assembly (26) and gear (26b) does not have to be replaced or if unit has no potentiometer feature, proceed to Step 35.

34. Potentiometer Assembly (26)
a. If nut and washer were removed from potentiometer, assemble washer (26d) and nut (26c) on potentiometer (26a). Nut (26c) should not be tightened on potentiometer (26a) face.

b. Assemble gear (26b) on potentiometer (26a) shaft.

Note
Gear should be assembled with a very light press. See sketch for required dimension of gear on potentiometer. Take care not to damage potentiometer.

35. Assembly of Cover
a. Feed motor (53) lead wires into capacitor box cover (9). Care should be taken not to damage lead wires. Assemble cover on housing (42), aligning dowel pins (27) with bore in cover and flats of limit switch shaft (22) with bore and slot in end of screw (62).

b. Caution: Be sure that limit switch shaft (22) is properly aligned with screw (62) and flange bearing before lightly tapping cover (25) into place with a soft hammer seating cover (9) against gasket (41) and housing (42).

Note
Limit switch shaft should be able to spring up when a light pressure with finger is applied downward on limit switch nut and removed.

c. Install lock washers (8) and button head screws (7).

d. Feed motor lead wires (red and blue small terminal ends only) into cover switch box through \( \frac{5}{16} \)" diameter hole. Install terminal of red lead wire on normally closed terminal of left side of switch. Install terminal of blue lead wire on normally closed terminal of right side of switch. (Wires going to switches should be same color.) It may be necessary to install terminals on switch terminal tabs with needle-nose pliers and care should be taken not to damage terminal tab or switch (see Figure 6-3).

e. Feed terminal wires, (17) red, (18) blue, and white motor lead wire through \( \frac{1}{2} \)" tapped hole in cover capacitor box outside of cover.

f. Moving wires out of the way, insert capacitor (5) into box (terminals up) and attach motor lead wire (large connectors) to capacitor terminals. (Red on one pair of capacitor terminals and blue on the other pair of capacitor terminals.)

g. Insert insulation (4) over capacitor and assemble gasket (3) and cover (2) with screws (1).

h. Adjust actuator limit switch settings per instructions in paragraph 2-2.

i. If actuator has potentiometer, refer to position indicator installation and calibration instructions in Paragraph 2-4.

j. Attach gasket (12) and cover (11) with screws (1).
Section V
Illustrated Parts List

5-1. Part List
Parts List For Duff-Norton Actuator, 6415 & 7415 Series, With Limit Switch

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* Denotes dash number is equal to travel.
** Denotes dash number is 3 fro travel. 3 inches or less. Otherwise denotes dash number is equal to travel in inches.

+ Optional

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Section VI
Technical Illustrations

6-1. Brake Alignment

Figure 6-1A. Brake, Spring, Motor and Pinion Coupling Alignment

Note: Pinion and motor coupling flats are opposite each other.

Figure 6-1B. Brake, Spring, Motor and Pinion Coupling Alignment

6-2. Limit Switch Wiring Diagram

Figure 6-2. Limit Switch Wiring Diagram, 6415 & 7415 Series AC Actuator
6-3. Limit Switch Assembly

![Diagram of Limit Switch Assembly]

Figure 6-3. Limit Switch Assembly, 6415 & 7415 Series AC Actuator


![Diagram of Wiring Diagram, Position Transducer and Visual Position Indicator]

Figure 6-4. Wiring Diagram, Position Transducer and Visual Position Indicator for PSPA 6415 & PSPA 7415 Models
Duff-Norton

P.O. Box 7010
Charlotte, NC  28241-7010

General Office (704) 588-0510
Customer Service (800) 477-5002
Customer Service (704) 588-4610
FAX (704) 588-1994

.8M/SK6415-200/01-03
Heavy-Duty Plug-In Switches

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E50 Modular Plug-In Limit Switch Components are the industry standard with versatility of design and high reliability for low maintenance, installation and inventory costs. Standard Viton gaskets, seals and boots and a zinc die cast enclosure provide exceptional chemical resistance to the common coolants, cleansing agents, and hydraulic fluids found in machine tool, automotive, waste water treatment and other heavy-duty industrial applications. Mounting dimensions accommodate both U.S. and DIN standards for easy retrofit installations. Super bright 24 – 120V AC/DC LED indicating light versions simplify setup and troubleshooting operations.

Approvals

- UL Listed
- CSA Certified
- IEC.947.5.1
- TUV — E9271605E02
- CE (where shown)

For the most current information on this product, visit our web site at: www.sensingsolutions.com

Modular Limit Switches Provide Extremely Easy Installation, High Reliability, and Low Maintenance and Inventory Costs

Available as Assembled Switches or Components

Dozens of Operators to Perfectly Fit Your Application

Rotary, Top and Side Push, Wobble and Specialty Operating Heads

Single or Double Pole Switch Bodies with Optional Indicating Lights

A Variety of Receptacles Meet Your Wiring Needs

Product Features

- Modular, plug-in components (head, body and receptacle) provide application flexibility, reduced inventory and less downtime
- Manufactured to take the physical and environmental abuse (including cutting fluids and chemicals) of harsh industrial environments
- Chemical resistant Viton gaskets, seals and boots are standard, and so are captive, posi-drive screws
- The switches have terminal identification on the nameplate for a visual wiring checkout without guesswork. Heads and switch bodies can be replaced without rewiring
- E50 devices can be ordered in separate components or as complete assembled switches
- 600V rating, ridge-topped contacts and wiping action assure continuity even to logic level circuits
- Keyed, four direction head positioning
- Standard 5° pre-travel and 90° total travel
- 24 – 120V AC/DC LED and 120V AC neon indicating lights available
- Rotary heads are field convertible CW, CCW, or both, without special tools
- Epoxy filled, pin connector or pigtail pin connector receptacles available
### Limit Switches

#### Heavy-Duty Plug-In Switches

**Model Selection — Assembled Switches — Standard**

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<td>Neon (120V AC)</td>
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| Switch Body      | E50SA 1N.O.-1N.C.                   | E50SB 2N.O.-2N.C.                   |
|                  | E50SAL 1N.O.-1N.C.                  | E50SBL 2N.O.-2N.C.                  |
|                  | E50SAN 1N.O.-1N.C.                  | E50SBN 1N.O.-2N.C.                  |
|                  | E50SC 1N.O.-2N.C.                   | E50SCL 1N.O.-2N.C.                  |
|                  | E50SCN 1N.O.-2N.C.                  |                                    |

| Receptacle       | E50RA E50RA E50RA E50RB E50RB E50RB |

**Operating Head Type**

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<tr>
<td></td>
<td>E50AR1 E50ALR1 E50ANR1 E50BR1 E50BLR1 E50BNR1 — E50CNR1</td>
</tr>
<tr>
<td></td>
<td>E50AR1 E50ALR1 E50ANR1 E50BR1 E50BLR1 E50BNR1 — E50CNR1</td>
</tr>
</tbody>
</table>

| Side Pushbutton, Spring Return — E50DS1 | E50AS1 E50ALS1 E50ANS1 E50BS1 E50BLS1 E50BNS1 E50CLS1 E50CNS1 |
| Side Pushbutton, Low Force Spring Return — E50DL1 | E50AL1 E50ALL1 E50ANL1 E50BL1 E50BLL1 E50BNL1 E50CLL1 E50CNL1 |
| Side Pushbutton, Maintained Two-Position — E50DM1 | E50AM1 E50ALM1 E50ANM1 E50BM1 E50BLM1 E50BNM1 E50CLM1 E50CNM1 |

| Side Pushbutton, Spring Return — E50DS2 | E50AS2 E50ALS2 E50ANS2 E50BS2 E50BLS2 E50BNS2 E50CLS2 E50CNS2 |
| Side Pushbutton, Low Force Spring Return — E50DL2 | E50AL2 E50ALL2 E50ANL2 E50BL2 E50BLL2 E50BNL2 E50CLL2 E50CNL2 |
| Side Pushbutton, Maintained Two-Position — E50DM2 | E50AM2 E50ALM2 E50ANM2 E50BM2 E50BLM2 E50BNM2 E50CLM2 E50CNM2 |

| Side Push Roller, Spring Return — E50DS3 | E50AS3 E50ALS3 E50ANS3 E50BS3 E50BLS3 E50BNS3 E50CLS3 E50CNS3 |
| Side Push Roller, Low Force Spring Return — E50DL3 | E50AL3 E50ALL3 E50ANL3 E50BL3 E50BLL3 E50BNL3 E50CLL3 E50CNL3 |
| Side Push Roller, Maintained Two-Position — E50DM3 | E50AM3 E50ALM3 E50ANM3 E50BM3 E50BLM3 E50BNM3 E50CLM3 E50CNM3 |

**Wiring:**

<table>
<thead>
<tr>
<th>Single Pole 1N.O.-1N.C. Must be same polarity</th>
<th>Double Pole 2N.O.-2N.C. Parallel wired Indicator light Same polarity each pole</th>
<th>Double Pole 1N.O.-2N.C. Series wired Indicator light Same polarity each pole</th>
</tr>
</thead>
</table>

**Option Code Suffix**

- **Mini-Connector** (with epoxy filled receptacle)
  - Single Pole (5-Pin Mini-Connector): P5
  - Double Pole (9-pin Mini-Connector): P9

- **Cable Connection** (with epoxy filled receptacle)
  - 8-foot cable length: S
  - 12-foot cable length: S12
  - 20-foot cable length: S20

- **Manifold Mount (rear wiring entrance)**: M

- **20 mm Conduit Entrance**: 20

**Notes:**

- Connection options (add the Code Suffix from the table below to the end of the Catalog Number):

- **For Operating Head specifications, see Page 5.**
- **CW (clockwise) and CCW (counterclockwise) operation, easily convertible to CW only or CCW only operation.**
- **Roller can be converted in the field between horizontal and vertical.**
## Model Selection — Assembled Switches — Standard (Continued)

<table>
<thead>
<tr>
<th>Assembled Switch</th>
<th>Single Pole (5 Terminal Receptacle)</th>
<th>Double Pole (9 Terminal Receptacle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicating Light</td>
<td>None</td>
<td>LED (24 – 120V AC/DC) Neon (120V AC)</td>
</tr>
<tr>
<td>Receptacle:</td>
<td>E50RA</td>
<td>E50RA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating Head Type</th>
<th>Catalog Number for Assembled Switches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Pushbutton, Spring Return — E50DT1</td>
<td>E50AT1, E50ALT1, E50ANT1, E50BT1, E50BLT1, E50BNT1, E50CLT1, E50CNT1</td>
</tr>
<tr>
<td>Top Pushbutton, Adjustable Spring Return — E50DT2</td>
<td>E50AT2, E50ALT2, E50ANT2, E50BT2, E50BLT2, E50BNT2, E50CLT2, E50CNT2</td>
</tr>
<tr>
<td>Top Push Roller, Spring Return — E50DT3</td>
<td>E50AT3, E50ALT3, E50ANT3, E50BT3, E50BLT3, E50BNT3, E50CLT3, E50CNT3</td>
</tr>
<tr>
<td>Wobble Head, Spring Return (requires a wobble operator, see PG.05C.04.T.E)</td>
<td>E50AW1, E50ALW1, E50ANW1, E50BW1, E50BLW1, E50BNW1, E50CLW1, E50CNW1</td>
</tr>
<tr>
<td>Standard Duty — E50DW1</td>
<td>E50AW2, E50ALW2, E50ANW2, E50BW2, E50BLW2, E50BNW2, E50CLW2, E50CNW2</td>
</tr>
<tr>
<td>Heavy-Duty High Strength Steel — E50DW2</td>
<td></td>
</tr>
</tbody>
</table>

| Wiring | Single Pole 1N.O.-1N.C. Must be same polarity | Double Pole 2N.O.-2N.C. Parallel wired Indicator light Same polarity each pole | Double Pole 1N.O.-2N.C. Series wired Indicator light Same polarity each pole |

- **Connection options (add the Code Suffix from the table below to the end of the Catalog Number):**
  - Option: Mini-Connector (with epoxy filled receptacle) Code Suffix: P5
  - Option: Single Pole (5-Pin Mini-Connector) Code Suffix: P5
  - Option: Double Pole (9-pin Mini-Connector) Code Suffix: P9
  - Option: Cable Connection (with epoxy filled receptacle) Code Suffix: S
    - 8-foot cable length: S
    - 12-foot cable length: S12
    - 20-foot cable length: S20
  - Option: Manifold Mount (rear wiring entrance) Code Suffix: M
  - Option: 20 mm Conduit Entrance Code Suffix: 20

- **For Operating Head specifications, see Page 5.**
- **CW** (clockwise) and **CCW** (counterclockwise) operation, easily convertible to CW only or CCW only operation.
- **Roller** can be converted in the field between horizontal and vertical.
## Model Selection — Assembled Switches — Special Purpose

<table>
<thead>
<tr>
<th>Operating Data — Nominal</th>
<th>Catalog Number</th>
<th>Circuit Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>5° Travel</td>
<td>E50NN1</td>
<td>Same Polarity Each Pole</td>
</tr>
<tr>
<td>15° Travel</td>
<td>E50NN2</td>
<td></td>
</tr>
<tr>
<td>Travel to Operate Contacts:</td>
<td>5° or 15° (depending upon model selected)</td>
<td></td>
</tr>
<tr>
<td>Total Travel:</td>
<td>2° 90°</td>
<td></td>
</tr>
<tr>
<td>Force to Operate Contacts:</td>
<td>1.8 in-lbs</td>
<td></td>
</tr>
<tr>
<td>Minimum Return Force:</td>
<td>2.5 in-oz</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature:</td>
<td>14° to 200°F (-10° to 94°C)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Two Step CW, CCW or both, Convertible (requires an operating lever, see PG.05C.04.T.E)</th>
<th>E50TD1</th>
<th>E50ST</th>
<th>E50RB</th>
<th>E50DD1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel to Operate Contacts:</td>
<td>1st Step 10°; 2nd Step 10° 4° Each 90°</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Travel:</td>
<td>3 in-lbs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Force to Operate Contacts:</td>
<td>4.5 in-oz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Return Force:</td>
<td>CW or CCW: 14° to 250°F (-10° to 121°C) CW and CCW: 14° to 200°F (-10° to 94°C)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Temperature:</td>
<td>14° to 250°F (-10° to 121°C) CW and CCW: 14° to 200°F (-10° to 94°C)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gravity Return (requires E50KL220, E50KL226 or equivalent operating lever, see PG.05C.04.T.E)</th>
<th>E50GG1</th>
<th>E50SG</th>
<th>E50RA</th>
<th>E50DG1</th>
</tr>
</thead>
<tbody>
<tr>
<td>without Indicating Light</td>
<td>E50GLG1</td>
<td>E50SGL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with LED Indicating Light (24-120V AC/DC)</td>
<td>E50GG1</td>
<td>E50SG</td>
<td>E50RA</td>
<td>E50DG1</td>
</tr>
<tr>
<td>with Neon Indicating Light (120V AC)</td>
<td>E50GG1</td>
<td>E50SG</td>
<td>E50RA</td>
<td>E50DG1</td>
</tr>
<tr>
<td>Travel to Operate Contacts:</td>
<td>10° to 170° 8° 90° 18° in-lbs 2.5 in-oz 14° to 200°F (-10° to 94°C)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel to Reset Contacts:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Travel:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Force to Operate Contacts:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Return Force:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Temperature:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Model Selection — Operating Heads

<table>
<thead>
<tr>
<th>Description</th>
<th>Travel to Operate Contacts</th>
<th>Travel to Reset Contacts</th>
<th>Total Travel</th>
<th>Force to Operate Contacts</th>
<th>Minimum Return Force</th>
<th>Operating Temperature</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side Rotary (requires an operating lever, see PG.05C.04.T.E)</td>
<td>Standard Spring Return + ⁰ 5°</td>
<td>2°</td>
<td>90°</td>
<td>3 in-lbs</td>
<td>4.5 in-oz</td>
<td>10° to 200°F (−12° to 94°C)</td>
<td>E50DR1</td>
</tr>
<tr>
<td></td>
<td>Low Temperature Spring Return</td>
<td>5°</td>
<td>2°</td>
<td>90°</td>
<td>4.5 in-oz</td>
<td>−40° to 175°F (-40° to 79°C)</td>
<td>E50DR19</td>
</tr>
<tr>
<td></td>
<td>Low Force Spring Return + ⁰ 15°</td>
<td>6°</td>
<td>90°</td>
<td>1.5 in-lbs</td>
<td>2.5 in-oz</td>
<td>10° to 200°F (−12° to 94°C)</td>
<td>E50DL1</td>
</tr>
<tr>
<td></td>
<td>Maintained Two-Position + ⁰ 50°</td>
<td>50°</td>
<td>90°</td>
<td>3 in-lbs</td>
<td>—</td>
<td>14° to 200°F (-10° to 94°C)</td>
<td>E50DM1</td>
</tr>
<tr>
<td>Side Pushbutton, Spring Return</td>
<td>0.065 in</td>
<td>0.030 in</td>
<td>0.250 in</td>
<td>4 lbs</td>
<td>8 oz</td>
<td>14° to 200°F (-10° to 94°C)</td>
<td>E50DS1</td>
</tr>
<tr>
<td>Side Pushbutton, Adjustable Spring Return</td>
<td>0.065 in</td>
<td>0.030 in</td>
<td>0.250 in</td>
<td>4 lbs</td>
<td>8 oz</td>
<td>14° to 200°F (-10° to 94°C)</td>
<td>E50DS2</td>
</tr>
<tr>
<td>Side Push Roller, Spring Return + ⁰</td>
<td>0.065 in</td>
<td>0.030 in</td>
<td>0.250 in</td>
<td>4 lbs</td>
<td>8 oz</td>
<td>14° to 200°F (-10° to 94°C)</td>
<td>E50DS3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14° to 200°F (-10° to 94°C)</td>
<td>E50DS4 + ⁰</td>
</tr>
<tr>
<td>Side Pushbutton, Maintained</td>
<td>0.200 in</td>
<td>0.130 in</td>
<td>0.320 in</td>
<td>5 lbs</td>
<td>5 lbs</td>
<td>14° to 200°F (-10° to 94°C)</td>
<td>E50DH1</td>
</tr>
<tr>
<td>Top Pushbutton, Spring Return</td>
<td>0.040 in</td>
<td>0.020 in</td>
<td>0.280 in</td>
<td>4 lbs</td>
<td>8 oz</td>
<td>14° to 250°F (-10° to 121°C)</td>
<td>E50DT1</td>
</tr>
<tr>
<td>Top Pushbutton, Adjustable Spring Return</td>
<td>0.040 in</td>
<td>0.020 in</td>
<td>0.280 in</td>
<td>4 lbs</td>
<td>8 oz</td>
<td>14° to 250°F (-10° to 121°C)</td>
<td>E50DT2</td>
</tr>
<tr>
<td>Top Push Roller, Spring Return + ⁰</td>
<td>0.040 in</td>
<td>0.020 in</td>
<td>0.280 in</td>
<td>4 lbs</td>
<td>8 oz</td>
<td>14° to 250°F (-10° to 121°C)</td>
<td>E50DT3</td>
</tr>
<tr>
<td>Wobble Head, Spring Return (requires a wobble operator, see PG.05C.04.T.E)</td>
<td>Standard Duty + ⁰ 10°</td>
<td>6°</td>
<td>15°</td>
<td>2 in-lbs</td>
<td>2.4 in-oz</td>
<td>14° to 250°F (-10° to 121°C)</td>
<td>E50DW1</td>
</tr>
<tr>
<td></td>
<td>Heavy-Duty High Strength Steel + ⁰ 10°</td>
<td>6°</td>
<td>15°</td>
<td>2 in-lbs</td>
<td>2.4 in-oz</td>
<td>14° to 250°F (-10° to 121°C)</td>
<td>E50DW2 + ⁰</td>
</tr>
</tbody>
</table>

1. Temperature ranges below +32°F (0°C) are based on absence of freezing moisture or water.
2. CW (clockwise) and CCW (counterclockwise) operation, easily convertible to CW only or CCW only operation.
3. For CW and CCW operation. For CW only or CCW only operation, high temperature limit increases to 250°F (121°C) without cable, and 221°F (105°C) with prewired cable.
4. Roller can be converted in the field between horizontal and vertical.
5. Roller shaft is 0.38 inches (9.5 mm) longer on E50DS4, see dimensions on Page 11.
# Limit Switches

## Heavy-Duty Plug-In Switches

### Model Selection — Switch Bodies

<table>
<thead>
<tr>
<th>Circuit</th>
<th>Switch Body Construction</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Pole 1N.O.-1N.C. Must Be Same Polarity</td>
<td>Without Indicating Light</td>
<td>E50SA</td>
</tr>
<tr>
<td></td>
<td>With LED Indicating Light 24 – 120V AC/DC</td>
<td>E50SAL</td>
</tr>
<tr>
<td></td>
<td>With Neon Indicating Light 120V AC</td>
<td>E50SAN</td>
</tr>
<tr>
<td>Double Pole 2N.O.-2N.C. Parallel Wired Ind. Light Same Polarity Each Pole</td>
<td>Without Indicating Light</td>
<td>E50SB</td>
</tr>
<tr>
<td></td>
<td>With LED Indicating Light 24 – 120V AC/DC</td>
<td>E50SBL</td>
</tr>
<tr>
<td></td>
<td>With Neon Indicating Light 120V AC</td>
<td>E50SBN</td>
</tr>
<tr>
<td>Double Pole 2N.C.-1N.O. Series Wired Ind. Light Same Polarity Each Pole</td>
<td>With LED Indicating Light 24 – 120V AC/DC</td>
<td>E50SCL</td>
</tr>
<tr>
<td></td>
<td>With Neon Indicating Light 120V AC</td>
<td>E50SCN</td>
</tr>
</tbody>
</table>

(1) Indicating lights are supplied from the factory wired as shown. However, they can easily be re-connected to terminals 1 and 2 if necessary (SPDT).
## Limit Switches
### Heavy-Duty Plug-In Switches

**Model Selection — Receptacles**

<table>
<thead>
<tr>
<th>Description</th>
<th>Poles</th>
<th>Conduit Entrance</th>
<th>Cable Length</th>
<th>Catalog Number</th>
<th>Wiring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Mount Conduit entrance, front or rear mounting</td>
<td>Single Pole</td>
<td>1/2 NPT</td>
<td>—</td>
<td>E50RA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Double Pole</td>
<td>1/2 NPT</td>
<td>—</td>
<td>E50RB</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 mm</td>
<td>—</td>
<td>E50RA20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3/4 NPT</td>
<td>—</td>
<td>E50RB34</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 mm</td>
<td>—</td>
<td>E50RB20</td>
<td></td>
</tr>
<tr>
<td>Manifold Mount Rear wiring entrance instead of conduit hole, gasket on back</td>
<td>Single Pole</td>
<td>—</td>
<td>—</td>
<td>E50RAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Double Pole</td>
<td>—</td>
<td>—</td>
<td>E50RBM</td>
<td></td>
</tr>
<tr>
<td>Mini-Connector Epoxy-filled receptacle with prewired Mini-Connector. (The -W version is a wiring scheme typically used in automotive applications.)</td>
<td>Single Pole</td>
<td>5-pin Mini-Connector</td>
<td>—</td>
<td>E50RAP5</td>
<td>E50RAP5-W</td>
</tr>
<tr>
<td></td>
<td>Double Pole</td>
<td>9-pin Mini-Connector</td>
<td>—</td>
<td>E50RBP9</td>
<td></td>
</tr>
<tr>
<td>Prewired Cable Epoxy filled receptacle with prewired 16 gauge, yellow jacketed, type SOOW-A cable. Cable enters through hole threaded for conduit</td>
<td>Single Pole</td>
<td>1/2 NPT</td>
<td>8-foot</td>
<td>E50RAS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12-foot</td>
<td>E50RAS12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20-foot</td>
<td>E50RAS20</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 mm</td>
<td>8-foot</td>
<td>E50RA20S</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12-foot</td>
<td>E50RA20S12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20-foot</td>
<td>E50RA20S20</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Double Pole</td>
<td>1/2 NPT</td>
<td>8-foot</td>
<td>E50RBS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12-foot</td>
<td>E50RBS12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20-foot</td>
<td>E50RBS20</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 mm</td>
<td>8-foot</td>
<td>E50RB20S</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12-foot</td>
<td>E50RB20S12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20-foot</td>
<td>E50RB20S20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- See Model Selection — Switch Bodies for wiring information.
- The wire colors referenced on these diagrams are those internal to the switch itself.
# Model Selection — Accessories

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Description</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapter Plate</td>
<td>Allows E50 to replace Cutler-Hammer 10316 Type LP Surface Mounting Plug-In Limit Switch</td>
<td>E50KH1</td>
</tr>
<tr>
<td>Adapter Plate</td>
<td>Allows E50 to replace Cutler-Hammer 10316 Type LP Manifold Mounting Plug-In Limit Switch</td>
<td>E50KH11M</td>
</tr>
<tr>
<td>Adapter Plate</td>
<td>Allows E50 to replace Square D Type AW Surface Mounting Non Plug-In Standard Box Limit Switch</td>
<td>E50KH7</td>
</tr>
<tr>
<td>Adapter Plate</td>
<td>Allows E50 to replace National Acme, Type D-1200M, Style 2 Mounting. Denison LoxSwitch, Model L-100W, Style 2 Mounting. Square D 9007 Type T, Style B Mounting. (Adapter plate is 1/8 inch thick, with 1/4 inch mounting holes.)</td>
<td>E50KH4</td>
</tr>
<tr>
<td>Adapter Plate</td>
<td>Allows E50 to replace National Acme, Type D-1200M, Style 1 Mounting. Denison LoxSwitch, Model L-100W, Style 1 Mounting. Square D 9007 Type T, Style C Mounting. (Adapter plate is 1/8 inch thick, with 1/4 inch mounting holes.)</td>
<td>E50KH5</td>
</tr>
<tr>
<td>Adapter Plate</td>
<td>Allows E50 to replace Cutler-Hammer 10316 Type LT Non Plug-In 2-Pole Limit Switch</td>
<td>E50KH2</td>
</tr>
<tr>
<td>Adapter Plate</td>
<td>Allows E50 to replace Allen-Bradley 802M Sealed Limit Switch</td>
<td>E50KH10</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Description</td>
<td>Catalog Number</td>
</tr>
<tr>
<td>------------</td>
<td>-------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Adjustable Mounting Plate</td>
<td>This is a mounting plate only 5/16 inch thick and includes the proper mounting bolts and nuts. The slots in the plate allow a maximum horizontal adjustment of 1 inch and vertical adjustment of 1-1/4 inches</td>
<td>E50KH3</td>
</tr>
<tr>
<td>Jumper Connectors for Two-Pole Receptacles</td>
<td>Jumper for series, parallel or series-parallel connection of 2-pole limit switches. Kit consists of one double and four single connectors. Photo shows installation of double connector, two screws removed for clarity</td>
<td>E50KH8</td>
</tr>
<tr>
<td>Conduit Sealing Nut</td>
<td>1/2 inch oiltight</td>
<td>E50KH6</td>
</tr>
</tbody>
</table>

① Limit Switch not included.
Specifications

<table>
<thead>
<tr>
<th>Environmental Ratings</th>
<th>NEMA 1, 3, 3S, 4, 4X, 6, 6P, 13, 1P67</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosure Construction</td>
<td>Zinc die cast</td>
</tr>
<tr>
<td>Switch Gasket Material</td>
<td>Viton (©)</td>
</tr>
<tr>
<td>Universal U.S./DIN Mounting Dimensions</td>
<td>1.16 in (30 mm) x 2.34 in (60 mm)</td>
</tr>
<tr>
<td>Conduit Entrance</td>
<td>1/2 in NPT or 20 mm threading</td>
</tr>
<tr>
<td>Contact Ratings</td>
<td>See below</td>
</tr>
<tr>
<td>Contact Operation</td>
<td>Snap action over center mechanism</td>
</tr>
<tr>
<td>Contact Material</td>
<td>Fine silver</td>
</tr>
<tr>
<td>Maximum Frequency of Operation</td>
<td>8000 operations per hour</td>
</tr>
<tr>
<td>Mechanical Life:</td>
<td></td>
</tr>
<tr>
<td>Side Rotary</td>
<td>13,000,000 operations minimum</td>
</tr>
<tr>
<td>Side or Top Push</td>
<td>10,000,000 operations minimum</td>
</tr>
<tr>
<td>Electrical Life:</td>
<td>1,000,000 operations typical at full load</td>
</tr>
<tr>
<td>Ambient Temperature Range</td>
<td></td>
</tr>
<tr>
<td>Standard without Cable</td>
<td>14° to 250°F (-10° to 121°C)</td>
</tr>
<tr>
<td>Standard with Cable</td>
<td>14° to 221°F (-10° to 105°C)</td>
</tr>
<tr>
<td>Low Temperature without Cable</td>
<td>-40° to 250°F (-40° to 121°C)</td>
</tr>
<tr>
<td>Low Temperature with Cable</td>
<td>-40° to 221°F (-40° to 105°C)</td>
</tr>
<tr>
<td>Repeat Accuracy:</td>
<td></td>
</tr>
<tr>
<td>Side Operated</td>
<td>Within 0.0012 in</td>
</tr>
<tr>
<td>Top Operated</td>
<td>Within 0.0003 in</td>
</tr>
<tr>
<td>Side Rotary</td>
<td>Within 0.0014 in</td>
</tr>
<tr>
<td>Torque Requirements:</td>
<td></td>
</tr>
<tr>
<td>Switch Body Screws</td>
<td>25 – 30 lb-in</td>
</tr>
<tr>
<td>Operating Head Screws</td>
<td>14 – 18 lb-in</td>
</tr>
<tr>
<td>Wire Size</td>
<td>Will accept AWG #22 – #12, single or stranded wire</td>
</tr>
</tbody>
</table>

Electrical Data — Maximum Contact Ratings (Same polarity each pole)

<table>
<thead>
<tr>
<th>AC Volts</th>
<th>Current, Amperes</th>
<th>Voltsamperes</th>
<th>DC Volts</th>
<th>Current, Amperes</th>
<th>Cont.</th>
<th>Max. Make or Break</th>
<th>Cont.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Make</td>
<td>Break</td>
<td></td>
<td>Make</td>
<td>Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make Break Cont.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Switches Except Gravity Return and Indicating Light Versions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA A600 Rating</td>
<td>NEMA R300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>60</td>
<td>6</td>
<td>10</td>
<td>7200</td>
<td>720</td>
<td>125</td>
<td>250</td>
</tr>
<tr>
<td>240</td>
<td>30</td>
<td>3</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>480</td>
<td>15</td>
<td>1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>600</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switches with Indicating Lights (LED or Neon)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA A150 Rating</td>
<td>NEMA R150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>60</td>
<td>6</td>
<td>10</td>
<td>7200</td>
<td>720</td>
<td>125</td>
<td>22</td>
</tr>
<tr>
<td>240</td>
<td>15</td>
<td>3</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>480</td>
<td>7.5</td>
<td>0.75</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>600</td>
<td>6</td>
<td>0.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gravity Return Switches — Maximum Contact Ratings

<table>
<thead>
<tr>
<th>NEMA 6600 Rating — Contacts on Same Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
</tr>
<tr>
<td>240</td>
</tr>
<tr>
<td>480</td>
</tr>
<tr>
<td>600</td>
</tr>
</tbody>
</table>

(©) Thermal rating. Valid only if switch does not have to make or break.
Approximate Dimensions in Inches (mm)

### Standard

**Shaft Dia.** 0.28 (7)  
0.38 (10)  
0.75 (19)  
0.63 (16)  
0.24 (6)  
0.20 (5)  
1.54 (39)

**Top Push Operators in mm [Inches]**

**Pushbutton**

- 0.70 (18)  
- 2.46 (63)

**Adjustable Pushbutton**

- 0.50 (13)  
- 0.50 (13)  
- 1.76 (45)  
- 0.65 (16)

**Roller**

- 0.24 (6)  
- 0.20 (5)  
- 1.54 (39)

**Wobble Operators**

- **Pipe Tap** 0.63 (16)  
- **Dia. 0.20 (5)**  
- **Manifold Mtg.** 0.24 (6)  

**Maintained Pushbutton**

- **Shaft Dia.** 0.28 (7)  
- 0.38 (10)  
- 0.75 (19)  
- 0.63 (16)  
- 0.24 (6)  
- 0.20 (5)  
- 1.54 (39)

- **Top Push Operators in mm [Inches]**

**Pushbutton**

- 0.75 (19)  
- 2.42 (61)

**Adjustable Pushbutton**

- 0.50 (13)  
- 0.50 (13)  
- 1.76 (45)  
- 0.65 (16)

**Roller**

- 0.24 (6)  
- 0.20 (5)  
- 1.54 (39)

- **For E50DS4.**  
- **For E50DS3.**

### E50SB34

**Shaft Dia.** 0.28 (7)  
0.38 (10) (Over Knurl)  
0.75 (19)  
0.63 (16)  
0.24 (6)  
0.20 (5)  
1.54 (39)

**Top Push Operators in mm [Inches]**

**Pushbutton**

- 0.70 (18)  
- 2.46 (63)

**Adjustable Pushbutton**

- 0.50 (13)  
- 0.50 (13)  
- 1.76 (45)  
- 0.65 (16)

**Roller**

- 0.24 (6)  
- 0.20 (5)  
- 1.54 (39)

**Wobble Operators**

- **Conduit Entrance** 3/4-14 NPT Pipe Threads 0.65 (16)  
- **Dia. 0.27 (7)**  
- **Deep Rear Mt. Holes (2)** 0.65 (16)  

**Side Push Operators in mm [Inches]**

**Pushbutton**

- 0.87 (22.1)  
- 2.11 (53.6)

**Adjustable Pushbutton**

- 0.87 (22.1)  
- 2.11 (53.6)

**Roller**

- 0.87 (22.1)  
- 2.11 (53.6)

**For E50DS4.**  
**For E50DS3.**

- **Can accommodate both U.S., 1.16 (29.4) x 2.34 (59.5) and DIN, 1.18 (30) x 3.26 (60), mounting dimensions.**

- **Pipe Tap** 0.63 (16)  
- **Dia. 0.20 (5)**  
- **Manifold Mtg.** 0.24 (6)  

- **[10-32] Tap** 0.38 (10)  
- **Deep Rear Mt. Holes (2)** 0.38 (10)  

- **Shaft Dia.** 0.28 (7)  
- 0.38 (10)  
- 0.75 (19)  
- 0.63 (16)  
- 0.24 (6)  
- 0.20 (5)  
- 1.54 (39)

- **Top Push Operators in mm [Inches]**

**Pushbutton**

- 0.70 (18)  
- 2.46 (63)

**Adjustable Pushbutton**

- 0.50 (13)  
- 0.50 (13)  
- 1.76 (45)  
- 0.65 (16)

**Roller**

- 0.24 (6)  
- 0.20 (5)  
- 1.54 (39)

**Wobble Operators**

- **Conduit Entrance** 3/4-14 NPT Pipe Threads 0.65 (16)  
- **Dia. 0.27 (7)**  
- **Deep Rear Mt. Holes (2)** 0.65 (16)  

- **Can accommodate both U.S., 1.16 (29.4) x 2.34 (59.5) and DIN, 1.18 (30) x 3.26 (60), mounting dimensions.**

- **Pipe Tap** 0.63 (16)  
- **Dia. 0.20 (5)**  
- **Manifold Mtg.** 0.24 (6)  

- **[10-32] Tap** 0.38 (10)  
- **Deep Rear Mt. Holes (2)** 0.38 (10)  

- **Shaft Dia.** 0.28 (7)  
- 0.38 (10)  
- 0.75 (19)  
- 0.63 (16)  
- 0.24 (6)  
- 0.20 (5)  
- 1.54 (39)
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